

63

THE ANNALS
AND
MAGAZINE OF NATURAL HISTORY,
INCLUDING
ZOOLOGY, BOTANY, AND GEOLOGY.

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

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

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VOL. IV.—SIXTH SERIES.  
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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 exulta; 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.

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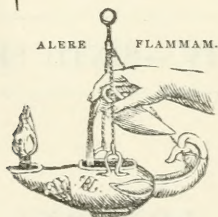
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THE ANNALS
AND
MAGAZINE OF NATURAL HISTORY.
[SIXTH SERIES.]

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

No. 19. JULY 1889.

I.—*Bryozoa from New South Wales.*
By ARTHUR WM. WATERS.

[Plates I.-III.]

PART IV.

SINCE I published in this periodical* descriptions of New South Wales Bryozoa sent to me by Mr. Brazier, of Sydney, I have received another box-full, and have to thank him for his kindness in sending it to me for description. This last box contains exclusively incrusting species obtained off Green Point, Port Jackson, in dredging-expeditions undertaken for conchological purposes.

There are several species not previously found in the colony and much better specimens of one or two forms described in my previous papers, thus enabling me to give particulars relating to the structure. This is especially the case with *Microporella inversa*.

As already suggested in my Supplementary 'Challenger' Report, I propose to drop the genus *Macronella*, for the classi-

* Ser. 5, vol. xx. pp. 81, 181, and 253.

fication of *Smittia* and the allied genera as *Mucronella* and *Porella* has never seemed to me satisfactory. On this account comparative drawings of the apertures of a series are given.

Until the weak points in our present classification are weeded out but slight progress can be made in our knowledge of geographical distribution, and all complete descriptions and working out of structures are helping towards this, while premature alterations are to be avoided.

In *Schizoporella* as now understood there are a number of forms with the true aperture emarginate and having a distinct sinus, such as *S. Cecillii*; then there are others where the lower part of the aperture is subtriangular, with lateral denticles, such as *S. lata*, MacG., *S. ambita*, W., &c., and these should probably be separated.

Since my last paper Mr. Whitelegge has published an important communication on some Australian Bryozoa*, dealing principally with the *Lunulites* group, and it is to be hoped that he will continue to use his opportunities to add to our knowledge of the structure of the Australian Bryozoa.

Mr. Whitelegge has favoured me with further specimens of "*Flabellopora*" *elegans*, d'Orb., and I feel no doubt as to the correctness of my identification. Probably Mr. Whitelegge will not mind my pointing out a fact of which he is now aware, namely that d'Orbigny only described *Flabellopora elegans* as recent and not fossil.

I have been informed that the locality mentioned ('Annals,' 1887, xx. p. 193) as Raton, New Guinea, should be Katow, the manuscript label with the specimen having been misread.

In my Supplementary 'Challenger' Report *Retepora jacksoniensis*, B., and *R. victoriensis*, MacG., are united.

Membranipora corbula, Hincks.

This species, mentioned in my previous paper, also occurs from Green Point. There is great variation in the size of the oral spines, so that sometimes the difference is not very marked between these and the spines over the front of the zoecium. The ovicell is frequently umbonate—in fact it may sometimes be described as a spinous umbo. I have a badly preserved specimen among some things from New Zealand (probably Napier), and in this the ovicell is also umbonate. *M. corbula* and *M. armata* are so similar that it may be doubted whether they are more than two extreme forms of the same thing.

* Proc. Linn. Soc. N. S. Wales, ser. 2, vol. ii. p. 337; also reprinted in the 'Annals,' ser. 6, vol. i. p. 13.

Membranipora pyrula, Hincks.

Membranipora pyrula, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. viii. p. 31, pl. i. fig. 2; MacGillivray, Zool. Vict. dec. xiii. p. 103, pl. cxxvii. fig. 1.

Membranipora lineata, MacGillivray, Zool. Vict. dec. iii. p. 34, pl. xxvi. fig. 3.

The spines in the Green Point specimen are not so stout as those figured by MacGillivray in the thirteenth decade, but somewhat stouter than those figured by Hincks.

Hab. Bass's Straits, Victoria; Green Point, Port Jackson.

Membranipora levata, Hincks.

Membranipora levata, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. x. p. 467, pl. xix. figs. 6, 6a.

The ovicell may be smooth or the umbo may form a keel. *M. irregularis*, B., as figured by Smitt in his 'Floridan Bryozoa,' is similar in shape and general characters, but the avicularia are wanting.

Loc. Houston Stewart Channel, 15-20 fath., and Cumshewa, British Columbia; Green Point, Port Jackson.

Membranipora lineata, L., var. (Pl. II. fig. 16.)

There are specimens from Green Point which differ from the typical *lineata* in having a small round globular ovicell without any rib. In one specimen the zoecia are connected by tubes forming an areolated space, and on some of these interzoecial connexions there are small triangular avicularia. Similar connexions occur in *M. circumclathrata*, H., in *M. acuta*, H., and sometimes in *M. lineata*, L.

The present form differs from *M. circumclathrata* in having small avicularia instead of large prominent ones. It is very much like *M. pectinata*, MacG., but its zoecia could not be described as large.

Membranipora cervicornis, Busk (non Haswell).

Membranipora cervicornis, Waters, Quart. Journ. Geol. Soc. vol. xliii. p. 47, which see for synonyms.

In the specimen from Green Point the spines have all been worn off, but the shape of the opesia opening, together with the widely open ovicell, suffice for the determination.

Loc. Living; Victoria; South Australia; Bass's Straits;

New South Wales. Fossil: Mt. Gambier (South Australia); Napier (New Zealand).

Beania quadricornuta, Hincks.

Diachoris quadricornuta, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. xv. p. 245, pl. ix. fig. 2.

Diachoris macilla, Jullien, Bryozoaires du Cap Horn, p. 74, pl. vii. fig. 3, pl. xi. fig. 4.

In my specimens from Victoria and New South Wales the number of supraoral spines is variable, there being frequently two long ones besides the four short ones.

Hab. Victoria; Cape Horn; Green Point, Port Jackson.

Beania hirtissima, var. *conferta*, MacG.
(Pl. II. figs. 12-14.)

Beania conferta, MacGillivray, Trans. Roy. Soc. Victoria, vol. xxii. p. 130, pl. i. fig. 5.

In specimens from Green Point the zoarium forms a thick mat over the shell or stone upon which it grows. The zoecia are semierect and the very stout oral spines are in marked contrast to the finer row of spines curved over the front of the zoecia or those at their sides. The position of these spines is, however, the same as in both the typical *hirtissima* and the form *robusta* from Naples*, though in these the distal spines are but very slightly larger than the frontal and lateral ones. There are usually about ten stout oral spines, and the frontal and lateral spines only occur on the distal half of the zoecia. There are very numerous small radical tubes, in this respect differing from the *B. conferta* described by MacGillivray. The ovicell occurs as an inflation on the dorsal surface behind the aperture (fig. 14). The distal portion of the operculum is double.

The distal end of the zoecium being erect and all the connexions occurring in the proximal half support MacGillivray's view that *Diachoris* should be merged in *Beania*.

It will be seen that a similar erect growth of part of the zoecium obtains also in *Diachoris crotali*, B.

This is the only *Beania* in which I am sure of having seen an ovicell. One is described by Busk in *Diachoris crotali* as "small, conical, superior," and a small conical protuberance is figured; and this occurs in specimens in my collection; but

* *B. hirtissima*, var. *robusta*, H., and var. *cylindrica*, H., both occur in the Bay of Naples, and the *B. hirtissima* var. *typica* is found at Rapallo, North Italy.

I have not been able to satisfy myself as to its signification. In no other case does an ovicell seem to have been described.

Cribrilina clithridiata, Waters. (Pl. I. figs. 6-9.)

Cribrilina clithridiata, Waters, Ann. & Mag. Nat. Hist. ser. 5, vol. xx. p. 187, pl. v. fig. 6, pl. vi. fig. 2.

In the material from Green Point there are several specimens with ovicells which are globose, large, much raised, with a large mark on each side, called a "pyriform fossa" by Hincks and a "large stigma" by Busk, being similar to the ovicells of *C. philomela* and *C. figularis*. On the upper part of the ovicellular elevation, though above the ovicellular chamber, there are six marks or papillæ similar to those on the front of the zoecium. The aperture of the ovicelliferous cells is subquadrangular, exactly similar to that of the ordinary zoecia of *C. figularis*, and this is a point which should be kept clearly in view when considering the classificatory position.

When *C. clithridiata* is decalcified there are conspicuous marks on the front, like the fenestræ of the *Catenicellæ* (much as in *C. ventricosa*), and the central area is thicker, forming a kind of shield; but there are no other marks, whereas in *C. figularis* (fig. 10), *C. latimarginata*, &c. when decalcified there are marks corresponding to the rows of punctures in the calcareous wall. The "fenestræ" are of course under the papillæ at the end of the ridges.

Cribrilina radiata, Moll.

For synonyms see Hincks, Brit. Mar. Polyzoa, p. 185.

A specimen from Green Point is a typical *C. radiata*, in shape and size similar to specimens from Naples. There are five ribs on each side and a central one below. The ovicell has a keel.

MacGillivray mentions the species in his 'Catalogue of Marine Polyzoa of Victoria,' p. 22; but it does not appear to have had any other notice from the Australian area.

Microporella coscinopora, var. *armata*, Waters.
(Pl. I. figs. 1-5.)

Microporella coscinopora, var. *armata*, Waters, Quart. Journ. Geol. Soc. vol. xxxvii. p. 331, pl. xv. fig. 25; 'Challenger' Suppl. Rep. p. 39.

Microporella coscinopora, var. *mucronata*, Waters, Quart. Journ. Geol. Soc. vol. xli. p. 295.

Eschara sulcata, M.-Edw. Ann. des Sci. Nat. 2^e sér. tom. vi. p. 43, pl. v. fig. 2.

Eschara mucronata, MacG. Zool. of Vict. dec. v. p. 43, pl. xlviii. figs. 6, 7.

Adeonellopsis latipuncta, MacG. Trans. Roy. Soc. Vict. vol. xxii. p. 134, pl. ii. fig. 5.

A specimen from Green Point, Port Jackson, is a flat piece, evidently part of a large foliaceous growth, and is the *A. latipuncta* of MacGillivray. Broad and narrow pieces from Port Phillip in my collection show that the width must not be made a specific character; and the 'Challenger' dredged fragments of three sizes from Station 162, of which the narrower one is only .2 millim. in diameter. A branched specimen from Green Point is the *Adeonellopsis australis* of MacGillivray; but in the size of the oral aperture, the form of the chitinous elements, and the other zoöcial characters I cannot find any difference from the above and do not think that the broad and narrow forms should be separated.

In the Green Point "*latipuncta*" specimen there is always the central avicularium directed upwards and usually one small one at the side of the aperture, sometimes two; but there is seldom one below the cribriform area. In many of the Australian specimens, both recent and fossil, there is in different parts of the same colony considerable variation with regard to the avicularia. In the typical Miocene *M. coscinopora* there is only a central avicularium, but the zoöcial characters are generally similar.

Loc. Living: Port Phillip (Victoria); 'Challenger,' Station 162, 38-40 fath.; Green Point, Port Jackson. Fossil: Curdie's Creek, Muddy Creek (Victoria); River-Murray Cliffs (South Australia).

Microprella inversa, Waters. (Pl. I. figs. 11, 12.)

Porina inversa, Waters, Ann. & Mag. Nat. Hist. ser. 5, vol. xx. p. 190, pl. iv. fig. 23, pl. v. fig. 5; Whitelegge, Proc. Linn. Soc. N. S. Wales, ser. 2, vol. ii. p. 680.

Much better specimens received from Green Point have revealed several points not seen in the specimens previously described. The pores on the front are distinctly stellate, as can be readily seen in mature zoöcia, though not distinguished in old cells without preparation, and the formation of these stellate pores is instructive.

At first raised tubes are formed (fig. 11, left-hand upper zoöcium), and in a later stage the stellate closure grows on the top (fig. 11, right-hand zoöcium); but as calcareous growth progresses the teeth are at the base of a round

depression (fig. 11, lower zoöcium), and in these mature zoöcia there are, as seen in calcined specimens, deep grooves between the stellate pores, starting from large pores near the borders of the zoöcia. One of these grooves seems usually to start from the upper lateral pore on the one side and pass above the suboral pore to the lateral pore on the other side, as shown in the left-hand zoöcium of fig. 11. Decalcification shows distinct tubes occupying the place of these grooves. The interior membrane of the zoöcial wall is perforated by the suboral pore, but not by the others.

As already pointed out, the operculum is the reverse of the usual shape, and when writing the previous description I naturally concluded that it was hinged on the distal edge and not at the proximal, as in other Bryozoa; but not having very good specimens, I merely presumed it, and it would seem to me that what I wrote suggests this; but it does not seem to have been so understood by Mr. Whitelegge, who, having had the opportunity of examining fresh specimens, points out that the aperture is of the same shape as in other Bryozoa, but reversed. I have certainly no objection to its being put in this way, but do not appreciate that it is different from what I said; and the name *inversa* was chosen on account of this reversal of shape, so that Mr. Whitelegge's and my own description seem quite the same though expressed in a different way.

Dr. Jullien * described a species as *Inversiula nutrix* about the same time that I published my description; and at first I thought they might be identical. The general appearance is so similar that they might readily be mistaken; but the individual characters must be examined, and then a material difference is found in the shape of the oral aperture, which in *I. nutrix* is nearly round but somewhat flattened on both the distal and proximal edges, and I am inclined to think that the operculum is here also reversed in position. I cannot speak on this point with certainty, as I have only been able to examine a very minute fragment, and have not made dissections. Dr. Jullien only possessed a small piece, but generously sent me a little bit of it for examination.

The suboral pore of *Inversiula nutrix* I should describe as round, with a tooth in the lower part, as in many Microporellidæ. One suboral pore without any such tooth is quite round, and the difference in this character in Jullien's species and mine does not seem of any generic importance.

In *M. inversa* I have only seen the small semicircular

* 'Mission du Cap Horn,' Bryozoaires, p. 44, pl. iv. fig. 8.

mandibles in decalcified specimens, and the apertures in the avicularia of *Inversula nutrix* are of the same shape. The operculum of *I. nutrix* is very thick round the border, reminding us of the operculum of *Diporula verrucosa*.

Although specifically very distinct, Jullien's species from South America and mine from New South Wales seem to fall into the same genus, and probably the New South Wales species will have to be called *Inversula inversa*. I am now unable to understand why I placed mine with *Porina*, but when describing it said that I thought it would have to be made the type of a new genus.

Micropora elongata, Hincks. (Pl. I. figs. 21, 22.)

Steganoporella elongata, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 380, pl. xvi. fig. 4.

Micropora variperforata, Waters, Quart. Journ. Geol. Soc. vol. xliii. p. 51, pl. viii. fig. 27.

From Green Point there are a few zoecia in shape and every particular exactly resembling Mr. Hincks's figure and description of *S. elongata*; but on the same shell there is another colony in which the surface has numerous similar large perforations (opesiules) and similar avicularia, but the zoecia shorter and wider. In the more typical specimens there is a well-marked "opesiule" at each upper corner, but in some cases it cannot be made out, and in others there are more than one on each side.

The number of opesiules has been shown to be variable in this and in *Micropora lepida*, Hincks. Dr. Jullien, however, would use the form of the opesiules as the chief generic character, making out of the Microporidae the genera *Gargantua*, J., *Calpensia*, J., *Andreella*, J., *Woodipora*, J., *Verminaria*, J., *Peneclausa*, J., *Thalamoporella*, Hincks, *Manzonella*, J., *Pergensia*, J., *Setosella*, Hincks. Surely genus manufacturing never has gone and never will go further than this; and as Dr. Jullien has called attention to many anatomical points of importance, it is much to be regretted that he should be so hasty in his generalizations on classification.

In its typical form this does not seem at all like *M. coriacea*; but when a series is examined there is found to be little difference. In older cells of *M. coriacea* the surface of the front wall seems almost closed, whereas in the younger zoecia the perforations are distinctly seen, and in some zoecia of *M. elongata* the pores are not large and distinct.

Schizoporella auriculata, Hass.

Loc. Living : European seas ; Madeira ; Azores ; Gulf of St. Lawrence ; Victoria ; Green Point, Port Jackson, New South Wales. Fossil : Pliocene of Italy and Sicily ; Mount Gambier and Bairnsdale (Australia) ; Napier and Tommy Gully (New Zealand).

Schizoporella auriculata, Hass., var.

There is also a *Schizoporella* which in most cases has only a round avicularium below the aperture ; but in a few zoecia there are besides two avicularia, one at each side of the aperture, as in *S. sanguinea*, Norman, var. (Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 382). The pores are small slits ; and should it be requisite to give it a name, *fissipora* would be appropriate ; but as there are no ovicells, it is for the present left as a variety of *auriculata*.

Schizoporella Cecilii, Aud.

Mr. Hincks (Ann. & Mag. Nat. Hist. ser. 5, vol. xix. p. 302) hesitates to identify this with Heller's *Lepralia Perugiana*, as he considers that has an avicularium ; but Mr. Hincks is mistaken in supposing that Heller alludes to an avicularium ; what he described was the "appendage" of the operculum as a "kleines, gelbes Zähnchen."

Loc. Britain ; Mediterranean ; Red Sea ; Japan ; Queen Charlotte Islands (British Columbia) ; Victoria ; Green Point, Port Jackson. Fossil : River-Murray Cliffs (South Australia).

Schizoporella biserialis, Hincks. (Pl. II. fig. 11.)

Schizoporella biserialis, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. xv. p. 250, pl. vii. fig. 3.

In a specimen from Green Point the shape and size of the zoecia, the sculpturing, and the ovicells are just the same as in the New Zealand specimens ; but there are numerous spines arising from the distal end of the zoecium, often as many as forty or fifty, and these do not seem to be arranged in series, though one might at first take them for three rows.

The pores on the surface of the zoecia in the specimens from both localities are internally slightly denticulated. *Schizoporella arachnoides*, MacG., is probably nearly related to this ; but the zoecia are smaller, the ovicell is elongate, there are not the large pores on the surface of the zoecia, and there is only a single row of oral spines.

Schizoporella mucronata, Smitt. (Pl. II. fig. 9.)

Hippothoa mucronata, Smitt, *Floridan Bryozoa*, p. 45, pl. viii. fig. 169.

In the Green Point specimen there is a semicircular raised ridge below the aperture. The aperture is about 0.12 millim. wide, and on the operculum there is a very distinct, elongate, semitransparent area. In young cells there is a row of pores round the edge of the zoecium; the ovicell is small, raised, globular, but seldom mucronate.

S. simplex, Johnst. (*S. Johnstoni*, Ridley), dredged by the 'Challenger' between Fayal and Pico, has a similar ridge below the aperture in the ovicelligerous cells, and these are very similar to cells of the present Australian specimens; but the species differ in the first only having the ridge on ovicelligerous zoecia.

Loc. Florida, 29 fath.; Green Point, Port Jackson.

Schizoporella floccincta, R ss. (Pl. I. figs. 17, 18.)

Lepralia floccincta, Reuss, "Bry. C st.-Ung. Mioc." *Denkschr. Ak. Wissensch. Wien*, vol. xxxiii. p. 178, pl. viii. fig. 4.

Schizoporella floccincta, Pergens, "Bry. du Tasmadjan," *Bull. Soc. Malac. de Belgique*, vol. xxii. p. 14.

Zoarium incrusting. Central zoecia erect, the outer ones decumbent; shell thick, with a few larger pores. The oral aperture is large, clithriate. There are a few semicircular avicularia between the zoecia, but they do not occur generally. The ovicells are wide and short, not very much raised, covered with pores similar to those on the surface of the zoecia.

At first I thought this was *Cellepora megasoma* of MacGillivray, as it corresponds with some of the figures, and it is not impossible that this is what MacGillivray first described under that name.

Loc. Living: Green Point, Port Jackson. Fossil: Miocene of Forchtenau and Belgrade.

Schizoporella lata, MacG.

Schizoporella lata, MacG. *Trans. Roy. Soc. Vict.* vol. xix. p. 132, pl. i. fig. 7; *Zool. Vict.* dec. xiv. p. 145, pl. cxxxviii. fig. 2.

This differs from *S. ambita*, Waters, in having a much narrower ovicell, evenly punctured, and in having a small triangular avicularium immediately below the aperture. *S. lata* is very much like *Lepralia tenella*, R ss.

Loc. Port Phillip (Victoria); Green Point, Port Jackson.

Schizoporella subimmersa, var. nov.
(Pl. II. figs. 10, 10 a, b, c.)

This is much like MacGillivray's description and figure of *Lepralia subimmersa*, but does not correspond with Hincks's more recent figure. The operculum of the ovicelligerous cells is somewhat larger than that of the ordinary zoecia, and forms a wide curve on the lower border. The ovicell is deeply immersed.

From the avicularian chamber there is a lateral tube on each side (see fig. 10 a, a zoecium decalcified). The same thing is often seen in the avicularian chambers of *Retepora*. In some of the older zoecia the opercula are whitish, in consequence of a slight subsequent calcareous deposit.

Loc. Victoria; Green Point.

Schizoporella ambita, sp. nov. (Pl. II. fig. 7.)

This occurs from Green Point and is in many points similar to *S. lata*, MacG., also abundant from the same locality; but the differences in the ovicells and avicularia enable them to be distinguished.

Zoarium incrusting. Zoecia ovate, distinct, with moderate-sized deep pores on the front, a small round avicularium immediately below the aperture. Oral aperture suborbicular, with the proximal edge subtriangular. Ovicell wide, raised, the front flat, with numerous pores, the rest of the ovicell imperforate.

This I have from Naples with and without the small round avicularium; and a specimen from Port Western, Victoria, sent to me as *S. lata*? has the characteristic ovicells and avicularia.

Probably this has been placed with *S. pertusa*.

In some cases a calcareous growth in the older zoecia forms a kind of lip in the lower part of the aperture.

Schizoporella laevigata, sp. nov. (Pl. II. fig. 8.)

Zoarium incrusting. Zoecia small, separated by an indistinct division, surface smooth. Avicularium tumid, directed forwards, mandible round with a central lucida and the distal end dentate; in the older cells the avicularium occupies nearly the whole of the front of the zoecium. The oral aperture is nearly orbicular, the sinus (?) being formed by an arc nearly the width of the aperture, and on each side there is a minute denticle.

Ovicell short, much raised, situated considerably above the aperture, widely open, and not closed by the operculum.

This is allied to *S. tumida*, but the avicularian chamber is lower down and does not spread out near the aperture. It is also allied to *S. Ridleyi*, MacG., which has recently been redescribed by Jullien as *Aimulosia australis*, J.

Loc. Green Point, Port Jackson.

Schizoporella sydneyensis, sp. nov.

There is only a small piece of this *Schizoporella* without ovicells. Zoarium incrusting. Zoecia hexagonal, separated by a distinct raised ridge; the distal portion of the zoecium is much depressed, the aperture wide (0.13 millim.), the lower border of the oral aperture widely emarginate. In young zoecia there is a thick ridge below the aperture, but in older ones the two ends are raised and form a stout blunt spine at each side below the aperture. The front wall of the zoecium is coarsely perforated.

The zoecia are very similar in several characters to those of *Eschara mortisaga*, Stol. (Bry. von Latdorf, p. 86, pl. ii. fig. 6).

This specimen was first noticed after the plates were drawn, and if the opportunity occurs should be figured at some future time.

Since writing the above I have had the opportunity of examining, in Miss Jelly's collection, older and larger colonies of what is no doubt the same thing; but in these the front of zoecium is not depressed, and sometimes besides the pair of tubercular spines there are others on the front of the zoecium. These specimens were determined as *S. vitrea*, MacG., and although the front of the zoecium is distinctly perforated, and not "granulated," most of the characters correspond with those given by MacGillivray, but his figures and descriptions are insufficient.

In my 'Challenger' Suppl. Report I considered that the *incisa* of Busk was the *vitrea* of MacG.; but I may have been misled by insufficient figures, and in the uncertainty it will be best for the present to allow the name *sydneyensis* to stand.

Lepralia vestita, Hincks, var. *australis*. (Pl. I. fig. 19.)

Lepralia vestita, Waters, Ann. & Mag. Nat. Hist. ser. 5, vol. xx. p. 194, pl. vi. fig. 21.

Since writing my previous paper I have had the opportunity of further examining Tahiti specimens, and think that the New South Wales form should be separated as a variety. The operculum of the typical *L. vestita* is shown in fig. 20.

In the Tahiti form there is more of a peristome than in the variety, and some zoecia have a broad avicularium at the side of the peristome which does not occur in the specimens from Green Point, where the variety is common.

Lepralia loncheca, B., is so closely allied to the typical *L. vestita* that I doubt whether it should be separated.

Lepralia elimata, Waters.

In young zoecia from Green Point there are supraoral spines.

Lepralia rectilineata, Hincks.

Lepralia rectilineata, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. xi. p. 201, pl. vii. fig. 5; Waters, Quart. Journ. Geol. Soc. vol. xliii. p. 60, pl. vii. fig. 16, pl. viii. figs. 34, 35, 36.

There are only two or three zoecia from Green Point; but there is no mistaking their identity with the New Zealand form.

Loc. Living: New Zealand; Green Point. Fossil: New Zealand.

Lepralia depressa, Busk. (Pl. I. figs. 13-16.)

Lepralia depressa, Busk, Cat. Mar. Polyzoa, p. 75, pl. xci. figs. 3, 4.
Escharella rostrigera, Smitt, Floridan Bryozoa, Sv. Vet.-Ak. Handl. n. ser. xi. p. 57, pl. x. figs. 203-205.

This was not recognized as identical with Mr. Busk's *L. depressa* until I had an opportunity of examining the British Museum specimens.

The bright red zoarium is incrusting. Zoecia irregularly rectangular, distinctly separated, with pores round the border. Oral aperture with straight sides and triangular proximal end, a small round avicularium at each side; sometimes an umbo on the middle of the zoecium, and from decalcified preparations this umbo appears to be sometimes perforate. The ovicelligerous cells have the aperture (0.13 millim.) much larger than that of the other cells (0.09 millim.); there is often an avicularium above the ovicelligerous aperture, and the distal end of these zoecia is somewhat raised.

Smitt gives the avicularia of various shapes.

The ordinary and ovicelligerous zoecia are now known to have different or larger apertures in several genera, as, for instance, in *Oribritina elithridiata*, *Schizoporella hyalina*, *S. jacksoniensis*, B., *Lepralia bistata*, W., *Monoporella waipu-*

kerensis, W., *Micropora*, *Adeonella*, *Adeona*, *Steganoporella*, *Catenicella*, and many others.

Loc. Ægean Sea (B.); Florida, 35-43 fath. (Sm.); Green Point, Port Jackson.

Lepralia Poissonii, Aud., var. (Pl. II. fig. 17.)

For synonyms and localities see "Tert. Chil. Bryozoa from New Zealand," Quart. Journ. Geol. Soc. vol. xliii. p. 59.

A specimen from Green Point is thickly calcified and has the ovicells immersed, showing, however, a round ovicellular area on a level with the wall of the zoecium. In *L. Poissonii*, as previously described, the ovicell is always raised, and it may be a question whether the specimen under notice should be considered a variety or whether the difference arises from a stronger calcification of older cells. The ovicells in the Chilostomata generally are subject to considerable variation with age, and great care must be exercised when using the ovicell for purposes of classification.

SMITTIA.

I have several times expressed my conviction that the classification of the family Escharidæ of Hincks would require modification when better understood, and have considered that some of the names were only used provisionally.

A considerable section possesses three teeth, which, following Jullien, we may call a central "lyrula," and two lateral "cardellæ." So far as I have had the opportunity of examination, the opercula of all of these, instead of being hard and horny, as in the majority of the Bryozoa, are soft and membranous. The method of teasing out in water, which I have found far the best for the separation of the opercula generally, is not here suitable, as the opercula cannot be removed without risk of altering their shape, and glycerine is in this case useful, though as a rule it should be avoided. This thinness of the operculum may not be found on further examination to be universal, but at the same time the probability of the value of this as a diagnostic character is pointed out.

I give under the present generic names figures of the teeth of a number of forms magnified about fifty times, and believe that they should be placed with the genus *Smittia*, dropping the genus *Mucronella*. Most of the *Mucronellæ* would come in here, but a few would come under *Lepralia*, for the so-called mucro has evidently represented various structures. In

Mucronella præstans, H., the whole front of the peristome is raised; in *M. porosa*, H., there seems to be no true mucro; and in *M. contorta*, B., and *M. bisinuata*, as previously pointed out, we ought not to speak of a mucro.

In *Smittia* the oral avicularium may, just as in *Porella*, be enclosed in the secondary aperture, as seen in some forms of *S. Landsborovii*; and, as at present defined, I find myself unable to decide what is *Porella*, though perhaps we shall find other characters uniting together a part of what is now called *Porella*.

The mandibles of the oral avicularia of a number of this group show a similarity in having a diagonal strengthening chitinous bar from each side of the lucida. We may call this the *Smittia Landsborovii* type, represented also by *Porella cervicornis*, Ell. & Sol., *P. marsupium*, *P. levis*, *P. rostrata*, *Umbonula verrucosa*, *Smittia rigida*, Lorenz; but before we can know the value of this character further comparisons of similarly placed avicularia are required. The variation in position, size, and direction of the oral avicularia of some *Schizoporella*, as for instance *S. auriculata*, must put us on our guard against hasty conclusions.

The *Eschara cervicornis* of Pallas and M.-Edwards has the oral avicularia within the orifice, and I have therefore called it *Porella*; but Mr. Hincks would call it *Smittia*, and from this I think we may see the artificialness of the genus *Porella*, as at present understood.

As to the peristomial characters, there is great variety in the genus *Smittia*, and again in *Schizoporella* there is in many species a raised peristome, as, for instance, in *Schizoporella discoidea*, B.; and in several *Celleporæ*, as represented by *C. granum*, the peristome is tubular above the oral aperture. Though no doubt often useful specifically, peristomial characters do not seem applicable for generic divisions.

I give a figure of the *Smittia* which Dr. Jullien would call *Exochella longirostris* from Cape Horn, as it shows the lyrula and cardellæ meeting and enclosing a space, and probably this is similar to the structure of *Smittia tricusps*, H., but in the latter the prolongation of the peristome forms a tube on each side.

Dr. Jullien has recently also suggested that *Mucronella* should be dropped; but I am unable to follow him in the way in which he would divide up the group.

Smittia unispinosa, sp. nov. (Pl. III. figs. 1-3.)

Zoarium incrusting. Zoecia large, quadrate, distinct, with

pores round the border. The peristome raised at each side of the aperture, but not at all on the distal end, where there is one large jointed spine, occasionally replaced by two, nor is the proximal edge raised.

At one side, rather below the aperture, a large raised avicularium with a round mandible, but sometimes replaced by a gigantic avicularium almost the size of the zoecium. In one specimen there is also one vicarious avicularium larger than a zoecium, with a spatulate mandible. The operculum is thin, scarcely chitinous, nearly orbicular, slightly curved inwards on the lower edge, and quite plain.

The ovicells are large, globular, much raised, and in mature specimens there are two or three mucronate processes and perforations on the front of the ovicell.

In young ovicells the markings remind us of the trifoliate stigma on the ovicells of a group of *Retepora*.

Smittia trispinosa, J., var. *munita*, Hincks.
(Pl. III. figs. 12, 13, 23.)

Smittia trispinosa, Johnst. var., Ann. & Mag. Nat. Hist. ser. 5, vol. xiv. p. 283, pl. ix. fig. 5.

Specimens from Green Point have the zoecia heaped up and short, with a peristomial sinus, caused by the peristome being raised on both sides. The surface is coarsely granulated, and to some zoecia there are three supraoral spines. The ovicells are distinct, partly buried in the zoecia above, with large pores over the surface, and there is usually an elongate avicularium on each side of the aperture. The lyrula and cardellæ are nearly equal and near together, and all three are directed inwards; but the operculum, on the other hand, is turned upwards towards a kind of hood on the distal end of the zoecium (see diagram, fig. 13).

Loc. Port Phillip Heads (Victoria); Green Point.

Smittia malleolus, Hincks. (Pl. III. figs. 14, 15.)

Porella malleolus, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. xiii. p. 361, pl. xiii. fig. 5.

In the specimen from Green Point the interoral avicularium is very marked, with the mandible projecting far into the aperture. The ovicells are wide and not very much raised.

In the avicularium there is a calcareous process arising from the calcareous bar. This I propose to call a ligula, and have pointed out ("On the Use of the Avicularian Mandibles" &c., Journ. Micro. Soc. ser. 2, vol. v. p. 776) that a ligula

occurs in *Cellepora sardonica*, W., *Schizoporella biaperta*, Mich., *S. auriculata*, Hass., *Lepralia edax*, B., *Retepora marsupinata*, Sm., var., *R. Couchii*, H., *Porella cervicornis*, M.-Edw. In my European specimens of *Smittia Landsborovii* it is extremely minute, but is somewhat larger in a New Zealand specimen.

I should feel inclined to consider *S. malleolus* a variety of *S. Landsborovii* and some varieties with the avicularia far down the peristomial aperture have previously been described.

Hab. Burmah (H.); New Zealand (W.); Green Point, Port Jackson.

Smittia Napierii, Waters. (Pl. III. figs. 34, 35.)

Smittia Napierii, Waters, Quart. Journ. Geol. Soc. vol. xxxix. p. 438, pl. xii. fig. 14, vol. xliii. p. 59.

The lyrula is directed inwards, but does not seem to be usually bifid, and at each side of the denticle the peristome is a little raised and forms an apparent sinus; the ovicells are usually somewhat immersed, but there is considerable variation in this particular.

This has small zoecia, and no doubt is closely allied to *Smittia* (*Mucronella*) *trieuspis*, H., but I still think they are distinct.

Smittia præstans, Hincks. (Pl. III. figs. 9-11.)

Mucronella præstans, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. x. p. 168, pl. vii. fig. 1; Waters, Quart. Journ. Geol. Soc. vol. xliii. p. 56.

Mucronella duplicata, Waters, *op. cit.* vol. xxxvii. p. 328, pl. xvi. fig. 54, and vol. xxxviii. p. 266.

The Green Point specimen is without ovicells. It differs from the typical form in having punctures in pits generally over the surface, and should perhaps be separated as a variety on this account.

Smittia signata, sp. nov. (Pl. III. figs. 4-6.)

Zoarium incrusting. Zoecia separated by a thick raised line, usually rectangular, punctured round the edge. Peristomial orifice suborbicular, narrower below, with the peristome thick and raised; on one side of the zoecia almost attached to the peristome there is a lanceolate avicularium. The oral aperture has a distinct sinus, probably formed by two lateral teeth; the operculum is thin and is strengthened by a thicker raised line, taking the shape of the mandibles of

many spatulate avicularia. Ovicell distinct, raised, but partly buried in the cell above; its surface is perforated.

It is very difficult to know where this should be placed; but the appearance and the general characters are decidedly those of *Smittia*, as is also the thin operculum; but there is no lyrula, and the sinus would make it *Schizoporella*. *Smittia obstructa* has a semicircular chitinous bar, and a bar also occurs across the operculum of *Lapralia macronata*, B.; but this is not a common character.

Smittia obstructa, sp. nov. (Pl. III. figs. 7, 8.)

The surface of the zoecium is granular, the sides of the peristome are very prominent, and sometimes there is a short triangular avicularium leaning against each prominence, the lower edge of the peristome is continuous, but not much raised.

Ovicells distinct, slightly elevated, proximal and distal portion thickened by a subsequent calcification, forming a perforated area between. Two or three suboral spines. Sometimes a fairly large avicularium on the front of the zoecium, and there are a few spatulate vicarious avicularia.

The operculum is characteristic, being marked by a thickened crescentic ridge starting from each lower corner; the rest of the operculum is thin. Lyrula distinct, not large.

This may be the *Smittia trispinosa* var. *bimucronata* of Hincks.

Retepora fissa, MacG.

Retepora fissa, MacG. Trans. Roy. Soc. Vict. vol. ix. p. 140; ib. vol. xix. p. 291, fig. 8; Zool. Viet. dec. x. p. 17, pl. xev. figs. 12-16.

There is a young colony from Green Point without ovicells, and many of the zoecia are unarmed, but some have avicularia. Two radical calcareous processes are thrown off, and there is often a triangular avicularium at the base of the fenestra. A young colony like this is with difficulty distinguished from *R. avicularis*. As mentioned in my Suppl. 'Challenger' Report, it would seem that *R. fissa* may be made the centre of a group.

Retepora porcellanea, MacG.

For synonyms see Waters, Suppl. Rep. on the 'Challenger' Polyzoa, p. 19.

Rhynchopora profunda, MacG. (Pl. II. fig. 15.)

Rhynchopora profunda, MacG. Trans. Roy. Soc. Vict. vol. xix. p. 193, pl. ii. fig. 8; Waters, Ann. & Mag. Nat. Hist. ser. 5, vol. xx. p. 196, pl. vi. figs. 11, 16.

A figure of a young colony from Green Point is given in order to show a zoecium in the first stage, and those a little older in which calcareous nodulated structure has been formed on the surface and in which the avicularian chambers are being formed.

Loc. Victoria; New Caledonia; Port Jackson, New South Wales.

Rhynchopora longirostris, Hincks.

Rhynchopora longirostris, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. viii. p. 125, pl. iv. figs. 7, 8; Waters, Quart. Journ. Geol. Soc. vol. xliii. p. 70, pl. vii. fig. 22.

Mucronella tubulosa, Hincks, *op. cit.* vol. vi. p. 383, pl. xvii. fig. 7.

In my specimens from Victoria and Green Point the processes are irregularly nodulated.

There is one curious abnormal mandible formed by the coalescence of two at their distal ends, so that there are two bases.

Loc. Living: Curtis Island (H.); Victoria; Green Point, Port Jackson, New South Wales. Fossil: Napier, New Zealand.

Cellepora columnaris, Busk. (Pl. II. figs. 1-6.)

Cellepora columnaris, Busk, Zool. 'Challenger' Exp. pt. xxx. p. 194, pl. xxix. fig. 11, and pl. xxxv. fig. 16.

Cellepora cidaris, MacG. Zool. of Vict. dec. xvii. p. 243, pl. clxv. fig. 4.

I did not appreciate that the specimens from Green Point were the *columnaris* of Busk until I saw the 'Challenger' specimens.

The columns are often very thick, occupying more space than a zoecium, and extend through several layers of the zoarium; they are solid throughout, but the central portion is more transparent than the outer, and the radiating lines only occur in the outer layer. I would call the attention of palaeontologists studying sections of problematic organisms to section fig. 4. The surface of the zoecia and columns are granulated, and the structure is no doubt the same as that of *C. cidaris*, though in no parts so strongly tuberculated as in MacGillivray's figure; the ovicells are not abundant, and where they occur are so much buried that the characters cannot be made out, but the surface appears to be plain; one large spatulate avicularium has been seen on one of the colonies.

Loc. Bass's Straits, 38 fath.; Port Phillip Heads (MacG.); Green Point, Port Jackson.

Cellepora granum, Hincks.

For synonyms see Waters, Ann. & Mag. Nat. Hist. ser. 5, vol. xx. p. 198.

There are some specimens from Green Point larger than the one previously mentioned, and they are more strongly calcified. In the most typical *C. granum* the peristome is not continuous, but carried up in "front;" and in one specimen from Green Point the peristome is in some zoëcia continuous, in others merely projects in front as if one half had been cut away, giving a very different appearance to the zoëcia. The same thing occurs in the Naples form (see Ann. & Mag. Nat. Hist. ser. 5, vol. iii. p. 195).

In the Green Point specimens there are large vicarious avicularia with the mandibles very wide at the distal end, just as in *C. Costazii*, Aud.

There seems to be a group of *Cellepore* with subglobular ovicells part way up a somewhat tubular zoëcium; the ovicells have a distinct area surrounded by elongate or radiating pores. They are known as *C. granum*, H., *C. Boryii*, Aud., *C. Costazii*, Aud., *C. Hassallii*, Johnst., *C. costata*, MacG., *C. retusa* var. *caminata*, Waters, *C. platalea*, MacG., *Lagenipora nitens*, MacG., *L. spinulosa*, H., *Phylactella lucida*, H., *C. rota*, MacG., *C. rudis*, B., *C. bilabiata*, B., *C. signata*, B.; but these should be reduced to two or three species.

In *Cellepora* perhaps we may see the signification of the perforated area on the ovicell which occurs in so many species. As growth of the colony progresses the ovicell becomes more and more immersed, often nothing being seen of it except the perforated calcareous wall of the area, and no doubt a readier communication with the surrounding water is thus maintained to the last. There are, however, many species in which the ovicell has only a lunar mark of thinner structure; this may be a degenerated form of the perforated area, where a less erect growth of the zoëcia has made the perforation of less importance.

A somewhat similar structure occurs in other genera, and then all except the area may become immersed, as, for instance, in *Smittia marmorea*.

Stomatopora incrassata, Smitt.

Stomatopora incrassata, Hincks, Brit. Mar. Polyzoa, p. 436, pl. lix. figs. 2, 3.

The Green Point specimens are no doubt identical with the form described by Mr. Hincks; but as I am not sure about other descriptions reference is only made to his.

The branches anastomose, and from various parts erect "cylindrical processes" rise up. These erect fasciculi remind us of *Fasciculipora bellis*, MacG. (see Ann. & Mag. Nat. Hist. ser. 5, vol. xx. p. 259); but in the latter they are about

double as wide and arise from a calcareous crust; this, however, is at first formed by a growth similar to the creeping branches of *S. incrassata*, and subsequently spreads out.

This would be *Filifascigera* of d'Orbigny (Pal. Fr. p. 684), and I have a recent specimen from New Zealand which I cannot distinguish from *F. dichotoma*, d'Orb. In it the bundles consist usually of four zoecia and the basal portion is punctate without zoecia. In such cases we must look upon the names given as registering the occurrence rather than expressing any opinion on the classification; and the same would apply to other Cyclostomata.

Loc. Britain; Green Point, Port Jackson.

Diastopora latomarginata, d'Orb.

Diastopora latomarginata, d'Orb. Pal. Franç. p. 827, pl. 758. figs. 10-12; Waters, Ann. & Mag. Nat. Hist. ser. 5, vol. iii. p. 272, pl. xxiv. fig. 12, which see for synonyms.

Tubulipora concinna, MacG. Trans. Roy. Soc. Vict. vol. xxi. p. 94, pl. i. fig. 10.

The zoecial tube of the Green Point specimens is a trifle smaller than that of my Naples specimens, measuring only about 0.06-0.07 millim., whereas those from Naples are about 0.08 millim. In both cases the ovicells are inflations transverse to the rows of the zoecia, with the ovicellular duct directed towards the centre of the colony.

Diastopora is not at all uncommon in the southern hemisphere, and it is therefore surprising to find that the author of the article on distribution in the 'Encyclopædia Britannica' speaks of *Diastopora* as mostly northern.

Loc. Living: Arctic Seas; Mediterranean; Victoria; Green Point, Port Jackson. Fossil: Pliocene of Sicily and Italy.

Idmonea serpens, Linn.

Loc. Living: European Seas; New Zealand; Green Point, Port Jackson. Fossil: Pliocene of Europe; various localities in New Zealand.

Lichenopora californica, Busk.

Unicavea californica, d'Orb. Pal. Franç. p. 972.

Discoporella californica, Busk, Cat. Mar. Polyzoa, pt. iii. p. 32, pl. xxx. fig. 5.

Lichenopora californica, Waters, Journ. Linn. Soc., Zool. vol. xx. p. 282. pl. xv. fig. 1.

There are several small specimens from Green Point without ovicells; but from the other characters they seem to be *L. californica*.

Loc. California; Victoria; Green Point, Port Jackson.

Lichenopora hispida, Flem.

Loc. Living: European Seas; Tristan d'Acunha, 100–1100 fath.; Green Point, Port Jackson. Fossil: Miocene and Pliocene of Europe; Australia and New Zealand, various localities.

Lichenopora victoriensis, Waters.

Lichenopora victoriensis, Waters, Journ. Linn. Soc. vol. xx. p. 284, pl. xv. fig. 4.

Lichenopora reticulata, MacG. Trans. Roy. Soc. Vict. vol. xx. p. 126, fig. 1.

I have changed the name given by MacGillivray, as *reticulata* had already been used for another species.

Loc. Victoria; Port Stephens, 5–6 fath.; New South Wales.

Diachoris spinigera, MacG., and *Cellepora hispinata*, B., described from other New South Wales localities, also occur from Green Point.

EXPLANATION OF THE PLATES.

PLATE I.

- Fig. 1.* *Microporella coscinopora*, Rss., var. *armata*, W., $\times 25$.
Fig. 2. The same. Mandible, $\times 85$.
Figs. 3, 4. The same. Opercula of ovicellular and ordinary zoecia, $\times 85$.
Fig. 5. The same. Section, $\times 25$.
Fig. 6. *Cribrilina clithridiata*, Waters, $\times 25$.
Fig. 7. The same, decalcified, $\times 25$.
Fig. 8. The same. Mandible, $\times 85$.
Fig. 9. The same. Operculum of ovicelligerous zoecium, $\times 85$.
Fig. 10. *Cribrilina figularis*, Johnst., Guernsey, decalcified, $\times 25$.
Fig. 11. *Microporella inversa*, Waters. Three stages of growth, $\times 50$.
Fig. 12. The same, decalcified, $\times 50$. *a*, pore, $\times 250$.
Fig. 13. *Lepralia depressa*, Busk, $\times 25$.
Fig. 14. The same. Operculum, $\times 85$.
Fig. 15. The same. Operculum of ovicelligerous zoecium, $\times 85$.
Fig. 16. The same. Pores, $\times 85$.
Fig. 17. *Schizoporella filocincta*, Rss., $\times 25$.
Fig. 18. The same. Operculum, $\times 85$.
Fig. 19. *Lepralia vestita*, var. *australis*, W., $\times 25$.
Fig. 20. *Lepralia vestita*, H., Tahiti. Operculum, $\times 85$.
Figs. 21, 22. *Micropora elongata*, H., $\times 25$.

PLATE II.

- Fig. 1.* *Cellepora columnaris*, B., $\times 12$.
Fig. 2. The same. Operculum, $\times 85$.
Fig. 3. The same. Section showing columns, $\times 12$.
Fig. 4. The same. Section cutting the columns transversely, $\times 12$.
Fig. 5. The same. Zoecium, $\times 25$.
Fig. 6. The same. Avicularian mandible, $\times 250$.

- Fig. 7. *Schizoporella ambita*, sp. nov., $\times 25$. *a*, operculum, $\times 85$.
 Fig. 8. *Schizoporella levigata*, sp. nov., $\times 25$. *a*, mandible, $\times 250$; *b*, ditto, $\times 85$; *c*, operculum, $\times 85$.
 Fig. 9. *Schizoporella mucronata*, Sm., $\times 25$. *a*, operculum, $\times 85$.
 Fig. 10. *Schizoporella subimmersa*, MacG., var. nov., $\times 25$. *a*, decalcified cell, showing lateral tubular connexions of the avicularian chamber, $\times 85$; *b*, operculum; *c*, operculum of ovicelligerous zoecium, $\times 85$.
 Fig. 11. *Schizoporella biserialis*, H., var., $\times 25$. *a*, operculum, $\times 85$.
 Fig. 12. *Beania hirtissima*, Hell., var. *conferta*, MacG., $\times 25$. *a*, operculum, $\times 85$.
 Fig. 13. The same. Dorsal surface, $\times 25$.
 Fig. 14. The same. Subdiagrammatic figure, showing the zoecia free in the upper part and with one ovicell to the middle zoecium.
 Fig. 15. *Rhynchopora profunda*, MacG., $\times 25$, showing young zoecium and stages of growth, $\times 50$.
 Fig. 16. *Membranipora lineata*, L., var., $\times 25$.
 Fig. 17. *Lepralia Poissonii*, Aud., var. with immersed ovicells, $\times 25$.

PLATE III.

- Fig. 1. *Smittia unispinosa*, sp. nov., $\times 25$.
 Fig. 2. The same. Mandible, $\times 85$.
 Fig. 3. The same. Operculum, $\times 85$.
 Fig. 4. *Smittia* (?) *signata*, sp. nov., $\times 25$.
 Fig. 5. The same, $\times 85$.
 Fig. 6. The same. Operculum, $\times 85$.
 Fig. 7. *Smittia obstructa*, sp. nov., $\times 25$.
 Fig. 8. The same. Operculum, $\times 85$.
 Fig. 9. *Smittia præstans*, H., var., $\times 25$.
 Fig. 10. The same. Operculum, $\times 85$.
 Fig. 11. The same. Mandible, $\times 85$.
 Fig. 12. *Smittia trispinosa*, var. *munita*, H., $\times 25$.
 Fig. 13. The same. Section showing denticles, cap, operculum, and spines.
 Fig. 14. *Smittia malleolus*, H., $\times 25$.
 Fig. 15. The same. Aperture showing avicularium with ligula, $\times 50$.
 Fig. 16. *Smittia Landsborovii*, Johnst. Aperture, $\times 50$.
 Fig. 17. *Porella cervicornis*, Pall. Aperture, $\times 50$.
 Fig. 18. *Smittia* — ? , from Port Phillip. Aperture, showing denticles, $\times 50$.
 Fig. 19. *Smittia ophidiana*, Waters. Aperture, showing denticles, $\times 50$.
 Fig. 20. *Smittia oculata*, MacG. Aperture, showing denticles, $\times 50$.
 Fig. 21. *Smittia cheilostoma*, Manzoni. Aperture, showing denticles, $\times 50$.
 Fig. 22. *Smittia reticulata*, MacG. Aperture, showing denticles, $\times 50$.
 Fig. 23. *Smittia trispinosa*, var. *munita*. Aperture, showing denticles, $\times 50$.
 Fig. 24. *Smittia delicatula*, B. Aperture, showing denticles, $\times 50$.
 Fig. 25. *Mucronella porosa*, Hincks. Aperture, showing denticles, $\times 50$.
 Fig. 26. *Mucronella ventricosa*, Hassall. Aperture, showing denticles, $\times 50$.
 Fig. 27. *Mucronella Elleri*, H., var. *biaciculata*, W. Aperture, showing denticles, $\times 50$.
 Fig. 28. *Mucronella biincisa*, H. Aperture, showing denticles, $\times 50$.
 Fig. 29. *Mucronella rostrata*, H. Aperture, showing denticles, $\times 50$.
 Fig. 30. *Mucronella lavis*, MacG. Aperture, showing denticles, $\times 50$.

Fig. 31. *Mucronella spinosissima*, MacG. Aperture, showing denticles, $\times 50$.

Fig. 32. *Mucronella diaphana*, MacG. Aperture, showing denticles, $\times 50$.

Fig. 33. *Mucronella Peachii*, Johnst. Aperture, showing denticles, $\times 50$.

Fig. 34. *Smittia Napierii*, Waters, $\times 25$.

Fig. 35. The same, $\times 85$.

Figs. 36, 37. *Exochella longirostris*, Jullien, $\times 85$.

Fig. 38. *Mucronella variolosa*, Johnst., $\times 50$.

Fig. 39. *Smittia Smittiana*, Busk. Aperture, $\times 50$.

II.—On the Cretaceous Species of *Podoseris*, Dunc.

By Prof. P. MARTIN DUNCAN, M.B. (Lond.), F.R.S., &c.

[Plate V.]

CONTENTS.

List of old and new Species.

Reconsideration of the old and Description of the new Species.

Young Forms of *Podoseridæ*.

Remarks upon some Morphological Details.

A VERY interesting collection of Corals, numbering nearly 140 specimens, has been entrusted to me by Thomas Jesson, Esq., F.G.S., who obtained them from the Red Chalk of Norfolk. The species do not assist the stratigraphical geologist in fixing a definite horizon for that interesting Cretaceous deposit. They are all members of the genus of *Lophoserine* *Fungida* which I established in 1869, under the name *Podoseris* (Pal. Soc. 1869, Monogr. Brit. Foss. Corals, 2nd ser. pt. ii. no. 1, p. 25) *. The species have not been found away from the Red Chalk. The great variability of the species of this genus was noticed in the essay which contained the generic diagnosis, and it is very evident after examining the collection lately received. The species *P. elongata* and *P. mamilliformis* have some very remarkable varieties, which are now described, and it is satisfactory to find amongst Mr. Jesson's treasures a perfect and unworn specimen of the last-named species. The diagnosis of both of the original species requires slight modification, and it is advisable to add some new species to the genus.

* The genus was considered during the publication of the "Revision of the Madreporaria" (Journ. Linn. Soc., Zool. 1884, vol. xviii. p. 153), and it was placed in the *Podoserioida*, an alliance of *Lophoserines*. It has of course no affinity with *Rhizangia*, Ed. & II., as has been suggested.

List of Cretaceous Podoseridæ.

1. *Podoseris elongata*, Dunc. (*op. cit.* p. 25).
2. — *mamilliformis*, Dunc. (*op. cit.* p. 25).
3. — *affinis*, sp. nov.
4. — *anomala*, sp. nov.
5. — *Jessoni*, sp. nov.
6. — *brevis*, sp. nov.
7. — *dubia*, sp. nov.

Reconsideration of the old and Description of the new Species.

Podoseris elongata, Dunc., was described in the Monogr. Brit. Foss. Corals, 2nd ser., Pal. Soc. 1869, Cret. Corals, pt. ii. no. 1, p. 26, pl. ix., and now requires some reconsideration on account of the discovery of some very interesting varieties. In one form, lately examined, the attached base is not so wide as the calice, whilst in the type the reverse occurred. This variation in the relative breadth of the calices is due to the coral having died at a particular stage of growth, and it can readily be imagined, after examining a tall corallum which has constrictions and enlargements of its otherwise cylindrical body, that calicular growth must have occurred both when the body was narrow and when it was broad. This variation in the breadth of calices is seen in many of the simple corals of the present day.

The septa are numerous and the greater number of them are long, stout, close, often uniting with a neighbour far inwards, or the union may not occur in all systems. Many septa, mainly formed by the union of others, reach the axis and join, forming with a very small amount of interseptal tissue a columella, which is usually seen at the bottom of the central fossula or which may project. The costæ were admirably drawn by De Wilde in pl. ix. of the memoir noticed above, and also the remarkable nodules shown on their flanks. These more or less wedge-shaped bodies are numerous and are either projected transversely or obliquely towards the neighbouring costa or septum. They rarely unite with these as stout synapticulæ directly, but interdigitate or are united by thin dissepimental ends, either with the corresponding bodies or with the opposed costa or septum. The synapticulæ are both stout and thin between the septa, but large ones are not common. The epitheca is sometimes preserved and is incomplete and in bands; it allows the alternately large and small costæ, the intercostal spaces, and even the synapticulæ to be recognized, and may be granular.

The former specific diagnosis therefore requires to be slightly enlarged.

Podoseris elongata, Dunc., 1869 (amended 1889).
(Pl. V. figs. 14, 15, 16.)

Corallum simple, tall, originally and usually permanently attached to foreign bodies by a circular base, the width of which may be larger or smaller than that of the calice. Stem cylindrical and with constrictions and expansions or bluntly conical.

Calice broad or narrow, concave or convex, with a small central fossula or a projection. Septa numerous, the fifth cycle more or less incomplete; the higher orders either very small and rudimentary, or absent here and there; the rest long, broad, arched, close, and uniting more or less, many reaching and forming part or the whole of the small columella. Swollen in regular series at the sides, swellings more or less oblique, ending in synapticulæ or arched processes or in delicate dissepiments; sides of septa in ridges and may be granular.

A small columella, formed by the septal ends, but some interseptal tissue appears to be present. Costæ well marked, usually alternately large and small, with bands of synapticulæ in transverse series and with many false synapticulæ more or less triangular in outline, with or without endotheca, between them. Epitheca in bands.

Height from 15 to 20 millim., breadth from 9 to 12 millim.
Red Chalk, Norfolk.

Podoseris affinis, sp. nov. (Pl. V. figs. 1 and 2.)

Corallum tall, formerly attached, base small; stem more or less cylindrical, unequally swollen and constricted; calice narrower than the thickest part, broader than the base. Calice convex, with a small central fossula surrounded by the inner ends of the longest septa. Septa numerous, long, moderately stout, the larger passing far inwards, rather far apart, some rudimentary, the fifth cycle very incomplete, upper edges convex and with a single row of blunt granules.

Columella deeply seated at the base of the fossula, mostly formed by the ends of septa. Costæ close, moderately unequal, apparently more numerous than the septa. Synapticulæ large in the calice and numerous between the costæ. Probably an epitheca.

Height 15 millim., breadth 6 or 7 millim.

This species is closely allied to *P. elongata*, Dunc., but the arrangement of the septa forms a satisfactory distinction, the long series preponderating, and they are wide apart.

Podoseris anomala, sp. nov. (Pl. V. figs. 3 and 4.)

Corallum simple, moderate in size, constricted above the wide circular attached base; ending superiorly in a projecting ridge some distance below the true margin of the calice. Calice tall, small, open, slightly deformed, with an indefinite margin. Septa numerous, unequal, irregular in direction inwards, long, straight, or curved, moderately stout and distinct, some reaching the axis and uniting there, others passing far in and uniting with those which pass to the columella, or not. Many rudimentary septa barely passing inwards; septa of the fifth cycle often absent in some systems, the free edge of the septa with large granules which slope over the flanks. Costæ of two kinds—those reaching the calicular margin and uncovered by epitheca, and which are subequal, granular, or alternately large and small, wavy or straight, uniting and bifurcating; and secondly those below the upper ridge and which reach to the base of the coral and are covered with epitheca; they are large, straight, swollen at intervals and joined by synapticulæ, and there are many small costæ in the spaces between the larger. Epitheca granular, upon the lower part of the stem.

Height 15.5 millim., breadth of base 13 millim., of calice 7 millim.

Podoseris Jessoni, sp. nov. (Pl. V. figs. 5 and 6.)

The corallum has a small circular base, is high, subcylindrical nearly to the calicular margin, but before that is reached there is a definite enlargement, so that the upper part is broader than the rest. Calice broad, widely open, slightly concave; the margin is higher than the axial region, the septa slope to this, which has a fossula with the ends of the larger septa rising in the midst, with a rudimentary columella formed by their ends with some slight additional structure. Septa small, crowded, unequal in width and length, usually alternately large and small, some straight, others wavy, some uniting with others, upper edge slightly convex, the inner or axial part of some seventeen to twenty septa rising up and surrounded by a groove in a small sunken fossula. The septa usually diminish in thickness from the margin of the calice inwards, and some are stout, and many

retain a considerable development as far as the columella. The septal number appears to be incomplete five cycles.

Costæ variable in thickness, some large, may be alternately large and small or subequal, never very prominent, close, wavy, and more numerous than the septa, occasionally uniting. Epithecæ covering the costæ and interspaces. Synapticulæ distinct, large between the costæ, with a broad attachment to the laminae, and a conical top; numerous and small between the septa.

Height 16·5 millim., breadth of calice 11·5 millim., breadth of stem 11 millim., breadth of the upper expansion 13 millim.

Loc. Red Chalk, east of England.

All the *Podoseridæ* appear to obtain their septal development soon, and when very short the coralla have usually a high septal number.

This evident truth rather led to the belief that a very short but broad form might be the young of *Podoseris elongata*, Dunc. (Pal. Soc. 1869, Monogr. Brit. Foss. Corals, 2nd ser. pt. ii. p. 26), or even of *Podoseris Jessoni*; but it appears that the short form must be credited with five complete cycles of septa.

Podoseris brevis, sp. nov. (Pl. V. figs. 7 and 8.)

Corallum attached by a broad base, very low, subcylindrical. The calice is widely open, shallow, and slightly narrower than the base. The septa stout, enlarging here and there, long, uniting in groups, so that a few only (seven or eight) reach the axial space, moderately close, lowly arched above, and with rounded papillæ on their free edge, or rudimentary and placed between pairs of larger septa, and rarely long enough to unite with one of the longer septa. Five cycles.

Columella formed by the septal ends. Costæ short, usually alternately large and small or subequal, covered with epithecæ; bifurcation of the costæ rare.

Breadth of the attached base 10·5 millim., breadth of calice 9·5 millim., height 3–3·5 millim.

Loc. Red Chalk, east of England.

Podoseris mamilliformis, Dunc. (Pl. V. fig. 9.)

Podoseris mamilliformis, Dunc. 1869, Pal. Soc., Monogr. Brit. Foss. Corals, 2nd ser. pt. ii. no. 1, p. 25.

This species was the type of the genus and was described from a considerable number of specimens, all of which were

unfortunately more or less worn and weathered. Specimens in a similar condition have passed through my hands since 1869, and there are some in the British Museum. Amongst the collection now under consideration there are probably a hundred specimens of various stages of growth and of decay, whilst a few present structures which, from their ready destruction under weathering, were not preserved in the specimens formerly examined.

The new specimens indicate that the ornamentation and shape of the septa, their number, their relation to a septal fossula, and the size and height of the corals vary, and that the true characters of the calices cannot be appreciated by the examination of weathered specimens. It is interesting to notice that in the specimens which were examined and described in 1869 there was a great amount of variation in their height and in the convexity of the calices. No satisfactory examples of the tall varieties with convex calices are amongst the new series. Most of the specimens are low, broad, slightly convex, with a massive-looking columella and numerous large uniting septa and synapticulæ. The usual cyclical number of the septa is incomplete five, but there are some specimens with five cycles complete, and in one very broad specimen there are some septa of the sixth cycle present.

The following is a description of what may now be considered to be a typical form:—

Corallum simple, attached, with a circular base, from which it rises very slightly and more or less vertically to the edge of the moderately convex calice, which has a distinct central fossula with the columella at its base. Broader than high, 12 millim. in diameter and 5·5 millim. in height.

Septa mostly long and stout, passing far inwards, many reaching, after uniting with others, the edge of the fossula and uniting at its base to form, with some slight interseptal structure, the columella; all more or less arched where free and carrying a single line of large distinct granules, which are especially large and distinct around the fossula and upon the columella; or the position once occupied by granules may be occupied by pits. The number of the septa is variable in the six systems; there is either a deficiency or a redundancy of large septa and the number of rudimentary small septa varies greatly; still the complete fifth cycle is rarely reached in spite of there being some very remarkable long and very slender and almost linear septa close to some of the largest. There is union of septa either near the fossula or near to the calicular margin. Septa swollen in regular series, their swellings interdigitate, oblique ridges upon the sides of the

laminae, which terminate either in synapticulæ, or in hooked processes with or without endothecal ends. The costæ are short, subequal or very unequal, having some granulation and a greater or less development of endotheca. Synapticulæ very numerous between the septa near the base, less so higher up; they occur between the costæ also. Another form shows the bifurcation of costæ and their union also. The height is 8·5 millim. and breadth 12·5 millim.

One specimen of *P. mamilliformis* deviates from the type in being comparatively taller, having a distinct, low, incurved part above the attached base and ending superiorly in a ridge-shaped calicular margin, and in having a very convex calice. The gradations of form and structure from the low and broad types to this high one with such a well-defined convex calice are fairly well seen in the collection. The height of the corallum is 9 millim., of the calice 6 millim., and the greatest breadth is 12 millim. Some orders of the sixth cycle of septa are present; there is no sunken central fossula, and the epitheca is granular.

Podoseris mamilliformis, Dunc., requires some modification of its original definition, and the following is the correct specific diagnosis:—

The corallum is simple, attached by a more or less circular flat, or concave base, being very low or slightly raised between the base and the calicular margin, constricted or not, and with costæ. The calice is circular in marginal outline, slightly or considerably convex, with or without a central fossula. The septa are numerous and become so early in life, are unequal, many long and some uniting and reaching the columella or the fossula, some slender and many rudimentary: longer ones, straight or wavy, ornamented at the arched free upper edge with a single row of large granules. Columella small, mostly formed by the septal ends, and there may be some interseptal structures there, at the base of the fossula, with large granules upon it, or projecting without a fossula. The costæ usually more numerous than the septa, straight or wavy, uniting and bitureating, ending in septal laminae, unequal or alternately very large and small, with granules. The septo-costal number is from less than complete five cycles to five cycles with part of a sixth. Synapticulæ moderate in number, continuous with a series of ridges placed obliquely upon the flanks of the septa; but the ridges may be curved, so as to resemble hooked processes in section, and may be free at one end or terminate in a thin endothecal process. Endotheca scanty, may exist

between the ridges of synapticulæ. Epitheca exists or not and is delicate and granular.

Breadth from 5-12 millim., height from 2-8 millim.

Podoseris dubia, sp. nov. (Pl. V. figs. 12 and 13.)

The corallum is small, attached, cylindrical, nearly as high as broad, with a slightly convex calice and a small central fossula. Septa numerous, subequal, mostly long, stout, and slightly wavy, often straight, passing far inwards, some uniting with others, and these reach the edge of the fossula, arched at the free edge, carrying a single row of large distinct granules; a few rudimentary septa. About sixty-four large septa, of which one half reach the fossula and form the columella, with probably the addition of some dissepimental structure, the top of the columella being the base of the fossula. Interseptal spaces well developed, but a slender horizontal growth is often seen upon the sides of the septa. Costæ more numerous than the septa, unequal in some parts, very straight and regular and well separated, alternately broad and narrow; in other parts very irregular, wavy, dividing and uniting, or straight, differing much in size. Synapticulæ few and deeply seated in the calice, probably few between the costæ, but in definite transverse lines and stout. Epitheca in bands in places, but the intercostal spaces are visible elsewhere; there is an indefinite and small granulation upon the costæ.

Height 8 millim., breadth of calice 9 millim.

Loc. Red Chalk.

Young Forms of Podoseridæ.

1. (Pl. V. fig. 10.)

Part of a small, simple, very low corallum, expanded, and about 2 millim. broad from the extremity of the base to the inner ends of the septa. The discoid coral slopes up very slightly from the outer edge of the costæ at the base to their septal end, which is raised. The septa are sunken below the calicular margin, large and small, long and short, irregular in thickness, radiating from a circle of synapticulæ, which unites the inner ends of the larger septa and surrounds a wide axial space; the smaller septa may unite with the larger; interseptal spaces large, shallow. Two, or in places three, concentric lines of synapticulæ and some small septa end in the circle nearest the costæ. Costæ larger than the septa; close, unequal, slanting synapticulæ seen. The wall

is a thin dissepimental looking circle at the junction of the costæ and septa, in places raised higher than the septal ends. Original width 5 millim.

The septa reach from the foreign body to which the coral is attached but a very slight distance upwards; *there is no true basal structure*. The axial space shows the stone at its base, and it is clear that the septal apparatus and its associated costal structures were the first parts of the skeleton.

2. (Pl. V. fig. 11.)

A young, flat, discoid corallum, upon the side of a *Porlosaris elongata*. The base is nearly circular at its edge, and the coral then slopes very slightly upwards, being covered by costæ, to the calicular margin. The calice is sunken close to its margin and the columella is raised above the level of the rest of the calice and is formed by the inner ends of the longest septa.

The calicular margin is broadly elliptical and is recognized easily in places, and elsewhere is produced by close synapticulæ.

The septa are narrower than the costæ, and some are very much smaller, unequal, irregular, long, and wavy, others rudimentary; close to the costæ there are seventy-two, and eight reach the columella, or, rather, form it. Some septa crooked, most uniting, and some bifurcating, the junction may result either in a narrow or a thick septum. The costæ are not so numerous as the septa, slope widely upon the supporting body, are subequal to very unequal, usually nearly straight, projecting, but slightly rounded, or flat or swollen here and there, close to touching, some bifurcating, united by transverse or oblique synapticulæ; the narrow intercostal spaces correspond with interseptal spaces.

Height about 2 millim. long diameter, 8 millim., short diameter of the calicular part 5 millim. and its long diameter 6 millim.

It is evident that the septa and costæ spring from the supporting foreign body *without any intervening basal structure*. The septo-costal cyclical number is attained very soon after a moderate breadth has been reached.

Remarks upon some Morphological Details.

The septa of the species are solid, unilamellar, and are formed by spicules which pass from within the septa outwards to their surface from definite centres or nodules. Often

very stout, the septa have corresponding large granules upon the free upper edges, or after the effects of weathering these granules may have disappeared and deep holes exist in their place. A very interesting structure is sometimes seen upon the flanks of these large septa and close to their upper free edge, and it consists of a thin, more or less horizontal, narrow lamella of hard structure which occludes, to a small extent, the interseptal loculus. The modern example is seen in *Bathyactis*, a deep-sea Fungid, but this is more complete, for the lamellæ of opposed septa join over the interseptal loculi, especially near the axis of the coral. Some septa are very delicate and long, and this is a truly Fungid character and is exemplified in the modern genus *Fungia*. The union of many septa with others, so as to form a converging series ending in one septum at the axis, is well seen in *Podoseris*. On the flanks of the larger septa are close, small, sharp, spinulose granules, and as all the septa are swollen tolerably regularly, so as to present a series of transverse or curved or oblique projections into the interseptal spaces, the general appearance is very irregular.

A transverse section of a specimen of *Podoseris elongata* (Pl. V. fig. 14) taken just below the surface of the calice shows structures similar to those of weathered calices. Synapticulæ stretch across interseptal spaces and fuse with the septa, and this union is especially well seen in the inner third of the section. Beyond that area, and where the interseptal spaces are often wider, the projections from the alternating nodules of opposed septa do not all terminate in synapticulæ, for many end in recurved blunt points, the ends being directed towards the circumference of the coral. These points and the curvatures of their processes, together with the alternating and interdigitating of the nodules of the septa, give a very characteristic appearance to the section. There is no doubt that some of the points terminate in stout laminae which reach the opposed face of the neighbouring septum, and are thus synapticulæ, whilst others end in very delicate arched processes which touch the opposed septum. These delicate processes are dissepimental for the most part, but some of them cannot be distinguished in structure or direction from very thin synapticulæ. It must be remembered that long and thin synapticulæ are exemplified in the modern *Bathyactis symmetrica*, Moseley (Report on 'Challenger' Deep-sea Corals, 1881, p. 186, pl. xi. fig. 2). They are the simplest forms of the structures. An advance upon this particular elongation is seen in the synapticulæ of *Pachyseris speciosa*, Dana, and *Mæandroseris Botte*, L. Rouss, and in

Lophoseris cristata, Ehr., the thickness of the growths being variable, but on the whole they are thicker than in *Bathyaetis* (Duncan, 1884, Journ. Linn. Soc., Zool. vol. xvii. pp. 304, 308, 312, pl. xiii.).

A longitudinal section of *Podoseris elongata* (Pl. V. fig. 15), taken nearly along the plane of the axis, shows in the middle numerous septa cut across longitudinally, and showing the alternating succession of nodules on their flanks. The nodules terminate in oblique processes, which either cross the interseptal space and are synapticulæ, or are curved and pointed more or less bluntly and are free at the end. Some of these hooks end in the same manner as in *P. mamilliformis*, and the delicate arched terminations so like those described by Pratz in *Thamnastræa* may also be seen. Now towards the sides of the section the septa are cut across obliquely, and close to the edge of the section the flanks of a septum are visible on either side of the fossil. The flanks show an oblique series of successive ridges, each series upon the nodular flank of a septum; and each ridge has been cut across parallel with the flank of the septum, for the ridge was once continued over the interseptal loculus as an elongate synapticulum. The oblique ridges are plainly united here and there by delicate processes, which are directed from one ridge downwards and slightly obliquely to reach the next ridge in downward succession (fig. 16). This feeble development of the endotheca does not resemble that of *Cyclolites* and of some *Thamnastræans* (Pratz, 1882, Palæontographica, vol. xxix. Taf. xiv. figs. 7, 12, 14, "Ueber die verwandtsch. Beziehung einiger Korall. mit hauptsächl. Berücksicht. ihrer Septalstructur").

The synapticulæ of the species are often large and are usually well developed, appearing in transverse section as cross bars, but in vertical sections the structures are elongate upon the flanks of the septa. The fossilization of the specimens is not altogether favourable to the microscopist, but in some places the synapticulæ blend intimately with the septa, whilst in others a line of separation can be seen between the synapticulæ and the sides of the septa on either side. This union of the two kinds of synapticulæ in the species would have had considerable significance at the time that Milaschewitsch wrote in 'Palæontographica,' 1875, Korall. d. Natth. Schicht. That author found in some genera, *Thamnastræa* for instance, that the synapticulæ did not fuse into the septa, but that there were junction-lines, indicating that the structures were at one time separate. This form of synaptacula was called a pseudosynaptacula. On the other hand, there are

genera which have the synapticulæ without any junction-lines, and they blend without lines of union. These are true (echte) synapticulæ. Pratz, following Milaschewitsch, gave some excellent figures of the kinds of synapticulæ (*op. cit.* pl. ix. figs, 7 *d*, 12 *a*, 13 *a*, and 14 *a*), and quoted his predecessor's remark that it is necessary to distinguish between the kinds of synapticulæ in classification. All the descriptions of these authors are excellent, and nothing can be more true than Pratz's delineations; but, as was shown after the publication of their essays, the modern example fails to substantiate the value of the distinctions between the kinds of synapticulæ (Duncan, 1884, *Journ. Linn Soc., Zool.* vol. xvii. p. 146), and, moreover, the microscopic investigation of *Siderastræa* and of a true Tertiary *Thamnastræum* leads to the same result as the study of *Fungia*; that is to say, as both kinds of synapticulæ are found in the same specimen of a species, and the difference between the kinds of structures is of no physiological importance, the distinction between so-called true and false synapticulæ is of no classificatory value.

The synapticulæ in *Podoseris* are therefore both thick and thin, long and short, and are long from without inwards and obliquely placed upon the flanks of opposed septa, which they unite. This last kind is a feeble representative of the synapticulæ of the recent *Fungia*, and as in that genus the upper and the lower synapticulæ form the roots and bases of so many oblique canals in regular succession. The delicate dissepiments interfere with the continuity of the lumen of the canals.

The Epitheca.—This structure varies in amount according to the height of the corallum. When the coral is low and plano-convex the epitheca is scanty or absent, and it exists over more or less of the costæ close to the periphery. But when the coral is tall the cylindrical or nipped-in stem above the attached base is covered with epitheca up to varying heights, but usually to the calicular margin. The epitheca is thin, moulded as it were to the outer edges of the costæ and to their interspaces; it is more or less granular, and it must have prevented any watery connexion between the synapticular canals and the surrounding medium.

There is no epitheca on the attached base, but the lower surfaces of the septo-costæ are in contact with the foreign body supporting the coral, and the synapticulæ may be seen to exist between the septa in concentric rows. The coral appears never to have been free.

In the very interesting young form the low septa and two concentric series of synapticulæ form all the coral.

The genus *Podoseris* evidently requires some further amendment.

Genus *PODOSERIS*, Dunc. Supp. Brit. Foss. Corals, Pal. Soc. 1869, Cretaceous Corals, pt. ii. no. 1, p. 25, and Oolitic Corals, pt. iii. p. 24; Revision of Madreporaria, 1884, Journ. Linn. Soc., Zool. vol. xviii. p. 153 (amended).

The corallum has a narrow or wide base of permanent attachment, the height varies from very low, plano-convex, to high, stem more or less cylindrical. Calice more or less circular, with a small axial fossula or projecting there: a columella formed by the septal ends, with or without other structure, small; septa numerous, uniting much, stout, or very slender, solid, largely granular at the free convex edge, minutely acicular at the sides; costæ as continuations of septa, in the direct line, usually the most numerous. Synapticulæ numerous, oblique, continuous with septal nodules, interseptal loculi also with recurved hook-like processes; a delicate arched dissepimental structure scanty. Epitheca exists on the sides and at the periphery.

Fossil: Red Chalk, Oolite, England.

The Oolitic species *Podoseris constricta*, Dunc., Pal. Soc. Supp. Brit. Foss. Corals, Oolitic Corals, pt. iii. p. 24, pl. iii. figs. 5, 6, came from the Lower Ragstone of Dorset. It has a higher septal number and much more delicate and nearly uniform costo-septæ than the Cretaceous species. It originally was fixed and probably upon a spine-shaped body.

EXPLANATION OF PLATE V.

- Fig. 1.* *Podoseris affinis*, sp. nov. Side view, nat. size.
Fig. 2. The same. The calicular fossula, magn.
Fig. 3. *Podoseris anomala*, sp. nov. Side view, nat. size.
Fig. 4. The same. Part of the calice, magn.
Fig. 5. *Podoseris Jessoii*, sp. nov. Side view, nat. size.
Fig. 6. The same. The fossula and some septa, magn.
Fig. 7. *Podoseris brevis*, sp. nov. Side view, nat. size.
Fig. 8. The same. Test of the costæ, magn.
Fig. 9. *Podoseris mammiliformis*, Dunc. Part of calice, magn.
Fig. 10. Young *Podoseris*, slightly magn.
Fig. 11. Older *Podoseris*, slightly magn.
Fig. 12. *Podoseris dubia*, sp. nov. Side view, nat. size.
Fig. 13. The same. Part of calice, magn.
Fig. 14. *Podoseris elongata*, Dunc. Part of a transverse section below the calice, magn. α , synapticulæ; β , dissepiments.
Fig. 15. The same. Part of a longitudinal section, magn. α , synapticulæ; β , dissepiments.
Fig. 16. The same. A longitudinal slice, polished. α , synapticulæ, long and oblique; β , dissepiments.

III.—On *Meiolania* and some Points in the Osteology of the Testudinata: a Reply to Mr. G. A. Boulenger. By Dr. G. BAUR.

[Plate VI.]

IN the February number of the 'Annals and Magazine of Natural History' I find some remarks by Mr. G. A. Boulenger in reply to my article on the systematic position of *Meiolania* published in the January number. Nearly all the comments of Mr. Boulenger need an answer.

1. "After having thought *Meiolania* to be allied to *Staurotypus*, Dr. Baur now regards this Chelonian as representing a highly specialized branch of the true land-tortoises." . . .

Many people may think from this statement that I have published such a view on *Meiolania*; this I never did. The fact is that during my visit in London last August and September I had some talk with Mr. Boulenger on *Meiolania*. I said that the skull looks very much like that of *Staurotypus*, and showed to Mr. Boulenger the cervicals of *Staurotypus triporcatus*, so kindly sent to me by Prof. v. Krauss for examination; this was all. I had not yet reached a definite conclusion on the systematic position of *Meiolania* among the Cryptodira when I left London; this was only obtained here after a careful examination and comparison.

2. "Dr. Baur's theory of the specialization from a land-Testudinoid, viz. a type with extremely reduced tail, with procœlous vertebræ and no chevrons" "is inadmissible."

Of course *Meiolania* did not come from any of the living forms of the Testudinidæ. This I have clearly shown in my remarks on the quadrate with an open fissure, which we find in *Meiolania*. That some of the fossil Testudinidæ, like *Hadrianus*, Cope, from the Eocene, showed such conditions is possible, but we have no proof yet. Besides that, I think it probable that after a careful study of the tails of the different land-tortoises we may find conditions somewhat similar to those in *Meiolania*. I only note Blyth's remarks on "*Scapia*," a form very much like *Hadrianus*. According to him there is "a group of five principal obtuse spines on either side of the tail, the medial of them remarkably strong and thick; two or more smaller spines or thick elongate scales above the tail." I do not know "*Scapia*"*; but these spines seem to indicate a longer tail, as in the other Testudinidæ. I think my discovery of opisthocœlian vertebræ in a land-

* Probably only a species of *Manouria*.

living form of the Emydidae, the "wood-tortoise" (*Clemmys insculpta*, Le C.), is a very good support of the correctness of my view.

3. "Dr. Baur has arrived at some curious misconceptions from not examining sufficient material, and, what is still less excusable, by not carefully perusing the standard works on the osteology of Reptiles. Thus, for example, he entirely ignores the cranial structure of *Chelys*, the type, in a systematic sense, of the Pleurodira, which has been figured by Cuvier, Wagler, Brühl, Hoffmann, and Mirart. He will find, by referring to *Chelys*, that his character of 'the quadrate connected with the basisphenoid, sometimes with the basioccipital,' falls to the ground."

I should say that Mr. Boulenger knows what I intended to express by the words "*the quadrate connected with the basisphenoid*"—it was *the fact*, that in all Pleurodira the pterygoids do not separate the quadrate and basisphenoid, as in the Cryptodira. This fact I defined by the words, not applicable to *Chelys*, "*the quadrate connected with the basisphenoid.*" But *Chelys* makes no exception from the other Pleurodira; *even here the pterygoids do not separate the quadrate and basisphenoid*. But these bones are separated by the petrosal nearly in the same way as in *Pelomedusa* and *Hydromedusa* (Peters), in which forms a small connexion between quadrate and basisphenoid still exists. I said that Mr. Boulenger knows what I wanted to express by the words "*the quadrate connected with the basisphenoid.*" I made him acquainted personally with the new character of the Pleurodira, found in the pterygoids; besides that, every body can see what I meant if he reads the words immediately following the above statement—"in all the Cryptodira and the Trionychoidea the pterygoids extend between these elements."

It was a wrong expression, but not ignorance!

4. The absence in the Pleurodira of the descending processes of the præfrontals, which connect the vomer, is a character of no great importance according to Mr. Boulenger.

a. That the connexion between the vomer and the "præfrontals" does not exist in the living Pleurodira is perhaps due to the fact that the vomer is absent in the Pelomedusidae."

To that I answer with the fact that the Cretaceous *Bothremys*, Leidy, has a very strong vomer, but no connexion between the vomer and the præfrontals.

b. "In *Chelys* and *Chelodina* a complete bony orbito-nasal septum is formed by connexion of the præfrontals with the palatines."

I cannot find a "*complete bony orbito-nasal septum*" in

Chelodina (*Chelys* not at hand). Besides, this would have nothing to do with the condition found in the Cryptodira. To explain this I give a description of the relations between præfrontals, palatines, and vomer in the Testudinata.

In all the Cryptodira the præfrontals show two inferior processes: one which we call the inner process is connected with the vomer and the inner portion of the palatines; the other, the outer process, is connected with the maxillary, or may even reach the outer portion of the palatines. Between these two processes and the palatines and maxillaries we find the foramen nasopalatinum.

a. *Cryptodira*.

Chelydridæ, Dermatemydidæ, Staurotypidæ, Cinosternidæ.

Inner process of præfrontal in extensive connexion with vomer and palatines; outer process in no connexion with palatines.

The Cheloniidæ show the same condition, but in some forms the connexion between the inner process and the palatines has gone. We may distinguish the following stages:—

Euclestes.—Like Chelydridæ.

Chelonia.—Inner processes clearly connected with palatines.

Thalassochelys.—The ends of the inner processes touch the palatines.

Colpochelys, *Caretta*.—No connexion between inner processes and palatines

Dermochelydidae.—Connexion still more reduced; ends of inner processes touching vomer only.

Emydidæ and *Testudinidæ*.—A similar condition to that in Chelydridæ we find in some of the Emydidæ (*Trachemys serrata*, *Ptychemys concinna* and *mobiliensis*). In others the outer præfrontal process begins to touch the palatines (*Mala-colemmys*, *Chrysemys*, *Terrapene*, *Clemmys*). Or in many of the Testudinidæ a strong connexion exists between this process and the palatines; hence the foramen nasopalatinum is formed by the præfrontals and palatines only. This foramen may be very much reduced and nearly disappear (*Emys melagris*, *Clemmys guttata*, different Testudinidæ, *T. polyphemus*).

β. *Chilotæ*, Wieg.*

The foramen nasopalatinum generally formed by præ-

* I use the name *Chilotæ* in preference to Gray's name *Trionychoidea*, expressing only a superfamily.

frontal, maxillary, palatinum, vomer. The inner process of the præfrontal connected with the vomer, the outer with the maxillary. In *Chitra* and *Cyclanosteus* there is no connexion between præfrontals and vomer; in *Emyda* and "*Baikia*" the inner process of the præfrontals becomes rudimentary.

γ. *Pleurodira*.

The inner process of the præfrontals is absent or rudimentary, there is never a connexion with the vomer and never with the palatines. The outer process is either connected with the maxillary alone or may even touch the palatines.

Podocnemididae.—In *Podocnemis* and *Erymnochelys* (*Dumérilia*) there is no connexion between the outer process of the præfrontals and the palatines. In *Erymnochelys* the inner process is indicated very much more than in *Podocnemis*.

Sternotheridae.—Like *Podocnemididae*, in *Sternotherus niger* the inner process is still more indicated than in *Erymnochelys*.

Chelydidae.—In *Chelymys victorie* the outer process is very near to the palatines, the inner process scarcely present. In *Chelodina longicollis* the ends of the outer process of the præfrontals and the palatines meet; the inner process is more developed, as in *Chelymys*, but not so much as in *Sternotherus*. This is called by Mr. Boulenger a "complete bony orbito-nasal septum."

To sum up. In all *Cryptodira* (if not highly specialized, as some *Cheloniidae* and *Dermochelys*) the inner process of the præfrontals shows a connexion with the palatines and the vomer.

In all *Pleurodira* not only the connexion with the palatines but also that with the vomer is absent.

In all *Testudinata* in which the inner process of the præfrontals is connected with the palatines this process is connected with the vomer also.

Now what do we find in *Meiolania*. There is a small palatonasal opening which is shown on the right side; the inner præfrontal process is connected extensively with the palatines; therefore a connexion must also exist with the vomer.

I may add that this region in *Meiolania* is nearest to the condition found in the *Testudinidae*. But according to Mr. Boulenger "Dr. Baur is not justified in saying that the præfrontals are connected with the vomer in *Meiolania*."

5. Mr. Boulenger claims to be better informed as to the

condition of the pterygoids than I am, "who, after examining merely the cast, thinks the lateral expansion of the pterygoids 'may be produced by crushing of the edges.'" But Mr. Boulenger forgets to state that I remarked, "even if it [the expansion] were natural, it would not be of great importance." This is a great difference. I did not think *only* that the edges are crushed; I admitted the other possibility that they are natural. I believe Mr. Boulenger when he says that they are natural, but even then this makes no difference. Such expansions are indicated in some of the Testudinidæ (conf. *Testudo elephantina*, Günther, 'Gigantic Land-Tortoises,' pl. ix. fig. A); and, as I stated before, in the Chilotæ we find all conditions of these expansions.

6. To Mr. Boulenger it seems extremely probable that [in *Meiolania*] "the quadrate did join the basisphenoid, as in *Podocnemis*." But I miss the reasons for this probability.

7. "The back of the skull of *Meiolania* is as typically Pleurodiran as can be, and totally different from that of the Testudinidæ." The complete bony ring is "decidedly held to be formed by the quadrate." Also here I miss the reasons.

8. "How Dr. Baur has acquired his information respecting the characters of the Pleurodiran cervical vertebræ as compared with the Cryptodiran is a puzzle to" Mr. Boulenger.

My information was acquired by the examination of many hundreds of Testudinata in the museums of this country and in Europe; and I have not to change a single point in my statements.

I said, "1. The centrum of the first vertebra [of the Pleurodira] (the so-called odontoid process) is absolutely free from the second, with which it articulates freely." In the Cryptodira "it is not absolutely free from the second, but more or less connected."

This is the fact; if the cervical vertebræ of a Pleurodiran are macerated the centrum of the atlas becomes free from the centrum of the axis; in the Cryptodira it remains more or less connected.

9. "Better than any lengthy discussion, the following figures will show whether Dr. Baur is justified in stating that an 'atlas-ring' is absent in the Pleurodira and that the centrum alone supports the neuroids of the atlas."

At first I have to protest against misstatements. I have never said that the centrum *alone* supports the neuroids. *I have clearly stated that in the Podocnemididæ the first inter-centrum is "slightly connected with the neuroids."* In regard to the atlas-ring I may say the following: an atlas-ring is

formed by the connexion of the neuroids with the first intercentrum (atlas-ring of birds and mammals). Such a ring does not exist in the Pleurodira, so far as I know. If the atlas of a Pleurodiran is macerated the intercentrum, if not coossified with the centrum, becomes free; it does not remain in connexion with the neuroids; these generally are united with the centrum or may become free, as in the Podocnemididæ (*Podocnemis Dumeriliana* and *expansa*) and some Chelydidæ (*Elseya* according to Vaillant). But if we macerate the atlas of a Cryptodiran we never find, so far as I know, that the neuroids of the atlas remain in connexion with the centrum; the neuroids of the atlas are connected with the intercentrum, or all parts may become separated, as in the Chelydridæ, Cheloniidæ. This I wanted to state, and therefore I used the words "it is the centrum which supports the neuroids of the atlas" in the Pleurodira. I excluded the Podocnemididæ, stating that the intercentrum also takes some part.

If we compare Mr. Boulenger's figures with these remarks there seems to be considerable contradiction.

In the specimen of *Erymnochelys madagascariensis* before me the atlas is missing; but for comparison I give an exact figure of the first two cervicals of *Podocnemis Dumeriliana*. *Podocnemis* and *Erymnochelys* are allied forms, and *Erymnochelys* is even not different from *Podocnemis* according to Mr. Boulenger. We may expect therefore that the first two cervicals show in both similar conditions. As anybody will see, my figures of *Pod. Dumeriliana* are entirely different from those of *Erymnochelys* given by Mr. Boulenger. The neuroids are supported by the atlas centre, the intercentrum is connected a little with the neuroids. The intercentrum is very small compared with the centrum and projects below it.

In *Chelymys victoriæ* we find a similar condition to that in *Pod. Dumeriliana*; but the intercentrum simply touches the neuroids. The neuroids are more connected with the centrum than in *Pod. Dumeriliana*. This condition is very much more expressed in the following genera of the Chelydidæ—*Chelys*, *Hydromedusa*, *Chelodina*, *Hydraspis*—and in the Sternotheridæ; in all these the neuroids have entirely gone on to the centrum, with which they become ossified.

In the Cryptodira the conditions are entirely different. The most generalized arrangement we find in the Cheloniidæ and Chelydridæ, in which the atlas-elements are only loosely connected; but even in these forms the centrum does not support the neuroids. *The connexion between these elements is on a vertical plane, there is no support*; the neuroids are

supported by the intercentrum. The conditions of the centrum of the atlas in the Testudinata may be expressed in the following diagram, in which the centrum is seen from above:—



1. Cryptodira : no face for neuroids.
2. Podocnemididæ : a small face for neuroids.
3. Chelydidæ, part, *Chelymys* (for ex.) : a larger face for neuroids.
4. Chelydidæ, part (Sternotheridæ) : a large face for neuroids.

The conditions of the first two vertebrae in the Cryptodira and Pleurodira could be expressed also in the following way:—In the Cryptodira the atlas-ring has a free articulation with the atlas-centrum; in the Pleurodira the associated neurooids and the atlas-centrum have a free articulation with the centrum of the axis.

10. "With regard to *Meiolania*, I can state that the neurooids of the atlas are supported by both the hypapophysis (first intercentrum) and the centrum, that the latter articulated freely with the second centrum, and that the diapophyses of the second vertebra are not partly below the præzygapophyses, as in all Cryptodira, but entirely behind; in all these respects agreeing with the vertebrae of *Podocnemis madagascariensis* figured above."

In regard to this I state that after a careful comparison of the atlas of *Meiolania* with other specimens I am convinced that the neurooids are exactly in the same connexion as in the Cryptodira, especially the Testudinidæ. They stand entirely on the first intercentrum, with which they are coossified; there is no articular face on the top of the atlas-centrum for the neurooids. Whether the atlas-centrum articulated freely or not is impossible to determine in the specimen, but it is very doubtful that it did articulate freely.

The diapophysis of the axis is a trifle behind the præzygapophysis in *Meiolania*; we have the same, if I remember rightly, in *Staurotypus*; if the diapophysis of *Testudo polyphemus* should become more slender, we would have the same arrangement; the thick basis of the diapophysis would be used up for this, and the diapophysis would be behind the zygapophysis. But this difference is of no importance. In

all the *Pleurodira* known the diapophysis of the second vertebra is in the middle; in all *Cryptodira* it is in front; and so it is in *Meiolania*.

11. "Two adult skeletons of *Testudo polyphemus*" in the British Museum "do not show the slightest resemblance to *Meiolania* in their first and second vertebræ."

I give an exact drawing of the atlas and axis of *Testudo polyphemus* (Pl. VI. figs. 3, 4) (no. 645 Peabody Mus.) and of *Meiolania* (fig. 5) *, and leave it to the judgment of the readers whether they are alike or not. Besides that I give a description of these vertebræ.

Meiolania.

Atlas.—Intercentrum coossified with neuroids of atlas, between intercentrum and each neuroid a foramen. Centrum very short, entirely free from intercentrum, convex in front, concave behind; intercentra two, coossified with the posterior part of the centrum, forming two processes behind; no face for neuroids on the upper part of centrum; anterior face convex, forming a ball, which moves in the posterior articular face of the atlas-ring.

Axis.—Centrum strongly emarginate behind, no keel on lower face; probably concave behind; a strong diapophysis directly behind and below præzygapophysis, but in front of centrum, not in the middle; diapophyses not directed backwards.

Testudo polyphemus (typical specimen from Florida).

Atlas.—Intercentrum coossified with neuroids in very old specimens; between intercentrum and each neuroid a foramen, which may be open behind. Centrum very short, entirely free from intercentrum, convex in front, concave behind; intercentra two, coossified with the posterior part of centrum in old specimens (suture still visible in no. 645), forming two processes behind; no face for neuroids on the upper part of centrum; anterior face convex, forming a ball, which moves in the posterior articular face of the atlas-ring.

Axis.—Centrum strongly emarginate behind, no keel on lower face; concave behind, a pretty strong diapophysis, anterior face a little below, posterior entirely behind præzygapophysis; in front of centrum, not in the middle. Diapophyses not directed backwards.

I beg to compare the figures and description of the first

* The drawing is made from the cast; the single elements of the vertebræ are placed in the natural position.

two vertebræ of *Meiolania* with the same elements of any Pleurodiran. There is a fundamental difference. *These vertebræ are typically Cryptodiran in Meiolania.*

12. "If Dr. Baur were acquainted with the structure of the hyoid in the Pelomedusidæ he could not have pointed to the character of the hyoid bones as proving the Testudinoid nature of *Meiolania*."

The hyoid apparatus of *Sternotherus niger* before me is very different from that of *Meiolania*. The copula and the proximal parts of the third pair of cornua are entirely coossified; in *Meiolania* we only have the ossified great cornua, and these show some resemblance to the same elements in *Sternotherus*; but such a similarity is not an affinity. I do not know the hyoids of *Pelomedusa*. In young specimens of *Podocnemis* only the great cornua are ossified.

EXPLANATION OF PLATE VI.

Fig. 1. Atlas of *Podocnemis Dumeriliana*, front view, $\frac{1}{2}$.

Fig. 2. Atlas and axis of *Podocnemis Dumeriliana*, from below, $\frac{1}{2}$.

Fig. 3. Atlas of *Testudo polyphemus*, front view, $\frac{2}{3}$.

Fig. 4. Atlas and axis of *Testudo polyphemus*, from below, $\frac{2}{3}$.

Fig. 5. Atlas, axis, and part of occipital condyle of *Meiolania platyceps*, $\frac{1}{2}$, from below. The elements are placed in the right position.

i^1 =intercentrum 1.

i^2 =intercentrum 2.

o =condyle.

c =centrum of atlas.

c^1 =centrum of axis.

New Haven, Conn.,

April 2, 1889.

IV.—Notes on the Histeridæ taken in Venezuela by Mons. E. Simon. By G. LEWIS.

THE object of this paper is to enumerate the species of Histeridæ captured in Venezuela by M. E. Simon during a journey extending through December 1887 to April 1888, and it will form, I believe, one of a series of memoirs relating to other insects taken by him at the same time. Almost every collection made in the warm parts of America brings to light some curious new form of Histerid, and the present one is not an exception. The *Phelister Simoni* noticed here is a most remarkable species and one which I only place in the genus with doubt. As, however, I have given an outline of the sternal structure (which differs so much from the structure in *Phelister venustus*, Leconte, the type of the genus)

those who study the family will be able to form an idea of its peculiarities and to judge whether or not I have assigned it rightly to *Phelister*. The specimen is unfortunately unique and the sex of it is not apparent without dissection; but I cannot for a moment think the structure of the prosternum can differ in the male and female.

List of Species.

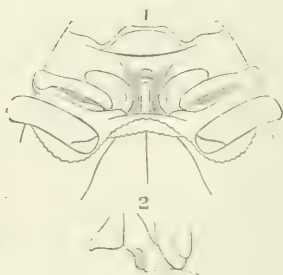
<i>Hololepta humilis</i> , Payk.	<i>Epierus brunnipennis</i> , Mars.
<i>Lioderma 4-dentatum</i> , Fabr.	—— <i>notius</i> , Mars.
<i>Phelister Simoni</i> , n. sp.	—— <i>vagans</i> , Mars.
—— <i>4-punctatus</i> , Mars.	—— <i>fulvicornis</i> , Fabr.
—— <i>globiformis</i> , Mars.	<i>Paromalus sincerus</i> , Lewis.
—— <i>hæmorrhous</i> , Mars.	—— <i>fissus</i> , Lewis.
—— <i>panamensis</i> , Leconte.	<i>Saprinus modestus</i> , Er.
<i>Homalodes vapulo</i> , Mars.	—— <i>auctus</i> , Sch. (1889).
—— <i>gagatinus</i> , Er.	<i>Idolia scitula</i> , Lewis.
—— <i>serenus</i> , Er.	—— <i>integra</i> , n. sp.
<i>Hister cænosus</i> , Er.	

Phelister Simoni, n. sp.

Oblongus, convexiusculus, niger, subopacus, undique minutissimo strigosus; antennis pedibusque piceis; fronte punctulata, antice impressa, supra oculos subelevata, stria integra leviter impressa in medio retrorsum acuminata; clypeo separato transverso; pronoto stria integra post oculos minute crenulata, subdense punctulato, punctis grossis intermixtis, ante scutellum triangulariter impresso; clytris striis integris subcrenulatis 5 cum suturali basi conjunctis, undique punctulatis; propygidio pygidioque parum dense punctulatis; prosterno in regione striarum prominulo, bistriato, striis anticis conjunctis, lobo separato; mesosterno antice late arcuato, striis transversis crenulatis; tibiis anticis 5-dentatis.

Long. 3 mill.

The minute surface sculpture of this species gives it the appearance of opacity. The frontal stria is lightly impressed and formed like that figured for *Homalodes faustus* and others in Marseul's monograph. The singular structure of the prosternum may be seen by the figures given here. The region of the striæ is built up to the same plane as the mesosternum and then cut off as it were in a diagonal direction, and at this point a pilose tuft is visible (indicated by punctures in the figures), and the lobe is pro-



duced on a much lower plane, as shown in a side view of the prosternum (fig. 2).

The prosternal striae join in front and the keel at the coxae begins to widen out gradually to its base. The apices of the anterior femora (shown in fig. 1) are grooved in a remarkable manner and are built up with semicircular edges, and the grooves are very finely but very distinctly transversely striate.

Hab. San Estaban; taken in March 1888.

Idolia integra, n. sp.

Orbicularis, perconvexa, picea, nitida, pedibus antennisque rufis; fronte subtilissime et minutissime strigosa, margine elevato, antice haud interrupto; pronoto, stria marginali integra, elevata, lateraliter distincte sinuato; prosterno minutissime strigoso, lateraliter striato; mesosterno stria antice integra metasternoque disperse punctulatis; pygidio laevi.

Long. 2 mill.

Hab. San Estaban.

This species is exceedingly like *Idolia gibba*, Lewis, but the mesosternal stria is complete in front and the two sternal plates are distinctly punctulate. In *Idolia gibba* the mesosternal stria terminates on each side at a point opposite the prosternal stria, and is therefore widely interrupted, and it is at present the only described species in which it is so.

V.—*Note on a new Species of Ampullaria from the La Plata.* By JOSEPH W. WILLIAMS.

MR. W. D. GEORGE, of Charlton, has recently sent me an Ampullarian which he collected in October 1888 from some marshes near the La Plata, at Buenos Ayres, in the Argentine Republic. I have, in company with Mr. Edgar Smith, examined the species belonging to this genus which are in the National Collection, and not found one to which this present shell could be referred; I have also looked over the various literature known to me on the genus, and have found no description which could be applied to this form. I therefore name it (provisionally at any rate) *Ampullaria canaliculata*, for a reason which will be readily noticed in the following description.

The shell is large, solid, and thick. Its length is 6 centim.

and its breadth (taking the body-whorl) 48 millim. The general shape of the shell is globoso-conoidal, the body-whorl in the region of the peritreme being considerably swollen, but compressed laterally in that part where it passes into the penultimate whorl. There are five whorls. The spire is very short (12 millim.) in comparison with the rest of the shell, and its apex is obtuse. The suture between the body and the penultimate whorl and also between this last and the antepenultimate whorl is deeply and triangularly channelled (hence the specific name of *canaliculata* proposed for it). The nucleus is of a light rufous colour. The general body-colour is of a dull yellowish green (similar to that of our English *Paludina vivipara*, Linn.) and is marked on the body-whorl by fourteen linear brown spiral bands, by four on the penultimate, and by three on the antepenultimate whorl. The periostracum is strongly marked with closely placed longitudinal striæ continuous from whorl to whorl over the sutures; the transverse striæ are much finer and wider apart than are the longitudinal striæ. The inner lip is reflected upon the body-whorl, and behind a ledge of it can be seen a large, deep, and obliquely placed umbilicus. The aperture is of an ovoidal shape, with a transverse diameter of 34 millim. and a longitudinal one of 45 millim. The peritreme is of a carneous colour, and this is continued on the inside of the body-whorl for a distance in one specimen of 14 millim., behind which the internal layer of the shell is coloured a chocolate-brown. The banding of the shell is visible on looking into the shell from the aperture. The operculum is chitinous (as is the case with nearly all New-World species) and somewhat of a reniform shape, its narrower end being placed in the aperture upwards. It is well marked by concentric striæ and the nucleus is placed excentrically, near to what corresponds to the hilum of its reniform shape. On its outer aspect the nucleus is placed on a depressed area, which corresponds to a circumscribed elevation on its inner aspect. The whole of the periostracum is glossy and the whole shell translucent. The umbilicus discloses a part of the penultimate whorl.

The specimens from which I have given the above description were collected by Mr. George in October last. They were sent to me on May 8th of this year, having been brought by him from Buenos Ayres, and the most interesting part of it is that one of the shells contained an animal which, on extraction, showed evidence of very recent death, and which, although giving off no fetor, was unfortunately not quite in a fit state for systematic dissection. Mr. George brought the shells over packed with *Unios* and *Helix* (*Macularia*) *punctata*,

Müller, in a cigar-box, and therefore the animal had existed for some months without water. How, then, had it lived? It appears to me that the animal had breathed atmospheric air by the right side of its pulmonary chamber, which the researches of Jourdain and Sabatier have shown to be vascularized, but had died on account of having received no help from the left side of the pulmonary chamber, which contains a ctenidium. The fact that a *Helix punctata* which Mr. George also brought over in the same box was alive until yesterday, when I dissected it, shows, I think, that *Ampullaria*, though amphibious, cannot exist out of water for a lengthened period of time.

Note.—Since sending the above to press I find that the name I propose has been preoccupied by Lamarck. I therefore, in its place, suggest for it the name of *Ampullaria Georgii*, after the gentleman who found it and sent it to me.—J. W. W.

VI.—*Pentacrini in peculiar Beds of Great Oolite Age near Basle.* By F. A. BATHER, B.A., Assistant in the British Museum (Natural History).

A MEMOIR entitled 'Description des Fossiles de la Grande Oolithe des environs de Bâle,' by Mons. Édouard Greppin, and consisting of 137 pages of text, with ten plates, was published early this year in the 'Mémoires de la Société Paléontologique Suisse,' vol. xv. (1888), at Basle and Geneva. M. Greppin, whose collection I had the pleasure of working through last summer at Basle, kindly gave me for examination some stem-joints of *Pentacrinus* which were new to me. He has printed in his memoir (pp. 133, 134) extracts from the letter that I wrote him anent these specimens; my drawings, however, he was unable to reproduce. To found a species on stem-fragments is, though good may come, to do evil; but to describe a new form without adequate illustration is utterly condemnable. I hasten therefore to complete the description by the accompanying figures, and at the same time would wish to borrow from M. Greppin's work such an account of the rock and of the associated fossils as may invest with interest an otherwise dry communication.

The Great Oolite is the most developed constituent of the
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Bathonian in the canton of Basle and reaches a thickness of 40 metres. It consists mainly of an oolitic freestone very poor in fossils, and these, even in the more fossiliferous lower beds, are much worn. Little attention therefore has been paid to it by geologists. M. Greppin, however, has discovered among the lower beds, which correspond more exactly with our Great Oolite, thin lenticular bands of organic *débris*. By heating fragments to a high temperature and dropping them into cold water he split up the calcareous cement and extracted the shells in the beautiful condition shown by his illustrations. These bands are due to depressions in the original sea-floor, which became filled with shells. One would naturally suppose that this was caused by the action of currents after the death of the animals. M. Greppin notes, however, that, while the genus *Cerithium* is most abundant at Muttentz, at Bubendorf, 3 kilometres distant, it is replaced by *Emarginula* and *Rimula* on the same horizon. He therefore considers that the animals lived where their remains are now found. The truth probably lies between the two opinions.

As the result of his researches M. Greppin recognizes 154 species, of which 30 are new; some score remain to be determined when better material shall have been found. Gastropoda are in the majority with 79 species; of these 24 are new; of the rest 39 are found also in England, and 8 of these were previously unrecorded out of Britain. The Lamellibranchiata are represented by 59 species, 10 of which are described for the first time; of the 49 that remain 41 are known in England, 8 of them being hitherto unknown elsewhere. The Cephalopoda are practically absent, the only example being an ill-preserved Belemnite referred to *Hastites fusiformis*. The Brachiopoda, though only of 5 species, are extremely numerous in certain parts, especially *Terebratulina maxillata*. Fragments of a *Glyphea ornata* are all the Crustacean remains. Two species of *Serpula* are recognized. Fragments of Echinoidea may be referred to 5 known species, while the Crinoidea number 2 species.

This fauna, as M. Greppin points out, is more akin to the Great-Oolite fauna of England than to that of other foreign countries. This may indeed be due to the fact that the beds of Basle are more exactly synchronous (or should we say homotaxial?) with those worked by Morris and Lycett, than are those continental beds which have hitherto afforded the most numerous fossils.

Perhaps the most interesting character of this fauna is the

small size of its constituents. The Gastropods are rarely more than 1 centimetre in length, and *Terebratula maxillata* averages 3 millimetres. These fossils are true dwarfs, not merely young forms; the stunting of growth is accompanied by no other change of character. It is, however, noticeable that the dwarfs are confined to the lenticular fossil masses; the same species when found, as a few of them are, in the freestone courses are of normal size. Some species are confined to the freestone and are never found as dwarfs.

The difficulty of figuring these minute fossils was overcome by M. Greppin in an ingenious manner, which he was good enough to explain to me. A fossil was fixed between wire points in the field of a microscope and its shadow thrown by a strong light on to a piece of ground glass. On this the outline was traced by a pencil. The object was then examined by reflected light in the usual way, and the details filled in on the glass; any error can be rectified in a moment on this surface. When the glass was filled with drawings it was photographed and phototype plates then made. This method combines accuracy, clearness, and softness, with the great advantage of the author being his own artist.

The Crinoid stem-fragments, to which I would now direct attention, are found by hundreds at both Muttenez and Bubendorf, and are often slightly worn. They share the stunted character of the other fossils, and appear to be the dwarf varieties of two species.

Of these species one is already known as *Pentacrinus Nicoleti*, Desor. The greatest diameter of the stem in the present specimens (5 millim.) is, however, less than the smallest diameter yet recorded for *P. Nicoleti*, and the majority of the fragments have a diameter of only 3 or 4 millimetres. I have therefore suggested that they should be known as *P. Nicoleti*, var. *minimus* (fig. 1, p. 52). Examples of this variety, found in the Great Oolite of Neue Welt by Mons. J. B. Greppin, were seen by me last year in the Strassburg Museum (Elsass-Lothringen Sammlung). The fragments of this species are distinguished by the re-entrant angle of the lateral faces, and by the depression of the sutures at the angles, from the other fragments found in the lenticular beds of Muttenez.

Of what species this other *Pentacrinus* is the dwarf I do not know. I can find nothing exactly like it among Jurassic species, and this, combined with its small size, has induced me to designate it *Pentacrinus Basileae* (from *Basilea*, Basle) (fig. 2).

Those who think such name-giving unsafe and worse than needless will perhaps excuse me when they learn that in the general collection of the Basle Museum there are similar fragments labelled "*Pentacr. tuberculatus*, Desor, Terrain à chailles, Kl. Basel," and that to this M. de Loriol has added in MS.: "Ce *Pentacrinus* me paraît app. à une espèce nouvelle très-voisine du *P. subsulcatus*, Münster, du Lias: ce dernier n'a pas de creux sur les sutures. Comme il n'y a ni localité ni niveau indiqué, je m'abstiens de la décrire." The stems are pentagonal and basaltiform; the stem-joints equal one another in height and diameter. The angles are well marked, but there is no re-entrant angle. The sutures are depressed on the lateral faces, but not on the angles; thus there is a ridge on each face of the joint between the angles. This gives the stem its characteristic scalariform appearance. The surface is otherwise smooth. The crenulations, which form a rosette on the articular surface, are only visible on the exterior at the angles; this is owing to the depression of the suture on the intervening face. The diameter is slight, varying from .9 to 2.5 millimetres in different specimens.

It should perhaps be noted that M. de Loriol has figured as *Pentacr. crista-galli*, Quenst., some small stem-fragments from the lower beds (Bajocien) of Muttentz, in the collection of M. E. Greppin*. These figures bear some resemblance to the present species. *P. Basilea* may be descended from *P. crista-galli*, but it is certainly not identical.

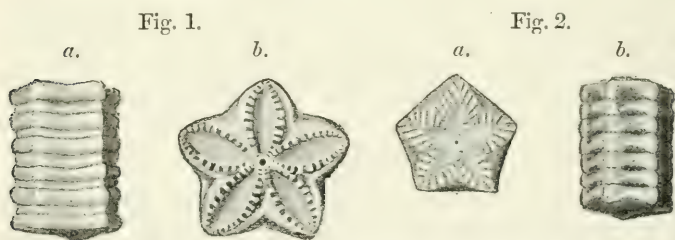


Fig. 1.—*Pentacrinus Nicoleti*, var. *minimus*, from Great Oolite of Muttentz, near Basle; in British Museum [E. 5505]; $\times 4$ diam. *a*, side view; *b*, articular surface.

Fig. 2.—*Pentacrinus Basilea*, Great Oolite, Muttentz; Brit. Mus. [E. 5506]; $\times 6$ diam. *a*, articular surface, rather worn; *b*, side view, the crenulation of the suture at the angle has not been copied well by the engraving process.

* Monogr. des Crinoïdes fossiles de la Suisse, pl. xv. figs. 29 and 30, vide p. 136; in Mém. Soc. pal. Suisse, vol. vi. (Basle and Geneva, 1879).

VII.—On a new *Chalcosiid* Moth obtained in Formosa by Mr. H. E. Hobson. By ARTHUR G. BUTLER, F.L.S. &c.

THE following new species was in a series of moths sent to us by Mr. Hobson about six years ago, and of which I have on several occasions commenced drawing up a list, but have been prevented from doing so by more pressing work.

Chalcosiidæ.

Erasmia Hobsoni, sp. n.

♀. Allied to *E. pulchella* of India, but smaller and less brilliantly coloured; the basal metallic green markings on the primaries noticeably smaller; the irregular oblique band beyond them broader and of a deep ochreous (instead of reddish clay-colour); the central metallic green markings narrower, the broad macular white belt less broken up, slightly broader, and with scarcely perceptible greenish edging; all the green streaks on the apical area and external border replaced by grey: secondaries whiter than in *E. pulchella*, with the metallic bluish-green colour confined to the basal sixth, not extending forwards into the cell, the black external border only narrowly edged internally with green, which colour does not extend along the veins or across the border, as in *E. pulchella*. On the under surface the differences are similar, the reddish clay-coloured markings being replaced by clear ochreous, and the green stripes on the external areas of the wings almost wholly obliterated. Expanse of wings 73 millim.

N. Formosa (Hobson).

The female of *E. pulchella* expands about 90 millim.

VIII.—On *Isometrus americanus* (Linn.), with a Description of a new Species of the Genus. By R. I. POCKOCK, of the British (Natural-History) Museum.

Isometrus americanus (Linn).

This species was described by Linnaeus (Mus. Adolph. Frid. p. 84, 1754); subsequently (in Syst. Nat. ed. 10, p. 625, 1758) its name was altered to *europæus*, and as *europæus* it

was described and figured by De Geer (Mém. vii. p. 344, pl. xli. figs. 5-8). De Geer's specimen was examined by Dr. Thorell and pronounced to be specifically identical with a scorpion known as *Atreus obscurus* of Gervais—a scorpion recorded from Columbia, described in Arch. Mus. iv. (1844) p. 219, and figured in Expéd. de Castelnau, Scorpions, pl. i. fig. 3. At the end of Gervais's description, on p. 220, reference is made to a specimen of *obscurus* belonging to M. Goudot.

In 1846 M. Goudot's collection came into the possession of the British Museum. One of the specimens in this collection agrees precisely with the description and figure of *obscurus*, and is, moreover, ticketed, apparently by either Gervais or Goudot, with that name.

An examination of this specimen corroborates Dr. Thorell's determination of the synonymy of *obscurus* with *americanus*. But my conclusions with regard to the sexes of the two typical specimens are by no means in accordance with those of that author. On p. 90 of his well-known work he remarks, "*Sc. europæus*, De Geer, mas est *Sc. obscuri*, Gerv." The grounds for this belief I do not know; but there are several reasons which lead me to think that the two specimens are of the same sex, and females. In the first place, judging from the figures, there is between the two no difference which by analogy can be regarded as sexual. In the second place, both specimens present that lobate dilatation of the base of the pectines, which is, I believe, a sexual character appertaining to the female alone. This belief is based (1) upon the discovery of ova in specimens of an allied species presenting this pectinal peculiarity, and (2) upon the existence in the collection of the British Museum of a number of specimens of a species of *Isometrus* (taken at the same time and in the same place) in some of which the pectines are lobate while in others they are not; and, further, those in which the pectines are not lobate differ from those in which they are lobate in other characters which by analogy belong to the male sex. These characters are—a wider tail, a wider hand, and a wider space between the fingers when closed. The specimens, then, presenting these last features there are good reasons for looking upon as males; and since the females of these differ only in minor particulars from the co-type of *obscurus*, I think there cannot be the smallest doubt that the two forms represent the sexes of *Isometrus americanus* (Linn.).

But another species described by Gervais, of which a co-type is also in the British Museum, differs from *obscurus* in

precisely the same characters (and not in others) as do the males just referred to from their females.

This species is *Sc. forcipula* (Gervais, Arch. Mus. iv. p. 221, pl. xi. fig. 26). Consequently there is no escape from the conclusion that *forcipula* is as much a synonym of *americanus* as *obscurus* is. But, in addition, *forcipula* with its wide and excavated fifth caudal segment falls within the definition of the genus *Phassus* of Thorell—a genus differing from *Isometrus* apparently only in this character. I suspect therefore that *columbianus*, the type of the genus *Phassus*, is a male of some species of *Isometrus* of which the female is unknown. If this be so, *Phassus* can scarcely be recognized as a genus, unless, indeed, one goes to the extent of keeping it for those species of *Isometrus* in which the sexes differ as do those of *americanus*.

If the conclusions here set forth are valid the synonymy of *Isometrus americanus* will be as follows:—

Isometrus americanus, Linn. Mus. Adolph. Frid. p. 84 (1754), ♀?

— *europæus*, Linn. Syst. Nat. ed. 10, p. 625 (1758), ♀?;
De Geer, Mém. vii. p. 344, pl. xli. figs. 5–8, ♀.

— *obscurus*, Gervais, Arch. Mus. iv. p. 219, ♀.

Phassus forcipula, Gervais, l. c. p. 221, ♂.

But this conclusion with regard to the sexes of this species by no means agrees with that of Dr. Karsch (Mitth. Münchn. ent. Ver. 1879, p. 113).

This author, who appears to be well acquainted with *Is. americanus*, asserts that the males may be distinguished from the females by the length of the hand and fingers with reference to the first two caudal segments. In the female, in short, the hand and fingers are considerably longer than these caudal segments; in the male they are equal to them in length—characters which do not obtain in the sexes as recognized by me.

But in the collection of the British Museum there are a number of specimens of *Isometrus* which agree sufficiently well with each other to be ranked as the same species, and which at the same time may be divided into two groups upon certain undoubtedly sexual features. These features are precisely those which Dr. Karsch has pointed out as distinctive of the sexes of *americanus*. Some of these specimens having a short tail and lobate pectines are unquestionably females; others having a long tail and simple

pectines are unquestionably males. The females are very like the females of *americanus*, and can only be distinguished from such female specimens of that species as I have seen by the confluence of the inferior keels of some of the caudal segments. This confluence occurs in the males also and serves, apart from other features, to separate them from the males of *americanus*.

It appears then, so far as a conclusion can be drawn from the few specimens that I have seen, that we have here a species distinct from *americanus*—a species in which the females can only be distinguished from those of *americanus* by the confluent caudal keels; whilst the males, in addition to this character, differ from the males of *americanus* in having a long slender tail, a narrow hand, and contiguous fingers.

But Dr. Karsch regards this confluence of the keels merely as of a varietal nature—having seen apparently intermediate forms—and has given to the specimens presenting it the name *americanus*, var. *androcottoides*.

If this be so, i. e. if the females of these long-tailed males be not specifically distinguishable from the females of the thick-tailed males, it seems that we have here a remarkable case of dimorphism, inasmuch as the males of *Isometrus americanus* present themselves under two very different aspects. But, so far as my observations go, there are two species to be dealt with, namely *americanus* and *androcottoides*; and it seems to me to be wiser to regard these two as distinct until the alternative hypothesis of dimorphism be more firmly established than it is at present.

The differences, sexual and asexual, between these two species may be set forth as follows:—

Isometrus americanus (Linn.).

♂ ♀.—Inferior caudal keels not confluent.

♀.—Pectines lobate.

Tail not more than six times as long as cephalothorax, parallel-sided or slightly thicker towards the fifth segment.

Brachium very slightly thinner than hand; fingers not sinuate and in contact when closed.

♂.—Pectines not lobate.

Tail not more than six times as long as cephalothorax, manifestly thicker towards the middle of the fifth segment, then abruptly narrowed.

Brachium only about two thirds the width of the

hand; fingers sinuate and not proximally in contact when closed.

The sexual characters of the male in this species are very variable. The above characters have been taken from specimens presenting the smallest amount of sexual variation. In others, such *e. g.* as the type of *forcipula*, these characters are much more marked.

Of this species I have seen one female from Moyabama, one female from Demerara, three females and two males from Iquitos, two females and two males from Columbia.

Isometrus androcottoides, Karsch.

♂ ♀.—Third caudal segment with a median inferior keel in its hinder half; fourth with a median inferior keel almost throughout its length.

♀.—Pectines lobate.

Tail not more than six times the length of the cephalothorax, parallel-sided or slightly thicker at its anterior extremity.

Brachium very slightly thinner than hand; fingers not sinuate and in contact when closed.

♂.—Pectines not lobate.

Tail more than seven times the length of the cephalothorax, parallel-sided; fifth segment of the same width throughout.

Brachium about seven eighths width of hand; fingers not sinuate and in contact when closed.

Of this species I have seen five males and four females without any locality, one male and two females from Demerara, one female from Trinidad.

Isometrus insignis, sp. n.

Colour.—Dull black above; hands, finger-tips, and under surface of the chelæ and legs with reddish tint; distal tarsal segments and pectines testaceous.

Cephalothorax a little wider than long; anterior margin angularly excised; ocular tubercle situated in the anterior half, shallowly excavated, its sides feebly roughened, the roughness continuous in front with a series of granules which extends towards the anterior margin; the posterior keels parallel, feebly granular, extending from the hind margin to a point about midway between this margin and the ocular tubercle; space between these keels bearing a deep median

smooth sulcus; between this sulcus and the keels on each side are a few granules disposed in two masses; anterior portion of cephalothorax between the anterior keels and the lateral eyes and the posterior portion at the sides sparsely granular; the lateral eyes about equally distant from each other; median eyes separated by a space which is about equal to the diameter of each eye.

Tergites more or less granular, the first marked in its posterior half by a transverse series of granules, which, almost marginal in the middle, curves forwards at the sides; the third with a short, median, longitudinal series of granules in its hinder third and on each side a conspicuous, slightly curved, transverse band, composed of many close-set granules, which does not reach the lateral margin of the tergite; the second in appearance midway between the first and the third; the fourth, fifth, and sixth resembling the third, but having the bands of granules more pronounced; the seventh marked in front with a median, short, granular prominence and on each side two granular keels, which, curving towards each other in front, unite some distance in front of the anterior margin of the tergite.

Sternites in part very finely and sparsely granular, dull-coloured, shining and smooth only behind and in the middle line. The fifth marked with four finely granular keels—two median, parallel, longer; two lateral, posteriorly converging, shorter.

Stigmata slit-like.

Tail robust, nearly parallel-sided, the fifth segment only very slightly wider than the first, about five and a half times the length of the cephalothorax; intercarinal spaces very feebly granular; upper surface scarcely at all hollowed; the fourth segment alone bearing in front a conspicuous depression; the keels bluntly and almost evenly denticulated throughout, the terminal granule of the superior keels of the second, third, and fourth being alone a little more prominent than the rest. The first segment furnished with ten complete keels; the second, third, and fourth with eight, the median lateral keel being wholly absent on the third and fourth and represented by merely a few granules on the posterior half of the second; in the fifth the granules of the inferior surface show a tendency to arrange themselves in a definite series on each side of and parallel to the median granular keel; upper surface of this segment nearly flat, bearing only a very shallow median sulcus.

Vesicle feebly and bluntly granular below, with a more conspicuous granule immediately beneath the aculeus.

Chela.—Upper surface of humerus covered with very fine close-set granules and bounded before and behind by a conspicuous series of larger granules; anterior surface bounded below by a similar series and completely divided into an upper and a lower half by a coarser series parallel to the last-mentioned series; inferior surface smooth; posterior surface furnished with one series; the whole segment therefore is furnished with five parallel series of granules. The brachium furnished with seven keels—two in front, two above, two behind, and one below, all granular except the last named, which is smooth; the intercarinal spaces finely shagreened. Hand a little wider than brachium, keeled; three keels running from the immovable finger to the proximal end of the segment, one bounding the “hand-back” above and two shorter, but unequal, keels running obliquely from the proximal end of the hand towards the movable finger. Fingers long, incurved, almost in contact when closed; movable finger longer than brachium, furnished with a conspicuous lobe, which fits behind a corresponding but smaller lobe on the immovable finger.

Legs furnished with granular keels.

Pectines furnished with twenty-three teeth; the proximal intermediate lamella produced into a large, rounded, smooth lobe.

Measurements in millimetres.—Length of cephalothorax $11\frac{1}{2}$, width $12\frac{1}{2}$; distance of eyes from posterior margin $7\frac{1}{8}$; length of tail 67; length of first segment 8, width $6\frac{1}{8}$, height $6\frac{1}{8}$; ditto of second 10, $6\frac{1}{8}$, 6; ditto of fifth $10\frac{1}{8}$, $6\frac{1}{2}$, 6; ditto of vesicle 6, $6\frac{1}{4}$, $5\frac{3}{4}$; length of aculeus 5; length of humerus $12\frac{1}{8}$, width $3\frac{1}{2}$; ditto of brachium 13, $4\frac{3}{4}$; length of “hand-back” 9, width of hand $5\frac{1}{4}$; length of movable finger $14\frac{3}{4}$, of pecten $7\frac{3}{4}$.

Several female specimens collected in the island of Santa Lucia for the West-Indian Exploration Committee by Mr. G. A. Ramage.

This species is very closely allied to *Isometrus americanus* (Linn.), but may be distinguished by the absence of a spine under the sting and by its greater number of pectinal teeth. The male is unknown.

IX.—*Additional Notes on some British Carboniferous Lycopods.* By R. KIDSTON, F.R.S.E., F.G.S.*

[Plate IV.]

THE present paper must be regarded as an appendix to that published by me in the *Ann. & Mag. Nat. Hist.* in 1885 †. Since that communication was written several important works dealing with the Carboniferous Flora have appeared which contain additional information regarding the Carboniferous Lycopods. I have also continued my investigations on this subject, and now wish to lay before this society some of the results. These are partly confirmative of the views I previously stated and partly correcting errors into which I had fallen.

I. *Lepidodendron Veltheimianum*, Sternb.

A few months ago I received for examination from the Geological Survey of England an impression of *Lepidodendron Veltheimianum*, collected by Mr. Rhodes, one of their fossil collectors, from the Lower Carboniferous of Lumby Law Railway-cutting, $\frac{1}{4}$ mile north of Edlingham Church, Northumberland. It was contained in an iron-stained sandstone and showed on the surface of the impression the leaf-scars and one of the large cone-scars. Attached to this latter is the basal portion of the appendicular organ which had been imbedded in the matrix, and from the fortunate manner in which the block containing the specimen has split one side of the appendicular organ is exposed. It is directed upwards and therefore similar in position to that of all the other specimens of the plant which have shown the appendicular organ *in situ*. Owing to the rough nature of the matrix the minute structural points of this organ are not shown; but the impression of the fossil is sufficiently well preserved to enable a satisfactory identification of the species to be made, and, further, to confirm the opinion that the organ in question is a cone.

My thanks are due to Dr. A. Geikie for the opportunity of

* Read before the Royal Physical Society of Edinburgh, March 20, 1889.

† "On the Relationship of *Ulodendron*, L. & H., to *Lepidodendron*, Sternb., *Bothrodendron*, L. & H., *Sigillaria*, Brongn., and *Rhytidodendron*, Boulay," vol. xvi. pp. 123-139, 162-179, 239-260, pls. iii.-vii.

examining this fossil, which is contained in the collection of the Geological Survey of England.

I was previously of opinion that *Lepidodendron Veltheimianum*, in addition to bearing lateral cones which produced the large Ulodendroid scars, might also have produced terminal cones. Continued investigations have, however, led me to relinquish this view, as the cones which I formerly believed to be the terminal cones of *Lepid. Veltheimianum* I have now seen attached to their parent branches, which show that they belong to an altogether distinct and, I believe, an undescribed species.

Note.—I wish to correct an error in the description of the leaf-scar of *Lepidodendron* which I made in the paper already referred to. In my previous communication it was stated on p. 173, "Leaf-base attached to the whole area of the leaf-scar (including the 'field')." That portion of the leaf-scar which is known as the "field" really belongs to the cortical system, of which it is in fact a cushion-like elevation. The true leaf-scar is only the small shield-like disk which bears the vascular and the two lateral cicatricules. These two "lateral cicatricules" have no connexion with the vascular system and are probably glandular.

II. SIGILLARIA.

In my previous memoir I placed in *Sigillaria*, under the name of *Sigillaria discophora*, König, sp., the plant originally figured by König as *Lepidodendron discophorum* *. This is identical with Lindley and Hutton's *Ulodendron minus* †. My reason for placing this plant in *Sigillaria* was the structure of the leaf-scar, which I stated on p. 178 (*l. c.*) possessed, as had been figured by Sir William Dawson, a central and two lateral cicatricules ‡; and though I had not observed them personally I had no reason to doubt the accuracy of this writer's observation. In reviewing my paper Mons. Zeiller § gives his reasons for doubting the accuracy of the figure given by Dawson, in which the three cicatricules were shown,

* König, *Icones fossilium sectiles*, pl. xvi. fig. 194.

† I should say here that although this latter name is the older one, it has been so much confused by authors, expediency almost demands that it be subordinated to the name given by König, from the use of which no confusion or misunderstanding can arise.

‡ 'Acadian Geology,' 2nd ed. 1868, p. 455, fig. clxx. G³.

§ "Présentation d'une brochure de M. Kidston sur les *Ulodendron* et observations sur les Genres *Ulodendron* et *Bothrodendron*," Bull. de la Soc. Géol. de France, 3^e sér. vol. xiv. p. 168 (1885).

especially founding his opinion on the fact that Dawson states in the description of his species—*Lepidophloios parvus* = *Sigillaria discophora*—that the vascular points are obscure.

I received, however, in 1886 from the Rev. David Landsborough, Kilmarnock, to whom I am indebted for many instructive specimens of our Carboniferous Lycopods, a fragment of a large specimen of *Sigillaria discophora*, which was unfortunately broken into several pieces when removing it from the roof of the Whistler Seam, Kilmarnock. This example shows clearly the central and two lateral cicatricules of the leaf-scar. A small portion of the specimen is shown in Pl. IV. figs. 1, 1 a. This specimen conclusively proves that the leaf-scars of *Sigillaria discophora*, König, sp. (= *U. minus*, L. & H.), are provided with three cicatricules very similar to those of *Sigillaria*, in which genus I believe the plant under discussion should be placed. It is very remarkable that in such a common British Coal-measure fossil the true outer surface of the bark, showing the leaf-scars in a good state of preservation, is so seldom met with. One reason for this is the persistence of the leaves, which appear to have retained their attachment to the stem much longer than in the other Coal-measure Lycopods, and it is not uncommon to find the leaf-scars on stems of large specimens of *Sigillaria discophora* entirely obliterated by the foliage of the plant being closely adpressed to the bark.

I united *U. majus* and *U. minus*, L. & H.; but M. Zeiller regards them as distinct species, and has since figured a specimen which he believes to be the *U. majus* of Lindley and Hutton*, with which he unites *Sigillaria* (*Lepidodendron*) *discophora*, König. From the examination of a plaster cast of König's original specimen, which is still preserved in the collection of the British Museum, I feel quite satisfied that König's plant is beyond all doubt referable to *U. minus*, L. & H., and not to their *U. majus*, whatever may be the claims of *Ulodendron majus*, L. & H., to rank as a species. The size of the Ulodendroid scars or of the leaf-scars is of no specific value, and I have specimens of *Sigillaria discophora* in my own collection with Ulodendroid scars ranging up to $5\frac{1}{2}$ inches in their greater diameter. There is no Ulodendroid scar on the specimen of *U. majus* figured by Zeiller; of course this does not prove that his specimen does not belong to that species, but as the case stands, I at present believe that *U. majus*, L. & H., and *U. minus*, L. & H., are different ages and conditions of one species. I also feel cer-

* 'Flore fossile du bassin houiller de Valenciennes,' p. 481, pl. lxxiii. fig. 1.

tain that *Sigillaria Menardi*, Lesqx. (not Brongn.)*, which Zeiller unites with *U. majus*, is likewise referable to *Sig. discophora* (= *U. minus*, L. & H.). The type of *U. majus* appears to be lost, but the counterpart of the type of *U. minus* is still preserved in the Hutton Collection, Newcastle-on-Tyne, and on the careful examination of this my identifications have been made.

III. BOTHRODENDRON, L. & H.

Bothrodendron, L. & H., Fossil Flora, vol. ii. p. 1 (1833).

Rhytidodendron, Boulay, Le terrain houiller du nord de la France et ses végétaux fossiles, p. 39 (1876, Lille).

In 1885 I recorded the occurrence of *Rhytidodendron minutifolium*, Boulay, from Scotland, and regarded the genus as distinct from all others; but to M. Zeiller we are indebted for showing that *Rhytidodendron*, Boulay, is none other than *Bothrodendron*, L. & H. To the defective descriptions of Lindley and Hutton must be ascribed the cause of this genus being so imperfectly known; and had it not been for the discovery of an original specimen, communicated by Hutton to the Museum of Natural History, Paris, the cloud that enveloped this genus might have hung over it much longer †.

In M. Zeiller's memoir, to which I have already referred, he figures stems and branches of *Bothrodendron punctatum*, the latter having their foliage attached. Recently I have met with specimens of *B. punctatum* as also with additional examples of *B. minutifolium* in Britain. The latter species I have found in several new localities, and it is represented by stems and branches with their foliage attached. *B. punctatum* I have only yet seen from the Kilmarnock Coal-field, and for specimens of it I am again indebted to the Rev. D. Landsborough and to Mr. Blackwood, Kilmarnock.

The leaf-scars in this genus are very small and provided with three punctiform cicatricules. On the young growing branches the leaf-scars of some of the species are close and surrounded by a *Lepidodendroid*-like "field," but this entirely disappears on the larger stems where the leaf-scars are distant; the surface of the bark between the leaf-scars is beautifully ornamented by delicate lines and granulations.

* Geol. Survey of Illinois, ii. pl. xliii.

† I am greatly indebted to M. Zeiller for figuring at my request the authentic specimen of *Bothrodendron punctatum*, L. & H., which had been presented to the Muséum d'histoire naturelle by Hutton and to which reference has been made (Zeiller, *l. c.* pl. viii. fig. 1).

In *Bothrodendron punctatum* the fruit has evidently been borne in lateral cones, from which originate the two vertical rows of large Ulodendroid scars; and one marked feature which distinguishes the large scars of *Bothrodendron* from those of the other Ulodendroid Lycopods is that in *Bothrodendron* the umbilicus of the large scar is eccentric, whereas in the Ulodendroid *Sigillaria* and *Lepidodendra* the umbilicus is central or approximately so.

In *Bothrodendron minutifolium*, Boulay, sp., the fruit is borne in long narrow cones at the terminations of the branches. The only specimen of the fruit of this genus which I have yet seen was collected by Mr. W. Hemingway at Monkton Main Colliery, near Barnsley, Yorkshire, in shale over the "Barnsley Thick Coal." This specimen he has kindly forwarded to me for examination. The cone is attached to a stem which still bears the foliage of the species. Unfortunately the cone is imperfect in its upper part, so its full length cannot be determined. The portion preserved is $3\frac{1}{2}$ inches long and at its thickest part rather over $\frac{1}{2}$ inch wide. The central axis in the compressed cone is seen to give off at right angles a number of transverse bars, which probably represent the basal portions of the bracts that bore the sporangia. Their leafy extension rises up at almost right angles to their basal portion, and is therefore nearly parallel with the axis. These bracts are closely placed, as many as eleven being contained on the axis in the space of half an inch. The specimen is shown nat. size in Pl. IV. fig. 6.

I have received a very interesting specimen of a portion of a stem of *Bothrodendron minutifolium* from Mr. Landsborough. The lower part of this specimen is decorticated and shows the subepidermal leaf-scars. These are not simple as supposed *, but when well preserved are seen to consist of two linear elongated elevations, which are frequently connected in the centre, as shown in figs. 5 and 5b. They are very similar to those of *Sigillaria*.

The foliage of *B. minutifolium* and *punctatum* is very small and the ultimate ramifications of the dichotomously divided branches have great similarity to those of recent Lycopods, as has been pointed out by Zeiller. Their systematic position is, however, probably intermediate between *Lepidodendron* and *Sigillaria*.

The genus *Bothrodendron* is not, however, restricted to the Coal-measures, for I have received from various localities in the Calcareous-Sandstone series specimens of a species of this genus, which I here describe.

* Zeiller, *l. c.* p. 181.

Bothrodendron Wükianum, Kidston, n. sp.
(Pl. IV. figs. 2-4.)

Cf. *Lepidodendron Wükianum*, Heer, Foss. Flora d. Bären Insel, p. 40, pl. vii. fig. 1 c, pl. viii. fig. 2 c, pl. ix. fig. 1.

Description.—Leaf-scars distant, small, varying in size according to the age of the branch, transversely oval. Cicatricules three, punctiform, situated towards the lower margin of the scar. Above the leaf-scar is a small punctiform cicatricule. Surface of the bark between the leaf-scars irregularly striated longitudinally, the striæ bending round the scars and leaving in their immediate neighbourhood a smooth space.

Remarks.—The leaf-scars vary in size and distance apart according to the age of the specimen. In my smallest example they are about 1 millim. and in the largest specimen 3·5 millim. in transverse diameter. On the young branches the little punctiform cicatricule is immediately above the leaf-scar and seems to rest upon it; but in the largest specimen of the species that I have seen it is separated from the leaf-scar by a short distance.

The bark is longitudinally striated, the striæ being slightly bent, especially in the neighbourhood of the leaf-scars round which they curve, and immediately below and above the leaf-scars they are absent, having the appearance as if they had separated to make room for the scars. There is, however, no "field," as in *Lepidodendron*.

I have named this species "*Wükianum*" as there seems to be a great probability that this plant is similar to Heer's *Lepidodendron Wükianum*, from Bear Island *. The British specimens are not, however, referable to the genus *Lepidodendron*, and, judging from Heer's figures and description, I do not think that his plant should be placed in that genus. As, however, I have not seen any of Heer's specimens, I cannot be certain that his species is identical with my *Bothrodendron Wükianum*, though I am strongly inclined to believe it is. I therefore, while adopting his specific name, place the British specimens in their proper genus; and should it eventually be proved that these two species are identical, it will be an easy transition to substitute *Bothrodendron Wükianum*, Heer, sp., for *Bothrodendron Wükianum*, Kidston.

Localities. Railway-cutting between Boags Mill and Kates

* In Kongl. Svenska Vetenskaps-Akademiens Handlingar, Band ix. no. 5 (Stockholm, 1871).

Mill, Water of Leith, Midlothian; collected by Mr. James Bennie. Wardie, near Granton, Midlothian; collected by Dr. J. M. Macfarlane, F.R.S.E. Little Whickhope Burn, near first branch above Cross Sike, Northumberland; communicated by Mr. H. Miller, F.R.S.E.

Horizon. Calceiferous Sandstone Series.

In my 'Catalogue of Palæozoic Plants in the Collection of the British Museum' * I stated the belief that the leaf-scar of *Cyclostigma*, Haughton †, did not differ in any character from those of *Rhytidodendron*, which is now known to be synonymous with *Bothrodendron*. Last year I had the opportunity of examining the fine collection of Kiltorkan fossils in the Science and Art Museum, Dublin, and in the collection of the Geological Survey of Ireland, Dublin, and this has confirmed my opinion that *Cyclostigma* should be merged in *Bothrodendron*.

The fructification of the Coal-measure *Bothrodendron* is but imperfectly known, and, so far as I am aware, the only cone identified with the Coal-measure members of the genus is that with short bracts figured in this communication. The cones, however, of the *Cyclostigma kiltorkense* are provided with long, linear, lanceolate bracts with a subtriangular base, on which the spores are borne. These have been figured by Schimper as *Lepidostrobus Bailyanus* ‡. Their whole structure reminds one much of Sigillarian cones.

At present so little is known about the fructification of the various species of *Bothrodendron* that on this important point a comparison cannot be made between the members of the genus; but so long as the generic characters of these Lycopods are founded on the structure of the leaf-scar, *Cyclostigma* must be enrolled in the older genus *Bothrodendron*.

I am aware that the description of the leaf-scar of *Cyclostigma* that I now give differs in some important points from that given by Dr. Haughton § and by Heer ||, as also from the figures and descriptions given by this last-mentioned author in his 'Fossile Flora der Bären Insel;' but in many of the specimens a certain amount of shrinkage appears to have taken place which may have reduced the leaf-scars to the condition in which many of them occur. Be this as it may, the fact remains that when well-preserved examples

* P. 236.

† Ann. & Mag. Nat. Hist. ser. 3, vol. v. p. 443 (1860).

‡ Traité d. paléont. végét. vol. ii. p. 71, pl. lxi. fig. 9.

§ L. c. p. 13.

|| Quart. Journ. Geol. Soc. vol. xxviii. p. 169, pl. iv.

are examined it is found that the leaf-scars of *Cyclostigma* contain three cicatricules similar to those of *Bothrodendron*.

EXPLANATION OF PLATE IV.

- Fig. 1. Sigillaria discophora*, König, sp., nat. size. 1 *a.* Leaf-scar enlarged and showing the three cicatricules. *Loc.* Shale over Whistler Seam, Bonnington Pit, Kilmarnock. Communicated by the Rev. David Landsborough. *Hor.* Lower Coal-measures.
- Figs. 2-4. Bothrodendron Wikianum*, Kidston, n. sp. 2. *Loc.* Little Whickhope Burn, near first branch above Cross Sike, Northumberland; nat. size. 2 *a.* Leaf-scar, enlarged. *Hor.* Calcareous Sandstone Series. Communicated by Mr. H. Miller, F.R.S.E. 3. *Loc.* Railway-cutting between Kates Mill and Boags Mill, Water of Leith, Midlothian. *Hor.* Calcareous Sandstone Series. Collected by Mr. J. Bennie. Nat. size. Specimen in the Collection of the Geol. Survey of Scotland. 3 *a.* Leaf-scar, enlarged. 4. *Loc.* Shore, Wardie, Midlothian. *Hor.* Calcareous Sandstone Series. Nat. size. Collected by Dr. J. M. Macfarlane. 4 *a.* Leaf-scar, enlarged.
- Figs. 5-6. Bothrodendron minutifolium*, Boulay, sp. 5. *Loc.* Shale over Whistler Seam, Bonnington Pit, Kilmarnock. *Hor.* Lower Coal-measures. Nat. size. Communicated by the Rev. D. Landsborough. 5 *a.* Leaf-scar, enlarged. 5 *b.* Subepidermal cicatricules, enlarged. 6. *Loc.* Shale over "Barnsley Thick Coal," Monkton Main Colliery, near Barnsley, Yorkshire. Middle Coal-measures. Collected by Mr. W. Hemingway. Nat. size.

X.—On a new Genus of *Macrura* (*Ophthalmeryon transitionalis*). By C. SPENCE BATE, F.R.S.

[Plate IX.]

SOME short time since a small and much battered Crustacean was sent to me by Mr. George Merritt, with the request that I would inform him what it was. It proved to be new, and I propose to call it *Ophthalmeryon transitionalis*.

Unfortunately the specimen had been swallowed by a dolphin, and had therefore been affected somewhat by the gastric juices of the fish's stomach. Having been preserved in a dry condition, it was consequently very brittle and not in a state fit for examination. I therefore placed it for several weeks in a preparation of glycerine &c. to preserve and soften its texture before subjecting it to the risk of observation.

Its general appearance is that of a small Brachyurous Crustacean somewhat allied in form to *Ebalia* in its dorsal aspect. The carapace is about 9 millim. long and as many

broad across the cardiac and branchial regions; but this cannot be clearly defined, as the laterally projecting tubercles are somewhat damaged either by the action of the gastric juices during the incarceration of the specimen in the dolphin's stomach or from manipulation afterwards in its dried condition.

The anterior portion or frontal region is narrow and depressed, the central line being produced anteriorly into a small rostrum, on each side of which is a slight concavity or hollow space for the greater freedom of the movements of the ophthalmopoda and antennæ. The antero-lateral angle is anteriorly projected downwards as a strong point or process that is slightly curved, and on the upper or dorsal surface is produced into a strong process or horn which is projected upwards and slightly curved backwards at an elevation higher than the median line of the gastric region, which lies as a plane between the two lateral prominences and separated from them by a deep and narrow fissure. The cardiac region is surmounted by two large tubercles that are separated from each other longitudinally in the median line. Both lateral prominences are circular at base, tipped with small tubercles, and mammiform in appearance; posterior to these on each side is a row of three tubercles continuous to the posterior margin of the carapace. On the outer or lateral side the branchial region is produced into large protuberances, the surfaces of which are not clearly distinguishable, from external injury; the lateral walls are curved inwards on the lower surface, leaving only a narrow space between them, in which lies the posterior portion of the pleon and the rhipidura or tail-fan.

The pleon is narrow, smooth, and laterally compressed; the telson tapers posteriorly and terminates in two processes, one at each postero-lateral angle, and on its inner margin bears a series of six sharp teeth which gradually increase in length, and the lobe is tipped with a smooth spine 0.5 millim. long. The telson is also armed on each side with three small spines—one near the middle, a second halfway between the first and the posterior extremity, and the third rather nearer than halfway between the preceding and the posterior extremity.

The carapace is about 9 millim. long.

The pleon is about 6 millim.

The telson is about 2 millim.

The ophthalmopoda (Pl. IX. fig. 1, *a*) are long and broad, the ophthalmus being large, pear-shaped, and projected upon a slender biarticulate peduncle.

The first pair of antennæ (*b*) are short, the first joint is

broad and furnished on the outer side with a wide and sharp-pointed stylocerite, which is of great tenuity and free from cilia, whereas the inner side of the shaft of the appendage is fringed with a few simple cilia. The second joint is about half the length of the first and more free from cilia, there being only three or four on the inner margin. The third joint is very short, but nearly as broad as the preceding, and is furnished with a bundle of long hairs on the inner distal angle; it supports two short flagella, of which the outer is the shorter, and carries towards its distal extremity a series of membranous cilia. The inner flagellum is subequally robust with the outer one, but free from cilia of any kind.

The second pair of antennæ (*c*) are furnished with a long ovate scaphocerite, the outer margin of which is rigid, and at the distal extremity, where a small tooth generally exists, the rudiment only of one is seen; the squamose portion is of extreme tenuity and projects distally beyond the rigid margin, and is fringed with numerous fine ciliated hairs; on the inner side of the scaphocerite is another joint that is short and robust, from the distal extremity of which projects a long and slender flagellum that is somewhat rigid and gradually tapers to its extremity.

The mandible (*d*) consists of a smooth and pointed psalidostoma which is in continuity with the slightly projecting molar process, having on the anterior margin a short three-jointed synalipod, the two distal joints of which are fringed with a few strong hairs.

The first siagonopod (*e*) is three-jointed and three-branched: the first joint is short, robust, and produced on the inner side into a large flattened process fringed with hairs: the second joint is narrower than the first, but not much longer; it has its distal extremity, which is broad and oblique, fringed with short, stiff, tooth-like spines; on its outer margin a small uniarticulate branch exists, which is adorned with two slender and rather long hairs at the distal extremity.

The second siagonopod (*f*) is of five branches, all of which are foliaceous and of extreme tenuity, and are unibranched, excepting the second, which is biramose; the fourth branch is shorter than the others, narrow, and sharp-pointed; while the fifth or outer one is broad and long, being equal in size to the three on the inner side; it is also pointed anteriorly and broad posteriorly, and represents homologically the mastigobranchial appendage, just as the fourth joint represents the continuation of the theoretical limb. The first three or inner branches are

fringed with long hairs at the broad and leaf-like extremity ; the fourth is fringed with a few hairs on the inner side and apex only ; whereas the fifth or posterior branch is fringed with cilia all round, the hairs being centrifugally arranged with their extremities slightly curved towards the anterior point.

The third siagonopod (*g*) is six-jointed and biramose. The first and second joints are produced on the inner side in the form of two large foliaceous plates, the margins being fringed with a series of fasciculi of long and stiff hairs ; the plate of the second joint is produced beyond its distal extremity or outer portion, from which it is distinctly separated for about half its length, and the distal extremity of the joint has the inner angle furnished with a bundle of long hairs.

Succeeding these, four other joints are successively produced, being subequal in length, of which the penultimate is the longest and the last the shortest, each gradually narrowing in diameter and tapering to the distal extremity, and each furnished with a fasciculus of hairs at the inner distal extremity ; on the outer side a second branch, a true basecephysis, projects, the base of which consists of a long and robust joint furnished on the outer margin with a few simple hairs and continued at the extremity into a multiarticulate ramus, which is nearly smooth or only sparsely furnished with hairs.

The first pair of gnathopoda (*h*) are pediform and biramose, the basecephysis being well developed and reaching rather beyond the extremity of the dactylos. The coxal joint is short and broad, and supports on its anterior and outer wall a small podobranchial plume. The basal joint is long and stout, the anterior margin is longitudinally concave, smooth, and produced somewhat beyond its articulation with the ischium, whereas the posterior margin is convex and adorned with three rather large fasciculi of short, stiff, and simple hairs. The ischium is a little shorter than the basis and about half its diameter in breadth ; it is smooth on the upper or anterior surface and thickly studded with short, simple, and rather stiff hairs on the posterior margin. The meros is shorter than the ischium, somewhat pear-shaped in form, having the narrow portion towards the ischium and the larger towards the carpus ; the upper or anterior margin is smooth and convex, while the lower is smooth and waved, being concave towards the ischium and convex towards the carpus ; the lobe and distal margin are fringed with a few long simple hairs. The carpus is subequal in length with the ischium, cylindrical

in form, the distal margin as well as the upper and lower angles being furnished with long hairs. The propodos is rather shorter than the carpus, conical in form, and furnished with numerous stiff hairs that have their surface thickly armed with short sharp-pointed teeth. The dactylos is long, slender, and hair-like, and only differing from those hairs with which it mingles by being a little more robust. The basecephysis is long, slender, and multiarticulate, the basal joint being robust and cylindrical.

The second pair of gnathopoda (*i*) are about one third longer than the first; the coxal joint is stout, short, and supports an efficient but not long podobranchial plume. The basal joint is large and strong and produced beyond the ischial articulation to form a strong process, with which articulates the multiarticulate basecephysis, which resembles that of the first pair excepting in its relative length. The ischium is cylindrical, having the anterior margin smooth and the posterior fringed with a few simple hairs. The meros is longer and not quite so robust as the ischium, and fringed on the sides and posterior margin with a few simple hairs. The carpus is long and slender, having the distal extremity somewhat stouter than the proximal, and the lower distal portion is furnished with a few hairs. The dactylos is slender and slightly tapering to an extremity that is armed with a few hairs, the more important of which are fringed with a few cilia.

The first pair of pereopoda (*n*) are short, feeble, and chelate; the coxa is short and supports an elongate podobranchia and a short appendage, which I take to be the rudimentary mastigobranchia. The basis is long and stout, rather broader at the distal than the proximal extremity, and supports a long and slender multiarticulate basecephysis that reaches considerably beyond the extremity of the dactylos. The ischium is short, being scarcely longer than it is broad, and fringed on the posterior margin with a few minute hairs. The meros is about three times as long as the ischium and similarly fringed on the posterior margin and furnished with one long ciliated hair on the anterior distal angle. The carpus is slightly longer than the meros and furnished with one ciliated hair on the posterior margin just behind the distal angle and another on the anterior distal angle; the propodos increases gradually to the level of the dactyloid joint, where it is broadest; the pollex is produced as a simple pointed process, slightly swollen previously to its reaching the apex, where it is furnished with two small spines, and two others a little posteriorly on the outer margin; two or three long and ciliated

hairs stand at the dactyloid articulation and reach beyond the extremity of the dactylos, which is formed like the pollex and tipped with three straight, stiff, and ciliated hairs.

The second, third, and fourth pairs resemble the first, being perhaps rather more slender; and the fifth pair (*o*) are still shorter and differ from the preceding chiefly in terminating in a non-chelate extremity free from hairs, excepting a simple one on the dactylos, a ciliated one on the carpus, and another on the meros.

The pleopoda are short and feeble and have not been properly examined.

The branchial plumes are numerous, but in consequence of having been preserved in a desiccated condition they are not capable of being carefully noted; but there appears to be a series of arthrobranchiæ and pleurobranchiæ, which probably may be arranged as follows:—

Pleurobranchiæ			1	1	1	1
Arthrobranchiæ			2	2	2	2
Podobranchiæ	1	1	1	1	1	1
Mastigobranchiæ	<i>r</i>	<i>r</i>	<i>r</i>	<i>r</i>
	<i>h</i>	<i>i</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>n o</i>

millim.

Length of the animal from the rostrum to the posterior extremity of the carapace	9
Length of the pleon	6
Breadth of carapace	about 6
Length of ophthalmopod	
" " first antenna	4
" " second antenna to extremity of scaphocerite.	4
" " flagellum, broken ^p	9
" " mandible, dissected out	5
" " synalphegopod	2
" " first gnathopod	6
" " second "	9
" " third pereopod	5
" " " baseophysis of	5
" " fifth "	3
" " " " baseophysis of	3

The general aspect of the animal to casual observation is more that of a Crustacean belonging to the Brachyura than to one of the Macrurous division.

The broad and quadrate character of the carapace and the narrow and folded condition of the pleon are features of the Brachyura type; but, on the other hand, the long and sweeping branches (ecephyses) attached to the ambulatory legs, which are themselves apparently too short and feeble to be of much use, and the imperfect condition of the chelate appendages,

while demonstrating their powerless condition as prehensile organs, seem to argue that the animal is related to the lower type of the long-tailed forms, more especially to that group which is denominated Schizopods, if Professor Sars's definition of the presence of long and sweeping appendages be a primary feature of their character. But this point I have, I think, successfully shown, in the Report of the 'Challenger' *Macrura*, to be a feature that is common with others and that it is not a condition peculiar to any group.

If we examine the animal now before us in detail we shall find that the pereopoda bear a characteristic resemblance to those found in the Eryonidæ, but differ from them in the retention of the branches, features consistent with immature forms, but rarely present in the adult condition and never previously found among the Eryonidæ, although there is nothing inconsistent with their presence in that family.

The Eryonidæ, looked at both in their fossil and recent condition, contain many forms which vary considerably in detail from each other and are more than specifically distinct.

The fossil species which has been figured by Desmarest, and on which the family is founded (*E. Cuvieri*), possesses the remains of a pair of biarticulate appendages which from position



Eryon Cuvieri, after Desmarest, with ophthalmi added in dotted outline.

and form can only be accepted as the pedicular bases of the ophthalmopoda; and I believe in this sense they were understood by Dr. Willemoes-Suhm when he wrote in his notes,

which have been transferred into the 'Challenger' Report on the Crustacea *Macrura*, p. 112, "*Eryon* was probably not blind, for the eye-stalks have been found in several specimens."

On the other hand, Dr. Woodward, of the British Museum, who as a geologist has given much attention to this group of Crustacea, says that the eye "has never been positively determined," and he has restored a specimen with these organs present. I have never seen a specimen, neither, I believe, has any ever been found in which the ophthalmus is undoubtedly preserved.

In *Eryon Brodiei* the orbit is preserved and shown to be moderately deep, and the latero-anterior angle is well advanced. It is the same, but in a rather less marked condition, in *Eryon wilmcotensis*, while in *Eryon Moorei* and *Eryon crassicheles* both orbital notch and antennal angle are reduced to a minimum.

In *Archæastacus Willemæsi* the latero-anterior angle of the carapace is so well developed as to produce a well-formed but shallow orbital notch in the frontal margin of the carapace in position corresponding with those found in the recent genera, but less excavate and characteristic. In this unique fossil the ophthalmopoda are not preserved, but the form of the orbit is suggestive of the existence of such an organ.

From the Upper Lias of Calvados M. Morière described* a species under the name of *Eryon calvadosii*, in which the orbits for the reception of the organs of vision are well preserved, and the specimen has the appearance of having had the ophthalmopoda broken off and retained in the lost matrix.

If we now turn to the specimen before us we find that the organs of vision are present in a peculiar and well-developed form. The ophthalmus is projected upon an elongated and slender stalk, and is capable of being bent considerably on itself; and both articulations possess considerable mobile power, so much so that the ophthalmus is capable of being bent beneath the frontal margin and hidden from view. But although it is not visible when inspected on the dorsal surface, it is so placed that it is capable of seeing through the curved or hollow space that exists on the outer side beneath the antero-frontal angle of the carapace; but when the animal wills it is capable of being projected forwards, and when advanced the peduncles may be seen very much like those shown in *Eryon Cuvieri*, as figured by Desmarest and shown in our woodcut on page 73.

The first pair of antennæ exhibit a peculiarity at variance

* Bull. Soc. Linn. de Normand. sér. 3, tom. vii. pp. 1-10, pls. i.-iii. (1863).

with all the group, and present a character in the presence of the stylocerite that distinguishes them from those that belong to the Trichobranchiata, and makes me much regret that the previously desiccated condition precludes a satisfactory examination of the branchial structure. In most of the recent forms allied to Eryonidæ the inner margin of the first joint of the peduncle of the antenna is laterally produced into a broad and thin plate which is projected upward in the median line in consequence of its meeting a similar projecting plate belonging to the opposite side. In a few species it is reduced in importance to little more than a big tooth; but it is absent generally from all other genera of the Trichobranchiata. On the outer side there is no stylocerite such as we find conspicuous in all the Phyllobranchiate *Macrura* and exists in a modified form in the Dendrobranchiata. In the species now under consideration it is prominent, well defined, and of considerable tenuity, and therefore in this character approaches that of the Phyllobranchiata.

The second pair of antennæ have the flagellum broken; but from its proportions it may be assumed to have been about the length of the carapace or perhaps a little longer; the scaphocerite is leaf-like and hairy, and has the margin on the outer side rigid and produced to the rudiment of a tooth, while the inner side is fringed with fine ciliated hairs, the whole structure bearing a membranous character of extreme tenuity.

The mandibles (*d*) are powerful organs, smooth along the psalisiform or cutting margin, with the molar protuberance short and robust, and on the outer surface there exists a three-jointed synhipod or appendage, which differs from the typical forms of the recent Eryonidæ in which there are only two joints, but corresponds with most other families of the normal Trichobranchiata.

The first pair of siagonopoda (*e*) or maxillæ bear a resemblance to those of *Willemasia*, but differ in the possession of a small joint on the outer side of the chief branch.

The second pair (*f*) resemble more nearly those of the family Astacidæ and differ chiefly in not having the mastigobranchial plates posteriorly produced, but rounded off short.

The third pair (*g*) are in a more advanced condition than I have found in any of the typical *Macrura* and have the primary branch six-jointed and support a well-developed multiarticulate basephysis.

The first pair of gnathopoda (*h*) are well developed and pediform, having the basis very long and furnished with a

multiarticulate basephysis that reaches beyond the distal extremity of the dactylos, which is sharp-pointed, slightly curved, and imbedded among a number of fringed stiff hairs; a small branchial plume stands on the outer frontal surface of the coxa.

The second pair (*i*) resemble the first, but have the joints longer and more slender and furnished with hairs that are more slender and fringed with delicate cilia instead of short spines. The basephysis, although absolutely longer, is relatively shorter than the limb to which it is attached and articulates with the basis at the extremity of a strong process, which is an unusual feature.

The four anterior pairs of pereiopoda (*n*) are similar in form and vary little in size; they are all chelate, but inefficiently so; the pollex and dactylos being straight and pointed appear to be organs ill adapted for the purpose of holding as by a finger and thumb; each joint is furnished with one or more long, straight, and ciliated hairs. The basis is long and robust, being with the coxa nearly equal in length to the other five joints; at the anterior and distal extremity is a multiarticulate basephysis which reaches considerably beyond the extremity of the dactylos and is fringed on the posterior margin only with numerous ciliated hairs. The coxa supports a long podobranchia and a small mastigobranchial plate of a rudimentary character.

The fifth pair (*o*) are shorter, being little more than half the length of the preceding; they terminate in an obtuse-pointed dactylos, and have an ecephysis attached to the basal joint.

The pleopoda are biramose, with subequal branches, and weak in their development. The posterior pair form the lateral plates of the rhipidura or tail-fan; but the plates are about one fourth shorter than the telson. The outer plate is broader than the inner, which is narrow, pointed, and a little shorter than the outer, which appears to be without a diæresis.

EXPLANATION OF PLATE IX.

Fig. 1. *Ophthalmeryon transitionalis*, seen dorsally.

Fig. 2. The same, viewed ventrally.

Fig. 3. The same, seen laterally.

a. Ophthalmopod.

b. First antenna.

c. Second „

d. Mandible.

e. First siagonopod.

f. Second „

g. Third „

h. First gnathopod.

i. Second „

n. First pereiopod.

o. Fifth „

v. Sixth pleopod.

z. Telson.

XI.—*Descriptions of new Species of Lepidoptera, chiefly from Central America.* By HERBERT DRUCE, F.L.S., F.R.G.S., F.Z.S.

THE new species of Central-American Heterocera will be figured in the 'Biologia Centrali-Americana.'

Fam. *Spingidæ*.

Subfam. *CHÆROCAMPINÆ*.

CHÆROCAMPA, Dup.

*Chærocampa ortospa*na, sp. n.

Primaries dark olive-green, crossed from the apex to the inner margin close to the base by two wide, pinkish, fawn-coloured bands shaded with green, the outer margin brownish green, with a submarginal brown line from near the apex to the inner margin: secondaries black, with a band of yellowish-white spots the same as on the hind wing of *C. tersa*, but those nearest the apex are confluent and of a reddish-brown colour; the outer margins are greenish brown. The underside closely resembles that of *C. tersa*, but it is much more brightly coloured, with a pale yellow band crossing the primaries from the apex to near the base.

The head, thorax, and the upper part of the abdomen dark olive-green. A pinkish fawn-coloured streak on each side of the head and thorax; the tegulæ green, edged with yellow. A tuft of pale primrose-coloured hairs on each side of the abdomen near the base, the sides of the abdomen golden yellow, the anal half of the abdomen greenish brown. A pinkish fawn-coloured line extends from the back of the head across the middle of the thorax and down the centre of the abdomen to the anus. The underside of the former is yellowish brown. The antennæ brown, paler at the tips; the legs pinkish fawn-colour. Expanse $3\frac{1}{2}$ inches.

Hab. Mexico, Coatepec (*J. Brooks*).

A fine distinct species, of which we have received one specimen; it is allied to *C. tersa*, Drury, and *C. titana*, Druce, but differs greatly from both.

Chærocampa suana, sp. n.

Primaries uniform greyish mouse-colour, with a narrow, submarginal, dark brown line from the apex to the inner margin: secondaries black, with an indistinct row of pale

spots crossing the wing from the anal angle to near the apex. The underside the same colour as above. The head, thorax, and abdomen greyish brown, the sides of the head and thorax with a greyish-white streak; the antennæ and legs brownish grey. Expanse $2\frac{1}{2}$ inches.

Hab. Bahama Islands, New Providence.

This small species is very unlike any known to me, but it is most nearly allied to *C. porcas*, Hübn.

Subfam. *AMBULYCINÆ*.

AMBULYX.

Ambulyx donysa, n. sp.

Primaries from the base to the middle pinkish fawn-colour and from the middle to the outer margin shaded with dark brown and olive-green; a large oval-shaped dark brown spot near the base, which extends from the inner margin across the wing, but does not reach the costal margin; a dark brown line crosses the wing about the middle from the costal to the inner margin; an indistinct dark brown marking on the inner margin close to the anal angle; three waved lines cross the wing from the costal margin near the apex to near the inner margin, but do not quite reach it; the apex is pale fawn-colour: secondaries bright rose-pink, crossed from near the apex to the anal angle by a wide black band, deeply dentated; on the outer edge above the black band are two very indistinct, narrow, brownish-black lines; the inner margin and two spots close to the anal angle pale yellowish fawn-colour. The underside of both primaries and secondaries pale yellowish fawn-colour, the primaries from the base to about the middle dark rose-pink. The head and front of the thorax pale brown; the tegulæ and base of the thorax and abdomen dark brown; the underside of head, thorax, and abdomen pale yellow; legs and antennæ dark brown. Expanse $4\frac{3}{4}$ inches.

Hab. Mexico, Cuesta de Misantla (*M. Trujillo*).

This very beautiful and distinct species is allied to *A. ganascus*, Stoll, and *A. rostralis*, Boisdu.

Fam. *Ægeriidae*.

ÆGERIA, Fabr.

Ægeria hades, sp. n.

Primaries and secondaries uniform glossy bluish black, with all the veins and outer margins dull black. The underside

as above. The head, thorax, and abdomen bluish black; the underside of the head and front part of the thorax white; the antennæ and legs black. Expanse $\frac{3}{4}$ inch.

Hab. Mexico, Teapa, Tabasco (*H. H. Smith*).

Mr. Smith took one specimen of this pretty little species in February 1888.

Ægeria halmýris, sp. n.

Primaries black, with the end of the cell and a round spot beyond hyaline: secondaries whitish hyaline, with the fringe black. The head, thorax, and abdomen black, the base of the abdomen slightly yellowish; the antennæ black, with a wide white ring near the tips; the legs greyish black. Expanse 1 inch.

Hab. Mexico, Rincon, Guerrero, 2800 feet (*H. H. Smith*).

One specimen was obtained in September 1888. It is most nearly allied to *Æ. producta*, Walker, but very distinct.

Ægeria hela, sp. n.

Primaries uniformly black, with a very minute hyaline dot at the end of the cell: secondaries hyaline, with the outer margin broadly bordered with black; the fringe black. The head and antennæ black, the latter with a narrow white ring near the tips; the front of the thorax and the tegulæ yellowish brown; the thorax, abdomen, and legs dull black; the underside of the thorax yellowish. Expanse $1\frac{1}{6}$ inch.

Hab. Mexico, Atoyac, Vera Cruz, April; Teapa, Tabasco, January (*H. H. Smith*).

This species is allied to *Æ. senta*, Druce, but is a much smaller insect and more darkly coloured.

Ægeria hermione, sp. n.

Primaries hyaline, slightly shaded with yellow on the inner margin, the costal and outer margins edged with yellowish brown: secondaries hyaline; the fringe of all the wings brown. The thorax and abdomen black, the collar and the tegulæ yellow, the abdomen banded with yellow; the antennæ black, with a wide yellowish-brown ring near the tips; the legs yellow, with black bands. Expanse 1 inch.

Hab. Mexico, Teapa, Tabasco, Atoyac, Vera Cruz (*H. H. Smith*).

Mr. Smith met with this species from February to May 1888.

Ægeria hipsides, sp. n.

Primaries dusky black, with the cell and a round spot at the end of the cell semihyaline: secondaries hyaline, with the veins and the fringe black. The head, thorax, and abdomen glossy black, the underside of the thorax white; the antennæ and legs black. Expanse $\frac{3}{4}$ inch.

Hab. Mexico, Amula, Guerrero, 6000 feet (*H. H. Smith*).

A very distinct species, of which only one specimen was obtained in August 1888.

Ægeria hippolyte, sp. n.

Primaries yellowish hyaline, the veins all black, the apex and outer margin edged with golden brown: the secondaries hyaline, the fringe of all the wings black. The head, thorax, and abdomen black, the base of the thorax and the anus yellow; the legs black, banded with yellow; the antennæ black. Expanse 1 inch.

Hab. Mexico, Cuernavaca, Morelos (*H. H. Smith*).

One specimen of this distinct species was taken by Mr. Smith in June 1888.

Ægeria helena, sp. n.

Primaries and secondaries clear hyaline; the costal and outer margins of all the wings brownish black. The head, thorax, and abdomen purplish black; the anus bright orange; the antennæ black from the base to the middle, then orange, excepting the points, which are black. The underside of the head, thorax, and abdomen, and the legs orange-yellow. Expanse $1\frac{1}{4}$ inch.

Hab. Mexico, Amula, Guerrero, 6000 feet (*H. H. Smith*).

This species was taken in August 1888; it is allied to *Æ. guatemalena*, Druce.

Ægeria pallene, sp. n.

Primaries and secondaries hyaline, with all the veins black; the apex and outer margin of the former broadly bordered with golden brown. The head, thorax, and abdomen black; the collar, the base of the thorax, and the last segment of the abdomen banded with orange-yellow. The underside of the head, thorax, and abdomen yellowish brown; the legs and antennæ black, the latter banded with white near the tips. Expanse $\frac{1}{2}$ inch.

Hab. Mexico, Teapa, Tabasco (*H. H. Smith*).

Mr. Smith took this species in March and April 1888; it is allied to *Æ. tryphoniformis*, Walker.

TARSOPODA, Butl.

Tarsopoda marcia, sp. n.

Primaries black; a spot at the end of the cell and a central streak reaching the base hyaline: secondaries hyaline, with the outer margin and the veins black. The head, thorax, and abdomen black; the anus yellow; the abdomen banded above with metallic gold; the underside black, the collar yellow; antennæ black; legs black, banded with yellow. Expanse $\frac{6}{10}$ inch.

Hab. Mexico, Dos Arroyos, Guerrero, 1000 feet (*H. H. Smith*).

Mr. Smith obtained two specimens of this beautiful little species in September 1888.

MELITTIA, Hübn.

Melittia Smithi, sp. n.

Primaries black, with a narrow hyaline streak from the base to the end of the cell, beyond which is an oval hyaline spot, the fringe greyish: secondaries hyaline, with the veins and fringe black, the base of all the wings clothed with long yellowish hairs. The head, thorax, and abdomen brownish black, each segment of the abdomen edged with yellow; the underside of the thorax and the abdomen yellowish brown; the antennæ black; the legs yellow, excepting the hind ones, which are thickly clothed with black hairs, with a few yellow hairs near the body. Expanse $1\frac{3}{10}$ inch.

Hab. Mexico, Rio Papagaio, Guerrero, 1200 feet, Dos Arroyos, Guerrero, 1000 feet (*H. H. Smith*).

This species was taken by Mr. Smith in September and October 1888; it is allied to *M. Butleri*, Druce, but is a smaller and altogether darker insect.

SINCARA, Walk.

Sincara mæonia, sp. n.

Primaries and secondaries hyaline, with the costal and outer margin of the former narrowly edged with black, the fringe of all the wings black; the inner margin of the primaries has a yellowish tinge extending from the base to near the anal angle. The head, thorax, and abdomen black; the front

of the palpi bright yellow; the tegulæ edged with yellow; the antennæ and legs black. Expanse 1 inch.

Hab. Mexico, Omilteme, Guerrero, 8000 feet (*H. H. Smith*).

This species is allied to *Syncara lytea*, Druce. Mr. Smith took the specimens in August 1888.

Sincara manilia, sp. n.

Primaries and secondaries yellowish hyaline, with the costal margin of the former and the fringe of all the wings black. The head, thorax, and abdomen black, the last four segments of the abdomen edged with bright yellow, the anus yellow; antennæ and legs black, the palpi yellowish in front. Expanse 1 inch.

Hab. Mexico, Sierra de los Aguas Escondidas, Guerrero, 7000 feet, Omilteme, Guerrero, 8000 feet (*H. H. Smith*).

This pretty little species was taken in July and August 1888.

Sincara manoba, sp. n.

Primaries brownish black, darkest along the costal margin; secondaries yellowish hyaline, with the fringe black. The head, thorax, and abdomen dull black; antennæ black. Expanse 1 inch.

Hab. Mexico, Teapa, Tabasco (*H. H. Smith*).

One specimen of this dull-looking species was taken by Mr. Smith in February 1888.

Fam. Chalcosiidæ.

GINGLA, Walker.

Gingla æqualis, sp. n.

Primaries orange-red, broadly bordered with black from the apex to the anal angle; secondaries deep black. The underside the same as above. The head, thorax, and abdomen black; the tegulæ orange-red; the antennæ and legs black. Expanse $1\frac{1}{2}$ inch.

Hab. Mexico, Coatepec (*J. Brooks*).

One specimen of this most interesting species was sent; it exactly resembles *Ptychotene æqualis*, Walker.

Fam. Zygaenidæ.

Subfam. EUCHROMIINÆ.

SYNTOMEDIA, Harris.

Syntomedia vulcana, sp. n.

Primaries uniformly deep glossy black, with a rich purplish tinge in some lights; a small streak in the cell and a round spot near the base on the inner margin very pale primrose-colour; a white dot close to the base on the costal margin: secondaries deep glossy black, the same as the primaries, the basal part hyaline, the same as in *Syntomedia melanthus*, Cramer. The head, thorax, and abdomen glossy bluish black, a row of white spots on each side of the latter; the legs and antennæ black, the antennæ with the tips white on the underside. Expanse $2\frac{2}{10}$ inches.

Hab. Mexico, Tierra Colorado, Guerrero, 2000 feet (*H. H. Smith*).

One specimen of this fine species was taken by Mr. Smith in October 1888; it is allied to *S. melanthus*, Cr., but more closely to *S. Sauleyi*, Guén.

ICHORIA, Butl.

Ichoria (?) *parthia*, sp. n.

Primaries glossy bluish green: secondaries the same, but slightly hyaline near the base and the inner margin. The head, thorax, and abdomen, the legs and antennæ bluish green. The underside of all the wings is bluer than the upperside. Expanse $1\frac{3}{10}$ inch.

Hab. Nicaragua, Chontales (*T. Belt*); Panama, Bugaba, 800 to 1500 feet (*Champion*).

A pretty little species, not nearly allied to any known to me.

LÆMOCHARIS, Herr.-Sch.

Læmocharis masa, sp. n.

Primaries and secondaries hyaline, the primaries broadly tipped with black at the apex and along the outer margin, secondaries edged with black from the apex to near the anal angle; a small spot on each side of the head and one at the base of the thorax bright carmine; the abdomen, legs, and antennæ dull black, the front of the head and collar greyish white. Expanse $\frac{3}{4}$ inch.

Hab. Mexico, Teapa, Tabasco, February, March, and April (*H. H. Smith*).

A small species allied to *L. stryma*, Druce, from which it is at once distinguished by the wide black apex of the primaries.

GYMNOPODA, Felder.

Gymnopoda mecrida, sp. n.

Primaries and secondaries uniform sooty black, slightly hyaline at the base of the wings. The head, tegulæ, and base of the thorax black, the thorax and abdomen bright scarlet; the antennæ and legs black. Expanse $1\frac{1}{4}$ inch.

Hab. Mexico city (*F. D. Godman*).

This beautiful little species is allied to *G. subflamma*, Druce, from Chiriqui, from which it is at once distinguished by the entirely different colour of the thorax and abdomen.

COSMOSOMA, Hübn.

Cosmosoma ethodæa, sp. n.

Primaries and secondaries yellowish hyaline; the costal margin from the base to near the apex edged with bright yellow and the inner margin from the base to beyond the middle edged with bright orange-yellow; the apex and outer margin broadly black, and a black spot at the end of the cell: secondaries with the apex and outer margin as far as the anal angle black, and a black line crossing the middle of the wing from the costal margin to the anal angle. The underside as above. The head and the underside of the thorax and abdomen black; the antennæ black, whitish at the tips; collar dark blue, the upperside of the thorax and abdomen bright orange, banded with dark blue; the two anal segments dark blue; the tegulæ orange, edged with black; the legs black. Expanse $1\frac{3}{10}$ inch.

Hab. Mexico, Atoyac, Vera Cruz, April (*H. H. Smith*).

A beautiful species, allied to *C. elegans*, Druce.

DYCLADIA, Felder.

Dycladia lydia, sp. n.

Primaries black, with the hyaline spaces as in *D. mexicana*, but slightly larger: secondaries hyaline, bordered with black at the apex and outer margin, but not so deeply as in *D. mexicana*. The front of the head bright dark blue; the

thorax and basal half of the abdomen chrome-yellow; the tegulæ chrome-yellow, edged with black on the lower side; antennæ black, with white tips; the sides of the abdomen near the base and two or three small dots in a line down the middle bright greenish blue; the lower half of the abdomen and the anus and underside bright red, the anal segment banded with blue; legs black. Expanse $1\frac{1}{4}$ inch.

Hab. Mexico, Teapa, Tabasco, March (*H. H. Smith*).

This species is allied to *D. mexicana*, from which it is at once distinguished by the entirely different coloration of the thorax and abdomen.

Dycladia thera, sp. n.

Primaries black, with the hyaline markings almost identical with those of *D. mexicana*, but with the apical spot smaller and narrower; also the black margin of the secondaries considerably narrower. The underside of all the wings as above. The head and collar bright blue, the thorax and upper side of the abdomen dull black; tegulæ black, with a yellow dot at the base, also a yellow spot on each side of the abdomen close to the base; the sides of the abdomen and the anal segment bright blue; the underside of the abdomen and the anal tuft bright scarlet; antennæ and legs black. Expanse $1\frac{1}{2}$ inch.

Hab. Mexico, Teapa, Tabasco, February (*H. H. Smith*).

This species is allied to *D. mexicana*, but it is a larger insect and entirely different in the coloration of the head, thorax, and abdomen.

Dycladia utica, sp. n.

Primaries hyaline, broadly bordered at the apex and along the outer margin with black, the base red; secondaries hyaline, with the apex and outer margin edged with black. The head, thorax, and abdomen black; the collar and the tegulæ red; a streak down the centre of the thorax and two spots at the base white; the underside of the thorax and the base of the abdomen white; the legs black and white; the antennæ black, becoming white near the tips. Expanse $1\frac{1}{10}$ inch.

Hab. Mexico, La Venta, Guerrero, 300 feet (*H. H. Smith*).

This species is most nearly allied to an unnamed one in my own collection from the Bahama Islands, and comes into the group with *D. columbina*, Hübn.; it was taken by Mr. Smith in September 1888.

Fam. Arctiidae.

Subfam. CTENUCHINÆ.

THEAGES, Walk.

Theages striata, sp. n.

Primaries brownish fawn-colour, streaked with yellowish-white lines from the base to the outer margin; a narrow streak of the same colour crosses the wing from beyond the middle of the costal margin to near the anal angle, from which a rather wider line extends to the outer margin: secondaries dusky hyaline white, shaded with brown at the apex and along the costal margin. Underside as above, but the markings of the primaries much more indistinct. The head, thorax, and abdomen blackish brown, the two anal segments and the sides of the abdomen almost to the base pale yellow; the underside of the abdomen streaked with dusky white from the base to the anus; the palpi orange at the base, with the tips black; antennæ pale whitish brown; legs pale brown. Expanse $1\frac{3}{4}$ inch.

Hab. Mexico, Coatepec (*J. Brooks*).

This species is allied to *Theages leucophaea*, Walk.

EVIUS, Walker.

Evius Walkeri, sp. n.

Primaries and secondaries uniform pale yellow, the primaries broadly bordered with white at the apex and outer margin; a series of black streaks cross the white between the veins as far as the yellow colour. The head, thorax, and abdomen pale yellow; the antennæ black. Expanse $1\frac{1}{2}$ inch.

Hab. Panama, Taboga Island (*J. J. Walker*).

A pretty little species, very distinct from any I have seen.

HALSIDOTA, Hübn.

Halsidota phellia, sp. n.

♂. Primaries pale straw-colour, thickly speckled with minute blackish-brown dots, a very distinct black spot at the end of the cell: secondaries creamy white, slightly hyaline near the base; two small brownish dots close to the anal angle, the fringe white. The head and thorax straw-colour; the tegulæ with a small black dot in front; the abdomen

brownish to near the anus, which is pale straw-colour. The female is the same as the male, excepting that it is larger and paler in colour. Antennæ of the male deeply pectinated, those of the female simple. Expanse, ♂ $1\frac{3}{4}$, ♀ $2\frac{1}{4}$ inches.

Hab. South-east Brazil, Rio.

Halesidota (?) *syracosia*, sp. n.

Primaries creamy white, with all the veins broadly edged with pinkish fawn-colour; the fringe yellowish: secondaries hyaline white, shaded at the base and along the inner margin with pale pink, the veins and the fringe yellowish. The head and the front of the thorax fawn-colour; the tegulæ darker, edged with white; the thorax and the abdomen pinkish, except at the apex of the latter, where it is yellow. The antennæ and legs reddish yellow. Expanse 2 inches.

Hab. Mexico, Omilteme, Guerrero, 8000 feet (*H. H. Smith*).

One specimen of this beautiful species was taken by Mr. Smith in July 1888; it somewhat resembles *Automolis lateritia*, Herr.-Sch., but is entirely differently coloured.

PHÆOPTERA, Herr.-Schäff.

Phæoptera hyalina, sp. n.

Primaries and secondaries entirely hyaline, the veins being slightly whitish. The head and thorax creamy white; the abdomen yellow at the anus and on the underside white; the antennæ yellow; the legs white. Expanse $2\frac{1}{2}$ inches.

Hab. Mexico, Sierra de los Aguas Escondidas, Guerrero, 7000 feet (*H. H. Smith*).

This distinct species is allied to *Phæoptera cornea*, Herr.-Sch., and was taken by Mr. Smith in July 1888.

ECPANTHERIA, Hübn.

Ecpantheria amulaensis, sp. n.

Primaries white, crossed from the costal to the inner margin by two broad, broken, black bands, between which a row of small black spots crosses from the costal to the inner margin; several small black spots close to the base, and a row of black spots along the outer margin, some larger than others: secondaries white, with some small black dots round the outer margin. The front of the head and the collar

white, tipped with black in front; the tegulæ white, with two black spots on each; the thorax white, with two central black spots. The underside of the head and thorax, the upper and underside of the abdomen, the legs and antennæ all deep black. The underside of the wings the same as above, excepting that the black bands are browner in colour. Expanse $1\frac{1}{2}$ inch.

Hab. Mexico, Amula, Guerrero, 6000 feet (*H. H. Smith*).

This species was taken in August 1888; it is allied to *Ecpantheria extrema*, Walker, but is very distinct.

ZATREPHES, Hübn.

Zatrephes philobia, sp. n.

Primaries golden straw-colour, irrorated with brown dots; a >-shaped line near the base, above the point of which is a round silver spot and beyond a large silver patch, much the same as in *Z. Trailii*, Butler, the silver patches surrounded with darker brown; a curved narrow submarginal line crosses the wing from the costal to the inner margin, the fringe dark brown: the secondaries creamy white, dusky along the outer margin from the base to near the anal angle, the fringe yellowish white. The head, thorax, and abdomen pale straw-colour. Expanse $1\frac{3}{4}$ inch.

Hab. Mexico, Jalapa (*Höge*); Omilteme, Guerrero, 8000 feet (*H. H. Smith*).

This very beautiful species was taken by Mr. H. H. Smith in July 1888; it is most nearly allied to *Zatrephes Trailii*, Butler, from the Amazons.

Fam. Lithosiidæ.

BRYCEA, Walker.

Brycea esula, sp. n.

Primaries uniform brownish fawn-colour, the costal margin edged with yellow: secondaries orange, broadly bordered with black from the apex to the anal angle. The underside of all the wings orange, broadly bordered with black. The head, thorax, and tegulæ brownish fawn-colour, the collar orange; the abdomen yellow, with a narrow, black, central streak from the base to the anus, where it becomes wider; the antennæ black; the underside of the abdomen and the legs brownish fawn-colour. Expanse $1\frac{1}{4}$ inch.

Hab. Mexico, Cuernavaca, Morelos (*H. H. Smith*).

A pretty species, taken by Mr. Smith in June 1888.

Brycea arbela, sp. n.

Primaries uniform slate-colour, edged with yellow along the costal margin, but not reaching the apex: secondaries pale yellow, broadly bordered with black. The underside of all the wings pale yellow, bordered with black. The head, thorax, abdomen, and legs all black. Expanse $1\frac{3}{4}$ inch.

Hab. Mexico, near the city (*F. D. Godman*).

Mr. Godman took one specimen of this species in poor condition; it is allied to the preceding species, but quite distinct.

Brycea semirosea, sp. n.

Primaries pinkish fawn-colour, the costal margin edged with bright carmine near the base; a short carmine streak from the base along the inner margin: secondaries bright carmine, broadly bordered with black from the apex to the anal angle. The underside of all the wings bright carmine, bordered with black. The head, thorax, and tegulæ brownish fawn-colour; the antennæ and legs black; the collar red. Expanse $1\frac{1}{2}$ inch.

Hab. Mexico, Atoyac, Vera Cruz (*Schumann*).

One specimen of this species was sent; it is allied to *B. arbela*, but very different in colour.

Brycea feronia, sp. n.

Primaries dark brown, darkest along the inner margin; a short streak from the base and beyond this a square-shaped spot, both creamy white: secondaries bright orange, broadly bordered with black, the underside of all the wings bright orange, bordered with black. The head, thorax, and abdomen black, the sides of the abdomen yellow; the antennæ and legs black. Expanse $1\frac{1}{2}$ inch.

Hab. Mexico, Omilteme, Guerrero, 8000 feet (*H. H. Smith*).

This very distinct and pretty insect was taken in July 1888 by Mr. Smith; it is allied to *Brycea disjuncta*, Walker.

PTYCHOGLENE, Felder.

Ptychoglene pomponia, sp. n.

Primaries brown, with the costal margin edged with red from the base to the apex: secondaries black, with the costal half bright carmine. The underside of the primaries bright

scarlet, the hind wings as above. The head and thorax brown; the abdomen glossy black, with a bright red line on each side; the antennæ and legs black. Expanse $1\frac{1}{2}$ inch.

Hab. Mexico, Xucumanatlan, Guerrero, 7000 feet (*H. H. Smith*).

One specimen of this fine insect was taken by Mr. H. H. Smith in July 1888.

Ptychoglène ira, sp. n.

Primaries glossy blue-black, with the basal half dark orange, the base on the costal margin black: secondaries dull black. The underside of all the wings the same as above. The head, thorax, and abdomen black; antennæ and legs black; the tegulæ yellow at the base. Expanse $1\frac{1}{10}$ inch.

Hab. Mexico, Jalisco (*Schumann*).

One specimen of this very distinct species taken in July 1888.

Ptychoglène pamphyliæ, sp. n.

Primaries blackish brown-yellow from the base to the middle of the costal margin, but the yellow colour does not touch the inner margin: secondaries blackish brown, the basal half orange. The underside of all the wings the same as above. The head, thorax, and abdomen black; the tegulæ and the sides of the abdomen yellow; the legs and antennæ black. Expanse $1\frac{1}{10}$ inch.

Hab. Mexico, Jalisco (*Schumann*).

One specimen of this distinct species was taken in July 1888.

Ptychoglène phrada, sp. n.

Primaries red-carmine, bordered from the apex to the anal angle and very slightly along the inner margin with black: secondaries black, slightly hyaline, a broad red-carmine streak from the base along the costal margin, but not reaching the apex. The head, antennæ, thorax, abdomen, and legs all black. Expanse $1\frac{3}{10}$ inch.

Hab. Mexico, Atoyac, Vera Cruz (*Schumann*).

This pretty species is allied to *P. erythrophora*, Felder.

Ptychoglène pertunda, sp. n.

Primaries bright scarlet, with the outer margin broadly bordered with black: secondaries deep black. The head,

thorax, and abdomen brownish black; the tegulæ bright scarlet; the antennæ and legs black. Expanse 1 inch.

Hab. Mexico, Coatepec (*Brooks*).

A pretty distinct species, allied to *P. æqualis*, Walker.

Fam. Melameridæ.

ÆNOTRUS, Druce.

Enotrus mamitus, sp. n.

Primaries and secondaries uniform dull black, with the fringe of all the wings greyish; the underside of the primaries black, with the costal margin from the base to beyond the middle edged with pinkish white; a curved cream-coloured band edged with pink crosses the wing from the costal margin near the apex to the outer margin close to the anal angle: secondaries brownish black, crossed by two pinkish-white lines, the costal margin edged with white. The head, thorax, and abdomen black; the collar and tegulæ edged with yellow; antennæ and legs black. Expanse $1\frac{4}{10}$ inch.

Hab. Mexico, Amecameca (*F. D. Godman*).

Mr. Godman took one specimen of this very distinct species in April 1888.

Enotrus splendens, sp. n.

Primaries dull black, with two cream-coloured spots on the costal margin near the apex in the male, and only one spot in the female: secondaries dull black, with two indistinct white spots on the outer margin near the apex in the male, without any in the female. The underside: primaries dull black, with the spots as above, and one minute white dot on the middle of the outer margin: secondaries black, with a streak at the base and two spots on the costal margin and one on the outer margin cream-colour. A large spot at the base and one on the inner margin near the anal angle bright carmine; in some specimens the latter spot joins a cream-coloured spot in the centre of the wing. The head, thorax, and abdomen black; the collar orange; the antennæ and legs black. Expanse $1\frac{1}{4}$ inch.

Hab. Mexico, Omilteme, Guerrero, 8000 feet (*H. H. Smith*).

Both sexes of this beautiful little species were taken by Mr. Smith in July 1888.

MELANCHROIA, Hübn.

Melanchroia phæbe, sp. n.

Primaries and secondaries blue-black, the apex of the former tipped with white, the base orange on the costal margin. The underside of all the wings dull black, with the veins deep black, the base of all the wings bright orange. The head, thorax, and abdomen black; the collar and tegulæ orange; the antennæ and legs black. Expanse $1\frac{1}{2}$ inch.

Hab. Mexico, Amula, Guerrero, 6000 feet (*H. H. Smith*).

This species is allied to *M. inconstans*, Hübn., from which it is at once distinguished by the orange-coloured base of the primaries and other differences on the underside. Both sexes of this insect were taken by Mr. Smith in August 1888.

Fam. Hepialidæ.

Phassus Smithi, sp. n.

Primaries pale fawn-colour, indistinctly mottled with a darker shade; a few lunular-shaped markings near the apex and along the outer margin: secondaries uniformly reddish fawn-colour, slightly streaked with paler colour along the costal margin near the apex. The underside of all the wings pale fawn-colour. The head and thorax reddish fawn-colour; the abdomen and legs pale fawn-colour; the antennæ brown. Expanse $4\frac{1}{16}$ inches.

Hab. Mexico, Atoyac, Vera Cruz (*H. H. Smith*).

One specimen of this fine species was taken by Mr. Smith in May 1888; it is allied to *P. Championi*, but it is considerably different in colour and marking.

Fam. Notodontidæ.

TIFAMA, Walker.

Tifama argentifera, sp. n.

Primaries silvery white, shading off to dark grey along the inner and outer margin; the costal margin bordered with dark brown from about the middle to near the apex; extending from the apex to the anal angle a submarginal row of black lunular-shaped marks, edged with white on the inner side; a white spot on the inner margin beyond the middle and a faint brown line crossing the wing towards the apex: secondaries pure white, with the outer margin from the apex

almost to the anal angle clouded with brownish black. The underside of the primaries pale brown, the secondaries white, with the costal margin brown. The head, thorax, and tegulæ silvery grey; the abdomen brownish grey; the antennæ and legs brown. Expanse 3 inches.

Hab. Mexico, Teapa, Tabasco (*H. H. Smith*).

A very fine species, quite distinct from any known to me; it was taken in March 1888.

DICENTRIA, Herr.-Schäff.

Dicentria phraortes, sp. n.

♂. Primaries cream-colour, shaded with brown along the costal margin: secondaries white, slightly hyaline, the fringe yellowish. The head, thorax, and abdomen pale brown; antennæ brown.

♀. Primaries dark purplish brown, with several black streaks near the anal angle: secondaries dusky white. The head and thorax brown; the tegulæ and abdomen pale fawn-colour; antennæ brown. Expanse, ♂ $1\frac{1}{2}$, ♀ $2\frac{1}{10}$ inches.

Hab. Mexico, Coatepec (*J. Brooks*); Jalapa (*in coll. Dognin*).

A very distinct species, not closely allied to any with which I am acquainted.

Fam. Palindidæ.

PALINDIA, Guén.

Palindia regina, sp. n.

Primaries silvery white, crossed from the costal margin to the anal angle by three wide bands of pale fawn-colour, edged with a dark brown line, the two inner bands being much the widest, the third band being little more than a narrow line; a marginal dark brown line extends from the apex to the anal angle: secondaries pale glossy yellow, shading off to white at the base and along the inner margin; a large black spot close to the apex; two black dots on the outer margin about the middle and one black dot nearer the anal angle. The underside pale glossy yellow, becoming whitish at the apex of the primaries and secondaries; the primaries crossed from the costal to near the inner margin by two wide black bands, becoming narrower as they reach the inner margin; the black spot at the apex of the secondaries is considerably

smaller than it is above. The head and collar pale yellowish white; the thorax, tegulæ, and the base of the abdomen silvery white; the abdomen yellowish white, darker at the anus and on the underside; the legs and antennæ pale fawn-colour. Expanse 2 inches.

Hab. Ecuador, Sarayacu (*Buckley*); Zamora, September (*in coll. Mons. P. Dognin*).

This very beautiful species is quite distinct from any known to me.

XII.—*Ramulina parasitica*, a new Species of Fossil Foraminifera infesting *Orbitolites* Mantelli, var. *Theobaldi*, with Comparative Observations on the Process of Reproduction in the *Mycetozoa*, *Freshwater Rhizopoda*, and *Foraminifera*. By H. J. CARTER, F.R.S. &c.

[Plate VIII.]

Ramulina parasitica, n. sp. (fossil).

Test thin, calcareous. Consisting individually of a single chamber (Pl. VIII. fig. 2, *a*), which is stoloniferous, and collectively (fig. 1, *ff*, and fig. 2) of the same, forming a reticulated structure in which the chambers are united to each other by the stolons (fig. 2, *b*). Chamber or lobe varying in shape from globularity to any kind of multiangulate figure, which may be produced by a variable number of stolons dragging out its convex surface in different directions into angular forms, so as in the aggregate to effect a reticulated structure in which the chambers are represented by the knots and the stolons by the interuniting cords of the net (fig. 1, *ff*). Chambers or lobes varying in size under 1-360th inch in diameter; stolons cylindrical, about 1-1800th inch in diameter, varying in length with the distance between the chambers which they connect. The projecting angles of neighbouring chambers often uniting directly, so that two or more become continuous without the intervention of stolons (fig. 1, *g*, and fig. 2, *ee*). Some are dark brown and others calc-white (what the brown colour arises from I am unable to say). Externally furnished (chiefly on the convex side or that opposite the stolons) with a number of delicate, straight, hair-like tubuli about 2-6000ths inch long and almost of immeasurable thinness (fig. 2, *ccc*), each of which projects

from a base about 1-1200th inch in diameter, apparently situated in the centre of a polygonal grain of calcite about 2-6000ths inch in diameter (fig. 3, *a* and *b*). Grains of calcite forming in apposition the structure of the chamber-wall, which is therefore very thin (fig. 4, *a*). Internally filled with a reticulated structure (fig. 4, *b*, and fig. 5, *a*), the larger interstices of which are in many instances occupied by a spherical cell (? reproductive body) (fig. 6, *g* &c.) varying under 4-6000ths inch in diameter. In the confined state parasitically extending into the cells of *Orbitolites Mantelli*, var. *Theobaldi*, which it infests, when each lobe or chamber of the parasite occupies a single cell in the central plane of this Orbitolite and is successively connected with its neighbours, chain-like, by a single stolon (fig. 1, *c*, and fig. 6, *h*), while instead of following the circular linear arrangement of the cells of the Orbitolite, the chain-like development frequently leaves it obliquely in a zigzag form (fig. 1, *e*); or in the free state (fig. 1, *ff*) spreading out independently in the reticulated one above mentioned among the sand &c. of the stratum in which the Orbitolites have been deposited, now more or less held together by a matrix of crystalline calcite, which in the *polished* fragment admits of the *Ramulina* in its free state being seen at different depths below the surface.

Loc. The bed of *Orbitolites Mantelli*, var. *Theobaldi*, in the west bank of the Irrawadi, 6 miles below Thayetmyo, in Burma ('Annals,' 1888, vol. ii. p. 342).

Obs. This microscopic form so prevails in the bed of the Orbitolites just mentioned, that it is hardly possible to subject a small fragment of the latter, which has been polished for an opaque object or ground down to a thin translucent slice, to microscopic examination without observing several portions of it; while its chief habitat appears to have been in and about the cells of the test of this species of Orbitolite, which is the only species of large Foraminifera in the deposit. So like is the chamber with its straight tubuli to the cells and their interuniting tubuli, of which the *crust* of the Orbitolite is composed, except that the tubuli of the former are only on one side, that it is often difficult to distinguish the difference; but that it is a distinct structure is confirmed by its growth in parts *only* of the central plane, as above mentioned, and its occurrence over part of the "crust" in the microscopic section of the "crust" and central plane together, where the contrast between the two is unmistakable. Of course all that is peculiar to it *now* in a lapidified state must have taken place before it thus became perpetuated by fossilization.

Although parasitic it was evidently a species of Foramini-

fera closely allied to the subfamily Ramulininæ, of which Dr. Brady has given several figures in his 'Challenger' Report (Zoology, vol. ix. text, p. 587, pl. lxxvi. figs. 22-28, 1884); but being "microscopic" it is of course almost infinitely smaller than the specimens of the recent species (viz. 1-15th inch) which Dr. Brady has described and delineated under the name of "*R. globulifera*," as well as the fossil ones (viz. 1-16th inch) previously found in the Chalk of the north of Ireland by Mr. J. Wright, and figured in the Report of the Belfast Nat. Hist. Field Club for 1873-4 (pl. iii. figs. 19 and 20).

The appearance of this fossil in its reticulated form (fig. 1, *ff*) also so much resembles that of the reticulated structure presented by similar phases of development in the Mycetozoa of de Bary (see M. C. (now Dr.) Cooke's 'Myxomycetes of Great Britain,' 1877, pls. iii., iv., and viii. figs. 24, 27, and 82 respectively), that one cannot help thinking that the Foraminifera must resemble them in other respects, especially in their stages of reproduction, if not in their elementary composition, since many of them develop calcareous material to such an extent in their structure that Rostafinski, in his classification ('Monograph of the Mycetozoa,' 1875), has made an order of them under the name "Calcareæ" (Cooke, *op. cit.* p. 2), which de Bary has illustrated in *Physarum leucophaceum* ('Morphologie und Biologie der Pilze,' 1884, p. 469, fig. 191).

Let us now compare the development of the spore or reproductive body of the Mycetozoa with that of the Foraminifera through the *freshwater* naked and testaceous Rhizopoda, adopting the same stages numerically in each to facilitate the comparison.

Thus, (1) the spore of the Mycetozoa is spherical, varying about 1-4000th inch in diameter, consisting generally of a dark brown cortex filled with colourless granuliferous plasma; (2) on germination the cortex bursts and the granuliferous plasma comes forth in the form of a colourless, monociliated, polymorphic body, possessing a nucleus and a contracting vesicle (see de Bary's figures, *op. cit.* p. 454 &c.); (3) the cilium is retracted and the polymorphic body assumes the condition of an Amœba; (4) after this the now unciliated bodies flow together and thus become massed into a state which is called the "plasmodium," still presenting active polymorphism; (5) this activity gradually ceases and a motionless condition follows under which the plasmodium subsides into a more or less flat cake-like form (in *Æthalum septicum* &c.), when the whole of the interior passes from a

colourless into an opaque, brown, dust-like mass, consisting of the spherical spores just described grouped together into variously shaped compartments constructed by flocculent septa, while in other forms, e. g. *Stemonites* &c., portions of the plasmodium are thrown up into stipitate heads (sporangia of exquisite form and structure according to the species) whose contents undergo similar changes to those of the *Æthelium* just mentioned; in short the plasmodium becomes transformed into the adult form of the species, whatever that may be; this bursts, and the spores becoming free follow the same process in germination as that above described, whereby the life-history of the Mycetozoon is completed.

Directing our attention next to the freshwater naked and testaceous Rhizopoda, which, through the Gromiidae, such as *Gromia fluviatilis*, Duj.*, are most intimately connected with the Foraminifera on the one hand, and in their polymorphic plasmodia &c. so much resemble the Mycetozoa on the other, it will be seen that in 1856-57 I described and illustrated the tests of *Amœba verrucosa* and *Euglypha alveolata* in an effete state, respectively charged with a number of spherical colourless cells similar in form and composition to the spores of the Mycetozoa ('Annals,' vols. xviii. and xx. pls. v. and i. figs. 26 &c. and 13), and following their stages of development after the same manner as that adopted for the spore of the Mycetozoa, it has been found that:—

(1) The spore or reproductive body of these Rhizopoda is spherical, about 1-1366th inch in diameter in *Amœba verrucosa* ('Annals,' 1857, vol. xx. p. 40, pl. i. fig. 13, *a*, *b*) and about 1-4000th inch in *Euglypha alveolata* (*ib.* vol. xviii. p. 244, pl. v. figs. 27 and 28), also that it consists of a transparent colourless cell-wall or cortex filled with equally colourless granuliferous plasma. (2) On germination (which has not been actually seen) the cell-wall or cortex may be fairly inferred to burst, as in the Mycetozoa, and the granuliferous plasma to come forth in the form of a colourless monociliated polymorphic body, possessing a nucleus and a contracting vesicle. (3) The cilium becomes retracted and the polymorphic body assumes the condition of an Amœba. (The presence of the cilium and its retraction in the young Rhizopod has been seen in the instance of a mother-cell in which the progeny came forth one by one in the form of monociliated polymorphic bodies, retracted their cilium respectively, and, putting forth pseudopodial rays, assumed the form of an *Actinophrys*

* With the marine species I have nothing to do here

(‘Annals,’ 1857, vol. xix. p. 261). But it can hardly be doubted that the polymorphic spore does in such instances always come forth in a monociliated condition, while the mere retraction of the cilium is of common occurrence.) (4) After the retraction of the cilium the now *unciliated* bodies flow together in the Mycetozoa, and thus becoming massed produce the “plasmodium.” This again has not been witnessed in the freshwater Rhizopoda, unless the groups of *Actinophrys* and the conjugations of *Diffugia*, in which I have found as many as five individuals together (‘Annals,’ 1872, vol. ix. p. 421), be taken as instances of it. What the object of this “flowing together” may be generally has not been discovered; but in the Mycetozoa it leads to the evolution of the particular form which the species finally assumes and the development of the spores or reproductive bodies. (5) The activity of the Rhizopod ceases after it has attained its adult form and the reproductive bodies have been developed, when, as in the Mycetozoa, the body becomes effete and the reproductive bodies become free. The latter then germinate and the life-history of the freshwater naked and testaceous Rhizopoda is also thus completed.

Of course it is comparatively easy to witness the germination of the spores of the Mycetozoa, because the species containing them are so large as to be capable of being handled, while the spores are so abundant in them that when torn to pieces they produce a dust (as before stated) which soils the fingers like *soot*, hence the name *Æthalium*. On the other hand, the freshwater Rhizopoda are microscopic objects which can only be satisfactorily seen under a high power and only occasionally with reproductive bodies or spores in them; hence, again, it is only when they are testaceous, e. g. *Euglypha* (which has an unmistakable form of test), that the young or small ones can be recognized; and this has been done by myself in one or more instances where the same vessel has contained a number of the adult forms more or less charged with the reproductive bodies (‘Annals,’ 1856, vol. xviii. p. 230, pl. v. figs. 26–31 &c.).

Turning now to the Foraminifera, we find:—(1) That the spore or reproductive body appears to consist in like manner of a “round ball” composed of granular plasma presenting in the aggregate a dark colour, held together by the natural coherency of the mass rather than by any specialized membrane. Max Schultze found such in the chambers of “living” Rotaliæ in great abundance and of various sizes, less than the diameter of the siphon (? stolon) which connects the chambers, say about 1-3000th of an inch, as seen in the soft

parts of a mounted specimen of *Operculina arabica* that I still possess, from which the calcareous material of the test had been removed by acid ('Organismus der Polythalamien,' 1854, p. 27, *a, b*); and two years afterwards he verified this in a species of *Miliola* (Müller's 'Archiv,' 1856, nos. 1 and 2, p. 165, Taf. vi. B). In 1861 I found the same kind of thing, but in a fossilized state, in a specimen of *Nummulites Ramondi* about one fifth of an inch in diameter, infiltrated with ochraceous oxide of iron, which thus renders the whole of the structure in a vertical section through the centre, when polished and overspread with Canada balsam under a glass slip particularly brilliant and distinct. (I am not now alluding to the "opaque scarlet spherules," to which I have lately called attention.) In this condition the last chamber especially is observed to be filled with spherical bodies about 1-1800th inch in diameter, translucent, and charged with light brown granular contents ('Annals,' 1861, vol. viii. pl. xvii. fig. 15). This preparation I still possess. So much, then, for the reproductive body in the Foraminifera. (2) The germination of this "body" has not been actually observed; but, like that of the freshwater Rhizopoda just mentioned, it may fairly be inferred to be similar to that of the spore in the Mycetozoa. (3) The retraction of the cilium would follow as a matter of course, and the plasmic contents thus become amœbiform. (4) But the "flowing together" of the amœbiform bodies to form a "plasmodium" is still less evident than in the freshwater Rhizopoda, for the development after the soft or plastic condition of the reproductive body of the species, especially in the Nautiloid forms, can be followed from the commencement to the end, through the plasmic chambers or lobes as they are successively produced becoming permanently represented in their forms by shell-substance.

At what period the reproductive bodies begin to appear in this development remains to be discovered. But as regards the possibility of the reproductive body germinating in the chamber of the parent, Dr. Strethill Wright's statement in 1861 may be noted ('Annals,' vol. vii. p. 362), viz. that he had seen "three small living *Spirilline*" in *S. perforata*, apparently confirming what Ehrenberg had noticed in 1841, which led the latter to call the species "*vivipara*." Here again I found the same kind of thing in a fossilized state in an infiltrated specimen of *Nummulites Ramondi* about one fifth of an inch in diameter, treated in the same way as that above described; that is to say, in the outer chamber, close to one angle of the vertical section, there are several bodies which

appear to be elements of reproduction in a state of germination, only one of which, however, has so far advanced as to produce a test which is recognizable, and this is a Nautiloid form consisting of the primary cell and two following chambers, altogether measuring about 1-360th inch in its longest diameter; so that if the surface of the section presents one of these the whole cavity may contain many more; nor does it appear likely that this one had come from the exterior, for besides the apparently closed and unfractured state of the chamber it is not likely that the reproductive body would return for germination to that or any other chamber of the Nummulite in which it was produced.

By what course the reproductive bodies of the Foraminifera are eliminated also remains to be discovered, or whether the test becomes effete like that of the Mycetozoa and fresh-water Rhizopoda. That the latter appears to be the case is indicated by the great number of empty tests and the few filled with the living animal that I found in the bed of *Operculina arabica* on the south-east coast of Arabia ('Annals,' 1852, vol. x. p. 168), and especially by the beds of Nummulites whose enormous thicknesses have given rise to the term "Nummulitic Series."

Thus *Ramulina parasitica* in an evolutionary point of view seems to be an initiatory form of the Foraminifera, and in organization ranks with the Mycetozoa and the fresh-water Rhizopoda.

N.B.—The type specimens referred to in the above paper, consisting of a slide and a small thin fragment about 13-12ths by 7-12ths inch square, polished on both sides, have been deposited in the Geological Department of the British Museum, and the two large "hand-specimens" from which they were taken, marked "H. 47. 83" and "H. 47. 84" respectively, have been returned to the museum of the Geological Survey of India at Calcutta. Also the type specimens to which I have referred in each of my last six papers in the 'Annals' have been deposited in the same department of the British Museum.

EXPLANATION OF PLATE VIII.

N.B.—All the illustrations are necessarily more or less diagrammatic, from the minuteness of the objects, but with as little deviation from the natural characters as possible.

Fig. 1. *Ramulina parasitica*, n. sp., lobes varying under 1-360th inch in

diameter. Diagrammatic sketch taken from a slice of *Orbitolites Mantelli*, var. *Theobaldi*, reduced to translucent thinness and cut a little obliquely, so as to show part of the central plane overlain by the crust. *a*, cells of the central plane; *b*, cells of the crust; *c*, globular lobes of the *Ramulina* confined to the cells of the central plane and joined together by a common stolon; *e*, the zigzag form; *f f*, lobes in the "free state" more or less multiangular and joined together by stolons, presenting in the aggregate a reticuliform character like that of the capillitium of some of the Mycetozoa; *g*, lobes united together directly.

Fig. 2. The same. Portion in the "free state," more magnified, to show:—*a*, the lobe or chamber; *b*, the stolon; *c c c*, tubuli projecting from the surface of the chamber; *d*, chambers below the surface unfinished; *e e*, two chambers united together. Taken from the polished surface of a fragment of the rock containing the said *Orbitolites*, where the chambers of the *Ramulina* appear at different depths in the transparent crystalline matrix. (On most of the chambers the tubuli are omitted for perspicuity and to save trouble in drawing.)

Fig. 3. The same. Single chamber, more magnified, to show the tubuli and their position on the surface *in situ* (fig. 3*a*). Fig. 3*b* represents a small fragment of the surface of the chamber magnified to the scale of 1-48th to 1-3000th of an inch, to show that the bases of the tubuli are respectively situated in the centre of grains of calcite, which appear to have a polygonal shape.

Fig. 4. The same. Two chambers, much magnified. Taken from the surface of the polished fragment, where their upper parts have been ground off, thus showing *a*, the thinness of the wall, and *b*, the reticulated structure in the interior of the chamber, at the same time.

Fig. 5. The same. Group in which both sides of the lobe, *a*, have been ground down, thus again showing the reticulated structure of the interior, but by transmitted light; *b*, one in which the section has not gone below the surface, showing the truncated ends of the tubuli; *c*, unfinished lobe. Taken from a microscopic slice which had been reduced to translucency.

Fig. 6. The same. Five cells of the central plane obliquely cut across, so as to show the structure of the globular lobes which they respectively contain *gradationally*. *a*, cells of "central plane;" *b*, opaque state of "globular lobe" uncut; *c*, showing indistinctly traces of the (?) reproductive bodies which it contains; *d*, the same more distinct; *e*, the same still plainer; *f*, the thinnest section of all, in which the reproductive elements appear to consist of spherical cells, *g*, imbedded in the reticulated tissue; *h*, stolon. All the parts of this illustration are magnified to the scale of 1-48th to 1-6000th inch and taken from a mounted microscopic slice.

BIBLIOGRAPHICAL NOTICES.

Bird-Life of the Borders: Records of Wild Sport and Natural History on Moorland and Sea. By ABEL CHAPMAN. Gurney and Jackson. London, 1889.

"Good wine needs no bush," and we have noticed with satisfaction that, although reviewers may play for safety when they are not sure of their subject as regards an indifferent book, they show a wonderfully quick appreciation for one which is thoroughly good. The present volume is a case in point, for the author is at once a true sportsman and naturalist as well as an artist of no mean ability, though no allusion to the numerous spirited illustrations appears on the titlepage. From all sides comes the chorus of praise; experienced wild-fowlers considering that, in the portion of the work relating to the gunning-punt, Mr. Chapman has done for the north of England what Sir Ralph Payne-Gallwey did for the sister island with his 'Fowler in Ireland,' while ornithologists have thoroughly appreciated the keen insight displayed in the description of the habits, food, changes of plumage, &c. of the birds which frequent the moorland and the coast. When treating of these, Mr. Chapman introduces from time to time some pertinent and interesting remarks upon his experiences in Spain and Spitsbergen—the southern and the northern extremities of Europe, if, indeed, the latter can be claimed as an appanage by any continent; and his personal observations over so wide an area are entitled to a respectful reception, but he must beware of accepting too readily, or at too high a value, the plausible hypotheses of others, and he must try to avoid the youthful fault of generalizing upon imperfect evidence. In asking such questions as "Where do the Common [Bar-tailed] Godwit, Knot, Sanderling, and Curlew-Sandpiper breed? Whence come they in myriad hosts every August to our shores?" he hardly seems to realize the enormous extent of the known but almost unexplored land which lies within the Arctic Circle. No doubt some large islands are as yet undiscovered, especially to the northward of Bering Sea; but we need not go so far as that for "tundras" sufficient for the reproduction of all the above species. It is true that neither Spitsbergen nor Novaya Zemlya appear to be suited to their requirements; but the little that is known of Franz-Josef Land does not altogether justify its being placed in the same category, for the climatic conditions of that territory are exceptional, open water existing throughout the winter; and Mr. Leigh Smith actually found Brünnich's Guillemot assembled there early in March! As regards the Bar-tailed Godwit, Mr. Chapman takes exception to the name because, he says, "its tail is *not* barred except in the young;" but therein he goes too far, for the adults in breeding-plumage—hardly known in Northumberland—have the true tail-feathers distinctly banded. The name was not, however, conferred by the unobservant pedant or the cabinet naturalist; it was given by practical sportsmen and wildfowlers, who distinguished a bird as "bar-tailed"

when they saw that its rump and the long tail-coverts—which in this species reach far down and cover the true tail-feathers—were barred at all seasons of the year; they never dreamt of limiting the meaning of the word “tail” to the ten stiff-shafted rectrices.

We have tried to find a little fault with a few passages in this excellent book, lest Mr. Chapman should become surfeited with eulogy, which, however deserved, has a tendency to prove unwholesome; and a gentle corrective may be the more beneficial, inasmuch as he is preparing a work on the south of Spain which cannot fail to prove interesting. If he will take a little pains to condense and to chasten his style he may become a very strong writer, for there can be no more doubt of his powers of description than there is of his general accuracy.

Sylvan Folk: Sketches of Bird- and Animal-Life in Britain.

By JOHN WATSON. T. Fisher Unwin.

THIS little book consists of a collection of articles, many of which have, we believe, already appeared in various newspapers; and the style in which they are written is only too characteristic of the slipshod “copy” considered good enough for the reader by editors of the present day. The late Richard Jefferies possessed a certain power of picturesque description which captivated the public; and, as usual, a host of imitators have been for some time clutching at the hem of his garment in the hope of acquiring the entire mantle of his inspiration—but in vain; for an attempt at writing crisply or epigrammatically too often ends in twaddle and even in bathos.

Mr. Watson boasts of having taken all his facts at first hand from nature; speaks of “caring little for the dry bones of science, and having but scant sympathy for that species of natural history which is acquired in closets;” and adds: “We know what science—or, rather, its masters—is doing for birds now-a-days. ‘One kills them, the other writes classifying epitaphs.’” After this declamation we are not surprised at being told that “the swift is the last to come of all the swallows,” in disregard of the fact that the latter are *Passeres*, while the former have long been placed among *Picariæ*; all these insect-eaters being spoken of as “*hirundines*,” by which we presume the author means *Hirundinidæ*. Our sympathies are with Mr. Watson in his desire to prevent the indiscriminate destruction of birds and beasts of prey; but his remarks upon grouse-disease and the overstocking of moors indicate that he is unaware of the very heavy mortality among grouse in 1815, when their natural enemies were still abundant. To speak of the Little Bustard as now extinct in Britain is absurd, for it never was more than an accidental visitor, and has become much more frequent of late years. Similar ignorance is displayed respecting the Great Auk, which, according to the author, was once plentiful “among certain of its icy haunts;” while the hope held out that “further north, and within the arctic circle, there are still surf-

beaten isles where garefowl probably breed" is delusive, for there is not one authenticated instance of the occurrence of this species within—or even very close to—that line. We think it unnecessary to point out further errors.

A Handbook of Cryptogamic Botany. By A. W. BENNETT, M.A., B.Sc., F.L.S., and G. M. MURRAY, F.L.S. With 378 Illustrations. London and New York: Longmans, 1889. 8vo. Pp. 473.

It is now above thirty years since Berkeley's 'Introduction to Cryptogamic Botany' was published, and in that time an enormous advance has been made in added genera and species in all the orders and in our knowledge of the complicated life-histories of many of the lower types. It is remarkable that during so long a period of active work, in which the number of teachers and students has been so greatly multiplied, that no other work of a similar scope has been written in the English language. Partly, no doubt, this has arisen from the circumstance that in the teaching at our universities and medical schools Cryptogamic Botany gets pushed into a small corner, and partly because the field of study is so vast that it has now got specialized into several different departments; so that our fern-men know very little about fungi and our algologists about mosses.

Mr. Bennett has specially worked at Algæ, and in the present volume he has also undertaken the vascular orders and the Muscineæ, whilst Mr. Murray has dealt with the Fungi, including the Lichens, Mycetozoa, and Bacteria. What they have attempted is not to deal nearly so much as Berkeley did with tribes or even genera in detail, but to give a general summary of the life-history of the leading types of form, such as might be suitable for the use of teachers and advanced students. The book is copiously illustrated by woodcuts interspersed in the text, the figures being to a large extent borrowed from recent German handbooks, such as those of De Bary, Sachs, Schenck, Luerssen, and Thomé. Following the example of the last edition of Huxley and Martin's 'Elementary Biology,' they make use of a descending in preference to an ascending order as regards complication of structure. The series of orders is classified out under seven primary subdivisions as follows:—First the Vascular Cryptogamia. Here the orders are grouped under a heterosporous and isosporous series, Ophioglossaceæ being treated as a class distinct from Filices. A useful chapter, founded mainly on Solms-Laubach's recent 'Handbook of Vegetable Palæontology,' is added, upon the fossil types, which, in Equisetaceæ, Lycopodiaceæ, and Selaginellaceæ are arborescent and extremely different from anything in existence at present. The second subdivision deals with the Muscineæ, separating them into Musci and Hepaticæ. A better subdivision of the Musci would be to keep up *Archidium* alone as a distinct order, for the other genera here associated with it, *Phascum*, *Ephemerum*, and *Bruchia*, are now by all the best authorities classified with the Bryaceæ, and *Pleuridium*, as the figure given (fig. 122) shows, has the calyptra separated as a distinct cap. The

third subdivision deals with the Characeæ, which are now universally admitted as a distinct structural type. The fourth subdivision deals with the Algæ, and is fuller in detail than any other part of the book. The types included here are placed under eight classes—Florideæ, Confervoideæ Heterogamæ, Fucaceæ, Phæosporeæ, Conjugatæ, Confervoideæ Isogamæ, Multinucleatæ, and Cænobieæ. In the fifth subdivision the Fungi are primarily subdivided as Phycomycetes and Sporocarpeæ, the Lichens being dealt with as parasitic fungi which do not develop beyond the earliest stage of germination without the aid of an algal host. Subdivision six deals briefly with the Mycetozoa, distinguished from the Fungi by their saprophytic nutrition and vegetative body constituting a plasmodium formed by the coalescence of peculiar swarm-spores. The seventh subdivision deals with the Protophyta, under which are included Diatoms, Protococcoideæ, and the Cyanophyceæ, the series ending with the Bacteria. Under each chapter is given a list of the principal recent memoirs that relate to its subject, and this bibliographical part of the work will be very useful to beginners and isolated workers.

The great puzzle for students in Cryptogamic Botany is in the nomenclature of the parts of the organism. It is most difficult to carry out the principle that the same organ should always bear the same name throughout the various orders, and that organs that are not identical should receive different names. The plan adopted by our authors is as follows:—They propose the restriction of the term spore to any cell which is produced by the ordinary processes of vegetation, not directly by a union of the sexual elements, which becomes detached for purposes of direct vegetative propagation. The simple term spore is used in the Pteridophyta and Muscinæ; but in the Thallophytes it is generally qualified by a prefix, *e. g.* zoospore, tetraspore. The cell in which spores are found is called a sporange. In the heterosporous Pteridophyta the spores from which the female prothallium arises are called megaspores and those which give birth to the antherozoids microspores. The cases which contain them are called megasporangia and microsporangia. The cell containing the male organs of fertilization is called an antheridium and the fecundating bodies antherozoids. Spore being abandoned for the female reproductive organs it is proposed to use sperm as a root-term in its place, oosphere for the unfertilized protoplasmic mass, and *gone* as a root-syllable for the various forms of the entire female organ before fertilization. In a similar way they differentiate between a sexual and non-sexual multiplication of individuals, by calling the first process reproduction and the latter propagation. If some such plan of limiting terminology could be carried out it would effect a great gain in clearness and precision.

A general elementary handbook of this kind was much wanted, and it deserves and no doubt will obtain a wide circulation. The Pteridophyta and Muscinæ are now known as thoroughly as the Phanerogamia; but in all the other divisions there is a wide field for further work in the study of life-histories.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

June 5, 1889.—Prof. J. W. Judd, F.R.S.,
Vice-President, in the Chair.

The following communications were read :—

1. "Observations on some undescribed Lacustrine Deposits at Saint Cross, Southelmham, in Suffolk." By Charles Candler, Esq. (Communicated by Clement Reid, Esq., F.G.S.)

These deposits are situated in the basin of the River Waveney, $3\frac{3}{4}$ miles E. by N. of Harleston, and 9 miles E.N.E. of Hoxne. They occupy a hollow in the Boulder-clay towards the northern edge of the plateau locally known as "High Suffolk." Saint Cross brickyard, which is the only section now visible, shows :—

	ft.
a. Surface-soil and gravel	1-3
b. Red and white loam, variable, fine or coarse, sandy or calcareous. Elephant, Horse, &c. at base of the bed.....	3-5
c. Fine, tenacious, grey and red clay, with carbonaceous seams towards the base. <i>Valvata</i> , <i>Bythinia</i> , <i>Pisidium</i>	2-5
d. Black peaty loam and sand, worked to a depth of 5 feet, but no bottom reached. Seeds and freshwater shells.....	5-
e. Chalky Boulder Clay	

No implements have yet been found in any of the beds; but Pleistocene Mammalia (determined by Mr. E. T. Newton) occur in bed *b*. From bed *d* Mr. Clement Reid obtained seeds of 29 species of flowering plants. These are all marsh or aquatic species, except the hawthorn and dandelion. Unlike those found in Prof. Prestwich's bed *d* at Hoxne, there are no Arctic forms among them; but the Author pointed out that the Arctic plants of Hoxne were determined from *leaves* found in laminated clays, while the matrix in which the plants are found at St. Cross is only suitable for the preservation of seeds. However, certain of the plants do not range far north, and the occurrence of a large tree in the upper part of bed *d* points to a less rigorous climate than that under which the leaf-bearing beds at Hoxne were deposited.

The lacustrine beds now occupy a ridge between two depressions, the valleys having been deeply eroded, or perhaps formed since the filling-up of the lake. It appears probable that on the final retreat of the last ice-sheet the hollows of the Boulder-clay were occupied by a series of lakes and pools. For the most part the sedimentary deposits formed in these hollows have been entirely swept away; but at Saint Cross the mud and loam of one such lake have been preserved.

2. "On certain Chelonian Remains from the Wealden and Purbeck." By R. Lydekker, Esq., B.A., F.G.S.

In the first part of the paper the Author described a portion of

the hind lobe of a Chelonian plastron from the Wealden, which was remarkable as showing a median row of epidermal shields. The name of *Archerochelys valdensis* was proposed for the form so represented. The new generic term *Hylaochelys* was also proposed for the Purbeck Chelonian described by Sir R. Owen as *Pleurosternum latiscutatum*, and was also taken to include some other forms from the Wealden.

The second section of the paper treated of the affinities of *Pleurosternum*. It was concluded that *Digerrhinum*, Cope (as represented by the so-called *Platemys Bullocki*), is identical with *Pleurosternum*, of which there appears to be only one Purbeck species. Evidence was brought forward to show that in the adult of *Pleurosternum* the pubis had a facet for articulation with the xiphiplastral; and it was proposed to refer this genus, together with *Platycheilus* and *Baëna*, to a new section termed "Amphichelydia," which was regarded as allied both to the true Cryptodira and to the Pleurodira.

MISCELLANEOUS.

Triassic Fish-scales from Siberia. By A. SMITH WOODWARD.

So little is known of the palæontology of Siberian formations that a recent memoir by Dr. J. V. Rohon* upon some fragmentary remains of fossil fishes from the Upper Yenisei is of considerable interest and importance. Even detached scales and bone-fragments are worthy of discussion when obtained from such a source; and among other fossils the author describes some unsatisfactory specimens of this character from an undetermined horizon near the village of Kubekowa. These fossils, however, do not appear to have been sufficiently compared with known forms elsewhere. The scales named *Palæoniscus sibiricus* (*loc. cit.* p. 12, figs. 22, 28) are so closely similar to those of the Lepidotoid Ganoid *Colobodus*† that they may be assigned with much probability to this genus; another fragment (*loc. cit.* fig. 21) is sculptured like some of the head-bones of *Colobodus*‡; and the associated ring-vertebræ (*loc. cit.* figs. 23, 29) may well pertain to the same fish, whereas they indicate a higher stage of development of the axial skeleton than has hitherto been observed in any of the Palæoniscidæ. *Colobodus* has only been recorded as yet from the European Muschelkalk and Lettenkohle, in which it is widely distributed; and the undetermined horizon of *C. sibiricus* may thus be provisionally regarded as Triassic.

* J. V. Rohon, "Ueber fossile Fische vom oberen Jenissei," Mém. Acad. Imp. Sci. St.-Petersbourg, [7] vol. xxxvi. no. 13 (1889).

† Cf. especially W. Dames, Palæont. Abhandl. vol. iv. (1888), pl. xvi. a. figs. 6-8.

‡ Cf. W. Dames, *ibid.* pl. xiv. fig. 1.

On the Morphology and Systematic Position of the Epicarides of the Family Dajidae. By MM. A. GIARD and JULES BONNIER.

In a previous paper (see 'Annals,' ser. 6, vol. iii. p. 512), for reasons derived from the ethology of the animals, we have regarded the Dajidae as a group intermediate between the Cryptoniscians and the Bopyrians proper, with which they would be connected by the family of the Phryxians. This view is now confirmed by the anatomical investigations which we have been enabled to make of some types of this group, which is still so little known and so badly represented in collections.

The Rev. A. M. Norman has been kind enough to send us a specimen of *Dajus mysidis*, Kröy., collected at the island of Jan Mayen upon a *Mysis oculata*, Fabr., during the Austro-Hungarian expedition to the arctic seas*. He has also submitted to our examination an *Aspidophryxus* parasitic upon *Erythropus microphthalmus*, G. O. Sars, and dredged by G. O. Sars himself upon the Norwegian coast.

The unique specimen of *Dajus mysidis* figured but not described by Kröyer was a young female, accompanied by a male in the Cryptoniscian stage. The six females collected at Spitzbergen during the Dutch 'Willem Barents' expedition and studied by Hoek were also immature, and only one of them bore a male in the second larval form. Buchholz alone has described the adult male and female of *Dajus mysidis*, Kröy., under the name of *Leptophryxus mysidis*†. But his description is very incomplete, especially with respect to the inner antennæ and the incubatory plates.

Of the latter there are five pairs as in all Bopyrians, and the fifth pair, which escaped the notice of Gerstäcker, is the most developed. This forms the greater part of the incubatory cavity. The body, bent ventrally on each side, also takes part in the formation of this cavity. The morphology of the head and thorax differs little from that of the same parts in the Phryxians. However, the feet of the sixth and seventh thoracic segments are entirely wanting, thus reproducing an embryonic arrangement which is transitory in the other Bopyrians. Further, the first five pairs of feet are very closely approximated to the anterior part of the animal, where they surround the aperture of the incubatory chamber. The metamerization is very visible upon the middle of the dorsal part in both the abdominal and the thoracic regions; in the latter the segments increase in size from before backward. On the pleon the first pair of feet alone are well developed in the form of biramose lamellæ, which, in this part, close the incubatory chamber. The other pleopoda are rudimentary, with no pleural laminæ; there are two uropoda.

* We keep the name of *Dajus mysidis*, Kröy., for the parasite of *Mysis oculata*, and give that of *Dajus mixtus* to the *Dajus* found by G. O. Sars at Vadsøe upon *Mysis mixta*, Lillj.

† 'Zweite deutsche Nordpolarfahrt in den Jahren 1869 und 1870,' Bd. ii. Abth. i. p. 287, Taf. ii. fig. 2 (Leipzig, 1874).

The adult male presents the pleon characteristic of the male of *Phryxus*, without pleopoda or uropoda. But the antennæ and the rostrum strongly remind us of the structure of the Cryptoniscian embryos.

The examination of *Dajus* renders that of *Aspidophryxus* much easier. The *Aspidophryxus* which has been entrusted to us by Mr. Norman had been determined as *A. peltatus* by G. O. Sars. But the type of *Aspidophryxus peltatus* described and figured by Sars is parasitic upon *Erythrops Goesi*, and what we know of the vigorous specificity of the Epicarides to each definite host led us at once to regard the parasite of *Erythrops microphthalmus* as belonging to a distinct species. A minute comparison of this parasite with the figures given by G. O. Sars, which are so exact, appears to us to justify this supposition, and we shall give the name of *Aspidophryxus Sarsii* to the Epicaride of *Erythrops microphthalmus*.

This new species differs from *Aspidophryxus peltatus* (1) in the less widened and more slender general form of the female, (2) in the number and arrangement of the ova in the incubatory chamber.

While in *A. peltatus* the ova are diffused in great numbers and without order in the incubatory cavity, in *A. Sarsii* they are 134 in number, arranged in regular concentric rows, each row containing respectively 17, 17, 15, 10, 5, and 3 ova in one half of the body, between the free margin and the median line. These ova are moreover larger than those of *A. peltatus*. Further, the animal is less distinctly segmented. In the male, on the contrary, the segments of the pleon, although soldered together, are more distinct than in *A. peltatus*.

If we referred exclusively to the description and figures given by G. O. Sars, there would be much more considerable differences between the two species, and the genus *Aspidophryxus* would seem far removed from the genus *Dajus*. The complete absence of incubatory lamellæ in the female (*lamince incubatorie nullæ*) and the existence of only six pairs of thoracic feet in the male would constitute characters of great importance in this group of Epicarides. But we have ascertained that these characters were due to errors of observation. The incubatory lamellæ all exist as in *Dajus*; the first four pairs are more reduced, in consequence of the approximation of the thoracic feet to the anterior part of the body. Like the first pair in the other Bopyrians, they have only an accessory function in the protection of the ova. As to the fifth lamellæ, these are represented by a pair of narrow plates bordering the free edges of the greatly enlarged last thoracic somites; they terminate in digitations posteriorly. These plates are applied to each other exactly in the median line, and with the lateral ventral folds of the thoracic somites form the incubatory cavity properly so called.

The pleon also presents considerable reductions compared with that of *Dajus*. It is completely destitute of appendages and forms a small cavity, in which is lodged the male, folded up like a Scarabæan larva and placed in profile.

This male differs little from that of *Dajus*; the segments of

the pleon are more distinctly indicated and there is a well-developed pair of uropoda. As to the thoracic feet, they are of the normal number of *seven* pairs, of which the first and smallest belong to a narrow segment soldered to the head, which has escaped the notice of G. O. Sars. The prominent rostrum and the very long outer antennæ very closely resemble in form the same organs in the Cryptoniscians. The passage from the Dajidæ to the Cryptoniscians may be understood in the following manner:—In the male the development has been arrested in the Cryptoniscians at the second larval form, whilst in the Dajidæ there has been a transformation into a degraded male. In the female the anterior part of the incubatory chamber has been considerably contracted in the Cryptoniscians, whilst a cavity was formed at the expense of the lateral folds and of the posterior part of the body: but this cavity cannot be in any way confounded, as suggested by Fraisse, with the coelomatic cavity. The profound modifications of the incubatory cavity of the Dajidæ and Cryptoniscians will be examined in detail in a memoir with plates. It may be observed, in conclusion, that the *Erythrops microphthalmus* parasitized by *A. Sarsi* was a female destitute of ova, no doubt owing to parasitic castration.—*Comptes Rendus*, May 13, 1889, p. 1020.

A Parasitic Copepod. By Prof. LEIDY.

The author stated that last summer while at Beach Haven, N. J., there was brought to him from the surf a living specimen of the singular transparent fish *Leptocephalus*. In examining it he observed attached to the tail-fin a minute Copepod Crustacean, apparently of the genus *Chalimus*. The parasite was attached by a long filiform rostrum, and resembled in this and other respects more the *Chalimus Scombri* as represented by Baird in fig. 5, tab. xxxiii. of the 'British Entomostraca,' than it does the original of this species as represented by Burmeister in the Nova Acta Nat. Cur. of Bonn, xvii. tab. xxiii. fig. 13. The species, which may be distinguished as *Chalimus tenuis*, is considerably less than half the size of *C. Scombri*. The cephalothorax, nearly twice as long as broad, is obcordate and proportionately much narrower than in the latter species. The frontal segment is narrow and not prominent laterally, and the biarticulate antennæ are concealed beneath. The abdomen, half the length of the cephalothorax, exhibits three conspicuous divisions, and the short caudal appendages end in three minute setæ. Abdominal feet ending in biramous leaf-like segments fringed with short setæ. Rostrum linear and almost as long as the cephalothorax. Whole length 1.125 millim.; length of cephalothorax 0.5, breadth 0.275: length of rostrum 10.5; length of abdomen 0.25.—*Proc. Acad. Nat. Sci. Philad.* April 16, 1889, p. 95.

Processes for the Preservation of the Lower Marine Animals.

By M. MAURICE BEDOT.

The author particularly describes a new process which he has invented by means of which Siphonophora may be preserved without the separation of a single appendage of the colony from the stem. To obtain good results the following method is to be adopted:—

A solution of sulphate of copper of 15–20 per cent. is made in distilled water (the strength may vary a little according to the species to be operated upon). Then the colony to be fixed is thrown quickly into this solution, and in doing this a considerable quantity of sea-water is at the same time poured in. The solution of sulphate of copper must therefore be of about ten times the volume of the sea-water. When the Siphonophore is fixed (which is effected in a few minutes) some drops of nitric acid are added to the solution, and it is stirred very gently with a glass rod, to prevent the formation of a precipitate.

The Siphonophore is left for four or five hours in this solution, and then hardened before placing it in alcohol. For the latter purpose several hardening reagents may be employed. The best results are obtained by employing Flemming's liquid, composed of 15 parts of chromic acid of 1 per cent., 4 parts of osmic acid of 2 per cent., and 1 part of glacial acetic acid. As it is desirable as much as possible to avoid touching the Siphonophore or changing its vessel before it is completely hardened, the following is the mode of operation:—Part of the solution of sulphate of copper is removed, leaving only sufficient to cover the Siphonophore. Then the Flemming's liquid is gently poured in and left to act for twenty-four hours at least. The volume of this liquid employed must be about double that of the solution of sulphate of copper.

The most important operation in the preservation of these animals is the transfer into alcohol, which must be very slow and gradual. First there are added to the liquid containing the Siphonophore a few drops of alcohol of 25 per cent., introduced by means of a pipette as far as possible from the colony. Then the dose and the concentration of the alcohol are gradually increased. This operation must go on at least for a fortnight before alcohol of 70 per cent. can be employed. The final preservation is made in alcohol of 90 per cent. The results obtained are better in proportion as the transfer into the alcohol has been slow. This rule is a general one in the preservation of all pelagic animals. Chloride and acetate of copper may also be employed; but they do not give such good results.

The solution of sulphate of copper may also be employed with success in fixing a number of pelagic animals, such as certain Ctenophora, Medusæ, Pteropoda, Heteropoda, Tunicata, &c.; but it is always well to harden them after fixation.—*Bibl. Univ., Archives des Sciences Physiques et Naturelles*, June 15, 1889, p. 556.

The Cockroaches of the Carboniferous Epoch.

By M. CHARLES BRONGNIART.

In the neururation of the first pair of wings Mr. Scudder finds little difference between the recent and fossil cockroaches. The latter he divides into two families, the Blattinariæ and the Mylacrindæ, distinguished chiefly by the arrangement of the mediastinal nervure. In the Blattinariæ the branches of this nervure start at regular intervals from a common trunk, so that the mediastinal area is usually in the form of a band. In the Mylacrindæ the branches of the mediastinal nervure originate from a common point at the base of the wing and appear to be arranged in a radiate manner around this point.

Hitherto the Mylacrindæ have been regarded as peculiar to the United States, but the author states that they are as numerous as the Blattinariæ at Commeny, where more than six hundred impressions of them have been collected by M. Fayol.

As authors have generally had only wings at their disposal they have been unable to give any precise information as to the form of the body. M. Brongniart now confirms Mr. Scudder's division of the group into Blattinariæ and Mylacrindæ by characters drawn from the body. The Blattinariæ have a very rounded prothorax, narrower than the part of the body covered by the wings; the Mylacrindæ have a thickset body with a wider prothorax, which, instead of being rounded, is nearly in the form of a triangle with the base in front.

But these two families have a common character which distinguishes them from the recent Blattariæ. The last dorsal arch of the abdomen in the fossils is widened, rounded, and divided into three parts by two longitudinal grooves. In the males the last ventral arch presents nothing extraordinary—it is truncated; but the females, instead of presenting, like the existing species, a keel-like last ventral arch cleft longitudinally in the median line to facilitate the deposition of the ootheca, have this arch terminated by a sort of slender borer, as long as the abdomen, widened a little and keel-shaped at the base, but straight towards the extremity. This apparatus resembles the ovipositor of *Eurycantha* among the Phasmodæ rather than that of the Locustidæ.

The presence of this borer leads to the supposition that the Carboniferous Cockroaches, instead of leaving their eggs on the ground enclosed in an ovigerous capsule, probably deposited them singly, like the existing Phasmodæ, perhaps introducing them, by means of the borer, into the trunks of trees.—*Comptes Rendus*, February 4, 1889, p. 252.

THE ANNALS

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[SIXTH SERIES.]

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XIII.—*Notes on British Amphipoda*.—II. *Families Leucothoidæ, Pardaliscidæ, and Gammaridæ (Marine)*. By the Rev. A. M. NORMAN, M.A., D.C.L., F.L.S.

[Plates X.-XII.]

Fam. Leucothoidæ.

Genus I. LEUCOTHOË, Leach, 1814.

1. *Leucothoë spinicarpa* (Abildgaard).

1789. *Gammarus spinicarpus*, Abildgaard, Müll., Zool. Dan. vol. iii. p. 66, pl. xciv. figs. 1, 2.

1804. *Cancer (Gammarus) articulatus*, Montagu, Trans. Linn. Soc. vol. iii. p. 70, pl. vi. fig. 7.

1814. *Leucothoë articulosa*, Leach, Edinb. Encycl. vol. vii. p. 403.

1853. *Leucothoë denticulata*, Costa, Crust. Amphip. del Regno di Napoli, p. 226.

1862. *Leucothoë articulosa*, Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 271.

1870. *Leucothoë spinicarpa*, Boeck, Crust. Amphip. bor. et arct. p. 78.

1876. *Leucothoë spinicarpa*, Boeck, De Skand. og Arkt. Amphip. p. 597.

Hab. Although as often perhaps found free, this species is commonly met with in the branchial sac of Ascidians (*mentula*, *venosa*, *sordida*, &c.). Shetland; the Minch; Skye; *Ann. & Mag. N. Hist.* Ser. 6. Vol. iv.

Oban; Loch Fyne; Firth of Clyde; Lulworth, Dorset; Jersey (*A. M. N.*); Banff (*T. Edward*); Polperro (*Laughrin*): *Mus. Norm.*

Distribution. Adriatic (*Heller and Claus*): *Mus. Norm.* Naples (*Costa*); Marseilles (*Catta*); Western France (*M.-Edwards &c.*); South and West Norway (*M. Sars &c.*); Azores (*Barrois*).

2. *Leucothoë furina* (Savigny).

1809. *Lycesta furina*, Savigny, Deser. de l'Egypte, Crust. pl. ii. fig. 2.

1830. *Leucothoë furina*, M.-Edwards, Ann. des Sci. Nat. vol. xx. p. 381.

1840. *Leucothoë furina*, M.-Edwards, Hist. Nat. des Crust. vol. iii. p. 57, pl. xxix. fig. 14.

1857. *Leucothoë procera*, Bate, Ann. & Mag. Nat. Hist. vol. xix. p. 146.

1862. *Leucothoë furina*, Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 275.

Hab. The specimen described by Bate and Westwood was taken by the late Mr. T. Edward at Banff. I know of no other British examples.

Distribution. Mediterranean (*Savigny &c.*); Western France (*Chevreaux &c.*).

I recorded specimens under this name in my 'Shetland Dredging Report' of 1868; but they seem to differ in so many particulars that I now describe them under the name *Leucothoë imparicornis*.

Chevreaux states that this species is always found free and not in Ascidians or sponges; he adds:—"On reconnaît facilement cette espèce à la forme toute particulière du telson, et surtout à un caractère fort net que Sp. Bate n'a pas signalé: le bord inférieur du troisième segment de l'abdomen se termine en arrière par un petit crochet aigu et recourbé tandis que ce bord est carrément tronqué chez *L. spinicarpa*."

3. *Leucothoë imparicornis*, n. sp. (Pl. X. figs. 1-4.)

Antennæ (fig. 1) feeble and very short, not longer, or only a little longer than the first two joints of the peduncle of antennules; in the specimen figured the penultimate joint only reaches to the end of the first joint of antennules, in other specimens it is slightly (but only slightly) longer, penultimate joint the longest; flagellum of seven or eight articulations, subequal in length to last joint of peduncle. *First gnathopods* (fig. 2) having the hand narrow and the finger short, about equal to one fourth of the length of the hand. *Second gnathopods* (fig. 3) elongated, pyriform, dorsal margin slightly concave

distally, palm rather waved, wholly devoid of teeth or tubercles. *Telson* (fig. 4) forming three fourths of an ellipse, sides gradually sloping to the well-rounded extremity. Length 7 millim.

Leucothoë imparicornis differs from the described British species in the very small size of the antennæ, in the narrow hand and short nail of the first gnathopods. The form of the hand approaches that of *L. furina*, but the palm has no teeth; the telson also distinguishes it from the species just named.

Hab. St. Magnus Bay and Balta Sound, Shetland (*A. M. N.*).

Genus II. *EUSIRUS*, Kröyer, 1845.

Eusirus longipes, A. Boeck.

1860. *Eusirus longipes*, Boeck, Forh. ved de Skand. Naturf. p. 656.

1862. *Eusirus helveticæ*, Bate, Cat. Amphip. Crust. Brit. Mus. p. 155, pl. xxix. fig. 2.

1862. *Eusirus helveticæ*, Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 207.

1866. *Eusirus bidens*, Heller, Amphip. des Adriat. Meeres, p. 32, pl. iii. fig. 19.

1868. *Eusirus helveticæ*, Norman, Last Report Dredging Shetland Isles, Brit. Assoc. Rep. p. 281.

1872. *Eusirus longipes*, A. Boeck, De Skand. og Arkt. Amphip. p. 504, pl. xix. fig. 4.

First two segments of pleon with a central dorsal tooth; hinder margin of third segment denticulately serrated throughout its entire length, serrations of lower portion pointing upwards, but those near the summit pointing downwards*. Length of thigh of last three peræopods measuring scarcely more than one fifth the length of the attenuated limbs. Telson cleft to not more than one third of its length. Thighs of last three peræopods strongly serrated posteriorly. Length 14 millim.

Hab. Shetland; Skye; Firth of Clyde; off Berwick (*A. M. N.*); Aberdeenshire (*Dawson*): *Mus. Norm.*

Distribution. West Norway (*G. O. Sars*): *Mus. Norm.* South Norway (*G. O. Sars*); Bay of Biscay (*Prince de Monaco*); Adriatic (*Heller*).

* In *Eusirus cuspidatus*, Kröyer (from Greenland, 'Valorous' Exped. 1876, and off Halifax, Nova Scotia (*S. I. Smith*): *Mus. Norm.*), the hinder margin of third segment is also denticulately serrated; but in that species the denticulations throughout the entire length point upwards.

Genus III. LILLJEBORGIA, Bate, 1862.

(=*Iduna*, A. Boeck, 1860 (name in use), = *Microplax*,
Lilljeborg, 1865 *.)

1. *Lilljeborgia pallida*, Bate. (Pl. X. fig. 10.)

1855. *Gammarus pallidus*, Bate, Brit. Assoc. Rep. p. 55.

1859. *Gammarus brevicornis*, Bruzelius, Skand. Amphip. Gamm. p. 62,
pl. iii. fig. 11.

1860. *Iduna brevicornis*, A. Boeck, Forh. ved de Skand. Naturf. 8de
Møde, p. 646.

1862. *Lilljeborgia pallida*, Bate, Cat. Amphip. Brit. Mus. p. 118,
pl. xx. fig. 5.

1862. *Lilljeborgia pallida*, Bate & Westw. Brit. Sessile-eyed Crust.
vol. i. p. 203.

1876. *Lilljeborgia pallida*, A. Boeck, De Skand. og Arkt. Amphip.
p. 497, pl. xviii. fig. 9.

The *Gammarus pallidus* of Goës is *Lilljeborgia fissicornis*,
M. Sars, and not the present species.

Hab. Oban; off Cumbræ, 20–25 fath. (*A. M. N.*): *Mus.*
Norm.

Distribution. Tromsø (*S. Schneider*): *Mus. Norm.* South
and West Norway, 50–300 fath. (*G. O. Sars*); Sweden
(*Bruzelius*); Finmark (*Lorén*); South-west France (*Chev-*
reaux &c.); Mediterranean (*Catta &c.*).

2. *Lilljeborgia picta*, n. sp. (Pl. X. figs. 5–9.)

Antennules (fig. 5) shorter than peduncle of antennæ,
secondary appendage consisting of only three articulations,
(the distal very minute), subequal in length to two joints of the
flagellum. *Antenna*: last joint of peduncle two thirds length
of the penultimate, flagellum eight-jointed, rather longer than
last joint of peduncle. *First gnathopods* with wrist not pro-
duced into a calx, the hand widening gradually from base to
extremity; palm oblique, well arched, scarcely occupying
more than one third of total length; anterior portion of hinder
margin with about six transverse rows of simple setæ and a
small spine at commencement of palm. *Second gnathopods*
(fig. 7): wrist with no produced calx; hand ovate, palm
occupying half the length, and forming with the anterior
portion a continuous arch, so that greatest width is at the
commencement of the palm, where there is a single spine;
the margin anterior to this with fascicles (about seven) of

* Lilljeborg, 'On *Lysianassa magellanica* and Crust. *Lysianassina*,'
p. 19.

divaricating simple setæ, which have hamate tips; outer margin of palm (fig. 7) furnished with regularly arranged long setæ, inner margin (fig. 8) with stiff bent setæ, each of which is furnished at the bend with two or three lateral prongs; alternating with these stiff setæ are a series of short, blunt-topped spinules, and another series is seen behind these of a similar character. Two anterior pair of *peræopods* with the dactylus scarcely more than one fourth length of preceding joint. Last *peræopods* (fig. 9) with meros and carpus subequal, propodos slightly longer, of good breadth (but not flattened out, as in *L. fissicornis*), with four pairs of spines on the anterior and two or three setæ on posterior margin; finger short, not exceeding one fourth of length of propodos, gradually attenuated, two spines on the propodos at its base. Telson longer than peduncle of last uropods, and these have the branches very broad and foliaceous. As in *L. pallida* the first, second, fourth, and fifth segments of pleon have a central dorsal tooth. The colouring of the two specimens is alike and remarkable, the ground-colour pale with markings as follows of deep purple (at least that is their colour now in specimens which were mounted fresh from the sea twenty-three years ago):—Antennæ and antennules each with a spot on the last joint of peduncle; the purple colour commences on the head, across which it passes obliquely from behind forwards to the mandibles; thence the colour is suffused over all parts except the distal joints of the anterior *peræopods* until the middle of the last segment of *peræon*; here it passes obliquely forwards, and is continued through the thighs of the fourth *peræopods*, leaving the thighs of the last *peræopods* white, except that distally on them is a small spot of the same colour, which also appears in a spot near the base of every joint (except ischium and propodos) of three posterior *peræopods*, as well as in blotches on the back of second and two following segments of pleon, and stainings at the base of the pleopods attached to these segments, on the distal portion of first and second and on the basal portion of the last uropods. Length 6 millim., exclusive of antennæ.

The absence of a produced calx to the wrist of the two gnathopods will, apart from all other characters, at once serve to distinguish this species from *L. pallida*, *L. Kinahani*, and *L. fissicornis* (M. Sars). In this respect it resembles *L. æquicornis*, G. O. Sars; but from that species it may be known by the different antennules, the much smaller wrists of the gnathopods, longer and less flattened propodos and shorter and stronger nail of last *peræopods*, and by the four dorsal teeth on the pleon instead of one only.

Hab. Two specimens taken at Guernsey, 1865 (A. M. N.):
Mus. Norm.

I figure the terminal joints of the last peraeopods of the four North-European species with which I am acquainted.

L. pallida, Bate (Pl. X. fig. 10).—Propodos longer than carpus by about one fourth, its hinder margin with groups of very long setæ; dactylus exceedingly long and slender, fully two thirds as long as propodos.

L. fissicornis (M. Sars) (fig. 11).—Propodos nearly half as long again as carpus, with single spines on front margin; dactylus scarcely more than one fourth its length.

L. aquicornis, G. O. Sars (fig. 12).—Propodos peculiarly flattened, somewhat fusiform, widest in the middle, only slightly longer than carpus; dactylus flattened, lanceolate, equal in length to two thirds of propodos.

L. picta, Norman (fig. 9).—Propodos slightly longer than carpus, front margin with three or four pairs of spinules; dactylus short, scarcely exceeding one fourth of the length of propodos.

3. *Lilljeborgia Kinahani* (Bate).

1862. *Phædra Kinahani*, Bate, Cat. Amphip. Crust. Brit. Mus. p. 119, pl. xxi. fig. 1.

1863. *Phædra Kinahani*, Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 211.

1887. *Lilljeborgia Kinahani*, Chevreux. Nouvelles espèces de Crust. Amphip. du Sud-ouest de la Bretagne, p. 2.

Hab. The British habitat of the type was "Nullipore bank off the coast of Cumbræ," where it was found by Mr. D. Robertson. Being anxious to see the type I applied to Mr. Robertson; but he found that the specimen had been mislaid. Dredged near Hope's Nose, Devonshire, Sept. 1874 (*Stebbing*).

Distribution. Coast of Brittany (*Chevreux*).

It is difficult to understand why this species was not placed by Bate and Westwood in the genus *Lilljeborgia*, to which they refer in their description, comparing *P. Kinahani* with it and pointing out similarities to *L. pallida*.

Chevreux says of it:—"Cette forme, décrite par Sp. Bate sous le nom de *Phædra Kinahani* d'après un spécimen dragué sur un banc de Nullipores, près de Glascon, n'a jamais été signalée depuis. Je me suis rangé à l'opinion de Boeck, qui pense qu'elle doit appartenir du genre *Lilljeborgia*. Elle est en effet très voisine de *L. pallida*, Sp. Bate, et n'en diffère guère que par sa petite taille, et par la forme de la main de ses deux premières paires de pattes thoraciques: sa coloration est à peu près semblable à celle de l'espèce voisine, la

partie antérieure du corps étant teintée de violet, tandis que la partie postérieure est du blanc rosé. Le telson, que l'auteur anglais n'a pu observer complètement, est fendu jusqu'à la base."

Fam. *Pardaliscidæ*.

Genus *NICIPPE*, Bruzelius, 1859.

Nicippe tumida, Bruzelius.

1859. *Nicippe tumida*, Bruzelius, Skand. Amphip. Gamm. p. 99, pl. iv. fig. 19.
 1868. *Nicippe tumida*, Norman, Ann. & Mag. Nat. Hist. ser. 4, vol. ii. p. 414, pl. xxi. figs. 4-6.
 1868. *Nicippe tumida*, Bate & Westw. Brit. Sessile-eyed Crust. vol. ii. p. 511.
 1872. *Nicippe tumida*, A. Boeck, De Skand. og Arkt. Amphip. p. 493.

Hab. Sound of Skye, 1866 (*A. M. N.*): *Mus. Norm.*

Distribution. South and West Norway (*G. O. Sars and Bruzelius*); Greenland (*H. J. Hansen*).

Fam. *Gammaridæ*.

Genus I. *AMATHILLA*, Bate & Westwood, 1863.

(=*Amathia*, Rathke, 1837, name in use.)

Amathilla Sabini (Leach).

1819. *Gammarus Sabini*, Leach, Appendix to Ross's First Voy. edit. ii. p. 178.
 1850. *Dexamine carinospinosa*, White, Cat. Brit. Crust. Brit. Mus. p. 49.
 1855. *Amathia carinata*, Bate, Brit. Assoc. Rep. p. 58.
 1855. *Amphithoe Moggridgei*, Bate, Ann. & Mag. Nat. Hist. ser. 2, vol. vii. p. 318, pl. x. fig. 10.
 1862. *Graia imbricata*, Bate, Cat. Amphip. Crust. Brit. Mus. p. 101, pl. xvi. fig. 4 (junior).
 1862. *Amathia Sabini*, id. ibid. p. 197, pl. xxxv. fig. 9.
 1862. *Amathia carinospinosa*, id. ibid. p. 199, pl. xxxv. fig. 11.
 1862. *Graia imbricata*, Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 152.
 1862. *Amathilla Sabini*, id. ibid. vol. i. p. 361.
 1870. *Amathilla Sabini*, A. Boeck, Crust. Amphip. bor. et arct. p. 136.
 1872. *Amathilla Sabini*, A. Boeck, De Skand. og Arkt. Amphip. p. 406.
 1874. *Amathilla Sabini*, Buchholz, Die zweite Deutsche Nordpolarfahrt 1869-70, vol. ii. p. 346, pls. viii. and ix. fig. 1.
 1884. *Amathilla Sabini*, Blanc, "Die Amphip. der kieler Bucht," Nov. Act. Leop. Akad. xlvii. no. 2, p. 73, pl. iii. figs. 78 and 79, and pl. iv. figs. 1-2.

As observed by Bate northern specimens greatly exceed in size those from southern localities. A Spitzbergen specimen in my collection measures (exclusive of antennæ) 37 millim. in length; large British examples measure 23 millim., while in a series from Cornwall the greatest length is only 12 millim.

The larger the specimen the more strongly marked are the sculpture and elevation of both dorsal spines and carina. In its younger stages there are no dorsal carinal teeth, the eye is small and nearly round, and the state is accurately represented by Bates's figure of *Graia imbricata*. But *Graia imbricata* is described and figured as having no secondary appendage to the antennules. The young always have such an appendage, though it is reduced to two articulations. My Northumberland specimens of *Graia imbricata*, taken by the late Mr. Alder and recorded by Bate, were *preserved dry*, which may account for the appendage having been overlooked; they were undoubtedly the young of the present species. It is not improbable that Mr. Webster's specimens were similarly preserved, as that gentleman sent to myself Amphipods only in that state. The fine figures of Buchholz may be consulted with advantage, and the difference in armature of pereopods, uropods, &c. there shown in the young and the adult have their warning lesson against the establishment of species on slight variations*.

Hab. Mostly taken in tide-pools among weeds; Shetland; Firth of Clyde; Durham and Northumberland coasts; the Humber; Devon and Cornwall (A. M. N.): *Mus. Norm.* Liverpool Bay (A. O. Walker).

Distribution. Spitzbergen (Lorén); Tromsö (Schneider); *Mus. Norm.* Greenland (Ross &c.); Siberia (Stuxberg); Norway (Rathke &c.); Sweden (Lilljeborg); Denmark (Meinert); Kiel (Blanc); Western France (Chevreaux &c.); Boulogne (Chevreaux); North-east America (Stimpson).

Genus II. MELPHIDIPPA, Boeck, 1870.

Mandibles with a short and very narrow palp, third joint shorter than the second. *First maxillæ* having the inner lamina moderately broad but not long, inner margin with numerous plumose setæ. *Maxillipeds* with narrow elongated palps; outer lamina short, broad, with a few small teeth on the inner margin. *Form* elongated, especially the pleon; segments of pleon armed on the hinder margin with teeth of

* British young examples in my collection 3-4 millim. long exactly agree with Buchholz's figure of that stage.

greater or less size. *Epimera* rather small. *Antennules* and *antennæ* long and slender, subequal in length. *Gnathopods* of both pairs long and slender; hands small, subchelate. *Pereopods* also long and slender, the three hinder pairs with the thighs only slightly dilated. *Last uropods* much longer than the two preceding pairs. *Telson* long, more or less deeply cleft. (*Boeck.*)

Melphidippa macra, Norman.
(Pl. X. fig. 14, and Pl. XII. figs. 4-7.)

1868. *Atylus macer*, Norman, Last Report Dredging Shetland, Brit. Assoc. Rep. p. 280.

1870. *Melphidippa longipes*, A. Boeck, Crust. Amphip. bor. et arct. p. 139.

1876. *Melphidippa longipes*, Boeck, De Skand. og Arkt. Amphip. p. 414, pl. xxiv. fig. 5.

Pleon having the posterior margin (Pl. X. fig. 14) of the first five segments serrated right across the back, with a large central hastate tooth, which increases in size from the first to the fourth segment, where it attains its greatest development. *First gnathopods* (Pl. XII. fig. 4) with wrist and hand subequal in length, somewhat fusiform, the former the broader; hand widest in the middle, front margin gently convex, no defined palm, finger half as long as the hand, slender. *Second gnathopods* (Pl. XII. fig. 5) with wrist and hand subequal, long, and narrow; hand narrow, fully four times as long as broad, margins subparallel, with four or five long setæ on dorsal and about five fascicles of shorter setæ on front margin; palm oblique, nail with a seta on outer and a group of about three setæ on inner margin. *Pereopods* excessively long and delicate, basos of posterior pairs (Pl. XII. fig. 6) very long, narrow, linear; meros and carpus both very long and slender (Pl. XII. fig. 7) and both longer than the long propodos; nail very slender, half as long as the propodos, with a single seta beyond the middle on the inner margin. *Uropods* very long, the last pair with peduncle and branches subequal, the total length equal to four segments of pleon (*i. e.* third to sixth). The *eye* is situated unusually low down and opposite the base of the antennæ. The antennules and antennæ are broken off in my specimens; Boeck says of the former "flagello accessorio brevissimo, fere obsoleto," and thus describes the telson:—"Appendix caudalis ultra medium fissa; laciniis in apice rotundatis." Length 5 millim.

Hab. St. Magnus Bay, Shetland, 60 fath., muddy bottom, 1867 (*A. M. N.*).

Distribution. Hardanger Fiord and Aalesund, Norway, 80-100 fath. (*G. O. Sars*); Christiania Fiord and Hangesund (*Boeck*).

The specimens found by me had all lost their antennules and antennæ, and, as genera were in 1868 understood, appeared to me to be most nearly allied to *Atylus*. *Melphidippa* belongs to the Gammaridæ, which family has a secondary appendage to the antennules. In *M. borealis*, *Boeck*, and *M. spinosa*, *Goës*, this appendage is well developed, consisting of two or three articulations; but it will be seen that *Boeck* states that in the present species it is rudimentary, "fere obsoleto;" indeed, his figure shows no trace of it.

Genus III. MEGALUROPUS, Norman, 1839.

Dr. P. P. C. Hoek, in his 'Crustacea Neerlandica,' has just described the type of this genus, and has used my name, which was MS. at the time he wrote, an act of the greater courtesy, inasmuch as I was unaware that he had met with the form, which, however, has been long known (twenty-five years) to myself and friends in Britain. Dr. Hoek has placed the genus in the family Pardaliscidæ, a position which in my opinion it cannot retain. The mouth-organs are quite different from those of *Pardalisca*. It does not, moreover, agree in the following very important characters:—"Antennæ superiores . . . articulis anterioribus apud marem coalitis et articulum magnum, intus fasciculis setarum instructum, junctis formantibus"—or with the following particulars:—"Pedes tertii et quarti paris [=first and second peræopods] validi, articulo tertio brevi. Pedes trium parium ultimorum . . . unguibus longis." Had Dr. Hoek been acquainted with the male or fully seen the mouth-organs he would not have assigned the genus to the Pardaliscidæ. His figures of the mouth-organs are very good as far as they go, except that the mandible was evidently seen by him in his dissection in an unsatisfactory position, while my own drawing also was defective as representing a broken specimen. I now give (Pl. X. figs. 15 and 16) illustrations of that member in two positions. The inner lamina (Pl. X. fig. 17) of the maxillipeds also escaped his observation, while the outer lamina and palp are accurately figured; this inner lamina is furnished at the extremity with about four blunt teeth, very similar in character to those of the outer lamina, and short setæ, and on the distal portion of the side are a few plumose setæ. The inner lamina of the first maxillæ is very small, rounded, and bearing two or three setæ.

Megaluropus agilis, Norman.
(Pl. X. figs. 15-17.)

1889. *Megaluropus agilis*, Norman, Ann. & Mag. Nat. Hist. ser. 6, vol. iii. p. 446, pl. xviii. figs. 1-10; Hoek, Crustacea Neerlandica, Tijdschrift der Nederlandsche Dierkundige Vereeniging, 2de Reeks, Dec. ii. p. 28, pl. vii. fig. 7, pl. viii. fig. 3, pl. ix. fig. 3.

Distribution. Holland (*Hoek*).

Female.—The second gnathopod of the female is well figured by Hoek. It is not ovate, as in the male, but narrow and not more than half the breadth of the wrist, widest and slightly angled below at half its length.

Male.—The figure given by me of the second gnathopod represents that of the male. The eye is considerably larger than in the female and passes upwards behind the base of the antennules. Antennules and antennæ longer, the two basal joints of the former and the three distal joints of the peduncle of the latter hirsute, with short stiff setæ. Antennules shorter than peduncle of antennæ, second joint longer than the first, third very short, subequal to first joint of flagellum; flagellum consisting of eight articulations, without calceola, but each articulation furnished with one of the long strap-formed membranaceous appendages or "olfactory papillæ" often met with in this situation; secondary appendage two-jointed, about as long as the first articulation of the flagellum. Antennæ with third and fourth joints stout and the latter and the fifth joint very long and subequal; flagellum of sixteen very long and slender articulations, without calceola or strap-shaped appendages.

Genus IV. ELASMOPUS, Costa, 1853.

Mandibles with third joint of palpus much larger than the second, curved and very setose. *Second maxillæ* having the inner lamina ovate, ending in setæ. *Antennules* longer than antennæ, the peduncle elongated. *Second gnathopods* longer than the first. *Peræopods* of last three pairs with the joints very broad and outspread. *Uropods* of last pair with branches of equal length and broad. *Telson* deeply cleft.

The chief points by which this genus is distinguished from *Mæra* are the very broad joints of the peræopods, and the branches of the last uropods being short, equal, and abruptly truncated apically.

Elasmopus rapax, Costa. (Pl. XI. figs. 1-8.)

1853. *Elasmopus rapax*, Costa, Crost. Amphip. del Regno di Napoli, p. 212, pl. iv. fig. 5, ♂.
 1855. *Gammarus brevicaudatus*, Bate, Rep. Brit. Assoc. p. 53, ♀.
 1862. *Megamæra brevicaudata*, Bate, Cat. Amphip. Crust. Brit. Mus. p. 228, pl. xl. fig. 2.
 1862. *Megamæra brevicaudata*, Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 409, ♀.
 1866. *Mæra brevicaudata*, Heller, Amphip. des Adriat. Meeres, p. 42, pl. iii. figs. 27, 28, ♂ ♀.
 1870. *Elasmopus latipes*, Boeck, Crust. Amphip. bor. et arct. p. 132.
 1876. *Elasmopus latipes*, Boeck, De Skand. og Arkt. Amphip. p. 393, pl. xxiv. fig. 1, ♂: 1887. Chevreux, Crust. Amphip. du Sud-ouest de la Bretagne, p. 20, and woodcut 3, ♂.
 1888. *Mæra rapax*, Th. Barrois, Cat. des Crustacés marins recueillis aux Açores, p. 39, pl. iv. figs. 1-4, and woodcuts, ♂ ♀.

Hab. In my 'Shetland Dredging Report' this species is recorded thus:—"A specimen, determined by Mr. Bate, dredged in 4 fathoms, Brassay Sound, 1861." That specimen I do not remember to have ever seen; it certainly is not in my collection now, nor have I seen any British specimen. On Bate and Westwood's authority we have the following:—Plymouth (*Bate*); Moray Firth (*Rev. G. Gordon*).

Distribution. Adriatic (*Heller*): *Mus. Norm.* Naples (*Costa*); Azores (*Barrois*); South-west of France (*Chevreux*); Norway? (*Boeck*).

Chevreux tells us that *Elasmopus rapax* is a commensal of *Maia squinado*, and states that in some places it is more abundant on that crab than its well-known companion *Isœa Montagu*. As, however, *Maia squinado* is not known in either the Moray Firth, Shetland, or Norway, *Elasmopus*, if found in these localities, must there forego the friendship.

I give figures taken from Adriatic specimens which will for the most part speak for themselves. But it is desirable to call attention to the variation in form of the hand in the second gnathopod of the male. I give figures (Pl. XI. figs. 3-5), all to the same scale, of this organ in three specimens of different size. The finger closes, as has been described by Barrois, into a hollow on the inner face of the hand, at the proximal end of which is a tooth-process (*a*). This hollow, it will be seen in the youngest specimen, is ovoid, and the hand itself is nearly oblong; with increasing age the hand becomes more pyriform, narrowing distally, the hollowed space longer and narrower, and the portion of the hand anterior to the commencement of the hollow shorter in proportion to that beyond it. As regards the spines and tubercles, in none of my specimens is the tooth-process (*a*) in

such a situation that it can be seen (as in Barrois's figured specimen) when the hand is viewed from the outside, and Costa's figure might very fairly represent the external aspect of the hand of such an example as that figured here as fig. 4, provided the tubercle (*c*) was not quite so prominent. The tubercle (*b*) is present in all three specimens and is tipped with short blunt spines; but the tubercle (*c*) is not developed in fig. 3; is small in the next size (fig. 4), but is largely developed in the most mature form (fig. 5).

A comparison of these figures with each other and with those given by other authors will show that there must be considerable latitude allowed for variation in the exact armature of this limb; the finger increases in comparative length with age and is more strongly bent in the younger specimens than in the mature.

The hand of the second gnathopods (Pl. XI. fig. 2) in the female is more regularly ovate, the finger closes on the inner face, but there is no groove, the finger impinging against a few spines on the surface.

The species is readily known from other British Amphipods by the characters of the telson (fig. 8), the remarkable last uropods (fig. 7), and the broadly expanded joints of the hinder peræopods (fig. 6).

Stebbing has described two more species of this genus in the 'Challenger' Report. The *E. subcarinatus*, Haswell, may at once be distinguished by the very different telson, and *E. delaplata*, Stebbing, by the difference in the last uropods. The general form of the second gnathopod is remarkably alike in the three species.

The illustrations of this species are to many scales of enlargement. The peræopod (fig. 6) is the least magnified; the illustrations of second gnathopods (♂) (figs. 3, 4, 5) are more magnified; those of the gnathopods of female and of last uropods (figs. 1, 2, 7) are more magnified than the last, and the telson (fig. 8) is the most enlarged of all.

Genus V. *MÆRA*, Leach, 1814.

(= *Megamæra*, Bate, *Ceradocus*, Costa, and *Leptothoë*, Stimpson.)

1. *Mæra othonis* (H. Milne-Edwards).

1830. *Gammarus othonis*, H. Milne-Edwards, Ann. des Sc. Nat. vol. xx. p. 373, pl. x. fig. 11, ♀.

1847. *Gammarus longimanus* (Leach, MS.), Wm. Thompson, Ann. & Mag. Nat. Hist. ser. 1, vol. xx. p. 242, ♂.

1847. *Gammarus elongatus*, Frey and Leuckart, Beitr. zur Kennt. wirbell. Thiere, p. 160.

1859. *Gammarus laevis*, Bruzelius, Skand. Amphip. Gamm. p. 60, pl. ii. fig. 10, ♂ ♀.
 1863. *Megamæra longimana*, Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 403, ♂.
 1863. *Megamæra othonis*, iid. ibid. p. 405, ♀.
 1868. *Mæra longimana*, Norman, Last Report Dredging Shetland, Brit. Assoc. Rep. p. 284, ♂ ♀.
 1876. *Mæra longimana*, Boeck, De Skand. og Arkt. Amphip. p. 382, ♂ ♀.

The *Gammarus othonis*, M.-Edwards, and *Gammarus longimanus*, Leach, MS., are female and male of one species, and the first name has precedence.

Hab. Shetland; the Minch; Sound of Skye; Oban; Loch Fyne; Firth of Clyde, many places; Northumberland and Durham coasts; Guernsey; Roundstone, Ireland (*A. M. N.*); Banff (*T. Edward*); North-east Scotland (*Dr. Day*): *Mus. Norm.* Salcombe, Devon (*Stebbing*); Liverpool Bay (*G. H. Fowler*).

Distribution. Bohuslän (*Bruzelius*); Moss, Norway (*Boeck*); Western France (*M. Dolfuss*, fide *Chevreaux*); Marsilles (*Marion*); Heligoland (*Frey and Leuckart*).

2. *Mæra grossimana* (Montagu).

1804. *Cancer* (*Gammarus*) *grossimanus*, Montagu, Linn. Trans. vol. ix. pl. iv. fig. 5.
 1814. *Mæra grossimana*, Leach, Edinb. Encyclop. vol. vii. p. 403.
 1830. *Gammarus Impositii*, H. Milne-Edwards, Ann. des Sc. Nat. vol. xx. p. 368.
 1862. *Mæra grossimana*, Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 350, ♂.
 1866. *Mæra Donatoi*, Heller, Beitr. Amphip. des Adriatischen Meeres, p. 41, pl. iii. fig. 26, ♀.
 1885. *Mæra Donatoi*, Carus, Prodr. Faunæ Mediterraneæ, p. 414, ♀.
 1885. *Mæra grossimana*, id. ibid. p. 414, ♂.
 1888. *Mæra grossimana*, Th. Barrois, Cat. des Crust. marins rec. aux Açores, p. 38, pl. iii. fig. 7, ♀.

Prof. Th. Barrois has rightly pointed out that the *Mæra Donatoi*, Heller, is the female of this species. The female, as found in our seas, exactly accords with it. That sex differs from the male chiefly in the form of the hand of the second gnathopods, which widens rather more distally and has the palm less irregular, being simply crenulated throughout and edged with small spines (as in male); the strong finger is similar to that of the male in being furnished on the upper margin with a row of setæ, but is without cilia on the lower margin.

Hab. So far as I am aware *Mæra grossimana* is confined to the southern part of our seas, Jersey, Guernsey, and Herm;

Falmouth, Torbay, Salcombe, and Starcross, Devon (A. M. N.).

Distribution. Adriatic (*Claus*) : *Mus. Norm.* Many places in the Adriatic (*Grube and Heller*) ; Marseilles (*Marion*) ; Western France and Azores (*Th. Barrois*).

Mr. Thomas Scott ('Sixth Annual Report Fishery Board of Scotland,' 1888, p. 239) has recorded this species from the Firth of Forth ; but he subsequently sent me the specimen for examination, and it proved to be *M. Loveni*.

3. *Mæra Batei*, Norman.

1868. *Mæra Batei*, Norman, Ann. & Mag. Nat. Hist. ser. 4, vol. ii. p. 416, pl. xxii. figs. 1-3.

1868*. *Megamæra multidentata*, Bate & Westw. Brit. Sessile-eyed Crust. vol. ii. p. 515.

Hab. The types were dredged off St. Martin's Point, Guernsey, in 1865 (A. M. N.) ; off Puffin Island, Liverpool Bay (*G. H. Fowler*!).

Distribution. Off Lorient, Western France (*Chevreaux*).

4. *Mæra semiserrata* (Bate).

1862. *Megamæra semiserrata*, Bate, Cat. Amphip. Crust. Brit. Mus. p. 226, pl. xxxix. fig. 6 ; Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 401.

1869. *Mæra semiserrata*, Norman, Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 359.

Hab. Oban, 1877 ; Salcombe, Devonshire, 1875 ; Roundstone, Ireland, 1874 ; off St. Martin's Point, Guernsey, 1865 (A. M. N.) ; Clifden Bay, Connemara (*G. S. Brady*) : *Mus. Norm.* Cumbræ, Scotland (*D. Robertson*!).

Distribution. Western France (*Chevreaux*).

5. *Mæra Loveni* (Bruzelius).

1859. *Gammarus Loveni*, Bruzelius, Skand. Amphip. Gamm. p. 59, pl. ii. fig. 9.

1865. *Gammarus Loveni*, Goës, Crust. Amphip. maris Spetsb. p. 14.

1862. *Mæra Loveni*, Bate, Cat. Amphip. Crust. Brit. Mus. p. 193, pl. xxxv. fig. 1.

1868. *Mæra Loveni*, Norman, Ann. & Mag. Nat. Hist. ser. 4, vol. ii. p. 416, pl. xxi. figs. 11, 12.

1870. *Mæra Loveni*, A. Boeck, Crust. Amphip. bor. et arct. p. 128.

1876. *Mæra Loveni*, A. Boeck, De Skand. og Arkt. Amphip. p. 378.

Form long and slender. *Epimera* very short, rounded

* The part in which this description was published, though dated 1868, was not published until 1869, and contains at p. 530 a reference to the previously published *Mæra Batei*.

below, the first pointed in front. *Pleon* with dorsal margins smooth, not spined; second and third segments with infero-posteal angles produced into a spine-like point. *Antennules* with first two joints of peduncle remarkably long, the second slightly longer than the first, third not one third the length of the second; flagellum of 17-24 articulations, secondary appendage five-jointed, subequal in length to four joints of flagellum. *Antennæ* about equal in length to the peduncle of the antennules; fourth joint longer than fifth; flagellum short, subequal in length to last joint of peduncle. *First gnathopods* with subtriangular wrist; hand subovate, wider at the extremity than at the base, subequal in length to the wrist, palm convex, scarcely defined; finger strong, slightly curved, simple, with setæ on the outer and cilia on the inner margin. *Second gnathopods* having the meros produced below into a spine-point; wrist subtriangular, widening much distally; hand of moderate size, subquadrate, length to breadth as 5 to 3, widening slightly to the palm; palm only very little oblique, defined by a long spine, crenulated or toothed, and edged with a few spinules. *Peræopods* all slender, with very long linear thighs, which in all the limbs are the longest joints; thighs of last three pairs gradually increasing in breadth, but that of last pair about four times as long as broad, its margins with distant serrulations; nails of moderate length and acute. *Last uropods* with very long lanceolate branches, about three times the length of the peduncle. *Telson* cleft to two thirds its length, cleft widely open, each apex ending in two spine-points and a cilium. Length 18-22 millim.

Hab. Sound of Skye, 1866 (*A. M. N.*); Loch Fyne, dredged by the 'Medusa,' the vessel of the Scotch Marine Station, 1888 (*D. Robertson*); *Mus. Norm.* Taken by 'Medusa' off the lighthouse, Little Cumbrae, Firth of Clyde, in 55-60 fath., and off the Isle of Arran, N.B., in 80 fath., on soft mud (*D. Robertson*!); one specimen among material dredged a little west of Inchkeith, Firth of Forth, 1887 (*T. Scott*!).

Distribution. Greenland (*Hansen*); Advent Bay, Spitzbergen, 20 fath. (*Smitt*, fide *Goës*); Bohuslän, Sweden (*Locin*, fide *Goës*); Denmark (*Meinert*); West Norway (*Danielssen*).

Genus VI. GAMMARELLA, Bate, 1857.

Gammarella brevicaudata (H. Milne-Edwards).

1850. *Gammarus brevicaudatus*, H. Milne-Edwards, Ann. des Sc. Nat. vol. xx. p. 369, ♂ ♀.

1853. *Gammarus punctimanus*, A. Costa, Ricerche sui Crost. Amphip. del Regno di Napoli, p. 222, pl. iii. fig. 6, ♂.
 1853. *Gammarus obtusunguis*, id. ibid. p. 219, pl. iii. fig. 8, ♂ junior.
 1853. *Amphithoë semicarinata*, id. ibid. p. 210, pl. iii. fig. 3, ♀.
 1857. *Gammarella orchestiformis*, Bate, Ann. & Mag. Nat. Hist. ser. 2, vol. xix. p. 143, ♂.
 1862. *Gammarella brevicaudata*, Bate, Cat. Amphip. Crust. Brit. Mus. p. 180, pl. xxxii. fig. 8, ♂; Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 330, ♂.
 1862. *Gammarella Normani*, id. ibid. vol. i. p. 333, ♀.
 1874. *Gammarella brevicaudata*, Stebbing, Ann. & Mag. Nat. Hist. ser. 4, vol. xiv. p. 13, pl. ii. fig. 3 a-g, ♂ ♀.
 1886. *Gammarella longicornis*, Kœhler, Faun. litt. des Iles Anglo-Normandes, p. 60, ♂ & ♀.
 1888. *Gammarella brevicaudata*, Th. Barrois, Cat. des Crust. marins aux Açores, p. 47, pl. iv. figs. 5-12, ♂ ♀.

Hab. Jersey; Falmouth (*A. M. N.*); Torquay (*Stebbing*): *Mus. Norm.* Salcombe Harbour, Devon (*Stebbing*); off Hunterston, Firth of Clyde (*D. Robertson*).

Distribution. Adriatic (*Heller*); Azores; Northern and Western France (*Th. Barrois*); St. Lunaire and Arcachon, *M. Dolfuss* (*Chevreaux*).

In young males the hand of the second gnathopod differs markedly from that of the adult, especially in the finger, which is not more than half the length of the hand.

This is a southern form, not as yet recorded from any station north of the Firth of Clyde.

Genus VII. CHEIROCRATUS, Norman, 1865.

(Nat. Hist. Trans. Northumberland and Durham, vol. i. (1865) p. 12.)

1. *Cheirocratus assimilis* (Lilljeborg). (Pl. X. fig. 13, and Pl. XI. fig. 11.)

1851. *Gammarus assimilis*, Lilljeborg, Öfv. af Kongl. Vet.-Akad. Förh. 1851, p. 23.
 1853. *Gammarus assimilis*, id. ibid. 1853, p. 445.
 1859. *Gammarus assimilis*, Bruzelius, Skand. Amphip. Gamm. p. 58.
 1862. *Gammarus assimilis*, Bate, Cat. Amphip. Crust. Brit. Mus. p. 214.
 1865. *Cheirocratus mantis*, Norman, Nat. Hist. Trans. Northumb. and Durham, vol. i. p. 13, pl. vii. figs. 14, 15, ♂.
 1868. *Cheirocratus mantis*, Bate & Westw. Brit. Sessile-eyed Crust. vol. ii. p. 513, ♂.
 1870. *Cheirocratus assimilis*, A. Boeck, Crust. Amphip. bor. et arct. p. 134.
 1876. *Cheirocratus assimilis*, A. Boeck, De Skand. og Arkt. Amphip. p. 398, pl. xiv. fig. 3.

The telson (Pl. X. fig. 13) has the central portion of the extremity of each half concave, while the corners are pro-

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jected in tooth-like form; from the concavity spring three spines, of which the central is the longest.

The female is very like the same sex of *C. Sundevalli*; but the transverse rows of setæ of the wrist of second gnathopod (Pl. XI. fig. 11) appear to want the hamate character so conspicuous in the adult and more or less evident in the young of the allied species.

Hab. Off Holy Island, on the Northumberland coast, 1864* (*A. M. N.*); off coast of Aberdeen (*the late Mr. R. Dawson*); off Farland Point, Isle of Cumbræ, 20 fath. (*A. M. N. and D. Robertson, 1888*): *Mus. Norm.*

Distribution. Florø, Norway, 45–70 fath. (*A. M. N.*): *Mus. Norm.* Bohuslän, Sweden (*Bruzeli*); Norway, at Mandal (*Boeck*); Christiansund (*Düben*); Arcachon, France, *M. Dolfuss*, Luc-sur-Mer, *M. Topsent*, and Croisic (*Chevreux*).

2. *Cheirocratus Sundevalli* (Rathke). (Pl. XI. figs. 9, 10, and Pl. XII. figs. 1–3.)

1843. *Gammarus Sundevalli*, Rathke, Beiträge zur Fauna Norwegens, p. 65, pl. iii. fig. 2, ♂.
 1853. *Gammarus Sundevalli*, Lilljeberg, Kongl. Vet.-Akad. Handl. p. 454.
 1859. *Gammarus Sundevalli*, Bruzelius, Skand. Amphip. Gamm. p. 57.
 1862. *Gammarus Sundevalli*, Bate, Cat. Amphip. Crust. Brit. Mus. p. 213, pl. xxxviii. fig. 1, ♂.
 1862. *Protomedea Whitei*, id. ibid. p. 169, pl. xxxi. fig. 3, ♀.
 1862. *Liljeborgia shetlandica*, Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 206, ♂.
 1862. *Protomedea Whitei*, id. ibid. p. 300, ♀.
 1868. *Protomedea* (?) *Whitei*, Norman, Last Report Dredging Shetland Isles, Brit. Assoc. Rep. p. 283, ♀ & ♂.
 1870. *Cheirocratus Sundevalli*, A. Boeck, Crust. Amphip. bor. et arct. p. 133.
 1876. *Cheirocratus Sundevalli*, A. Boeck, De Skand. og Arkt. Amphip. p. 396, pl. xxiv. fig. 2, ♂ ♀.
 1874. *Liljeborgia Normanni*, Stebbing, Ann. & Mag. Nat. Hist. ser. 4, vol. xiv. p. 10, pl. i. fig. 1 a–c, ♂.
 1876. *Liljeborgia Normanni*, id. ibid. vol. xvii. p. 76, pl. v. fig. 4, ♂.
 1880. *Cheirocratus brevicornis*, Hoek, Carcinologisches (Tijdschr. d. Ned. Dierk. Vereen. vol. iv.), p. 142, pl. x. figs. 10–13, ♂.
 1884. *Cheirocratus brevicornis*, Blanc, Die Amphipoden der Kieler Bucht, p. 72, pl. viii. figs. 76, 77, ♂ ♀.

Great confusion has existed respecting this species. This confusion has arisen from three causes:—first, the separation of the sexes; secondly, the insufficiency of the earlier figures

* Mr. Robertson, in his 'Contrib. to Cat. of Amphipoda and Isopoda of the Firth of Clyde,' has by an error thought that the Holy Island off which I took this species was the island so named in the Firth of Clyde.

and descriptions; thirdly, from some of the figures in Boeck's plate xxiv. having been wrongly lettered.

Boeck's plate xxiv. fig. 2 *k*, has nothing to do with the present species, and probably ought to have been lettered 4 *k*, as representing, though imperfectly, a second gnathopod of the female of *Melita palmata* (or possibly, from the shortness of the wrist, the second gnathopod of *Melita pellucida*, (L. O. Sars); the 4 *k* should perhaps be 2 *k*, and intended to represent the second gnathopod of the immature male of *Cheirocratus Sundevalli*.

While all the other general characters are nearly similar in the two sexes of *Cheirocratus Sundevalli*, the second gnathopods are widely different. That of the male (Pl. XII. figs. 1-3) has a large and remarkably ovate hand; this hand is densely clothed with long setæ towards the distal extremity of the upper margin, and the lower side (not the margin only) is also densely setose; but the peculiarity of the hand is that the strongly curved finger, which is half the length of the hand, does not close against the margin, but upon the middle of the inner face of the hand, where there are three or four spines, against which it in some measure closes, the position being such that when the hand is viewed from the outside the closed finger is completely hidden*. This hand has been well figured by Hoek and Blanc, but not accurately by any previous authors; and I give illustrations of three forms of it.

The second gnathopod in the female (Pl. XI. fig. 10) is very like the first gnathopod (fig. 9), but the finger is straightly porrected and the face of the wrist is furnished with numerous transverse rows (about seven to nine in number) of hooked setæ; these setæ are confined to the front half of the limb, and the innermost seta of each transverse row is very short, while each seta thence to the margin increases in length in most regular gradation, the outermost and longest being simple (*i. e.* not hooked).

The hinder segments of the pleon with their three dorsal teeth and intervening long erect spines are well represented by Stebbing (pl. v. fig. 4), Hoek (pl. x. fig. 13), and Blanc (fig. 77). A glance at this portion of the body will suffice to distinguish this species from all others except its congener *C. assimilis*.

Hab. Outer Skerries Harbour, 2-5 fath.; off these same islets in 40 fath., and also in Balta Sound, Shetland; the

* In the immature male (fig. 3) the finger is shorter and thicker in proportion to its length and closes on the palm instead of on the face, while the lateral spines are not developed.

Minch; Sound of Skye; Loch Fyne; Firth of Clyde, many places; off Holy Island, Northumberland; Salcombe, Devon; Guernsey; Roundstone, Ireland (*A. M. N.*); Banff (*T. Edward*); *Mus. Norm.* Kirkwall Bay, Orkney (*D. Robertson*).

Distribution. Florö, Norway (*A. M. N.*); *Mus. Norm.* Off west coast of Schleswig-Holstein (*Metzger*); Kiel (*Blanc*); Holland (*Hoek*); Denmark (*Meinert*); Bohuslän (*Bruzelius*); Norway, many places (*Rathke &c.*); St. Lunaire, France, *M. Dolfuss* (*Chevreaux*); Bay of Biscay (*Chevreaux*).

Genus VIII. MELITA, Leach, 1813.

1. *Melita palmata* (Montagu).

1806. *Cancer* (*Gammarus*) *palmatus*, Montagu, Trans. Linn. Soc. vol. vii. p. 69, pl. vi. fig. 4.

1813. *Melita palmata*, Leach, Edinb. Encycl. vol. vii. p. 403.

1840. *Gammarus Dugesii*, M.-Edwards, Hist. des Crust. vol. iii. p. 54.

1853. *Melita palmata*, Costa, Rec. sui Crust. Amphip. del Regno di Napoli, p. 192, pl. ii. fig. 4.

1857. *Gammarus inaequimanus*, Bate, Ann. & Mag. Nat. Hist. ser. 2, vol. xix. p. 145.

1862. *Melita palmata*, Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 337.

1876. *Melita palmata*, Boeck, De Skand. og Arkt. Amphip. p. 388, pl. xxiv. fig. 4.

1878. *Melita palmata*, G. Zaddach, Die Meeres-Fauna an der preussischen Küste, p. 25, woodcuts.

Hab. Firth of Clyde; Guernsey; Starcross, Devon (*A. M. N.*); Polperro, Cornwall (*Laughlin*); *Mus. Norm.* Banff (*T. Edward*); Rhos and Colwyn Bays, North Wales (*A. O. Walker*); Ilfracombe and Seaton, Devonshire (*Parfitt*).

Distribution. Adriatic (*Heller*); *Mus. Norm.* Naples (*Costa*); Baltic (*Zaddach*); Sweden (*Lilljeborg*); Norway (*Boeck*); Denmark (*Meinert*); Northern France (*Guerne*); Western France (*Milne-Edwards*, *Bouchard-Chantereaux*, &c.); Portugal and Azores (*Chevreaux*).

The form of the hand in the first gnathopods of the male is very remarkable, the finger being peculiar as springing from a deep hollow in the middle of the wide extremity of the hand. It is well figured by Zaddach (*l. c.*).

2. *Melita obtusata* (Montagu).

1815. *Cancer* (*Gammarus*) *obtusatus*, Montagu, Trans. Linn. Soc. vol. ix. p. 5, pl. ii. fig. 7.

1830. *Gammarus podager*, Milne-Edwards, Ann. des Sci. Nat. vol. xx. p. 369.
 1840. *Amphithoe obtusata*, M.-Edwards, Hist. des Crust. vol. iii. p. 83.
 1852. *Gammarus maculatus*, Lilljeborg, Öfv. af Kongl. Vet.-Akad. Förh. p. 10.
 1859. *Gammarus obtusatus*, Bruzelius, Skand. Amphip. Gamm. p. 55.
 1862. *Melita obtusata*, Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 341, ♂ (figure but not description).
 1862. *Melita proxima*, iid. ibid. p. 334 (var. ♂).
 1862. *Megamæra Alderi*, iid. ibid. p. 407, ♀.
 1862. *Melita podager*, Bate, Cat. Amphip. Brit. Mus. p. 184, pl. xxxiii. fig. 5.
 1868. *Melita obtusata*, Norman, Last Report Dredging Shetland, Brit. Assoc. Report, p. 284.
 1872. *Melita obtusata*, Boeck, De Skand. og Arkt. Amphip. p. 386.
 1880. *Melita obtusata*, Hoek, Carcinologisches, p. 140, pl. x. figs. 8, 9.

In the 'Last Report of Dredging among the Shetland Isles' I drew attention to the facts that *obtusata* and *proxima* were two forms of the male, and that *Megamæra Alderi* was the female of this species; and it is not without some hesitation that I retain even the following species *M. gladiosa* as distinct from the present. If it is to be kept distinct some corrections must, I take it, be made in the synonymy.

M. obtusata is characterized by several forms, those named being the type, which has a single dorsal tooth upon the second and third segments of pleon, "segmenta postabdominis secundum et tertium in medio margine posteriore dentibus singulis armata; segmenta quartum et quintum dentibus binis aut ternis instructa" (Boeck), and the variety *proxima*, in which the dorsal teeth of second and third segments are absent. Judging from Bate and Westwood's figure (which is, however, at any rate unsatisfactory as regards the fourth and fifth segments) Montagu's type appears to be the first form. When we come to examine further, however, there appears to be confusion. The figure in the Cat. Amphip. Brit. Mus. must have been taken from Bate's Plymouth specimen, and represents three teeth or divisions of the second and third segments, while in the description no mention is made of the exact number of teeth. "Second, third, fourth, and fifth segments of the pleon have small teeth upon the postero-dorsal margin." On the other hand, in the Hist. Brit. Sessile-eyed Crust. the Plymouth specimen and not Montagu's is described, and we are told "the second, third, fourth, and fifth segments of the tail are furnished at the posterior margin, on the back, with a central and two small lateral denticles or tooth-like processes." It would seem therefore that the Plymouth specimen thus figured in the Catalogue and described in Brit. Sessile-eyed Crust.

must be referred to the following species if that form is to retain specific rank.

In both *obtusata* and *gladiosa* the armature of the fourth segments is alike and much more constant than that of the other segments. This segment is furnished with three dorsal teeth, the laterals considerably exceeding the central in size: the fifth segment varies greatly in armature; sometimes there are two teeth, one behind the other on each side, the posterior being the larger; sometimes one tooth and an articulated spine; sometimes no tooth and only the spine; rarely smooth, without either tooth or spine. The armature of the second and third segments also varies greatly, sometimes the second has three teeth, the third one, a rare condition; sometimes one on the second and one on the third, when it is typical *obtusata*; sometimes one on the second, but none on the third; sometimes these two segments are unarmed, when it is the typical *proxima* ♂ and *Abderi* ♀. I have never met with a specimen in which the second segment has been unarmed, and the third armed, though probably such a variety will sometimes occur.

The hinder corner of the epimera of the third segment is much produced, acute, and upturned, and either quite smooth on the margins or with very few serrations.

Hab. Shetland; the Minch; Firth of Clyde; Northumberland; Roundstone, Ireland: *Mus. Norm.* Liverpool Bay (*G. H. Fowler*).

Distribution. South and West Norway (*Boeck*); Sweden (*Bruzelius*); Denmark (*Meinert*); Holland (*Hoek*); Northern France (*Guerne*); Western France (*Chevreaux &c.*).

3. *Melita gladiosa*, Bate.

1862. *Melita gladiosa*, Bate, Cat. Amphip. Brit. Mus. p. 185, pl. xxxiii. fig. 6, ♂ (example figured abnormal).

1862. *Melita obtusata*, Bate, l. c. p. 183, pl. xxxiii. fig. 3 (partim), ♂.

1862. *Melita gladiosa*, Bate & Westw. Brit. Sessile-eyed Crust. p. 346, ♂.

1862. *Melita obtusata*, iid. ibid. p. 341 (description, not figure).

1876. *Melita gladiosa*, Stebbing, Ann. & Mag. Nat. Hist. ser. 4, vol. xvii. p. 77, pl. iv. fig. 2, ♀.

For notes on synonymy see the last species.

M. gladiosa is usually characterized by three largely developed teeth on the first four segments of the pleon, but sometimes the first is without teeth*. These teeth are of large size except that the central tooth of the fourth segment is

* The figure of *M. obtusata* given in Cat. Amphip. Brit. Mus. appears to have been taken from such a specimen of *M. gladiosa*.

much smaller. The fifth has four teeth—two on each side—of which the exterior is the larger, and between them an articulated spine; the sixth segment sometimes bears a pair of small tubercles or minute spines at the base of the telson. The infero-posteal angle of the epimera of the third segment of the pleon is greatly produced, upturned, very acute, and strongly toothed on both margins.

The armature of the earlier segments of the pleon is subject to some variation. Bate's figure of the type in *Cat. Amphip. Brit. Mus.* represents a remarkably abnormal form, the first segment of the pleon having five and the second seven teeth; but much latitude must be allowed for variation in the dorsal armature of members of this genus.

In the female the second gnathopods are nearly similar in form to the first, but larger, and it is without the fur which clothes the front margin of meros, carpus, and hand in the first pair.

Hab. Salcombe, Devon; Falmouth; Guernsey (*A. M. N.*); North-east Scotland (*Dr. Day*); *Mus. Norm.* Plymouth (*Parfitt*).

Distribution. Boulogne (*Paris Museum*); Western France (*Chevreaux*); Azores (*Th. Barrois*).

4. *Melita dentata* (Kröyer).

1842. *Gammarus dentatus*, Kröyer, *Nat. Tidskr.* vol. iv. p. 159.

1854. *Gammarus purpuratus*, Stimpson, *Invert. of Grand Manan*, p. 55.

1855. *Gammarus Kröyeri*, Bell, *App. to Belcher's Last Arctic Voyage*, p. 405, pl. xxxiv. fig. 4.

1859. *Gammarus dentatus*, Bruzelius, *Skand. Amphip. Gamm.* p. 61.

1862. *Megamæra dentata*, Bate, *Cat. Amphip. Brit. Mus.* p. 225, pl. xxxix. fig. 4.

1862. *Megamæra Kröyeri*, id. *ibid.* p. 229, pl. xl. fig. 4.

1865. *Gammarus dentatus*, Goës, *Crust. Amphip. Gamm. maris Spetsb.* p. 14, fig. 29 (not fig. 29').

1870. *Melita dentata*, Boeck, *Crust. Amphip. bor. et arct.* p. 131.

1872. *Melita dentata*, Boeck, *De Skand. og Arkt. Amphip.* p. 389, pl. xxiii. fig. 10.

1884. *Melita dentata*, S. Schneider, *Crust. og Pycnogon. indsamlede i Kvænangsfjorden, 1881*, p. 113.

Antennules: first joint with a long spine at the lower side of the distal margin, second joint much more slender and longer than first; third one third length of preceding and equal to two first of flagellum; accessory flagellum of four long joints. Antennæ shorter than antennules, but peduncle longer than that of antennæ, its last two joints subequal; flagellum about equal to last joint of peduncle in length.

First gnathopods having meros rather longer than broad, below well rounded and covered with dense fur, and with a fascicle of setæ at the extremity; wrist fully twice as long as meros, upper margin with transverse rows of simple setæ, the distal portion between the two distal rows of setæ densely clothed with short fur, the face of the joint below with two or three transverse rows of setæ; lower margin with numerous fascicles of setæ; hand regularly ovate, much shorter than wrist, upper margin having the distal portion with transverse rows of setæ; lower margin with fascicles of setæ, the portion which forms the palm terminated by a small tooth-like process, very minutely crenulated and furnished with a series of little spinules; finger falcate, its inner margin divided up into minute teeth of peculiar form, widening in the middle and apiculate. All the setæ of the limb are simple except that mixed in the two distal fascicles of setæ on the lower margin are a few flattened setæ with pectinated edges.

Second gnathopods of moderate size; meros small, produced distally below to an acute point; carpus triangular, short, sparingly setose on the margins; hand nearly twice as long as wrist, of nearly equal width to the commencement of the palm (which occupies two fifths of the length), thence tapering to extremity; margins sparingly setose; palm defined at its commencement by a tooth-like process, slightly denticulated, one denticle near base of finger larger than the rest, set with a few long setæ and spinules; about four spines on side of the hand just within the palm; a row of equidistant cilia on inner and of setæ on outer margin of the nail.

Thigh of last pereopods oblong, nearly parallel-sided, but the widest part at the base, distally truncate behind, front margin set with short spines, hind margin with distant crenulations, a cilium occupying each crenulation.

Epimera of the anterior segments of body with a single tooth on the infero-posteal corner. Third segment of pleon acutely produced infero-posteally and bent upwards.

All the segments of the pleon are furnished on the dorsal margin with numerous teeth; but their exact number is subject to considerable variation, as has been noticed in previous remarks to be the case in *M. obtusata* and *M. gladiosa*. In the specimen here described from Cullercoats they are: first segment five, second seven, third nine, fourth five, fifth three and two articulated spines.

The British examples measure 11 millim. exclusive of antennæ.

A large Greenland specimen taken in 1876 by H.M.S. 'Valorous' measures 22 millim. exclusive of antennæ, and

corresponds most closely in all its characters with those taken in our seas, except that the palm of the first gnathopods is more defined, being slightly hollowed, and the hand of the second gnathopods is a little larger in proportion to the wrist. All the microscopic characters of setæ, spines, fur, &c. exactly agree; but in consequence of the coarser growth of the limb the characters of armature of the inside of the finger of first gnathopods cannot be so exactly determined. The dorsal armature in this specimen is:—first segment (by accident lost in dissection); second eleven teeth; third eleven teeth; fourth seven, the central very large; fifth three, central large, and two articulated intervening spines.

In specimens received from Tromsø the dorsal spines are larger in size proportionately than in examples which I have had the opportunity of examining from other localities. The larger the number of spines on a segment the smaller the size those spines attain.

Hab. Three specimens taken from fishing-boats, Cullercoats, Northumberland (*A. M. N.*): *Mus. Norm.*

Distribution. Greenland, in lat. $66^{\circ} 59'$ N., long. $55^{\circ} 27'$ W., 57 fath., 'Valorous' Exped. 1876; off Halifax, Nova Scotia (*S. I. Smith*); Tromsø (*S. Schneider*); Sweden (*Lovén*): *Mus. Norm.* Iceland (*Torell*); Spitzbergen (*Goës*); Grand Manan (*Stimpson*); Labrador (*Packard*); West Norway, at Haugesund (*Boeck*); Denmark (*Meinert*).

Genus IX. GAMMARUS, Fabricius, 1776.

1. *Gammarus locusta* (Linn.). (Pl. XII. fig. 11.)

- 1767. *Cancer locusta*, Linné, Syst. Nat. edit. xii. p. 1055.
- 1780. *Oniscus pulex*, Fabricius, Fauna Grœnlandica, p. 254.
- 1820. *Gammarus arcticus*, Scoresby, Account of the Arctic Regions, vol. i. p. 451, pl. xvi. fig. 4.
- 1824. *Gammarus boreas*, Sabine, Suppl. Appendix Parry's Voyage, p. 229.—1862. Bate, Cat. Amphip. Brit. Mus. p. 213, pl. xxxvii. fig. 10.
- 1830. *Gammarus ornatus*, H. Milne-Edwards, Ann. des Sci. Nat. xx. p. 372, pl. x. figs. 9, 10.—1840. Hist. Nat. des Crust. vol. iii. p. 47.—1862. Bate, Cat. Amphip. Brit. Mus. p. 212, pl. xxxvii. fig. 8.—1873. S. I. Smith, Report United-States Comm. Fish & Fisheries, p. 557, pl. iv. fig. 15.
- 1851. *Gammarus sitchensis*, Brandt, Middendorff's Sibir. Reise, Bd. ii. p. 137, pl. vi. figs. 28 a-c.—1862. Bate, Cat. Amphip. Brit. Mus. p. 210, pl. xxxvii. fig. 4.
- 1853. *Gammarus pulex*, Stimpson, Invert. Grand Manan, p. 55.
- 1854. *Gammarus mutatus*, Lilljeborg, Kongl. Vet.-Akad. Handl. p. 447.
- 1862. *Gammarus locusta*, Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 378 (et auct.).

Hab. Common all round our coast between tide-marks.

Distribution. This species is found apparently everywhere throughout the arctic and boreal regions, and, as will be seen by the above synonymy, has received many names from different localities. I have carefully compared specimens from Spitzbergen, Greenland, and the United States with others from our own coasts. It extends also southwards as far as Naples (*Costa*), South-west France (*Barrois &c.*); Cullera, Spain (*Don Pedro Antiga, in Mus. Norm.*).

A large British example in my collection measures 34 millim.*, and one from Spitzbergen reaches 38 millim.

The telson, of which one half is figured (Pl. XII. fig. 11), is elongated and each half usually bears three terminal spines and a seta at the extremity, a spine and seta at a short distance from it, and two spines and one or two setæ near the base. A certain latitude must be allowed as to the exact number of setæ and spines on the telsons in the genus *Gammarus*; but the general character in each species appears to be constant.

2. *Gammarus marinus*, Leach. (Pl. XII. fig. 12.)

1815. *Gammarus marinus*, Leach, Linn. Trans. vol. xi. p. 359.

1830. *Gammarus Olivii*, H. Milne-Edwards, Ann. des Sci. Nat. vol. xx. p. 369, pl. x. fig. 9.

1837. *Gammarus gracilis*, Rathke, Zur Fauna der Kryn. p. 374, pl. v. figs. 7-10.

1840. *Gammarus affinis*, Milne-Edwards, Hist. Nat. des Crust. vol. iii. p. 47.

1843. *Gammarus Krøyeri*, Rathke, Beitr. zur Fauna Norwegens, p. 69, pl. iv. fig. 1.

1853. *Gammarus pæcilurus*, id. ibid. p. 68, pl. iv. fig. 2.

1862. *Gammarus marinus*, Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 370.

Hab. Common round the British coasts.

Distribution. From Norway to the Bay of Biscay; Adriatic Sea (*Heller*); North-east America (*S. I. Smith*): *Mus. Norm.*

The telson (Pl. XII. fig. 12) has each half terminated by three spines and a spine at the side near the base; sometimes there is the small seta as figured near the extremity, but it is by no means always present; rarely there are one or two setæ at the extremity, but the character of the telson as distinguished from that of allied species is the entire absence or fewness of setæ.

* All measurements in these papers are exclusive of the antennules, but include the uropods unless otherwise stated.

3. *Gammarus campylops*, Leach. (Pl. XII. fig. 13.)

1815. *Gammarus campylops*, Leach, Linn. Trans. vol. xi. p. 360.

? 1844. *Gammarus locusta* (?), E. G. Zaddach, Syn. Crust. Prussic. Prod. p. 4.

? 1851. *Gammarus Duebenii*, Lilljeborg, Öfv. af Kongl. Vet.-Akad. Förh. p. 22.

? 1854. *Gammarus locusta*, Lilljeborg, Kongl. Vet.-Akad. Handl. p. 448.

1862. *Gammarus campylops*, Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 375.

Hab. Bamborough, Northumberland; Guernsey; Newport, co. Mayo (*A. M. N.*).

Distribution. I know of no record beyond the British seas, unless Lilljeborg's and Zaddach's species are synonymous with the present.

The telson of this species (Pl. XII. fig. 13) terminates in three spines and as many (or about as many) setæ; towards the base is a group of three spines, and between this and the extremity two setæ having their bases close together, and sometimes accompanied, as in the figured example, by a small spine.

4. *Gammarus tenuimanus*, Bate.

1862. *Gammarus tenuimanus*, Bate, Cat. Amphip. Brit. Mus. p. 214, pl. xxxviii. fig. 2; Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 384.

Described from a single specimen which was found by Mr. Spence Bate among a lot of Crustacea sent to him by the Rev. G. Gordon from the mouths of the Rivers Ness and Braulley, which flow into the Moray Firth. It is unknown to me.

5. *Gammarus Edwardsii*, Bate.

1862. *Gammarus Edwardsii*, Bate, Cat. Amphip. Brit. Mus. p. 208, pl. xxxvii. fig. 2; Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 386.

This species is also unknown to me. The two known specimens were found by Mr. Spence Bate in a pool into which the tide formerly flowed, but which is now of fresh water, at Starcross, Devon. Mr. D. Robertson recorded this species in his Contrib. to Cat. Amphip. and Isop. of Firth of Clyde, 1888, p. 94, but is now satisfied that the specimens must be referred to the young of other species.

Genus X. ERIOPIS, Bruzelius, 1859.

Eriopis elongata, Bruzelius.

1859. *Eriopis elongata*, Bruzelius, Skand. Amphip. Gamm. p. 65, pl. iii. fig. 12.
 1862. *Eriopis elongata*, Bate, Cat. Amphip. Brit. Mus. p. 178, pl. xxxii. fig. 5.
 1868. *Eriopis elongata*, Norman, Ann. & Mag. Nat. Hist. ser. 4, vol. ii. p. 415, pl. xxi. figs. 7-10.
 1870. *Niphargus elongatus*, A. Boeck, Crust. Amphip. bor. et arct. p. 136.
 1872. *Niphargus elongatus*, A. Boeck, De Skand. og Arkt. Amphip. p. 403, pl. xxii. fig. 5.

Hab. This interesting species has occurred in two localities in our seas. In 1866 I took a specimen when dredging with my late friend Dr. Jeffreys in the Sound of Skye; and in 1885 I took a second in 80 fathoms between the isles of Cumbræ and Arran, in the Firth of Clyde, when dredging in company with my friend Mr. J. Murray in the 'Medusa,' the vessel of the Scotch Marine Station: *Mus. Norm.*

Distribution. Sweden (*Lovén*): *Mus. Norm.* South Norway (*Boeck*); West Norway (*Koren*).

EXPLANATION OF THE PLATES.

PLATE X.

- Fig.* 1. *Leucothœ imparicornis*, n. sp. Antennule and antenna.
Fig. 2. The same. First gnathopod.
Fig. 3. The same. Second gnathopod.
Fig. 4. The same. Telson.
Fig. 5. *Lilljeborgia picta*, n. sp. Antennule and antenna.
Fig. 6. The same. Dorsal portion of hinder segments of pleon.
Fig. 7. The same. Second gnathopod, seen from without.
Fig. 8. The same. Spines and setæ of palm of second gnathopod, as seen from within.
Fig. 9. The same. Last peræopod, terminal joints.
Fig. 10. *Lilljeborgia pallida*, Bate. Last peræopod, terminal joints.
Fig. 11. *Lilljeborgia fissicornis* (M. Sars). Last peræopod, terminal joints.
Fig. 12. *Lilljeborgia æquicornis*, G. O. Sars. Last peræopod, terminal joints.
Fig. 13. *Cheirocratus assimilis* (Lilljeborg). The telson.
Fig. 14. *Melphidippa macra*, Norman. Hinder margin of a segment of pleon.
Figs. 15, 16. *Megaluropus agilis*, Norman. The mandible.
Fig. 17. The same. Inner lamina of maxilliped.

PLATE XI.

- Fig.* 1. *Elasmopus rapax*, Costa. First gnathopod, ♀.
Fig. 2. The same. Second gnathopod, ♀.

- Figs. 3-5. Elasmopus rapax.* Second gnathopod, ♂, showing three stages of development of the hand.
Fig. 6. The same. Last peræopod.
Fig. 7. The same. Last uropods.
Fig. 8. The same. Telson.
Fig. 9. Cheirocratus Sundevalli (Lilljeborg). First gnathopod, ♀.
Fig. 10. The same. Second gnathopod, ♀.
Fig. 11. Cheirocratus assimilis (Lilljeborg). Second gnathopod, ♀.

PLATE XII.

- Figs. 1-3. Cheirocratus Sundevalli* (Lilljeborg). Three stages of development of hand of second gnathopod in male.
Fig. 4. Melphidippa macra, Norman. First gnathopod.
Fig. 5. The same. Second gnathopod.
Fig. 6. The same. Last peræopod, the thigh (basos).
Fig. 7. The same. Last peræopod, terminal joints.
Fig. 8. Melita dentata (Kröyer). First gnathopod.
Fig. 9. The same. Second gnathopod.
Fig. 10. The same. Last peræopod, the thigh (basos).
Fig. 11. Gammarus locusta (Linn.). The telson (one half).
Fig. 12. Gammarus marinus, Leach. The telson.
Fig. 13. Gammarus campylops, Leach. The telson.

XIV.—*Descriptions of new Species of Tenthredinidæ, Cynipidæ, and Chalcididæ in the Collection of the British Museum.* By W. F. KIRBY, Assistant in the Zoological Department, British Museum (Natural History).

IN the present paper I offer descriptions of six interesting new species which have recently been received belonging to families of Hymenoptera which I had previously arranged.

Tenthredinidæ.

*SELANDRIINÆ.**Selandria limbata.*

Exp. al. 18 millim.

Female.—Head, antennæ, and jaws black, rhinarium and nasus pale yellow; thorax pale yellow above, with very large black spots on the frontal and lateral lobes, and with the sutures round the scutellum and postscutellum marked with blackish; prothorax beneath pale yellow, with a large black spot on each side, followed by a small one, the latter just before the front coxæ; mesopectus and mesopleura shining black; metapectus pale yellow, with a large black spot on

each side; all the legs pale yellow, hind tibiæ with an indistinct brownish spot at the tip on the inside; and the two apical joints of the four hinder tarsi dark brown. Abdomen luteous, the sides (especially beneath) brown, shading into blackish towards the tip. Wings hyaline, slightly clouded, with brown nervures; costal nervure and stigma yellow.

The male differs little, except that the hind tibiæ are brown for most of their length on the inside.

Hab. Theresopolis, Brazil (*Frühstorfer*).

TENTHREDININÆ.

Siobla bicolor.

Exp. al. 15 millim.

Female.—Luteous; head, abdomen beyond the first four segments, and hind tibiæ and tarsi black; the last two or three joints of the front and middle tarsi are also marked with black. Fore wings clouded hyaline, with dark brown stigma and nervures; hind wings clear hyaline.

Hab. Theresopolis, Brazil (*Frühstorfer*).

Tenthredo Haberhaueri.

Exp. al. 22 millim., long. corp. 14 millim.

Female.—Black; mandibles yellow at base and red at tips; thorax strongly punctured on the sides; cenchri white; abdomen with the last three segments and at least a stripe above at the extremity of most of the preceding segments red; legs red, coxæ and trochanters, the tips of the hind tibiæ, and a great part of the hind tarsi, black; the front legs are varied with yellowish in front. Wings iridescent hyaline, with a smoky band crossing the lower part of the radial cells; the costal and adjacent nervures blackish, the others pitchy; stigma yellow.

Hab. Turkestan (*Haberhauer*).

Allied to *T. hybrida*, Eversm., from the Kirghis steppes; but the latter species has the stigma black, and the middle segments of the abdomen red.

Cynipidæ.

ONYCHIINÆ.

Aspicera (?) nigricornis.

Long. corp. 6 millim.

Female.—Black, shining; legs dark red; ovipositor yel-

low. Antennæ 14-jointed, as long as the body, black, scape pear-shaped, thicker at the extremity than the flagellum, half as long as the third joint; second joint annular, third to thirteenth of equal length, about four times as long as broad; terminal joint half as long again as the preceding and pointed at the tip; the antennæ are clothed with short hairs, most distinctly so towards the tip, and all the joints are well separated; all the joints except the scape, which is smooth and shining, are dull black and longitudinally striated. Head with a fovea behind each ocellus, the hindermost falling away to the occiput.

Prothorax transverse, with two contiguous foveæ in the middle above, and the sides clothed with grey hairs; mesothorax with the edges raised, and with four distinct and converging depressions above, the two innermost only reaching to the middle; scutellum with the edges raised, two large foveæ at the base, and a strong carina rising between them and running to the extremity of the long and strong spine; the mesothorax and scutellum with scattered raised bristles; metathorax clothed with grey hair.

Abdomen mostly black, smooth and shining, the first segment black, opaque, short, and very strongly longitudinally striated, the second segment inclining to rufous and longitudinally striated at the base; the remaining joints are smooth, the third occupying three fourths of the length of the abdomen, the apical segments very short.

Legs dull red, slender, except the coxæ, which are thickened at the base; sparingly clothed with whitish diverging bristles; tibiæ with two slender yellow spines at the tips; first joint of tarsi as long as the rest, the three following narrowed at their bases; a long pointed pulvillus between the claws.

Wings hyaline; fore wings slightly smoky, venation normal.

Hab. Theresopolis (*Frühstorfer*).

Allied to *A. rufipes*, Cress., from Cuba; but this species is only $1\frac{3}{4}$ lines in length, and has reddish antennæ.

Chalcididæ.

CHALCIDINÆ.

Smicra gracilis.

Long. corp. 5 millim., exp. al. 10 millim.

Head above and behind, thorax, and hind femora black; eyes green; face (except mentum), scape of antennæ beneath,

petiole, four front legs, and hind tarsi yellow; antennæ, abdomen, hind trochanters, femora, and tibiæ mostly reddish; abdomen oval, about as long as the petiole, hind coxæ with a short upright spine above just before the tip; hind femora varied with blackish on the inside and on the outside at the tip; the upper surface varied with yellowish and the lower surface armed with seven or eight moderate-sized teeth; hind tibiæ with a blackish spot at the base, followed by a short yellow space; the rest reddish on the inside and browner on the outside. Wings hyaline, slightly clouded, costal nervure yellow at the base, but its extremity as well as the stigma dark brown.

Hab. Theresopolis (*Frühstorfer*).

Shape of *Thaumapus*, to which I should have referred it, but that the scutellum and metathorax appear to be entirely unarmed.

EUCHARINÆ.

Tetramelia (?) *meridionalis*.

Long. corp. $6\frac{1}{2}$ lin., exp. al. 12 lin.

Female.—Tawny yellow; head black, transverse, short and broad, longitudinally striated; antennæ placed high up on the face, black, tawny at base and tip and sometimes beneath, 12-jointed, scape short, second joint small, third as long as the three following ones, the rest gradually diminishing to the extremity, but all distinctly longer than broad; thorax very rugose, tawny yellow, a large spot on the base of the frontal lobe, a spot on each of the lateral lobes, more or less of the hinder sutures above, a stripe on the median line of the scutellum and its terminal forks, and the greater part of the pectus black; scutellum bidentate; metathorax with a curious, broad, half-wheel-shaped projection on each side; legs unarmed, tawny yellow, claws black; petiole tawny yellow, as long as the height of the abdomen; abdomen smooth and shining, vertical, four times as high as broad, black, the sides and the median line behind tawny yellow.

Hab. Theresopolis (*Frühstorfer*).

This species perhaps represents a new genus; but as it is possible that the structure of the appendages of the metathorax may differ in the sexes, I refer it provisionally to my genus *Tetramelia* (only known in the male sex, type *Schizaspidia plagiata*, Walk.), with which it agrees in all other essential characters.

XV.—*Francolinus Altumi*, Fischer and Reichenow, is the Male of *F. Hildebrandti*, Cabanis. By W. R. OGILVIE GRANT.

THE statement made in the above heading would at first seem almost incredible to any one who knows the two forms to which those names have been given; yet the evidence I shall put before my readers leaves no room for doubt that my assertion is correct.

Francolinus Hildebrandti was described and figured by Cabanis (J. f. O. 1878, p. 243, pl. iv. fig. 2) from a single female specimen obtained at Taita, which was armed on the right leg with a single sharp spur. The species is characterized by being dull brick-red on the under surface and having some of the feathers of the lower breast and belly margined with pale buff spots, while the feathers of the upper surface (except those of the mantle, which are more strongly vermiculated with black and white) are very finely vermiculated with reddish brown and black, and most have a narrow rufous shaft-streak.

Francolinus Altumi was described and figured by Fischer and Reichenow (J. f. O. 1884, p. 179, pl. ii.) from specimens obtained in Massailand, and referred by them to the group of Francolins including *F. Rueppelli* and *F. Clappertoni*, though really much more closely allied to *F. icterorhynchus* from Central Africa and *F. natalensis* from Natal.

It is characterized by having the feathers of the breast and belly white, with a subterminal, heart-shaped, black spot, while the upper surface and under tail-coverts are the same as in *F. Hildebrandti*.

Through Mr. H. C. V. Hunter's generous gift to the Natural-History Museum of the birds collected by him in Massailand our National Collection now contains a good series of each of the above so-called species. On examining the series of *F. Hildebrandti*, which was specially interesting to me as representing a species new to the collection, I noted the facts that all the specimens were sexed female and that all had at least a pair of sharp spurs, while in two examples a second and additional pair of spurs were fairly developed; at the same time I expressed an opinion that *F. Hildebrandti* would certainly prove to be the female of some other species. Not being then engaged in working at the Francolins, I determined to let the matter rest till I should have an opportunity of speaking to Mr. Hunter and hearing his opinion on the

subject. When this gentleman was last at the Museum I asked him how it was that he had obtained no male specimens of *F. Hildebrandti*, and very much to my surprise and pleasure found (though he had forgotten to mention it before) that he had not only arrived at the same conclusion as myself, but had solved the riddle long before on Kilima-njaro, and discovered that *F. Altumi* is the male and *F. Hildebrandti* the female of one and the same species.

Mr. Hunter had been considerably exercised in his mind by on the one hand never being able to obtain the male of *F. Hildebrandti*, while on the other hand all the specimens he got of *F. Altumi* proved invariably to be males. As these two birds were always obtained in company by his collectors, the truth gradually dawned on him and was subsequently proved beyond a doubt by the dissection of a large number of specimens obtained for food.

On comparing the two birds the different points of resemblance are at once seen, viz. the plumage of the upper surface and under tail-coverts and the colour of the bill and legs, which are all practically the same in both; but, so far as I know at present, the extraordinary difference in the colour of the under surface in the sexes is unique in this genus. A still more extraordinary thing is that in the two apparently closely allied forms, *F. icterorhynchus* and *F. natalensis*, the females resemble the males but are without spurs.

The name *Francolinus Hildebrandti*, Cabanis, must therefore be used in future to designate this species.

XVI.—On *Angelopsis*, and its Relationship to certain *Siphonophora* taken by the 'Challenger.' By J. WALTER FEWKES.

[Plate VII. figs. 1-3.]

ONE of the most interesting genera of Medusæ discovered in the depths of the Gulf-stream by the United States Fish-Commission steamer 'Albatross' is a new Physophore which was described a few years ago (1884) under the name of *Angelopsis* in my paper on the Medusæ of this region.

This genus is remarkable for its large float and the reduction in size and increase in thickness of the walls of the polyp-stem, which has the form of a semicartilaginous expansion with a cavity, and with its external walls covered with

the polypites, sexual bells, and possibly tentacles. It is also remarkable in possessing bud-like structures on the lower part of the float, near its junction with the base. These bag-like bodies recall in general appearance the form of the float itself, and somewhat resemble structures to which Hæckel has given a special name (aurophore) in certain related genera.

My original description of this strange Siphonophore was necessarily a short one, and for reasons beyond my control at that time the figures which were given of it were somewhat imperfect. Since the publication of the first notice of *Angelopsis* I have reexamined my types and have been able to make a dissection of the larger of them, from which study it is possible for me to add something to my first description, which, although superficial, is accurate as far as it goes. The present paper has in part been called forth* by Prof. Hæckel's report on the 'Challenger' Siphonophora, which contains descriptions of allied genera, the account of the anatomy of which throws considerable light on the interpretation of certain structures in *Angelopsis* the function of which was not wholly plain four years ago.

Among the interesting Siphonophora described or figured in the 'Challenger' Report already quoted are four new genera which differ from other known Siphonophora in very important particulars. Hæckel has found it necessary to form a new group for the reception of these genera, and assigns to it the name of Auronectæ. In this group he includes doubtfully my *Angelopsis*, and regards it as possibly the same as his genus *Auralia*. Although *Angelopsis* seems to be allied to *Auralia*, there are certain marked differences so far as I can make out from his meagre and unsatisfactory account of *Auralia*. Unfortunately Hæckel does not describe or figure his genus in the report† referred to, so that I am ignorant of some of the main characters of his *Auralia*. The genus *Angelopsis* is so different from other Siphonophora that there is a call for a more intimate knowledge of its anatomy.

* I have delayed my publication of the new facts embodied in this paper in the hope that it might be possible to collect *Angelopsis* alive and gather information in regard to its nectocalyces, tentacles, tentacular knobs, and other structures.

† The editor speaks of this work as a "Monograph of the whole class of Siphonophora." Any report which simply mentions the names of new genera and refers to publications yet to appear for descriptions of these novelties does not come up to the highest standard of what a "Monograph" should be.

Hæckel does not say whether his *Auralia* was taken by the 'Challenger' or not. The locality given for it, viz. "depths of the Tropical Atlantic," is also somewhat vague.

I have been able to examine but two specimens, both of which are somewhat mutilated and more or less distorted in preservation*.

Angelopsis globosa was taken by the 'Albatross' in lat. $37^{\circ} 50'$ N., long. $73^{\circ} 3' 50''$ W., from the depth of 1395 fathoms†. The remaining genera of the Aurnectæ, to which group Hæckel ascribes *Auralia*, the supposed relation of *Angelopsis*, are called by him "deep-sea Siphonophoræ"; but no genus is recorded from more than 650 fathoms‡. It will thus be seen that *Angelopsis* may have come from considerably deeper water than any other Aurnectid yet described.

From the existence of the "aurophore" among the Aurnectæ Hæckel regards them as preeminently deep-sea Siphonophores. He considers the aurophore to be an organ for the secretion of "air" (gas) which is emptied into the cavity of the float. It is not wholly evident, even if the aurophore is a gas-secreting organ, that on this account the Aurnectæ are permanent deep-sea Siphonophores. Moreover, additional proof is necessary to demonstrate that the physiological rôle of the aurophore is to secrete air (gas). Upon this latter point more observations are needed, and it must be confessed that the large size of the float looks as if the Siphonophore *Angelopsis* is better fitted for life at or near the surface than at great depths.

Certain "striking features" of the Aurnectæ, according to Hæckel, "make it very probable that the Aurnectæ are permanent deep-sea Siphonophoræ, which may move up and down within certain limits of depth, but never come to the surface." Among the peculiarities referred to by him are "the extraordinary development of the swimming-apparatus,

* In the figures of *Angelopsis* which are here published accurate outlines are attempted even when there is no doubt that certain distortions are present which are due to the method of preservation. The system of "restoration" by which "semidiagrammatic" figures are constructed and "missing parts supplied from a knowledge of the form of the same in other Medusæ" does not wholly commend itself to the author. Possibly while figures not treated in this way are less effective, they are less liable to propagate erroneous ideas of the form and structure of these animals.

† Hæckel ascribes my *Angelopsis* to the "Tropical Atlantic." What he exactly means by the term is not clear to me. Lat. $37^{\circ} 50'$ is certainly outside of the tropics. *Rhodalia*, which came from lat. $37^{\circ} 17'$ S., he ascribes to the "South Atlantic."

‡ I have already elsewhere in these 'Annals' discussed the unreliability of the data of depth at which certain Medusæ are recorded. *Auralia*, according to its discoverer, came from the "depths of the Tropical Atlantic;" but as he does not mention the depth, the datum is not very reliable and does not contribute much to demonstrate that this genus is deep-sea in habitat.

the voluminous pneumatophore, the powerful horizontal corona of radially expanded nectophores, and particularly the singular aurophores, wanting in all other Siphonophoræ, and acting probably as an important gas-secreting gland or a pneumadenia." It is certainly difficult to see how any of the above-mentioned features "make it probable that the *Auronectæ* are permanent deep-sea Siphonophoræ . . . but never come to the surface." One might even suggest that exactly the reverse conclusion might be drawn and that some of these features imply life at or near the surface.

The failure to find nectocalyces in *Angelopsis* led me to suppose that these organs or individuals are wanting in this genus. I cannot now say that they are present, as they are also not found in the new specimen which I have lately studied. As Hæckel found them in the same bottles with his *Auralia** and *Rhodulia*, it is possible that they once existed in *Angelopsis*, and future studies may bring them to light.

The following general description of *Angelopsis* was given in my original account† of this Medusa:—

"This Medusa has a spherical region above, which is considered [to be] a float, on the underside of which is clustered a number of small bodies resembling tentacles. The former region (*py.cy.*) resembles the bell-like body in a Medusa; the latter a clump of tentacles closely massed together, with the form which we might suppose they would have if the entrance to the bell-cavity were closed by the velum and tentacles developed over its lower floor. The so-called float is spherical, without apical opening or protuberance, smooth on the outer surface and without radial elevations. Diameter from 7 to 10 millim. The wall of the float is thin, and in the interior is a second thin-walled sac or float, which is supposed to correspond to the pneumatocyst (*py cy.*) of *Rhizophysa*. The inner sac has no opening into the outer, and does not communicate with organs below. It is destitute of appendages. Its cavity (*cav. p.*) occupies the whole interior of the float.

"The lower floor of the float is formed of the thickened outer walls which bear the so-called tentacles. The thickened region is found to have a cavity within (*cav. b.*) and to

* Hæckel simply says that the corona of nectocalyces (nectophores) is simple in *Auralia*, but gives no more information about them in this genus. He gives no account of their anatomy, whether they were sessile or pedunculate, or any detail of any scientific value about them. His description of *Auralia* is so superficial that it is very difficult to tell whether it is the same as or different from *Angelopsis*.

† "Report on the Medusæ collected in 1883-84," Ann. Rep. U.S. Fish Comm. 1884.

be separated by a muscular floor from another cavity (*cav.*) just below the inner air-sac. On the outer walls of this thickened layer (*mm.*), at the point where it joins the thin walls of the outer layer of the float, there are found spherical bag-like structures (*gm.*) of unknown function. These bodies recall in appearance the larger float, from which they hang, and suggest the possibility that they are buds from the outer walls. Whether they are new individuals, peculiar zooids, or chance swellings, I cannot determine. They are found in both specimens, and so closely resemble the larger float that the supposition that they are *new individuals budding from the thickened region* of the bell seems highly probable. The cavity of one of them was found filled with bodies resembling those found on the lower floor.

"The whole external surface of the thick walls of the lower hemisphere of the Medusa is covered with small clusters of bodies which resemble the gonophores in *Verella* or the sexual clusters of *Physalia*. These clusters have a small axis, from the sides of which hang, in grape-like clusters, small, spherical, and ovate bodies resembling tentacular knobs, fastened by a delicate peduncle to an axis. The appended bodies are of two sizes, large and small, and through the walls of the latter radial structures which arise under the peduncle can be seen. All are snugly approximated to the outer wall of the animal, and in one instance a small fragment of what appears to be an Echinoderm test (*a*) was firmly grasped by them. No *external opening* into the *cavity* of the muscular base on which they hang was found, although carefully searched for, especially at the lower pole of the Medusa. In cutting open one of the small spherical bodies (*gm.*) which arise from the side of the Medusa I found it filled with a granular mass, which had some resemblance to the botryoidal clusters on the lower hemisphere of the Medusa."

As we have no printed account of the genus *Auralia*, it is premature at present to accept Hæckel's reference * of *Angelopsis* to this genus. He promises, however, a description of *Auralia* in a work, 'Morphology of the Siphonophoræ,' yet to be published, which with the present account may make it possible to tell whether or not the two belong to the same genus. If on such a comparison they are found to be the same, the name *Auralia* by the laws of scientific nomenclature will have to be regarded as a synonym of the older designation *Angelopsis*.

* The author mentioned was unable "with any certainty" to identify his *Auralia* and my *Angelopsis*. I find the same difficulty, but the cause of my difficulty is not wholly the same as his.

The *Rhodaliidæ*, according to Hæckel, have the following characters:—"Trunk of the siphosome without permanent central canal and distinct primary mouth." It includes, according to him, two genera, *Auralia* and *Rhodalia*. Looking now at his synopsis, we find that *Auralia* has the "trunk of the siphosome *with* a large central cavity," which would seem to throw it out of the family; and if his definition of the family is followed it would include *Rhodalia* only. It is certainly desirable that his diagnosis of a new family should be broad enough to include the characters of the genera embraced in it, and that one description should not be the negative of the other. Several other instances of a similar kind * might be mentioned which detract very greatly from the value of the Report on the 'Challenger' Siphonophoræ.

I cannot accept Hæckel's interpretation of the "spherical bag-like structures" of *Angelopsis* given on p. 301, where he says they are probably "nectophores," nectocalyces. There are two reasons which lead me to doubt the validity of his conclusions. First, it is very difficult to detach them from their connexion with the float, and, secondly, they have neither bell-openings nor radial tubes so far as can be discovered. It is also to be noted that they arise in a different position from the nectocalyces on the float and nectostem. When we recollect with what ease the nectocalyces ordinarily separate from the "corm" in Siphonophores, and the same is true in *Auronectæ*, the persistency with which these buds cling to the "corm" is significant. Moreover in their general appearance they are unlike nectocalyces. It is not impossible that they are homologous with the organs which he calls aurophores, but unlike them they have *no external opening* so far as could be discovered. I have searched in vain for these openings; if they exist, they are rendered invisible by the contraction of the walls of the orifice.

My remark that these bodies are buds from the floats, which was ventured not as a dogmatic assertion but as a

* As will be seen, for example, on pp. 242, 243, in his account of a genus of Forskaliadæ, Fewkes, called *Strobalia*. He speaks of a *Strobalia*, *S. cupola*, sp. nov., which will be described in his 'Morphology of the Siphonophoræ.' One is disappointed not to find a description of it in the 'Report,' and has good reason to expect a description of a second species, for Hæckel mentions a species of his *Strobalia*, *S. conifera*, as collected by the 'Challenger,' but does not describe it. He does not even promise to describe it in his 'Morphology of the Siphonophoræ.' It is unfortunate that species collected by the 'Challenger' should not be described in a report on them, but simply mentioned by name; and the statement made that they are similar to other species, also undescr^{ibed}, adds very little to our knowledge.

suggestion, does not seem to have been shown to be false by Hæckel's criticism. I cannot agree with him that they are "probably nectophores," and that if they are aurophores they may still be "new individuals * budding from the thickened region" &c. as suggested.

Float.—The float of *Angelopsis* is spheroidal, the longer diameter being situated in a horizontal plane. The upper portion is somewhat flattened and convex. There is no apical external opening. The longer diameters of the two specimens examined are respectively 5 and 7 millim.

No variation in colour was observed in the external walls. The float is whitish in alcohol †.

When the external surface of the float is examined with a hand-lens there are observed scattered over its surface clear spaces, *c*, resembling nematocysts. Similar structures are recorded and figured by me in *Rhizophysa gracilis* from Florida ‡.

Nectocalyces.—No nectocalyces were observed, although the characteristic elevations from which they are said by Hæckel to arise in related genera are prominent. The structures *gm*, *gmm*, *gm'*, which Hæckel says "are probably nectophores," are not "nectophores," and have no anatomical features of the nectophores of other Siphonophora. The ease with which nectocalyces are dropped renders it possible that they once existed in *Angelopsis*; but as I have not found them they are not described or figured §.

Polyp-stem.—The portion of the *Angelopsis* corresponding to the polyp-stem (siphosome) of other Siphonophores is enlarged into a thick-walled, bulbous, more or less cartilaginous structure, which forms the lower or basal region of the animal. In one specimen this portion is contracted into a globular base of about the same size as the float, and in it forms a dish-like cavity, the diameter of the rim of which is

* Hæckel in one place (p. 283) considers the aurophore an "organ," in another, two lines below, a "peculiar Medusoid person." I am unable to tell which opinion he holds as to its character.

† The marked reddish pigment, which in *Athorybia* and other genera is found at the apex of the float, retains some of its colour even after specimens have been in alcohol several years.

‡ "Notes on *Acalephæ* from the Tortugas, with a Description of new Genera and Species," Bull. Mus. Comp. Zool. vol. ix. no. 7.

§ Hæckel gives a beautiful figure of *Stephalia* with a circle of nectocalyces. Unfortunately he does not describe the nectocalyces in his specific diagnosis. He also gives figures of *Rhodalia*, the nectocalyces of which are "semidiagrammatic," and says in his text, "Of course the form and position of the detached nectophores could not be recognized in the spirit specimens with full certainty, the soft jelly substance being much contracted by the action of the alcohol."

somewhat larger than that of the float. This region is more or less distorted by the alcohol, as shown in my figure. It is crossed by radial elevations similar to the peduncles of the siphosome (nectostem) of *Rhodulia*, which are more or less torn, especially at one extremity (distal). There is no external opening into the interior of this dish, and covering its surface there are clusters of sexual bodies, and here and there pyriform organs, which are possibly polypites. The tentacles are not sufficiently well preserved to determine their relationship, and the tentacular knobs, if such exist, were not recognized.

The two bodies (*gm*, *gmm*) which hang from the neighbourhood of the base of the float bear some resemblance to an organ called the aurophore * by Hæckel. As neither of them has external openings they do not resemble aurophores in this particular. It is also an important fact that there is no external opening in the external walls of the polyp-stem †.

One of these "buds" is larger than the other, but both are very much shrunken and too poorly preserved for their internal structure to be definitely made out.

The contents of these "buds" show the falsity of regarding them as the same as true nectophores or nectocalyces, although there is nothing to prevent their being homologized with these structures. From the imperfection of the material at my command it was not possible for me to give an accurate account of their anatomy; but enough was seen to show that they are not true swimming-bells.

One of the most characteristic and interesting features, morphologically speaking, of the anatomical structure of *Angelopsis* is the fact that the polyp-stem is thickened and its walls penetrated by a network of canals, which seem to ramify in all directions through it. This bulbous, thickened polyp-stem is peculiar to genera belonging to the Auronectæ.

* Hæckel regards the aurophore as "adapted to the production and emission of the gas contained in the large pneumatophore." The reasons which he gives for this conclusion are not all that might be desired. One reason seems to be "the great internal surface of the endodermal epithelium, thus produced, together with the extraordinary size and glandular appearance of its high cylindrical cells, make it probable that the great mass of air contained in the pneumatophore is secreted by the lacunar system of the aurophore and conducted into the cavity of the pneumatocyst by pores which pierce the inner wall of the aurophore." One is tempted to ask, Why regard the contents as air rather than some other gas?

† The "lacunar systems" of irregular canals in the aurophore closely resemble the "gastral canals" of the cartilaginous polyp-stem. See Hæckel's section of the aurophore of *Rhodulia* (pl. v. fig. 21). In the one case he seems to regard these lacunæ as gas-secreting. Why not ascribe the same function to the gastric canals?

The interior is hollow, forming a cavity which is destitute of an external orifice. This cavity is divided into regions and is lined by a more or less cartilaginous * plate. *Auralia* alone of the *Auronectæ* resembles *Angelopsis* in the absence of an external orifice to this cavity.

Directly below the air-float the cavity of the polyp-stem forms a thin disk-shaped recess, the upper walls of which are formed by the float, the lower by lamellar folds of the cartilaginous plate which lines the cavity of the polyp-stem. A large orifice or communication leads from this vestibule into the main cavity (*cav. b.*) of the polyp-stem. There is no opening from the cavity of the float into the vestibule (*cav.*) of the cavity of the polyp-stem.

Cormidia.—The clusters of sexual bodies (*p*) and polypites dot the whole underside and skirt the margin of the external surface of the polyp-stem of *Angelopsis*. They are in a very poor state of preservation, so that I am unable to recognize with certainty their different parts. I have supposed that each cluster consists of a central axis, with clusters of male and female sexual bells arising from its external walls. Some of these are much larger than the others, and those are interpreted as polypites; but of this interpretation I have some doubt. Tentacles were not observed, and if they once existed have been ruptured from their connexion with the cormidia. Hæckel finds tentacles and tentacular knobs or like structures in several genera which he regards as closely related to *Angelopsis*; but I have not been able to find them in this genus. A small fragment of the shell † (test) of a sea-urchin was found clinging to the underside of the polyp-stem, and I have supposed that it was held there by the tentacles; but the only structures observed were those which looked like immature tentacular knobs.

After calling attention to the possibility that *Angelopsis* is the same as another genus (*Auralia*), Hæckel speaks of the "inaccuracy" of my description and the "superficiality" of my examination of *Angelopsis*.

So far as inaccuracy goes this criticism is believed to be unjust, although the poor character of my material rendered it difficult to make out many details of structure. My descrip-

* The use of the word cartilaginous here and elsewhere refers rather to the tough nature of this plate than to its histological characters. It recalls closely the "shell" of *Tetella* in its general characters and differs very strikingly from the soft gelatinous body of most *Medusæ*.

† In the original figure of *Angelopsis* this little fragment was represented; but when my second drawing was made this foreign body had dropped off and was found in the bottom of the bottle containing the type.

tion, which was the first printed account of an Auronectid, the revelation * of which group Hæckel styles "*one of the most splendid discoveries of the 'Challenger,'*" was the first account of these strange Medusæ. It was made from poorly preserved material and was not intended to be histological or anatomical.

EXPLANATION OF PLATE VII. FIGS. 1-3.

The following letters have the same signification in the three figures:—

- c. Clusters of transparent bodies found in the walls of the float and easily seen in alcoholic specimens. They consist of clear spaces or "cells" arranged in clusters, rows, or irregular figures.
- cav. Lens-shaped cavity of the nectostem below the float.
- cav. p. Cavity of the float.
- cav. b. Cavity of the polyp-stem.
- f. Floor of the float, separating the cavity of the pneumatocyst (cav. p.) from cav. b., the cavity of the polyp-stem.
- gm. Globular bodies resembling nectocalyces in position, but unlike them in structure. *gmm.* is very much shrunken in preservation, *gm.* is less so and somewhat resembles an "aurophore."
- gm'. Small immature "buds," which may be undeveloped nectocalyces. Their true character is not known.
- l. Folds of a cartilaginous plate separating the cavity of the nectostem, *cav.*, and that of the polyp-stem, *cav. b.* The figure of these folds is a little too regular, and in nature they are more plicated.
- mm. Thickened wall of the polyp-stem through which ramifying tubes extend. Several of these tubes are seen longitudinally, others, as at *t*, in cross section.
- o. Opening of the bud *gm.* into the cavity of the float.
- p. Cluster of sexual bells and a single polypite. In fig. 3 a sexual bell, *s*, and a single polypite is shown.
- py. cy. Pneumatocyst or float.
- rn. Ridges or elevations, possibly remnants of the attachment of nectocalyces.

Fig. 1. Side view of the larger specimen of *Angelopsis*. The want of symmetry is mainly due to contraction in preservation. The specimen is distorted, and probably some of the organs which exist in the live animal are lost.

Fig. 2. Section through the float and enlarged polyp-stem, vertically, showing the cavities of the float and body. Two clusters of sexual bodies are shown on the left of the figure. From the shape of the larger specimen, shown in fig. 1, it is probable that the transverse diameter of the polyp-stem is relatively to that of the float somewhat larger in live specimens than here shown.

Fig. 3. A detached cluster of sexual bodies and a single polypite. This cluster was taken from the bulbous polyp-sac of fig. 2.

Boston, Mass., U.S.A.,
April 10th, 1889.

* Of the four genera regarded by Hæckel as belonging to the Auronectæ, *Stephalia* was taken by the 'Triton' Expedition, *Stephalia* and *Rhodalia* by the 'Challenger,' and the collector of *Auralia* is not mentioned. The 'Challenger' increased very greatly our knowledge of the possible allies of *Angelopsis*, which was discovered by the 'Albatross.'

XVII.—*On the Collection of Lepidoptera formed by Basil Thomson, Esq., in the Louisiade Archipelago.* By W. F. KIRBY, F.E.S., Assistant in Zoological Department, British Museum (Natural History).

THE collection of Lepidoptera entrusted to me for examination includes forty-one specimens, belonging to twenty-one species, of which two only are moths. Among the butterflies I found eight species which appear to be new and which are described below. So far as can be seen from so small a selection, the affinities of the species are mainly Papuan, especially with those previously received from Port Moresby. Several of the species also exhibit strong Moluccan and Australian affinities, while others show a relationship to the insects of Kei, Aru, New Georgia, and other islands lying east or west of the Louisiades. There are not more than one or two species, such as *Eurema hecabe* and *Leptosoma integrum*, which exhibit any special relationship to the Indo-Malayan fauna. Perhaps the most interesting of the novelties obtained by Mr. Thomson are the species of *Tenaris*, belonging to a genus of butterflies which obtains its maximum of development in the Papuan Islands. That so large a proportion of novelties as eight conspicuous butterflies out of a total of nineteen were collected during a flying visit to one or two islands sufficiently indicates the richness of the fauna of the Louisiades and the desirability of its being more systematically investigated.

RHOPALOCERA.

Nymphalidæ.

DANAINÆ.

LIMNAINA.

Genus ASTHIPA.

Asthipa, Moore, Proc. Zool. Soc. Lond. 1883, p. 246.

1. *Asthipa Schenkii*.

Danaïs Schenkii, Koch, Indo-Austr. Lep.-Fauna, p. 107 (1865).

Danaïs gloriola, ♀ var., Butl. Proc. Zool. Soc. Lond. 1866, p. 57.

"Rossel Island, Oct. 18, 1888." A pair, male and female.

This is a larger and paler species than *A. gloriola*, Butl.

(=*citrina*, Feld.), from Aru; but it would need a good series of both to ascertain their comparative differences with precision. Koch's type was from the island of New Georgia, and there is a specimen of the female in the British Museum from Kei Island which hardly differs from Mr. Thomson's except in being a little yellower at the base. It is this which Mr. Butler formerly described as a variety of his *Danaïs gloriola*. Felder appears to have confounded the two, as he states that it occurs both in Kei and Aru, though his description and figures correspond with Butler's *gloriola* from the latter locality.

Genus SALATURA.

Salatura, Moore, Lep. Ceylon, i. p. 5 (1880); Proc. Zool. Soc. Lond. 1883, p. 239.

2. *Salatura affinis*.

Papilio affinis, Fabr. Syst. Ent. p. 511 (1775).

"Sudest Island, Oct. 18, 1888 [two specimens]; Normunby Island, Oct. 30, 1888."

A common species in all parts of Australia; it is likewise in the British Museum from Aru and Kei, and Moore records it from Ceram and Amboina.

EUPLOEINA.

Genus HAMADRYAS.

Hamadryas, Boisd. Voy. Astr., Lép. p. 91 (1832).

3. *Hamadryas niveipicta*.

Hamadryas niveipicta, Butl. Ann. & Mag. Nat. Hist. (5) xiii. p. 191 (1884).

"Normunby, Oct. 30, 1888." One specimen.

In the British Museum from North Ceram, Kei, and Kei Dulan (type).

Genus PENOA.

Penoa, Moore, Proc. Zool. Soc. Lond. 1883, p. 244.

4. *Penoa Thomsoni*, sp. n.

Exp. al. 70 millim.

Male.—Dark brown; costa of the hind wings paler; a

submarginal row of large suffused white spots, only divided by the nervures, running across both wings, those nearest the costa of the fore wings longest and furthest from the hind margin.

Underside similar, but rather paler; a small pale blue spot before the end of the cell, followed beyond the cell by a row of three spots on the fore wings and five on the hind wings; the first of the three on the fore wings is a small streak, and the third is a long white streak, tapering outwards to a point.

Body and extreme base of wings spotted with white.

"St. Aignan, Oct. 21, 1888; Normunby, Oct. 30, 1888."

Two specimens from the former locality and one from the latter. A very distinct species, with but little resemblance to any previously described species allied to *Euphea*.

Genus CALLIPLÆA.

Calliplæa, Butl. Trans. Ent. Soc. Lond. 1875, p. 1; Moore, Proc. Zool. Soc. Lond. 1883, p. 292.

5. *Calliplæa Jamesi*.

Calliplæa Jamesi, Butl. Proc. Zool. Soc. Lond. 1876, p. 766, pl. lxxvii. fig. 2.

"Normunby, Oct. 30, 1888." One specimen.

A rather variable species. The present specimen has five white spots on the fore wings and three white dots on the hind wings, and beneath, in addition, a white dot just above the discocellular nervule, and a submarginal row of white dots, which, on the hind wings, do not extend to the tip.

There are four specimens in the British Museum, two (the types) from Port Moresby, New Guinea, and two from New Guinea without further specification of locality. None of these agree exactly in spotting with Mr. Thomson's specimen, though the correctness of the identification is hardly doubtful.

Genus SALPINX.

Salpinx, Hübn. Verz. bek. Schmett. p. 17 (1816); Moore, Proc. Zool. Soc. Lond. 1883, p. 300.

6. *Salpinx eustachius*, sp. n.

Exp. al. 69–71 millim.

Male.—Rich tawny brown, hardly paler except towards the margins of the posterior wings; a large buff sexual mark

extending over the upper half of the cell of the latter, as in the allied species. Anterior wings with a bluish-white spot, obsolete above, in the middle of the costa, and a submarginal row of seven white spots, the first three largest and approximating; an oval bluish-white spot below the first branch of the median nervure. Posterior wings with two white submarginal dots (sometimes nearly obsolete) below the tip.

Underside: anterior wings with the submarginal spots nearly as above, but opposite to the last is a larger and slightly bluish-white spot nearer the base; beneath this, on a large buff patch covering the inner margin of the wing, is an oval black ring occupying the position of the bluish-white spot of the upper surface. Posterior wings with one or two white dots close to the base, and a submarginal row of more or less distinct white dots.

“Rossel Island, Oct. 18, 1888.”

Three specimens obtained.

Closely allied to *S. grueffiana*, Heer, from the Fiji Islands, in the arrangement of its spots; but the latter species has the hind margin paler and the costal spot (which is entirely absent in one specimen of *S. eustachius*) more distinct above. In colour *S. eustachius* more resembles *S. oculatus*, Moore, from Mindanao.

Genus STICTOPLÆA.

Stictoplera, Butl. Journ. Linn. Soc., Zool. xiv. p. 301 (1878); Moore, Proc. Zool. Soc. Lond. 1883, p. 319.

7. *Stictoplæa Macgregori*, sp. n.

Exp. al. 72 millim.

Female.—Rich velvety black; hind wings browner, especially towards the costa and inner margin, the latter slightly inclining to red. Anterior wings with a submarginal row of eight white dots of irregular shape, the second the largest, the fourth very minute, and the seventh and eighth approximate. Posterior wings with a submarginal row of eleven white spots (the first obsolete above), increasing in size to the seventh, at first round and then oval, the seventh and ninth the longest.

Underside paler; anterior wings with the small fourth dot obsolete; posterior wings with small pale bluish dots, one before the end of the cell, one in the first fork of the subcostal, and another in the upper fork of the median nervure; a submarginal row of eleven white spots as above, but the second, third, eighth (sometimes), and ninth with a smaller

spot obliquely beyond, nearer the hind margin, that beneath the ninth spot only separated from it by a constriction.

Body black, spotted with white; anal appendages tawny.

"Normunby Island, Oct. 18, 1888." One specimen.

Allied to *S. palla*, Butl., from Aru, which appears from the description to be identical with *S. papuana*, Reak.

SATYRINÆ.

Genus MYCALESIS.

Mycalesis, Hübn. Verz. bek. Schmett. p. 54 (1816?).

8. *Mycalesis flagrans*.

Mycalesis flagrans, Butl. Ann. & Mag. Nat. Hist. [4] xviii. p. 243 (1876).

"Rossel Island, Nov. [Oct. ?] 18, 1888."

A single worn specimen. The type was received from Port Moresby.

MORPHINÆ.

Genus TENARIS.

Tenaris, Hübn. Verz. bek. Schmett. p. 52 (1816?).

Drusilla, Swains. Zool. Ill. i. pl. xi. (1820).

9. *Tenaris Kirschi*.

Drusilla Kirschi, Staud. Exot. Schmett. p. 199, n. 16 (1887).

"Normunby Island, Oct. 30, 1888."

Two males. This species is new to the British-Museum collection. It was described by Staudinger from Port Moresby, South-west New Guinea. It is allied to *T. dioptrica*, Voll.

10. *Tenaris fimbriata*, sp. n.

Exp. al. 90 millim.

Female.—White; fore wings with the costa and apex, as far as the lowest branch of the median nervure, dark brown; hind wings with the costa, apex, and hind margin nearly to the anal angle dark brown, the upper ocellus with the small pale pupil and large yellowish ring faintly defined on the dark colour of that portion of the wing; the lower ocellus not visible above.

Underside similar; the ocelli of the hind wings well-marked, black, slightly speckled with blue, and with a small

white ocellus and a yellow ring. The upper ocellus is placed on the dark border near the edge of the ring; the lower one is placed well within the dark border and is surrounded by a brown outer ring.

Head and antennæ black; thorax grey, with a black stripe on each side and a broader and shorter one in the middle in front; pectus and legs brown, the proboscis and tarsi inclining to reddish; palpi and abdomen bright yellow, the palpi blackish above.

“Normunby Island, Oct. 30, 1888.”

Allied to *T. catops*, originally described by Prof. Westwood from a specimen from New Ireland, in Boisduval's collection. The only specimen in the British Museum agreeing with the description of *T. catops* is a female from Port Moresby, from which *T. fimbriata* differs in the broader marginal markings, the lower ocellus, which is nearly as large as the upper one, though much smaller in *T. catops*, and, what is probably of much greater consequence, the absence of any yellow colouring towards the inner margin of the hind wings.

11. *Tenaris barbata*.

Exp. al. 83 millim.

Male.—Pure white; fore wings with the inner margin convex beyond the base, the costa and apex narrowly and evenly edged with black, ceasing at the extremity of the first discocellular nervule; hind wings narrowly dusted with blackish at the tip as far as the second subcostal nervule, and again from the anal angle halfway along the inner margin, the upper ocellus showing indistinctly through, but the black, blue-dusted lower ocellus with its white pupil well marked, though the outer rings are less distinct; at the base is a large brush of reddish-brown hair, and the hair between the median and first submedian nervures is yellow for a third of the length of the wing and white beyond; the hair between the first and second submedian nervures, parallel to the dusky stripe on the inner margin, is also reddish brown.

Underside: fore wings as above; hind wings with the whole of the base from the costa to the inner margin yellow, slightly interrupted at the base of the cell; ocelli of moderate size, black, with inner crescents of blue dusting, and white pupils; the concentric rings are yellow and brown; the upper ocellus is so close to the tip of the wing that the costa cuts off half the upper edge of the outer brown ring; the lower ocellus is placed near but well within the hind margin.

Head, legs, pectus, and front of thorax above dark brown; thorax grey, with a dusky median stripe, including a short black one in front; head behind the antennæ, palpi, and abdomen yellow; palpi blackish on each side above.

"Rossel Island, Oct. 18, 1888."

A single male. This insect may be the male of *T. Jamesi*, Butl., described from a single female without further locality than New Guinea; but in this specimen the yellow is widely extended at the base of both pairs of wings above and less so below, and the outer half of the inner margin of the fore wings is blackish, instead of that of the hind wings. It is much to be regretted that insects of the genus *Tenaris* are often received singly, for it is impossible without large series from the same locality to be certain whether the numerous closely allied forms are really distinct or not, and we have therefore no alternative but to describe them provisionally as species.

12. *Tenaris affinis*, sp. n.

Exp. al. 93 millim.

Male.—Extremely similar to the last species, but the base of the fore wings is slaty grey, extending from the base nearly to the end of the cell, conterminous with the dark costa, and then crossing the median nervure, and covering the whole of the wing between its lowest branch and the submedian, and likewise the hinder angle, leaving only the inner margin white, beneath the submedian nervure, which runs white through the dusky portion of the wing to its extremity; on the hind wings the costa and hind margin are moderately broadly blackish to below the upper branch of the median nervure; the lower ocellus is larger and the outer rings on the underside are wider and darker. On the underside the yellow hair at the base is only visible between the median nervure and the inner margin, for the whole base of the fore wings and of the costa of the hind wings (for the costal edging is narrower between the base and the ocellus) is black.

The thorax is darker grey than in *T. barbata*, without black markings, and the palpi are black above.

"Rossel Island, Oct. 18, 1888."

If the single specimen had been a female I should certainly have regarded it as the female of the last. It has, however, more resemblance to *T. onesimus*, Butl., in some respects.

ACRÆINÆ.

Genus ACRÆA.

Acræa, Fabr. Illiger's Mag. vi. p. 284 (1807).

13. *Acræa ænone*, sp. n.

Exp. al. 50-51 millim.

Male and Female.—Fore wings semitransparent grey, darker along the margins and especially at the tip, with a black spot at the base of the cell and transverse black spots in its middle and at its extremity. Beyond the cell is a row of three smaller more or less confluent spots, and there are two more between the branches of the median nervure near their origin; there are also two larger spots between the median and submedian nervures, one near the base and the other above the middle of the inner margin, and a row of indistinct sagittate spots between the nervures on the hind margin. Hind wings black, with a submarginal series of eight oblong buff spots, divided by the nervures, those nearest the anal angle emarginate on the inside. The spot nearest the costa is linear and considerably produced inwards; below its inner edge descends a row of three smaller spots, divided by the nervures, and within this is another large irregular spot; in the black border is a row of obsolete tawny spots, more distinct as they approach the anal angle.

Underside similar, but on the hind wings the submarginal tawny spots are much more distinct, and there are several cream-coloured spots in the dark basal portion of the wings, which are only indistinctly indicated on the upper surface.

Body black; the palpi, two round spots on the prothorax above, a double row of spots on the sides of the abdomen, and transverse stripes beneath buff. Pouch of the female reddish.

“Eust Island, Oct. 24, 1888” (one specimen); “St. Aignan, Oct. 21, 1888” (two specimens).

Allied to the Australian *A. andromache*, Fabr.; but the latter species is larger and the buff colour extends over the whole hind wing except at the extreme base and hind margin, being divided in the middle by a single or Y-shaped row of confluent black spots.

Lycænidæ.

Genus THYSONOTIS.

Thysonotis, Hübn. Verz. bek. Schmett. p. 20 (1816).

Danis, Westw. Gen. Diurn. Lep. p. 497 (1852).

14. *Thysonotis regina*, sp. n.

Exp. al. 42-45 lin.

Male.—Wings rather broad, subdentate; costa of fore

wings strongly arched. Fore wings sky-blue, costa and hind margin bordered with black, fringes white, spotted with black at the ends of the nervures, a comparatively narrow white band, divided by the nervures, running from the inner margin to above the median nervure. Hind wings pale blue at the base, followed by a white band continuous with that on the fore wings; the outer half of the wing is black, the upper portion being filled up with blue from the white band nearly to the hind margin. Fringes white, spotted with black on the nervures.

Underside black, sometimes paler towards the margins; the white bands on the wings as above, but more sharply defined on the fore wings and continuous, a blue stripe divided by the nervures intersects the dark costal portion of the wing and curves downwards on the hind margin, where it is more macular, as far as the lowest branch of the median nervure; on the hind wings the black basal part is intersected by an oblique blue stripe, and there is another along the basal part of the inner margin; on the wide black border is a row of large oval black spots surrounded with blue.

Head white, a spot between the antennæ (which are black, spotted with white beneath) and hinder orbits pale blue; a black stripe runs from the frontal blue spot to the palpi, which are black beneath and at the tips; thorax black or brown, clothed above with shaggy white hair; legs black, tarsi narrowly spotted with white; abdomen black above, ringed with blue, and more or less blue towards the base; beneath white.

Female.—Blackish brown, with a white band, as in the male, but that on the fore wings is wider, better defined, and divided by the branches of the median nervure; that on the hind wings is narrower, so that the black border covers two thirds of the wing. The hind margin of the fore wings is more convex than in the male. The under surface differs little, but the blue submarginal band on the fore wings descends nearly to the submedian nervure.

Six males and one female taken at Normunby on Oct. 30, 1888.

Size of *T. seba*, Westw., but the male more resembles *T. danis*, Cram., in its markings and the female has the fore wings more convex and the hind wings more widely bordered with black. The under surface in both sexes is of a less greenish blue.

Papilionidæ.

PIERINÆ.

Genus EUREMA.

Eurema, Hübn. Verz. bek. Schmett. p. 96 (1818?).

Terias, Swains. Zool. Ill. i. pl. xxii. (1821).

15. *Eurema hecabe*.

Papilio hecabe, Linn. Syst. Nat. ed. x. i. p. 470. n. 74 (1758).

Two specimens, not differing appreciably from Indian ones, taken on Eust Island, Oct. 24, 1888; a third without locality.

Genus APPIAS.

Appias, Hübn. Verz. bek. Schmett. p. 91 (1818?); Butl. Cist. Ent. i. p. 49 (1869).

16. *Appias cilla*.

Pieris cilla, Feld. Reise d. Novara, Lep. ii. p. 165. n. 139 (1865).

"Normunby Island, Oct. 30, 1888."

One male, not differing from a specimen from Aru in the British Museum.

Genus BELENOIS.

Belenois, Hübn. Verz. bek. Schmett. p. 92 (1818?); Butl. Cist. Ent. i. p. 50 (1869).

17. *Belenois niseia*.

Pieris niseia, MacL. King's Surv. Austr. ii. p. 459. n. 138 (1827).

"Sudest Island, Oct. 24, 1888."

Four specimens of this common Australian insect, three males and one female. Two of the males and the female are unusually small, and the female, which expands only 41 millim., belongs to a variety (?) hitherto unrepresented in the British-Museum collection; but it cannot safely be regarded as a distinct species in a group where the males are fairly constant and the females extremely variable. The fore wings are pale to beyond the cell; but the costa, a line above the basal half of the submedian nervure, a very large oblong blotch conterminous with the costa, covering the end of the cell, and the apical third and hind margin are dark brown. The base is stained with orange as far as the level

of the black blotch which closes the cell, and the rest of the wing within the border, and a row of about six submarginal spots, of which the second and third are the largest, are white. Hind wings with the apical half and all the nervures broadly black; the cell is filled up nearly to the extremity with pale sulphur-yellow; the costa is of the same colour, faintly marked with orange, and within the fork of the median nervure is a large pale spot followed by three smaller ones and then by longer ones, the two nearest the inner margin extending to the anal angle. There is a submarginal row of orange spots, partly bordered with white, and the base below the cell and the inner margin are likewise marked with orange.

Underside similar, but the orange at the base of the fore wings is more intense and the pale markings on the hind wings are smaller, better defined, and therefore wholly macular. There is an orange mark at the base of the costa, and on the whole the underside hardly differs from that of ordinary females of *B. niseia*.

PAPILIONINÆ.

Genus PAPILIO.

Papilio, Linn. Syst. Nat. ed. x. i. p. 458 (1758); Doubl. Ill. Diurn. Lep. p. 5 (1846).

18. *Papilio pandion*.

Papilio pandion, Wall. Trans. Linn. Soc. Lond. xxv. p. 56 (1865).

Normunby Island, Oct. 30, 1888.

A single female, closely resembling Wallace's figure of *P. ormenus*, Guér. ♀ (*l. c.* pl. iii. fig. 3), but with light orange instead of red spots on the hind wings. It stands in the British-Museum collection as the female of *P. pandion*.

19. *Papilio ulysses*.

Papilio ulysses, Linn. Syst. Nat. ed. x. i. p. 459. n. 4 (1758).

A rather small male, without special locality attached.

HETEROCERA.

BOMBYCES.

Nyctemeridæ.

Genus LEPTOSOMA.

Leptosoma, Boisd. Voy. Astr., Lép. p. 197 (1832).

20. *Leptosoma integrum*.

Nyctemera integra, Walk. Cat. Lep. Het. B. M. xxxv. p. 1879 (1866).

"Rossel Island, Oct. 18, 1888."

In the British Museum from the Philippines and Ternate.

GEOMETRÆ.

Euschemidæ.

Genus CELERENA.

Celerena, Walk. Trans. Ent. Soc. Lond. (3) i. p. 71 (1862).

21. *Celerena vulgaris*.

Celerena vulgaris, Butl. Proc. Zool. Soc. Lond. 1876, p. 768.

"Normunby Island, Oct. 30, 1888." Two specimens.

In the collection of the British Museum from Port Moresby. I much doubt whether this insect is distinct from *C. perithea*, Cram., which is found in Amboina, as the width of the markings appears to be a variable character.

XVIII.—*Description of a new Stenodermatous Bat from Trinidad.* By OLDFIELD THOMAS.

MR. H. CARACCIOLA, of Trinidad, has recently sent to the British Museum some few bats which appeared to him to be of unusual occurrence there. Among these there is a specimen belonging to the genus *Vampyrops*, but representing a very striking new species, for which I propose the name

Vampyrops Caracciolæ.

Size rather less than in *V. vittatus*, Peters. Markings unusually conspicuous, the white lines, both facial and dorsal, brighter and more prominent than in any other species of the genus. General colour a uniform soft greyish brown both above and below, rather paler over the shoulders. Supra-orbital white stripes broad, nearly touching one another anteriorly, and running from just behind the nose-leaf to the posterior corner of the ear; dorsal stripe commencing on the occiput, expanding between the shoulders, and continued

quite to the base of the interfemoral. Structure of nose-leaf, ear, and tragus apparently, so far as can be judged from a skin, quite as in *V. lineatus* and *vittatus*. Ear-conch margined with white anteriorly.

Fur on the upper surface extending along the arms to the middle of the forearm, and on the wings as far as a line from the elbow to the middle of the femur. Interfemoral membrane and hind limbs thinly hairy.

Skull, except in its smaller size, very like that of *V. vittatus*, broader and heavier in proportion than that of *V. lineatus*.

Dental formula :— $I. \frac{2}{2}$, $C. \frac{1}{1}$, $P. \frac{2}{2}$, $M. \frac{2}{3} \times 2 = 30$.

Teeth (figs. 1–3).—Outer upper incisors well developed, filling up the space between the canines and inner incisors. Canines proportionally short and stout. Upper premolars and anterior molars as in *V. vittatus*. Second molars convex instead of being flattened or concave behind, owing to the total absence of $\overline{m. 3}$. Lower incisors four in number, about equal in size. Anterior cusp of the last lower premolar almost as high as the canine.

$\overline{m. 2}$ in horizontal section slightly longer than $\overline{m. 1}$; $\overline{m. 3}$ small, not so minute as in *V. bidens*, but still only about one quarter the size in section of the anterior premolar.

Fig. 1.

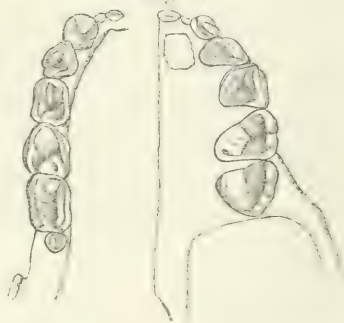
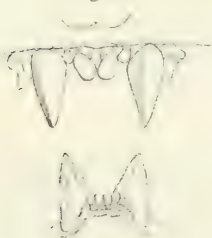
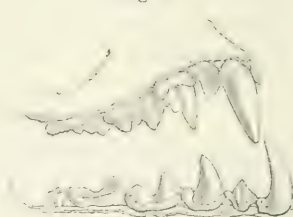
Teeth of *Vampyrops Caracciolo*.

Fig. 2.



Front view.

Fig. 3.



Side view.

Dimensions of the type, a slightly immature* specimen preserved as a skin (sex not determinable) :—

* The epiphyses of the hind limbs are not united, but the teeth are all fully exerted.

Head and body (c.) 73 millim.; ear, above crown, 9; forearm 50 (=1.96 inch); tibia 19.

Skull: basal length (c.) 20 millim.; greatest breadth 16.8; interorbital, breadth 6.2; palate, length 12.6, breadth outside $\frac{m.1}{m.1}$ 11.4, inside $\frac{m.1}{m.1}$ 6.2.

Teeth: upper canines, vertical length 3.6, greatest horizontal diameter 2.0, distance from tip of one to tip of the other 4.1; front of canine to back of $\frac{m.2}{m.2}$ 9.8; front of $\frac{m.1}{m.1}$ to back of $\frac{m.2}{m.2}$ 4.7; transverse breadth of $\frac{m.1}{m.1}$ 2.6; height of lower canine 3.3; front of canine to back of $\frac{m.3}{m.3}$ 10.3; front of $\frac{m.1}{m.1}$ to back of $\frac{m.3}{m.3}$ 5.9; length of $\frac{m.1}{m.1}$ 2.2, $\frac{m.2}{m.2}$ 2.9, $\frac{m.3}{m.3}$ 0.8.

No detailed comparison of this new species with its allies is necessary, as its dental formula ($I. \frac{2}{2}, M. \frac{2}{2}$) at once separates it from every other member of the group except the otherwise very different *Artibeus perspicillatus* and *Stenoderma achradophilum*.

In working out the relationships of this form, however, several points in connexion with the genera of the group have arisen which seem to be worthy of mention. The number of the molar teeth, a character elsewhere usually of generic importance, here only seems to be of specific value, a fact only recognized after the foundation of almost as many "genera" or "subgenera" as there really exist species. Mr. Dobson, in his invaluable 'Catalogue,' has practically adopted the later views of Prof. Peters on the subject, and has wisely only admitted such genera as are based on other characters than those of the molars; but some of the species appear to me to be referred to the wrong genera owing to the principle of ignoring the molars not being sufficiently rigidly carried out.

In comparing the two genera *Vampyrops* and *Chiroderma* Mr. Dobson says of the latter:—"This genus is undoubtedly closely allied to *Vampyrops*. . . . The form of the upper and lower first premolars is, however, very different and peculiar; the second molar in both jaws is larger than any of the other teeth; and in immature specimens a well-defined cleft extends backward from the nasal opening in the middle between the orbits."

Now, in my opinion, this last character, that of the nasal cleft, is the only valid distinction between the two genera, and the statement by Prof. Peters that it closes up in old age is simply due to his having wrongly attributed to *Chiroderma* an old individual of a species (*Phyllostoma pusillum* of Wagner) really referable to *Vampyrops*, he at that time thinking that the form and number of the molars was of more importance than the presence or absence of the nasal cleft.

But not only has *Vampyrops pusillus* (as it should be called) no cleft, but Mr. Dobson's "*Chiroderma bidens*" is also without it; and since there appears to be no generic importance in the other characters of *Chiroderma* as mentioned by him, I propose that the two species just referred to should be shifted to *Vampyrops*, which would then contain all the members of this group of bats with oblique incisors and perfect nasal regions.

The genera to which the new Trinidad bat is most nearly allied may therefore be arranged as in the following synopsis:—

A. Palate continued some way behind molars.

- a. Middle upper incisors vertical 1. *Artibeus*.
- b. Middle upper incisors oblique.
 - a'. Nasal region not cleft 2. *Vampyrops*.
 - b'. Nasal region cleft 3. *Chiroderma*.

B. Palate not continued backwards behind molars.

- c. Palate emarginate to level of $\frac{m. 1}{m. 1}$. Crown not unusually elevated 4. *Stenoderma*.
- d. Palate emarginate to level of $\frac{m. 3}{m. 3}$. Crown much elevated above muzzle 5. *Ametrida**.

The enlarged genus *Vampyrops* may then be arranged as follows:—

A. Molars $\frac{3}{3}$.

- a. Forearm about 60 millim. Front of canine to back of $\frac{m. 2}{m. 2}$ 12-13 millim. 1. *V. vittatus*, Ptrs.†
- b. Forearm 52 millim. 2. *V. infuscus*, Ptrs.
- c. Forearm 35-43 millim. Front of canine to back of $\frac{m. 2}{m. 2}$ about 8 millim. 3. *V. lineatus*, Geoff.

B. Molars $\frac{2}{3}$.

- d. Incisors $\frac{2}{2}$. Front of canine to back of $\frac{m. 2}{m. 2}$ 9.8 millim. 4. *V. Caraccioloæ*, Thos.
- e. Incisors $\frac{2}{1}$. Front of canine to back of $\frac{m. 2}{m. 2}$ 6.4 millim. 5. *V. bidens*, Dobs.

C. Molars $\frac{2}{2}$.

- f. Forearm 35 millim. 6. *V. pusillus*, Wagn.

* From which *Sphæronycteris*, Peters (MB. Ak. Berl. 1882, p. 987), is very doubtfully separable.

† With which *V. Helli*, Ptrs., is synonymous; see Alston, Biol. Centr.-Am., Mamm. p. 48 (1879).

XIX.—*A few Remarks respecting Insects supposed to be distasteful to Birds.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

THE question as to the distasteful nature of certain insects and their larvæ has of late years occupied the attention of several eminent naturalists, and certainly is one worthy of consideration.

Many years ago I published an account of experiments which I had recorded touching the refusal of certain caterpillars &c. by lizards, frogs, and spiders: the attention which that paper of mine has since received has been interesting, as showing how very little has since been done by naturalists either to prove or disprove the truth of the theories based thereon.

The other day I was reminded by a simple occurrence of the fact that two years ago Mr. Poulton asked me to take careful notes of all insects and their larvæ or pupæ which were accepted or rejected by my birds (if I remember rightly I had at the time about 108 birds), and to send the notes to him, to assist him in more thoroughly investigating the subject. This I did most conscientiously, not even retaining a copy of my notes, but so far nothing seems to have come of it; I presume therefore that my facts have rather tended to mystify than clear the matter up, for the following reason:—

My experience ever since I have kept birds—nearly six years—has been that no insect in any stage was ever refused by all the birds, what one bird refused another would eat*; but the other day I thought I had discovered a moth which no bird would touch—*Zenzera asculi* ♀. I threw it into my aviary of insectivorous birds, and they positively showed fear of it; the Grey Wagtail inspected it askance from a yard's distance, but flew off in a fright when the moth moved; at the end of half an hour I took it away and gave it to my Missel-Thrush, who behaved exactly as I had seen him do to the stag-beetle (*Lucanus cervus*), standing almost on tiptoe, giving it a sudden peck, and immediately jumping back; finding, however, that no harm resulted from his boldness, he presently plucked up courage, pulled it to pieces, and devoured it, apparently with the greatest satisfaction. What is there in a wood-leopard moth to produce fear in a bird? Certainly not the smell, for both Missel-Thrush and Blackbird

* Possibly *Zygæna* and *Procris* may be exceptions; I have had none lately.

at once attack *Cossus ligniperda*, and although it is evidently not relished by them, my blackbird devoured one and thereby made his cage offensive for weeks. There must, I think, be something startling to birds in the violent black and white contrasts in the colouring of the moth which makes them hesitate to touch it.

The idea that metallic colours are a protection to insects is a mistake; they are rather the reverse. A bird knows nothing of the nature of metal, but whatever is brilliant and shining he makes for at once, to see whether it is good to eat; all insectivorous birds, excepting, I think (but Mr. Poulton has my notes and can correct me if I am wrong), the Wryneck, will eat the golden chrysalides of *Vanessa urticae*, and as for those bright metallic moths, the *Plusie*, they are devoured immediately, as I found quite recently when I turned *P. chrysitis* into my outside aviary and the Grey Wagtail seized and tore him to pieces directly he settled.

As a rule it may be taken for granted that finches, omitting birds with such bunting-like habits as the type of *Fringilla* and the Waxbills, are very slightly insectivorous, and therefore are very particular as to what they eat. Thus the Linnet group, including the Canary, will occasionally eat small green caterpillars, the Goldfinch group, including the Siskin, will eat aphides in abundance and probably also green caterpillars; the Chaffinch and Brambling, on the other hand, which more nearly resemble the Buntings in their mode of progression, are both ravenous insect-eaters, quite as much so as the Nonpareil, Indigo Finch, or Weaver-birds.

Of truly insectivorous birds the Thrushes and their allies the Robins, including the Nightingale, are the least particular, the Missel-Thrush and Blackbird even eating without hesitation the most hairy of hairy caterpillars, merely waiting to rub off the bristles before swallowing them; the Wryneck, on the other hand, is extremely dainty.

It therefore appears to me that certain species of Lepidoptera and of other insects may become abundant in certain years owing to the temporary scarcity of their particular enemies, but that never do they enjoy perfect immunity from destruction.

Before closing these remarks I wish to disabuse entomologists of the notion that the spider-like appearance of the larva of *Stauropus* is intended as a protection against birds. If there is one thing that all insectivorous birds love it is a spider; unless he is at the point of death the sight of a spider will rouse even a sick bird to activity; the shout of pleasure which a Bulbul gives when you offer him a spider is alone

sufficient evidence of the absurdity of supposing that because the Arachnida are terrible to women they must therefore be equally alarming to birds.

The sting-like tentacles of the larva of *Dicranura vinula* are likewise no protection; three young Nightingales, which I had the year before last, never hesitated for a moment to use the tentacles as handles to assist them in knocking the life out of the caterpillar before devouring it.

XX.—*Diagnoses of new Shells from Lake Tanganyika.*

By EDGAR A. SMITH.

A SMALL series of shells from Lake Tanganyika has lately been purchased of Mr. Coode Hore by the British Museum. Among other interesting specimens are some very remarkable varieties of *Neothauma tanganyicense*, considerably larger and more finely developed than those originally described and showing also much variation in form. After careful consideration I cannot but regard all the five described species* of this genus as modifications of one and the same variable form.

The collection also contains some very fine examples of *Pleiodon Spekei*, Woodward, *Spatha tanganyicensis*, Smith, and *Unio Burtoni*, Woodward, fresh specimens of *Limnotrochus Kirki* but without opercula, a large form of *L. Thomsoni*, and a large, solid, tabulated variety of the ever variable *Paramelania nassa*. Taking the extreme forms of the last species, it seems impossible to regard them as belonging to the same species; yet in large series it becomes impossible to draw reasonable lines of specific limitation. Bourguignat in his absurd manner has already created twenty-three so-called species out of this remarkable shell!

Some specimens of *Spekia zonata*, Woodward, fortunately contain the operculum, which has not previously been observed.

It has the appearance of being rather small in proportion to the size of the shell. It is of a long ovate form, concave externally, concentrically striated except near the central nucleus, where it is paucispiral. The lower surface has a smooth glossy margin, broader on one side than on the other, and the muscular impression is dull, ovate, and marked with concentric lines of growth.

* *Vide* Grandidier, Bull. Soc. Mal. France, vol. ii, pp. 162-164; Bourguignat, Moll. terr. et fluv. du lac Tanganyika, 1885, pp. 25-29.

It is much of the same character as that of *Tanganyicia rufifilosa*, Smith, but is still more like a miniature of *Paramelania Damonii*, Smith.

Syrnolopsis carinifera.

Testa elongata, cylindracea, superne acuminata, subpellucido-alba, imperforata; anfractus 9, primi tres læves, convexi, cæteri carinis validis duabus (una infra, altera supra suturam) instructi, inter carinas plani, fere læves, ultimus circa medium bicarinatus; apertura irregulariter subauriformis, longit. totius $\frac{1}{4}$ subæquans; peristoma continuum, margine externo late sed haud profunde sinuato, inferne producto, margine infra columellam quoque late sinuato, marg. columellari incrassato, in medio plica valida instructo.

Longit. 7, diam. 2 millim.

Var. Testa minor, carinis in anfractibus inferioribus plus minus obsoletis.

This species also has two palatal liræ, like *S. lacustris*, the typical species of the genus; but they are invisible unless the labrum is broken away for some distance. The texture and carinæ recall the genus *Pyrgula*, but the columellar fold &c. distinguish it. There is considerable difference between extreme forms of this species both in size and in the strength of the carinations. The smallest examples are not much more than half as long and broad as the largest, although they consist of as many whorls.

Reymondia minor.

Testa imperforata, ovata, superne acuminata, nitida, subpellucido-alba, zona lata pallide fuscesciente infra suturam opaco-albo marginatam cineta; anfractus 7 sensim accrescentes, læves, leviter convexi, ultimus in medio obtuse subangulatus, antice leviter ascendens; apertura ovata, superne leviter acuminata, longit. totius $\frac{2}{3}$ adæquans; perist. continuum, incrassatum, margine externo levissime expanso, columellari callo albo instructo.

Longit. $6\frac{1}{2}$, diam. 3 millim.; apertura $2\frac{1}{3}$ longa, $1\frac{1}{2}$ lata.

The general tone of this species is a very pale brown. On close inspection, however, the colour is not uniform throughout the shell. A very narrow, opaque white line revolves up the spire beneath the suture; below this there is a broad but indistinctly defined light-brownish zone, and on the body-whorl a second is feebly observable around the base, the interval between the two zones being semitransparent white.

Under a very strong power excessively fine spiral striæ are discoverable in well-preserved specimens.

Reymondia tanganyicensis.

Testa minima, imperforata, ovata, superne acuminata, polita, sordide cornea, infra suturam lineis duabus angustis cineta (una nivea, altera inferiore sed contigua nigrescente); anfr. 5, convexiusculi, ultimus magnus; apertura irregulariter ovata, superne leviter acuminata, longit. totius $\frac{1}{2}$ subæquans; peristoma paulo incrassatum, margine externo leviter patulo, columellari valde incrassato, expanso, superne labro callo tenui juncto.

Longit. $3\frac{1}{2}$, diam. $1\frac{2}{3}$ millim.

This little shell appears to agree with Bourguignat's genus *Girandia* and is probably closely allied to his *G. preclara*. That genus and *Baizea*, also described by Bourguignat, appear to be founded upon very trivial characters and not well distinguishable from *Reymondia*. Indeed, I am almost inclined to believe that all of these so-called genera could well have been dispensed with until more is known about the various species which compose them. The well-known genus *Hydrobia* would, at present at all events, serve well for their reception.

Rissoa (Horea) Ponsonbyi.

Testa parva, ovata, superne acuminata, imperforata, vix nitens, dilute fusco-grisea; anfractus 7, convexiusculi, striis spiralibus numerosis, lineisque incrementi obliquis distinctis plus minus cancellati, sutura subprofunda sejuncti, ultimus subglobosus; apertura inverse auriformis, longit. totius $\frac{1}{2}$ fere æquans; labrum intus incrassatum, levissime patulum; columella infra medium albo callosa, superne callo tenuissimo labro juncta.

Longit. $6\frac{1}{2}$, diam. $3\frac{3}{4}$ millim.; apertura $3\frac{1}{2}$ longa, $1\frac{2}{3}$ lata.

The colour and sculpture of this interesting species recalls certain forms of *Plecotrema*, e. g. *Pl. concinna*, H. and A. Ad., *P. monilifera*, H. Ad., &c.

I have created a new section of Rissoidæ for it, as it does not conveniently associate itself with any of the known groups, and this (*Horea*) I have named in honour of Mr. E. Coode Hore, the discoverer of this and many other new and interesting Tanganyikan shells. It may thus be characterized:—

HOREA, subgen. nov.

Shell small, ovate, transversely striated, and cancellated by oblique lines of growth. Aperture with a thickened peristome; columella also thickened. Operculum unknown.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

June 19, 1889.—Prof. J. W. Judd, F.R.S.,
Vice-President, in the Chair.

The following communications were read:—

1. "The Descent of *Sonninia* and of *Hammatoceras*." By S. S. Buckman, Esq., F.G.S.

The Author reviewed the history and literature of the genus *Sonninia*, Bayle, which was founded to receive the Ammonites of the *Sowerbyi*-group, formerly classed, together with those of the *Insignis*-group, in the genus *Hammatoceras*.

The reasons why the genus *Sonninia* is not descended from *Hammatoceras*, or from *Hangia* (*Variabilis*-group), were set forth. Then, proceeding to trace out the life-history of *Pleuroceras*, *Amaltheus*, and *Sonninia*, as shown by their inner whorls, the Author arrived at the conclusion that these three genera were descended from a common source, and that they form three branches from one stem.

The development of the genus *Hammatoceras*, *sensu stricto*, was then traced out, and its descent shown to be from the genus *Deroceras*, which is in accordance with the general ideas upon the subject.

The difference in the descent of *Sonninia* and *Hammatoceras* was taken to justify the separation of the former from the latter. The genus *Sonninia* would be correctly placed in the family Amaltheidæ; while the genus *Hammatoceras* would be placed in the same family as *Stephanoceras*.

Of the numerous new species belonging to the genera *Sonninia* and *Hammatoceras*, certain forms, necessary to elaborate the ideas set forth above, were described and definitely separated. The paper also touched upon certain other facts connected with *Hammatoceras*, *Sonninia*, and cognate genera.

2. "Description of some new Species of Carboniferous Gastropoda." By Miss Jane Donald. (Communicated by J. G. Goodechild, Esq., F.G.S.)

The Gastropoda described in this paper have, with one exception, been collected by Mr. John Young from the Upper Limestone Series of Scotland. After discussing the characters of the genus *Orthonema*, Meek and Worthen, the following forms were described:—*Orthonema pygma*, n. sp.; *O?*, n. sp.; *Murchisonia turriculata*, de Kon. (Yoredale Shales, Askrigg, Yorkshire); *M. turriculata*, var. *scotica*; and *M. compacta*, n. sp.

3. "*Cystechinus crassus*, a new Species from the Radiolarian Marls of Barbadoes; and the evidence it affords as to the Age and Origin of those Deposits." By J. W. Gregory, Esq., F.G.S.

In this paper the discovery of a species of *Cystechinus* from the Radiolarian earth of Barbadoes was recorded. The specimen is now preserved in the National Collection, South Kensington. The form was described and distinguished from the three modern species which were found during the 'Challenger' Expedition. The latter have shown that the bathymetrical range of the genus is from 1050 to 2225 fathoms.

The Author gave proofs that the specimen really came from the Radiolarian marl, and not from the overlying Coralline limestone, and after discussing the age of the marl, as inferred by Prof. E. Forbes from an examination of the Mollusca, and by Prof. Haeckel after studying the Radiolaria, gave his reasons for supposing that it is in reality more modern than these authors supposed, and may be referred to the Pliocene or Pleistocene.

Though *Cystechinus crassus* possessed plates of greater thickness than those of the previously described species, the ambulacra were apetaloid, and the Author concluded that though an inhabitant of seas of less depth than those in which the modern forms occur, it may be fairly considered to have been a dweller in deep seas, and to indicate that the Radiolarian deposit is a true deep-sea ooze.

MISCELLANEOUS.

A new Marine Larva and its Affinities.

By J. WALTER FEWKES *.

[Plate VII. fig. 4.]

THERE are in the waters of the Atlantic, near the coast of the United States, a large number of marine larvæ, very different from characteristic larvæ of the European seas, of the adult state of which the naturalist is in profound ignorance †. The adults of these larvæ may have been described and figured, and may be well known, but from the fact that many young marine animals are so different from the adults their relationship is unsuspected, although both mature and immature stages are known. It is certainly a desirable thing to trace these larvæ to their parents as a part of the great study of the metamorphosis of marine animals. This special line of zoological work has many attractions to an earnest band of working naturalists,

* From 'The Microscope' for June 1888.

† Conversely also we are ignorant of the young of a much larger number of adult animals of our seas and bays.

and offers remarkable possibilities for discovery. The same branch of marine research has been prosecuted for many years on the shores of the North Sea and the Mediterranean, and a large number of larvæ, known to be such, but which have as yet not been raised into adults, have been described and figured. This provisional nomenclature of a larval animal known to be such has been a means of attracting the attention of other naturalists to the larva, and in many instances has led to the discovery of the adult.

The larval forms of marine animals of the coast of New England are varied in form and rich in number. They are as different from those of Europe as the fauna of our bays and sounds is different from the European. We have few descriptions of these larval animals from our waters, and so different are they from the European that it is hard, almost impossible, to identify them. Shall we give these undoubted larvæ new names which shall be provisional, or shall we delay publication until we have traced them to the adults? Something is to be said in favour of both courses; but a description of a new stage of a larva by one observer may attract the attention of another naturalist, and fit into a series of observations otherwise complete, thus leading to a discovery which neither alone could possibly make from the material at his command.

The object of the present paper is to record a brief notice of an unknown larva of peculiar morphology found in the Bay of Fundy. Its general affinities are apparent and will be spoken of later; but its special relationship is unknown. It is hoped that this mention may meet the eyes of those interested in the study of the metamorphosis of the marine animals of the United States, and attract the attention of some one who may be able to add to our limited knowledge of it. No more interesting questions can at present be raised, so far as the determination of the facies of our marine fauna is concerned, than those which deal with the identification of the larval forms of life which inhabit the populous waters of our coast.

A number of naturalists have expressed the belief that the larvæ of some Annelids are closely related to the young of certain Bryozoa, and have supposed that the phylogenetic history of the two groups is closely interwoven. A young Chaetopod, which combines many characters of the larvæ of the Bryozoa, is called *Mitraria*. While several of the features which distinguish this larva are undoubtedly secondary modifications and are of little phylogenetic importance, the general form of *Mitraria* is believed to approach closely the prototype or ancestral form of both the Chaetopods and the Bryozoa, if not of the Brachiopods and other related groups. It is the purpose of the present paper to consider the form of a larva allied to *Mitraria* from the Bay of Fundy, and to call attention to the interest attached to the study of this interesting animal.

A true *Mitraria* has never been described from the coasts of North America. I have found specimens of this genus at the Bermudas and at Santa Cruz, California; but neither of these have been figured or described. No other naturalist has recorded *Mitraria* from American waters, and but few have found it in European seas.

It is consequently with great pleasure that I am able to figure for the first time a beautiful *Mitraria*-like larva, which is found in abundance in the cold waters of the Bay of Fundy. This larva does not occur south of Cape Cod, although it is represented in the waters of Massachusetts Bay at Provincetown, Mass. It is different in form from the European representative, of which, in truth, considering the part which it has played in discussion of the affinities of larval forms of animals, too little is known.

My new larva was first taken by means of the drag-net or tow-net in the summer of 1886. I first found it at Frye's Island, New Brunswick, and afterwards it was taken at Grand Manan. The larva occurred in countless multitudes in July, and later decreased in numbers, but was collected far into August. Later than August, however, I have never seen *Mitraria* in the nets, although it may and probably does last long into the autumn. The following description will give an idea of the general contour and structure of the body of my new larva.

The body (Pl. VII. fig. 4) is hat-shaped, with a narrow rim, gelatinous and transparent. When contracted the equatorial rim or belt of the worm is drawn to the body, imparting a spherical form to the animal.

There are two ciliated regions of the body. One of these is situated at the apex of the larva, forming a small tuft of cilia, shown in fig. 4. The second ciliated region is found on the rim of the larva, forming a belt skirting the outer border. This second region or ciliated belt is conspicuous on account of the masses of reddish pigment shown in the figure.

Hanging down from the pole of the larva, opposite the apical tuft of cilia, there is a bifid protuberance, from which arise two fan-shaped bundles of provisional setæ. These setæ resemble the embryonic setæ so common in larval Chaetopods. They can be drawn together or separated, and are always very conspicuous. Above the protuberances from which the spines arise there is a spherical darkly pigmented body easily seen through the walls of the larva.

Under the apex of the larva there is a thickening of the epiblast which is connected with the marginal belt by means of a fine thread, shown in fig. 4. The apical tuft of cilia rises from this epiblastic thickening. The digestive system of our larva is very simple, and its yellow walls are readily seen through the sides of the body. It consists of a long tubular œsophagus, the inner wall of which is richly ciliated, opening into an elongated stomach, simple and without cilia*. The mouth lies just inside the ciliated rim or belt, and is separated from the stomach by the globular body, at the base of the spine-bearing protuberance on the lower pole of the larva.

The larva is, when expanded, from .15 to .2 millim. in diameter.

Only a single stage in the growth of this larva was found, and consequently its adult form is unknown.

* No external opening of the stomach through an intestine was observed.

The question now arises, What are the affinities of the curious larva described above? It has Chaetopod, Brachiopod, and Bryozoan features, and may be supposed to resemble the archetype or ancestral form of these three groups.

I was at first led to regard it as the young of the genus *Terebratulina* *, a Brachiopod common in the Bay of Fundy. It differs, however, very considerably from any figure of a Brachiopod which I have ever seen, although in some features it recalls *Argiope*. It also resembles somewhat *Cyclopelma*, the young of *Loxosoma*, often-times regarded a Bryozoan. Its closest affinities appear to me to be with *Mitraria*, a larva which Metschnikoff has already shown to belong to the developmental stages of a Chaetopod annelid. It differs, however, considerably from *Mitraria*, and its true affinities, whether with Brachiopods or Chaetopods, must be discovered by later investigation.

Balfour, in his well known 'Comparative Embryology,' has sagaciously suggested that *Pilidium*, a larval form of certain Nemertean worms, reproduces the larval prototype in the course of its conversion into a bilateral form. Other naturalists have carried the idea still further, and find the *Pilidium* to represent a definite stage in the development of several groups of marine larvæ. While I cannot subscribe to many of the statements made by the several naturalists who have written on this subject, it seems to me not improbable that Balfour's interpretation of the signification of the *Pilidium* as a definite ancestral stage may be considerably amplified, and that the *Pilidium* or a *Pilidium*-like larva may be recognized in other groups than that of the Nemerteans. The well-developed *Pilidium* is probably more or less modified by secondary characters; but the essential form of the young *Pilidium* is probably ancestral for several groups of marine animals.

Following the *Pilidium*-stage in the groups of Brachiopods, Chaetopods, and Bryozoa is one which we may call the *Mitraria*-stage. It is thought to be assumed, possibly in a modified form but with certain general features which are characteristic, by the young of certain genera of each of the three groups mentioned.

It is the opinion of the author that while the beautiful *Mitraria*-like larva here figured has many secondary characters which are not ancestral for the Bryozoa, Chaetopoda, and Brachiopoda, it also has features which are phylogenetic for the three groups. Considering, then, the *Pilidium* as a stage following the gastrula, the next stage in these groups may not be unlike the *Mitraria*. This stage, which may be looked upon as a common one in the three groups named, adds to the gastrula, among other features, the following:—1. An apical tuft of cilia mounted upon an epiblastic thickening; 2. A mouth surrounded by a ciliated rim; 3. A protuberance near the mouth from which arise embryonic setæ.

* It cannot be asserted dogmatically that my new larva is not a Brachiopod; but it differs essentially from the larval Brachiopods which have been described.

While undoubtedly some of the characters of the *Mitraria* indicated above are secondary and special adaptations of limited distribution, it is believed that the majority are ancestral for Brachiopods, Bryozoa, and Chaetopods, and that the common ancestor of these three groups is most closely preserved to us in the genus *Mitraria*. I therefore suggest as a name for the common ancestor of the Brachiopods, Chaetopods, and Bryozoa that of *Mitraria*, which up to the present is applied simply to the larval form of a single genus of Chaetopoda.

Museum of Comparative Zoology,
Cambridge, Mass.

Aspidophryxus Sarsii, Giard and Bonnier.

By the Rev. A. M. NORMAN, M.A., D.C.L., F.L.S.

The July 'Annals' contains a translation of the description of this parasitic Isopod, which I had placed in the authors' hands. It is, however, erroneously stated that the *Erythropus microphthalmus* upon which it occurred was "dredged by G. O. Sars himself upon the Norwegian coast," and the *Aspidophryxus* is said to "have been determined as *A. peltatus* by G. O. Sars." I know not how the authors can have fallen into this error. The host with its parasite was dredged by myself in 1882 in Solems Fiord, Florø, Norway, among dead *Zostera* in 5 fathoms, and was named by me *A. peltatus*, as it appeared to be that species when still in the host, and while therefore those small differences on which Messrs. Giard and Bonnier have felt justified in establishing a new species were not visible. I have thought it just to correct the statement that my friend Prof. G. O. Sars had identified it as his *A. peltatus*.

July 15, 1889.

The Sepiolæ of the French Coasts. By M. A. GIARD.

The author refers to the two species supposed to be most abundant in the Pas de Calais, namely *S. atlantica* and *S. Rondeleti*, and notes that since the researches of Peters (in 1842) it has been supposed that the ink-bag in *S. Rondeleti* presents different forms at different seasons, being trilobate at the time of breeding and simple during the rest of the year. The modifications undergone by the organ in this respect were regarded by Peters as so important that at the first glance they might be regarded as of generic value. Girod (in 1882) confirmed Peters's opinion and extended it further to *S. atlantica*.

Steenstrup, in a memoir on the Mediterranean species of *Sepioida* (Overs. Kongl. Dan. Vidensk. Selsk. Forh. 1887, pp. 47-56), describes the results of an investigation of a great number of types from various localities and collected at different seasons, and shows

that the ink-bag does not present the modifications supposed to occur in it, but that the form of the bag corresponds to other characters of systematic importance and also frequently to a different habitat.

The following table, taken from Steenstrup's 'Notæ Teuthologicae,' furnishes an

*Analytical Key to the Species of the Genus Sepiola from the
Mediterranean, the Atlantic, and the North Sea.*

- | | |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| A. Ink-bag trilobate or auriculate; fins exceeding in length the half of the mantle (equal to $\frac{2}{3}$ of the mantle). | |
| a. Suckers of all the arms biseriata | 1. <i>S. Rondeleti</i> , Leach. |
| b. Suckers of the ventral arms pluriseriate (4-seriate) at the apex; suckers of the other arms biseriata | 2. <i>S. atlantica</i> , d'Orb. |
| B. Ink-bag simple or pyriform; fins nearly equalling half the mantle, but never longer than half. | |
| a. Suckers of all the arms biseriata | 3. <i>S. Petersi</i> , St. |
| b. Suckers of the ventral arms pluriseriate at the end; suckers of the other arms biseriata | 4. <i>S. scandica</i> , St. |
| | 5. <i>S. Oweniana</i> , d'Orb., St. |

All these species (1-5) differ from each other by the clubs of the tentacles, as regards the relative size of the suckers, and the number of longitudinal series and of the teeth in the horny rings. *S. Oweniana*, especially, differs from all the rest in the very small suckers of its clubs. The valve of the funnel in the males is half or one third of the size of that of the females; it seems to be entirely wanting in the male of *Sepiola scandica* (?=*S. Rondeleti* of the English and Scandinavian faunas). The species with long fins (1 and 2) have lanceolate cultriiform sepiostega. Those with short fins (3-5) have narrow, linear, or setiform sepiostega, to some extent resembling those of the type species of the genus *Mioteuthis*, Verrill. The other species of that genus are referred by Steenstrup to a new genus under the name of *Euprymna*.

The commonest species in the North Sea and the Pas de Calais is *Sepiola atlantica*, d'Orb. At Roscoff *S. atlantica* seems to be less common, and the dominant form is *S. Rondeleti* or *S. scandica*, both of which occur. From a statement of M. Girod it seems probable that *S. Oweniana* also exists at Roscoff.

According to M. Girod a specimen of *S. atlantica* obtained by dredging had the ink-bag simple: all the individuals seen by the author had it trilobate. M. Girod based his identification solely upon the *pluriseriate suckers*, the possession of which combined with the simple ink-bag is shown by the above table to lead to *S. Owen-*

iana, a species hitherto regarded as exclusively Mediterranean. It would be very interesting to see whether the individuals with pluri-seriate suckers and simple ink-bag agree in other characters with *S. Oweniana*, or whether they represent in the Atlantic a parallel form related to *S. Oweniana*, as *S. scandica* is to *S. Petersi*.—*Bulletin Scientifique*, 1889, pp. 171-175.

Note on Mr. Williams's Paper on a new Species of Ampullaria.

By EDGAR A. SMITH.

In the last number of these 'Annals' Mr. J. W. Williams, in his "Note on a new Species of *Ampullaria* from the La Plata," observes:—"I have, in company with Mr. Edgar Smith, examined the species belonging to this genus which are in the National Collection, and not found one to which this present shell could be referred."

This statement, although partly correct, but published without my knowledge, seems to imply that I also am of opinion that the Museum does not contain the species in question.

Of this I am not at all certain, for I well remember that Mr. Williams's study of the Museum series was very brief—nor did he examine the South-American *Ampullariæ* contained in the d'Orbigny collection.

It seems to me improper to cite my name apparently in support of the validity of the supposed new species without warning or permission. A museum official in assisting a visitor or student does not, without a distinct request, pledge himself that any species brought for comparison is or is not contained in the Museum!

Acanthodian Fishes from the Devonian of Canada.

By A. SMITH WOODWARD.

The known geographical distribution of the extinct Acanthodian fishes is gradually becoming extended by their discovery both in Canada and in Siberia; but the only genus hitherto definitely determined outside the European area is the typical *Acanthodes*. It is therefore interesting to note that fragmentary evidence of a remarkable generic type, first distinguished in the Lower Old Red Sandstone of Forfarshire, has lately been described and figured* from a corresponding horizon at Campbellton, New Brunswick; and the circumstance seems worthy of a brief special notice, since the relationships of the fossils in question are misinterpreted and unrecognized by their discoverer. These specimens are triangular dermal spines, more or less elongated, laterally compressed, marked with longitudinal ridges

* J. F. Whiteaves, "Illustrations of the Fossil Fishes of the Devonian Rocks of Canada.—Part II.," Trans. Roy. Soc. Canada, vol. vi. sec. iv. (1889), pp. 95, 96, pl. x. figs. 3, 4.

and furrows, and exhibiting some indications of posterior denticles; no smooth base of insertion is distinguishable, and the variation in relative length and breadth in the fossils is very striking. Three of the stouter examples figured are named *Ctenacanthus latispinosus*, and compared with the so-called *Ctenacanthus ornatus*, Ag., while a fourth spine, more slender, is recorded as *Homacanthus gracilis*. If, however, these fossils be compared with the spines of the Acanthodian *Climatius*, as elucidated by Egerton * and Powrie †, there will be observed to exist the closest agreement in every respect: the shape and ornamentation of the spines is similar; posterior denticles are known in certain of the spines of at least one Scottish species ‡; and there is no more variation among the Canadian fossils than is exhibited in the dermal armature of a single individual of any species. *Climatius*—or some genus undistinguishable from *Climatius* by its spines—thus occurs in the Lower Devonian of the New World exactly as in the Old, and the Canadian species will at present retain the provisional name of *Climatius latispinosus*.

Note on Palinostus, Spence Bate.

By Prof. T. JEFFERY PARKER, F.R.S.

In Mr. Spence Bate's Report on the Macrura of the 'Challenger,' which has just reached me, I find that the author proposes to place certain species of *Palinurus*, viz. *P. Lalandii*, *P. frontalis*, and *P. Hügelii*, in a new genus *Palinostus*.

I should like to point out that this group is precisely equivalent to my subgenus *Jasus*. Nearly six years ago I proposed to restrict the name *Palinurus* to those of the "Langoustes ordinaires" in which the rostrum is vestigial and the stridulating organ present, and to place those in which the rostrum is well developed and provided with "clasping processes" and in which there is no stridulating organ in a new subgenus *Jasus*. This name has therefore priority over *Palinostus*.

My paper on this subject is contained in the sixteenth volume (1883) of that little-known publication 'The Transactions of the New-Zealand Institute,' and is referred to in the 'Zoological Record' for 1884.

Dunedin, N. Z.,
May 28, 1889.

* Sir P. Egerton, "Figs. and Descrips. Brit. Organic Remains" (Mem. Geol. Surv. 1861), dec. x. pp. 65-68, pl. viii.

† J. Powrie, Quart. Journ. Geol. Soc. vol. xx. (1864), pp. 420-423; also Trans. Edinb. Geol. Soc. vol. i. (1870), pp. 295-297, pl. xiii. fig. 10, pl. xiv. figs. 11-13.

‡ *Climatius uncinatus*, Powrie.

THE ANNALS

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[SIXTH SERIES.]

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XXI.—*On the Organism of the Siphonophora and their Phylogenetic Derivation: a Criticism upon E. Haeckel's so-called Medusome-theory.* By Professor CARL CLAUS *.

As is well known, opinions as to the interpretation of the Siphonophora diverge in two directions, a number of naturalists regarding them, after the example of C. Vogt and R. Leuckart, and in accordance with the latter's theory of polymorphism, as free-swimming Hydroid-stocks with Polypoid and Medusoid individuals, while other zoologists adhere to the older conception of Eschscholtz and Huxley, and, aided by the image of a proliferating *Sarsia* (Metschnikoff), refer the organism of the Siphonophore to the Medusa. I endeavoured, as long since as 1860 †, to demonstrate the correctness of the former view; but more recently, in two memoirs, I have pointed out what is common to the two theories and sought to combine them. The same thing has lately been done, although partly from other points of view, by Haeckel in his 'Report on the Siphonophoræ collected by H.M.S. 'Challenger' during the years 1873-76,' so rich in descrip-

* Translated from a separate copy, furnished by the Author, of the memoir published in the 'Arbeiten des Zoologischen Instituts der Universität Wien,' tom. viii. Heft ii. pp. 159-174 (1889).

† "Ueber *Physophora hydrostatica*," in Zeitschr. f. wiss. Zool. Bd. xii. *Ann. & Mag. N. Hist.* Ser. 6. Vol. iv.

tions of interesting and previously unknown forms, as also in a previously issued extract from this work*, in which he develops a mediatory theory, uniting, in the opinion of its author, the true constituents of the two older theories, whilst eliminating their errors, and for the first time revealing the true nature of the Siphonophora.

Haeckel has very cleverly succeeded in giving an appearance of novelty and speciality to his "*Medusome-theory*," as he calls it, by placing in the foreground, in the definition of the two theories, certain subordinate points, and, in accordance with this, employing new designations which conceal the *essence* of the theories. The first is indicated as the *poly-person* theory, the second as the *poly-organ* theory; and it is asserted of the two that they are still, as formerly, in absolute opposition to each other. According to the latter the Siphonophore is a simple Hydromedusoid person, therefore a morphological individual of the third order; while according to the other, which affirms the derivation from polypes, it is a swimming hydropolyp stock or a morphological individual of the fourth order. Such a conception, however, by no means represents the true state of affairs, but is a one-sided representation, obscuring the essence of the question, which, in the light of our notions as to the relation of Medusa and Polype, obtained by more recent investigations, must be regarded as incorrect.

In accordance with these notions the theory of polymorphism founded by Leuckart could by no means be sustained unaltered in its old form and conception; and just as the supposed absolute opposition of poly-persons and poly-organs has long since been swept away, it is also no longer admissible to deduce from the reference of the Siphonophore to a swimming Hydroid stock "the philosophical corollary that the whole class sprang from Polypes."

Any one who is to some extent informed upon the subject of the Cœlenterata will at once see that the theory which in the Siphonophore goes back to the Medusa, and which therefore may perhaps be best designated the *Medusa-theory*, also by no means involves as a necessary conclusion that the Siphonophore is to be regarded as an individual of the third order in Haeckel's sense. For, although the starting-form for the morphological formation of the larva is a Medusa from which, by continual gemmation of new Medusæ or parts of Medusæ, the appendages of the Siphonophore were developed, the Siphonophore, in the same way as the *Sarsia*-stock

* "*System der Siphonophoren auf phylogenetischer Grundlage*," in *Jenaische Zeitschr. f. Naturw.* Bd. xxii. (1888).

which is produced by the proliferation of daughter-Medusæ upon the parent animal, must, by the sprouting forth of a great number of new Medusæ and their dislocated parts upon the body of the primary Medusa, become a stock or cornus, an individual of the fourth order in Haeckel's sense. The central point of the controversy lay, not in the question between person and animal-stock, but in the issue, prescriptive as to the interpretation of the larva, from the Hydromedusa or from the *swimming Hydroid-stock*. But even in the latter case the Hydromedusa continues to be the sexual animal giving origin to the stock. It is therefore a serious error for Haeckel to assert of this second theory, which we shall designate the *Hydroid-theory*, that it deduces the origination of the latter from the Polypes, and is therefore compelled to conceive of all the *swimming-organs of the Siphonophora as new formations*.

From these considerations, which have already been repeatedly adduced by me, we see how incorrect is the assertion that the two theories still stand in direct opposition. Eleven years ago, in a special chapter of my memoir on *Halistemma* * bearing the title "Ueber die Auffassung der Siphonophoren als polymorphe Thierstöcke," I have shown the relation between the two theories, and demonstrated that they are by no means sharply and irreconcilably opposed to each other. In the same way five years afterwards, in a small paper "On the Phylogenetic Development of the Siphonophora" †, I have laid down the position of matters and indicated that even the *Hydroid-theory*, which takes the swimming Hydroid-stock as the starting-point of the comparison, presupposes as the stem-form the Medusa as the sexual animal from which it originates, and consequently attempted a reconciliation in both directions, with reference both to the conception of polymorphism and animal-stock and to the stem-form of the Medusa. Haeckel has entirely ignored the contents of both these memoirs as regards this question, although, to my surprise, he quotes the former, but does not esteem it necessary even to cite the second in the list of papers appended to his work. Had he taken them into consideration it would certainly have been impossible for him to teach that there at present exists a direct opposition between the poly-person and the poly-organ theory, or to represent his *Medusome-theory*, which, in reality, coincides

* "Ueber *Halistemma tergestinum* &c.," in den Arbeiten des Zool. Inst. zu Wien, tom. i. (1878).

† *Ibid.* tom. v. (1883).

with the Medusa-theory, as a new theory reconciling the two.

Under these circumstances I may venture to reproduce some passages which are decisive upon the present question, especially as the statements made in both memoirs seem to be but little known generally.

In the above-cited chapter of my memoir on *Halistemma* the arguments which are in opposition to the Medusa-theory of Huxley and Metschnikoff are first of all discussed. Then it is said (p. 48):—"But the very tendency to the repetition of similar organs which Metschnikoff is obliged to ascribe to the Siphonophoran organism carries him from his different starting-point (Medusa) back again to the theory of polymorphism, which he thinks he has confuted so very decidedly. For in reality if a second bract or a new nectocalyx, a second or third polyp or feeler be added, the stem of the primary stomach or Medusan stomachal peduncle becomes, I readily admit, like a *Sarsia prolifera*, a kind of proliferating stem with many hundreds of appendages. But by this, at the same time, the conception of the Siphonophore as a *multiplicity of repetitive Medusan parts, purposely reduced Medusæ with special functions, is manifested, and the theory of polymorphism and of the division of labour is perfectly confirmed*, for if the buds on the stomachal peduncle of *Sarsia* here brought into comparison shape themselves into new Medusæ, and therefore are morphologically the foundations of new individuals, the same applies to the sprouting Siphonophoran appendages, whether these, as genital nectocalyces, assume the perfect Medusan form, or as feelers and polype (gastric sac), relatively as nectocalyx and bract, merely reproduce parts of Medusæ, *i. e.* reduced Medusæ, and consequently are only able to perform parts of the functional work.

"The difference of Leuckart's interpretation of the Siphonophoran body as a polymorphic free-swimming Hydroid-stock *therefore fundamentally relates only to the starting-form*, which Leuckart, in accordance with the then existing state of the theory of development, thought was to be recognized in the larva which, as an isolated gastric sac, founded the colony, whilst, according to the more recent views of developmental history, it appears to be represented by the parts of a Medusa.

"But if, as the results of later investigations will perhaps furnish decisive data to show, the morphologically higher Hydroid-form, the Medusa, be really the starting-point in the production of the Siphonophore, the polymorphism of our

organisms, now to be designated as Siphonophora ("Röhren-quallen"), which acquire the character of Hydroid-stocks, would not, as the preceding remarks have shown, be in the least degree contradicted; but rather their appendages, according as they repeat the stomachal peduncle (polypites) or the Medusan umbrella, and relatively both segments in a simplified form (sexual buds), would be now as before characterizable as *Polypoid* and *Medusoid* individuals in Leuckart's sense. But as we have already ascertained that the *Polype* and *Medusa* are fundamentally one and the same*, the difference expressed in the two conceptions would be of significance only with regard to the phylogenetic relations of the Siphonophora.

"Moreover it is evident, as may also be deduced in the same way from the morphology and developmental history of the Cestodea, that the ideas of the individual and animal-stock in the lower animals are by no means morphologically sharply defined and opposed to each other in Haeckel's sense of 'person' and 'cormus,' but must be regarded only as *relative ideas* in the same way as those of 'organ' and 'individual,' and vary in their application according to the objects compared. Therefore, also, Leuckart's criterion, which is supposed to prove the individuality of all the Siphonophoran appendages, namely their similarity of constitution in the bud-state, cannot in this sense be in the least degree accepted. By it the marginal filaments of the Medusan umbrella, the tentacles of a Scyphistoma, or of any polyp would also be shown to be individuals. This certainly unmistakable contradiction, which, however, is at once got rid of by the conception of the individual and stock as relative ideas, appears to have been Metschnikoff's principal inducement to oppose the theory of polymorphism and, so to speak, empty out the baby with the bath."

In the subsequent smaller paper I expressed myself no less definitely (p. 9) upon the relation of the two views and the possibility of combining them as follows:—"I have already (in the memoir on *Halistemma*) endeavoured to show that the difference between the two conceptions, especially considering the relative value of the idea 'Individual' and the relation of the Medusa to the Hydroid-stock as the sexual animal produced by the latter, is by no means so considerable as it seems to be at the first glance, and that even the second con-

* In a previous passage of the same memoir (pp. 26-30) the morphological derivation of the nectocalyx, Hydroid Medusa, and Acaleph from polypes was genetically established.

ception (Medusa-theory) *does not in the smallest degree alter the theory of polymorphism.*"

When, therefore, Haeckel objects to the Medusa-theory that it ascribes to the developed Siphonophoran cormus only the value of a "person" and regards the persons which constitute it only as organs (in the morphological sense), it has escaped him that I had already repeatedly shown how little any such deduction is founded in the theory itself, inasmuch as, in full accord with the requirements of his Medusome-theory, *it has to regard the developed Siphonophore as a cormus composed of numerous polymorphic persons.* When he further asserts of the Hydroid-theory that it goes too far and is wrong in ascribing to the different (morphological) organs of these persons the same value, he has forgotten to say that these deficiencies were already removed by the explanations given in these memoirs, and no longer existed in the conception of the theory supported by me, so that there was already a reconciliation of the two theories by which the supposed abrupt opposition between them had been cancelled. But had Haeckel taken account of the contents of my papers, not only would the reconciliation contained in his Medusome-theory have lost the appearance of novelty, but the essential thing, the true nature of the opposition of the two previous theories, and at the same time the coincidence of his Medusome-theory with the Medusa-theory, would have come to light.

It was, however, consistent that Haeckel, in consequence of a representation made to him by Metschnikoff relating to the interpretation* of the Siphonophoran larva as a Medusa, was converted from the theory of Vogt and Leuckart, of which he had previously been a zealous adherent, to the Medusa-theory and transferred to this the polymorphism of the former. Nevertheless we might have expected from him at least a statement of the reasons why a swimming polyp-stock could not have been the phylogenetic origin of the Siphonophora, more especially as of late several arguments in favour of this view and in contradiction to the Medusa-theory have been brought forward. Instead of clearing away the difficulties raised by R. Leuckart and afterwards by myself and others, which are offered to this theory by the supposed dislocation of many parts of Medusæ, and confuting the objections raised by me to the assumption that the sexual form of the Hydroid polype in its perfected form as a Medusa furnished the starting-point for the production of the Siphonophora, a series

* "Studien über die Entwicklung der Medusen und Siphonophoren," in Zeitschr. f. wiss. Zool. tom. xxiv. (1874) p. 38.

of assertions are posited as axioms and adopted as established propositions in the schematization of the new Medusome-theory.

How does Haeckel prove to us that the primary Medusiform Siphonophoran larva is to be interpreted *palingenetically*, and demonstrate the truth of the assumption of an extensive multiplication and dislocation of the individual organs of the Medusa? And to what new factual conditions does he appeal when, as arbitrator in this main question, he rejects as erroneous the opposite view, which denies a far-reaching secondary multiplication and dislocation of these organs, and regards the primary Medusiform larva as a cænogenetic form? Or is it more than an axiom to start from a bilateral Medusa as the primary larva or "siphonula," which, distinguished by a ventral umbrellar fissure and the possession of a single marginal filament, has originated from a primæval bilateral stem-form of the Anthomedusan group, to be christened "Proto-meda"? How long, in Hæckel's system, has the bilateral symmetry, which, according to his Gastræa-theory, is produced as a consequence of a creeping mode of life, been thus a primitive character of the Medusa, the ontogenetic development of which on the Hydroid-stock would indicate a regular radiate fundamental form?

By such a dogmatic assertion, at variance with all observation, we certainly escape answering the question* in what manner the stomachal tube and tentacles have passed from the centre and the umbrellar margin to the outside of the Medusan umbrella, and what advantage this deviation from the radiate fundamental form could have had for the maintenance of the organism, but without considering that in this way the knot has been cut and not loosened.

It is the same with the second axiom, which gives Haeckel's Medusa-theory its special character, namely the assumption of a second primitive stem-form of octoradial structure of the Trachymedusan group, called the "Archimeda," in order to derive therefrom a second Medusiform larva, the "Disconula," which, in possession of a marginal circle of tentacles, has produced the individuals of the stock by gemmation from the subumbrella, and formed the starting-point for the development of the Discoidea (*Porpita*, *Veella*), rechristened Discosanthæ. By this hypothesis and the supposition involved in it of a diphyletic origin of the Siphonophora, Haeckel's theory certainly beomes a *new variety* of the Medusa-theory, but at the same time it loses probability in the same degree that the

* See Claus, "Ueber das Verhältniss von *Monophyes* zur den Diphyiden &c.," in *Arbeiten des Zool. Instituts &c.* (Vienna, 1883), p. 9.

new special assumption appears arbitrary and unfounded. From the two axioms follows the division of the Siphonophora into two primary divisions, which Hæckel denominates Siphonanthæ and Disconanthæ, and which, according to their origin, would be referred, the former to the Anthomedusæ and the latter to the Trachymedusæ. The inadmissibility of this diphyletic derivation has already been shown by another hand, and the contradictions have been indicated which would result for the structure and development of the *Veellæ* from the association with octoradial Medusæ*. It is not only that the stage of the radiate Disconula only follows upon a simply constructed bilateral stage of development, rendering it probable that here this is preceded by a bilateral division like that in Siphonanthan larvæ, but also the mode of origin of the mantle, which is by no means to be referred directly to the Medusan umbrella, as well as the development of an abundant vascular net and powerful muscular layer on the aboral surface, in contrast to the non-vascular and non-muscular exumbrella of the Medusæ, cannot be reconciled with Hæckel's views.

Against the Medusa-theory, however, in whatever form or modification it may be put forward, I have in my former paper urged another argument, which has been entirely ignored by Hæckel. I remarked that "another consideration renders it improbable that the sexual form of the Hydroid polyps in its perfect form furnished the starting-point for the production of the Siphonophora, *seeing that its ontogenetic origin is precluded by Hydroid-stocks, which consequently, even in a Medusa† altered by dislocation of particular parts of the body and transformed into the stem-form of the Siphonophora, must have recurred in the development of the latter.*" "The direct development (without alternation of generations) of individual Hydroid Medusæ ‡ is, however, unquestionably only a subsequent secondary condensation of the developmental process, which, therefore, we are not justified in taking as the starting-point of the derivation." The Medusa-theory, however, commences with this subsequent, secondary, hypogenetic development of the stem-form, which is already repeated as a Medusa in the bilateral (Siphonula) or radial (Disconula) Siphonophoran larva, and consequently leaves the older and originally meta-

* Chun, Sitzungsab. der k. preuss. Akad. der Wiss. Berlin, 1888, Bd. xlv. pp. 3, 4. See 'Annals,' ser. 6, vol. iii. pp. 216-218.

† As supposed by Metschnikoff and also by Hæckel in his "Proto-meda."

‡ To these belong the Trachymedusæ and also, therefore, Hæckel's "Archimeda."

genetic development of the Medusa by Hydroid-stocks entirely out of consideration. That is the central and at the same time the weakest point of the theory, which at once brings the opposition to the Hydroid-theory into prominence. This commences with the older and original metagenetic development of the stem-form, and refers the resemblance to a bilaterally constructed Medusa which makes its appearance so early in the young Siphonophoran larva, only to external analogies secondarily produced. In this the Siphonophoran larva does not appear as the repetition of a primitive, *hypogenetically* reproducing, bilateral Oceanid with dislocated stomachal tube and marginal filaments, which by continued gemmation of new Medusæ and parts of Medusæ produces the polymorphic stock, but a free-swimming developmental stage of the Hydroid-stock of an Oceanid reproducing *metagenetically*, furnished the starting-point for the production of the Siphonophora, and in fact the prevention of fixation was the cause of the first change, the occasion of a series of transformations which then also affected the sexual Medusæ budding forth from the stock. Of course, in the absence of any data furnished by transitional stages and intermediate forms, it must be left to fancy to finish the picture of the changes through which in the phylogenetic process the original form resembling a larval *Hydractinia* or *Podocoryne* could have transformed itself into a Siphonophoran. It is only in this light that the attempt made in my little paper is to be judged, as a representation which, when compared with the picture of the budding Medusa, has at least an equal justification. The reconciliation between the Medusa- and Hydroid-theories which I attempted in this statement therefore depended upon the proof that, while for the former the conception of the Siphonophore as a polymorphic stock appears by no means excluded, the second theory also presupposes the presence in the stem-form of a Hydroid Medusa. I could approve of the Medusa-theory in so far as it starts from the Hydromedusa, but could not concede to it that this is to be found repeated even in the primary larva, and that the latter was to be palinogenetically interpreted. On the other hand, I defended the Hydroid-theory, in the conception of the polymorphic stock in which I found no contradiction to the former with reference to the starting-point of the Siphonophora, which is to be sought not in the mature Hydroid-stock, but in the free-swimming larval stock. The supposed stem-form was not a symmetrical Medusa with dislocated organs and hypogenetic development, but a metagenetically developing, normally constructed Medusa, in the swimming larval stocks of which the

starting-point of the production of the Siphonophore was recognized.

Consequently the two theories no longer stood by any means in *direct opposition*, as the *Polyorgan*- and *Polyperson*-theories, and were also brought nearer together in that in the case of the latter the derivation from the Hydroid Medusa might be accepted. Already it was attempted to clear up the mixture of truth and error, although in a different form and direction from Haeckel's Medusome-theory, and, indeed, in favour of the Hydroid-theory, which regards the Siphonophora as "swimming Hydropolyp-stocks" and deduces the resemblance of the larvæ to Medusæ from cænogenetically altered conditions. It was necessary to modify the original conception formulated by R. Leuckart only so far that in the room of the Hydroid-stock which after separation from its support adopted the pelagic mode of life and acquired a hydrostatic apparatus at its base now turned upwards, the swimming-larva, prevented from fixing itself but not affected in its nutrition, was placed, and, in agreement with the recently established views as to relation of the Medusa to the Polyp, the derivation of the Siphonophore from the Medusa as the sexual animal of the Hydroid-stock was recognized.

As regards the new Classification of the Siphonophora, on which Haeckel has based his work, its specialities follow directly as consequences of his hypothesis of diphyletic origin. The Siphonophora are raised into a class, and divided into two legions or subclasses with reference to their binary origin:—1. The SIPHONANTHÆ, derivable from the hypothetical *Protomeda*; and 2. The DISCONANTHÆ, originating from the hypothetical *Archimeda*. The first subclass is divided into the ordinal sections *Calyconectæ*, *Physonectæ*, and *Cystonectæ*, which correspond to the previously recognized groups *Calycophoridae*, *Physophoridae*, and *Physalidae*, to which are added, as a fourth order, the *Auronectæ*, a group of exceedingly remarkable deep-sea forms previously unknown. The second subclass contains the single order *Disconectæ*, which corresponds to the fourth Siphonophoran group, known as *Chondrophoridae* or *Discoideæ*. As the assumption of a special stem-form for the Discoideæ, which may be easily and naturally derived from the Physophoridae, seems neither necessary nor well founded, the alteration of the system founded upon it, which places the Discoideæ in an equivalent relation to the whole of the other groups, will have to be rejected as a novelty by no means justified by the state of the case. And we cannot deal otherwise with the many new denominations by which Haeckel, following his previous

custom, without any sufficient reason, wishes to make a number of old names which have obtained a footing in science disappear. Not only are new designations given to the orders and to many families and genera, but a new nomenclature is introduced, quite unnecessarily, for the parts and appendages of the Siphonophora.

In accordance with the fiction of the Medusome-notion all organs which may have originally belonged to a Medusa-person are comprised as a "Medusome," and palingenetic are distinguished from cænogenetic Medusomes. In the former the chief organs are considered to have remained more or less in their original connexion, while in the latter they have been more or less dislocated in consequence of cænogenetic displacement, and a secondary increase of homologous parts, a "multiplication" of the organs, has taken place. Groups of correlated Medusomes are denominated *cormidia*, and these are distinguished as *ordinate* (*Cormidia ordinata*) when they are repeated in metameric sequence, and *dissolved* (*Cormidia dissoluta*) when they are scattered on the stem and their organs are separated from each other. The swimming column is henceforth to be called the "Nectosome," the stem following beneath this the "Siphosome," the swimming-bell the "Nectophore;" the gastric sac or nutritive polyp is rechristened "Siphon," and the feelers (taster) "Palpons;" the filaments (*Fangfaden*) are called "Tentacles"*, the terminal threads on the urticating nodes "Tentilla," the subsidiary filaments of the taster "Palpacles," the tentaculiform appendage with a terminal aperture "Cyston," the covering pieces "Bracts," the taster or gastral tube bearing sexual buds "Gonostyle," and the sexual buds themselves "Gonophores." In the air-chamber or pneumatophore we find the air-sac denominated the "Pneumatossaccus," the air-flask the "Pneumatocystis," its lower part which functions as a gas-gland the "Pneumadenia," and the basal aperture or funnel of this the "Pneumatopyle." That Haeckel makes a very

* In my writings I have repeatedly made use of the expression "tentacles" as synonymous with "tasters," just as the "feelers" of the Mollusca are usually called "tentacles." With Haeckel, who designates the "stinging filaments" as tentacles, this different use of the word leads to the following logical conclusion:—"Not unfrequently palpons are confused with tentacles, as, for instance, repeatedly by Claus, even in *Physophora*" ('Report,' pp. 17, 193, 260). A glance at my memoirs, and especially that on *Halistemma* (1878), will at once convince any one that I use "tentacle" as synonymous with "taster," and adopt the two denominations indifferently, so that there can be no question of a confusion with "stinging filaments." Moreover it is quite incomprehensible how any one could confound the "tasters" with the "stinging filaments," especially in *Physophora*.

extensive, indeed almost unlimited, use of his skill in making new and suitable names, is certainly intelligible from the fact that he possesses this faculty in a very high degree and has developed it, by many years' practice, into a speciality, in which at present no other naturalist can hope to equal him. But, although it cannot be denied that the introduction of new and appropriate names has many advantages, and is especially indispensable for the sake of conformity in the schematization of theory and system, it is, however, indisputable that by the continual accumulation of synonyms it leads to a nearly unlimited complication of nomenclature, causes much confusion, and instead of facilitating investigation renders it more difficult. It is therefore only in place when moderately exercised where the conditions absolutely require it, but when immoderately done without absolute necessity decidedly mischievous, and to be rejected at once when by it old, equally good names, which have become historical by the personality of meritorious authors, are displaced and removed from science.

However, our knowledge of forms has been extraordinarily enlarged by Haeckel's work, inasmuch as out of 240 species more than 60 were previously unknown, and these for the most part belong to new and interesting genera. By this astonishing enrichment of the materials the system must also have undergone a corresponding complication of form and abundance of divisions, and besides new genera new categories of higher rank, especially families and subfamilies, have had to be established. Unquestionably the special descriptive part, which is also of much greater extent, possesses a much higher value than the general or "philosophical" part, which is more aphoristically treated in the short introductory chapters, and which is intended to found the Medusome-theory and the system established upon it. Whether in the former the author has everywhere hit upon the right course and has not often gone too far may even now be justly doubted, and will be decided in the future by later investigations. There are numerous novelties in connexion with the division of pre-existing genera into two or more, and, indeed, on the ground of trifling distinctions scarcely applicable as generic characters. As examples may be cited the division of *Physalia* into *Physalia* and *Caravella* and of *Alopleota* into *Alopleota* and *Arethusa*, as also the establishment of two subfamilies associated therewith; further the breaking up of *Rhizophysa* by its different species into the genera *Aurophysa*, *Cannophysa*, *Linophysa*, *Nectophysa*, *Pneumophysa*, and *Rhizophysa*, and

the distinction of two subfamilies as Cannophysidæ and Linophysidæ upon differences which perhaps justify generic separation. The same thing applies to the splitting of the genera of Agalmidæ so far as in their foundation the form of the tentilla is exclusively taken into account (*Agalmopsis*—*Lychnagalma*; *Halistemma*—*Cupulita*; *Anthemodes*—*Cuneolaria*; *Agalma*—*Phyllophysa*; *Stephanomia*—*Crystallodes*).

Further, it seems to me quite unjustifiable to establish a special order of Siphonophora for the remarkable deep-sea genera *Stephalia* (*Stephonalia*), *Auralia*, and *Rhodalia*, as these forms possess the pneumatophore of the Physophoridæ (Physonectæ) and have only acquired the character peculiar to them and by which they take their place as a special group of Physophoridæ by the union of the proximal section of the pneumatophore with an air-discharging apparatus (aurophore). That the peculiar apparatus designated an *aurophore* has been produced by the transformation of a nectocalyx is not only not proved, but is even very improbable, as we cannot very well see how a nectocalyx could have got upon the dorsal line of the stem, which is always destitute of buds. Even if this remarkable pneumoduct should be superinduced, in analogy with the foundation of the nectocalyx, by a bud-like elevation of the two cell-layers of the stem with subsequent growth of the entoderm and invagination of the surrounding entoderm, this would by no means prove that it was actually produced by transformation of a nectocalyx, but it would be much more justly interpreted as a special differentiation of the wall of the stem at the air-funnel of the pneumatophore in connexion with the necessity of the escape of air. However, even in the first case there would be no reason for the establishment of a special order.

Another much heavier criticism relates to the classification of the Calyphoridæ (Calyconectæ), under which the Eudoxidæ and Ersæidæ with their genera and species figure as distinct families side by side with the Monophyidæ and Diphyidæ. It is, in fact, a fundamental offence against the idea of a natural system constructed upon a phylogenetic foundation to separate the sexual generations which have become independent from the generations which produce them and to treat them as distinct species of distinct genera and families, to be arranged and enumerated as equivalent to the corresponding categories of the nursing generations. No fewer than 25 species, 8 genera, and 2 families in consequence occur twice over and under two denominations. In point of fact such a duplication of equivalent categories would con-

vert the natural system, based upon genealogy, by the dislocation and repetition of related members, into an artificial mosaic patchwork. If the example here given by Haeckel were to be accepted and imitated we should soon come to have an analogous alteration of the classification of the Cestodea, for example, put forward as a consistent advance, in accordance with the spirit of the times. Following the present pattern distinct families would first of all be established for the Proglottides and Strobila-forms, and then also for the Cysticerci, and by the analogy of the dislocation and multiplication of organs divided into families, genera, and species. It is difficult to find a reasonable ground which can have induced the author to make so inconceivable a logical mistake. Was it conformity of arrangement that ruled the scheme of classification? The other orders commence with monogastric families, the Physonectæ with the Circalidæ and Athoridæ, the Cystonectæ with the Cystalidæ, the Disco-nectæ are exclusively monogastric Siphonophora, and so monogastric families must come at the head of the Calyconectæ. However, the unequal values of the monogastric families ought to have attracted attention, inasmuch as in those orders they represent the simplest and, in development, the oldest genera, whereas the Eudoxidæ and Ersæidæ, as metameric fragments equivalent to the so-called Prodoxiæ of the polygastric Apolemiadæ, represent the final terms of the evolution.

How far the changes relating to the nomenclature of the genera and families are justified shall not be further discussed here, only a deviation from the old-established practice which Haeckel has permitted himself, as in previous writings, in his *System of the Siphonophora*, may be mentioned and rejected as inadmissible. This relates to the perfectly new proceeding of striking out the name of the author in the case of already known species established by previous authors on the ground of a change in the generic designation, placing in its stead the name of the author of the new genus. This is a licence which, so far as I know, no other naturalist allows himself, one of Haeckel's peculiarities which, in conjunction with the principle of splitting the genera into new ones upon unimportant differences previously used only for the distinction of species, opens to the "mili" of the systematist a glimpse of a new and exceedingly fertile field.

XXII.—On the Land- and Freshwater-Shells of the Louisiade Archipelago. By EDGAR A. SMITH.

[Plate XIII.]

THE British Museum has recently received from Mr. Basil Thomson a very interesting collection of land- and freshwater-shells made by him in some of the islands of the Louisiade Archipelago. In naming these specimens it has been necessary to study what has been written upon the shell-fauna of these islands, and I have thus got together a complete list of the known species*.

The first and only collections of any extent from this locality which have come to Europe were those made by MacGillivray during the voyage of the 'Rattlesnake' in May, June, and July 1849.

Most of the species proved to be new, and the majority were described and figured by Forbes in the second volume of MacGillivray's narrative of the voyage.

About half a dozen additional new forms have since been described by Pfeiffer, Cox, Angas, and H. Adams.

The present collection consists of fourteen species of terrestrial forms, ten of which are new, and nine freshwater species.

The most important discovery made by Mr. Thomson is that of the four new species of *Pupinella*, one among them being still larger than the *P. grandis* of Forbes. They are remarkable in presenting curious modifications in the labial slit or notch; indeed in two of them this feature is so abnormal that it might almost be considered of subgeneric importance. Mr. Gwatkin, however, who has kindly examined the radula of *P. Macgregori* and *P. rosseliana*, observes: "there is certainly nothing in the radula to call for subgeneric distinction."

Fifteen land-shells have already been recorded from the Louisiade Islands, and Mr. Thomson has now added eleven others, making, together with three forms collected by MacGillivray and not recorded by Forbes, a total of twenty-nine. With the exception of the Auriculidæ and of *Helix Boyeri* and *H. coniformis*, about the locality of which there is some doubt, all the species are peculiar to these islands.

Of freshwater forms only a single species has hitherto been noticed, namely *Neritina diadema*. I now enumerate fifteen

* With the exception of Nos. 9, 11, 12, and 14, all the species are in the Museum.

additional species, nine collected by Mr. Thomson and the rest by MacGillivray.

In the following list a few species * recorded from Woodlark Island are omitted, as that island scarcely comes within the Louisiade group, being situated considerably to the north.

A. TERRESTRIAL SPECIES.

1. *Nanina divisa*, Forbes.

Helix divisa, Forbes, Appendix to MacGillivray's Voyage of the 'Rattlesnake,' vol. ii. p. 376, pl. ii. figs. 5 *a-b*; Reeve, Conch. Icon. fig. 1450; Tryon, Man. Conch. ser. 2, vol. ii. pl. xiii. fig. 70.

Hab. Sudest Island.

2. *Nanina inclinata*, Pfr. (Pl. XIII. fig. 16.)

Helix inclinata, Pfeiffer, Proc. Zool. Soc. 1863, p. 526; Monogr. Hel. vol. v. p. 129.

Hab. Louisiade group (New Caledonia). This is evidently a *lapsus calami*, New Guinea of course being intended.

A number of specimens from St. Aignan obtained by Mr. Thomson agree in many respects with the description of this species, but exhibit on the upper surface excessively fine spiral striæ, which are not mentioned but may have been overlooked by Pfeiffer. *N. divisa* is rather smaller, less acutely keeled, and has the perforation a little more open.

3. *Nanina rosseliana*. (Pl. XIII. fig. 15.)

Testa anguste perforata, depresso conoidea, in medio acute carinata, roseo-fuscescens, superne subnitida, infra valde polita; anfract. 6, planiusculi, lente crescentes, lineis incrementi obliquis arcuatis, striisque spiralibus confertis minutis sculpti; ultimus haud descendens, supra et infra carinam impressus, inferne haud spiraliter striatus; apertura angulato-lunata; perist. simplex, tenue, supra umbilicum leviter expansum et reflexum.

Diam. maj. 40, min. 36, alt. $21\frac{1}{2}$ millim.

Hab. Rossel Island.

This species is larger than either *N. divisa* or *N. inclinata*. It is of a brighter vinous brown colour and has a rather more conical spire.

4. *Trochomorpha nigrans*. (Pl. XIII. figs. 9-11.)

Testa late umbilicata, depresso conoidea, castanea, linea filiformi

* *Helix woodlarkiana*, Sowerbie, *Partula similis* and *P. woodlarkiana* of Hartmann, *Pupina moulinsiana*, Fisch. & Bern., &c.

pallida circa peripheriam quoque ad suturam ornata; anfract. 6, vix convexiusculi, sensim accrescentes, parum nitidi, lineis incrementi tenuibus sculpti, ultimus acute carinatus, antice haud descendens, inferne nitens; umbilicus perspectivus, latus, profundus; apertura diagonalis, subrhombico-lunaris; perist. simplex, acutum, margine superiore oblique arcuato, inferiore recedente.

Diam. maj. 17, min. 15, alt. 7 millim.

Hab. Rossel Island.

This species approaches *T. papua* and *T. planorbis* and some other species in many respects. It may be recognized by the dark chestnut-colour and the white thread-like keel and suture.

5. *Helix (Chloritis) Leei*, Cox.

Helix Leei, Cox, Proc. Zool. Soc. Lond. 1873, p. 565, pl. xlviii. figs. 5, 5a; Pfeiffer, Mon. Hel. vol. vii. p. 395.

Hab. St. Aignan (*B. Thomson*).

Dr. Cox does not quote any particular island for his type.

6. *Helix (Chloritis) subcorpulentus*. (Pl. XIII. fig. 14.)

Testa late et profunde umbilicata, subtenuis, globoso-depressa, nitida, pallide fuscescens, apicem versus pallidior; anfract. 5, convexiusculi, subceleriter accrescentes, lineis incrementi obliquis tenuibus sculpti, sutura bene impressa sejuncti; ultimus inflatus, antice breviter oblique descendens; apertura late lunata, parum obliqua, intus margaritacea; perist. livido-rufescens, late expansum et reflexum, marginibus callo tenuissimo junctis, columellari valde dilatato.

Diam. maj. 40, min. 32, alt. 25 millim.

Hab. Rossel Island.

In form this species is very like *H. Leei*; it is, however, much larger and differently sculptured; it exhibits no trace of the oblique rows of granules occurring in that species, the epidermis apparently being non-pilose.

7. *Helix (Geotrochus) Chapmani*, Cox.

Helix Chapmani, Cox, Proc. Linn. Soc. N. S. Wales, 1880, vol. iv. p. 115, pl. xvi. fig. 2.

Helix (Acavus) coraliolabris, Smith, Ann. & Mag. Nat. Hist. 1887, vol. xix. p. 419, pl. xv. fig. 4.

Hab. Rossel Island (*Cox and Thomson*).

I must plead as an excuse for describing this species that it is not referred to in the 'Zoological Record' for 1880, upon which I relied for species published since the eighth volume of Pfeiffer's Monogr. Helic.

8. *Helix* (*Geotrochus*) *lousiadensis*, Forbes.

Helix lousiadensis, Forbes, Voy. 'Rattlesnake,' vol. ii. p. 376, pl. ii. figs. 8 a, b; Reeve, Conch. Icon. fig. 1449.

Hab. Sudest Island (*MacGillivray*).

9. *Helix* (*Geotrochus*) *millicentæ*, Cox.

Helix millicentæ, Cox, Proc. Zool. Soc. 1871, p. 323, pl. xxxiv. figs. 2-2 a.

Hab. Louisiade Islands (*Cox*). No special island mentioned.

10. *Helix* (*Geotrochus*) *Thomsoni*.

(Pl. XIII. figs. 12, 13.)

Testa imperforata, subconico-globosa, roseo-purpurea, pallido-luteo maculata et variegata, leviter nitida, incrementi lineis striisque obliquis minutis corrugatis confertis sculpta; anfract. $4\frac{1}{2}$, convexiusculi, celeriter crescentes, sutura simplici sejuncti, ultimus primo carinatus (carina antice obsoleta), prope aperturam subito deflexus, pone labrum constrictus; apertura obliqua, elongata, intus roseo-purpurea; perist. albidum, expansum et reflexum, margine superiore antice sinuato, columellari lato, appresso, intus oblique rectilineari.

Diam. maj. 27, min. 20, alt. 18 millim.

Var. Testa subdiaphana, luteo maculata et variegata.

Hab. St. Aignan.

This species, *H. lousiadensis*, and *H. millicentæ* are all closely allied, but exhibit certain differences which probably will prove constant, being confined to specimens from particular islands.

11. *Helix* (*Geotrochus*) *Dampieri*, Angas.

Helix (*Geotrochus*) *Dampieri*, Angas, Proc. Zool. Soc. 1869, p. 47, pl. ii. fig. 6; Pfeiffer, Mon. Helic. vol. vii. p. 310.

Hab. Louisiade Archipelago (*Angas*). No special island mentioned.

12. *Helix* (*Geotrochus*) *Boyeri*, Fischer and Bernardi.

Helix Boyeri, Fisch. & Bern. Journ. de Conch. 1856, vol. v. p. 297, pl. ix. figs. 8, 9; Pfeiffer, Mon. Helic. vol. iv. p. 201, vol. v. p. 270, vol. vii. p. 312.

Hab. Admiralty Islands (*F. & B.*); Louisiade Islands (*Angas*, fide *Pfeiffer*).

13. *Helix* (*Geotrochus*) *coniformis*, Férussac.

Helix (*Helicostyla*) *coniformis*, Férussac, Tab. Syst. Limaçons, p. 51; Hist. nat. Moll. pl. cviii. fig. 1; Pfeiffer, Conch.-Cab. p. 435, pl. cli. figs. 9, 10; Reeve, Conch. Icon. pl. xxiii. fig. 101.

Hab. New Ireland (*Férussac* and others); Louisiade Archipelago (*Kobelt*).

This species is quoted by *Kobelt* in his list of land- and freshwater-shells from the Louisiade Islands (*Jahrb. deutsche mal. Gesell.* 1880, p. 15); but he does not state upon whose authority he has included it. This and the preceding can only be accepted with reserve as Louisiade species.

14. *Helix* (*Geotrochus*) *Gurgustii*, Cox.

Helix Gurgustii, Cox, Proc. Linn. Soc. N. S. Wales, vol. iv. p. 114, pl. xvi. fig. 1.

Hab. Rossel Island (*Cox*).

15. *Helicina* *congener*. (Pl. XIII. fig. 17.)

Testa depresso trochiformis, in medio acute carinata, sordide albida vel flavescens, supra carinam (interdum quoque suturam infra) maculis sanguineis ornata; spira breviter conica, lateribus rectilinearibus; anfract. 5, celeriter crescentes, supremi 3-4 convexiusculi, ultimus planiusculus, liris spiralibus conspicuis circiter 8 supra angulum, et numerosis gracilioribus infra sculptus, antice vix descendens; apertura fere horizontalis, triangularis; peristoma album, leviter expansum.

Diam. maj. 19, min. 16, alt. 13 millim.

Hab. St. Aignan.

This species closely resembles *H. novo-guineensis* (Smith, Ann. & Mag. Nat. Hist. 1887, vol. xix. p. 425, pl. xv. figs. 11, 11 a). It has, however, a more elevated and conical spire, with the outlines straight instead of slightly curved, coarser spiral ridges upon the upper surface, and a different style of coloration.

16. *Helicina*, sp. nov.

Hab. Rossel Island.

A single dead shell in worn condition is all that was obtained. It is smaller and less sharply keeled than the preceding, apparently of a pale yellowish tint without markings, and finely spirally lirate.

17. *Helicina Stanleyi*, Forbes.

Helicina Stanleyi, Forbes, Voy. 'Rattlesnake,' vol. ii. p. 381, pl. iii. figs. 4 *a, b*; Pfeiffer, Mon. Pneumon. i. p. 401.

Hab. Duchateau Isles, Louisiade Archipelago (*MacGillivray*).

18. *Helicina lousiadensis*, Forbes.

Helicina lousiadensis, Forbes, *l. c.* p. 382, pl. iii. figs. 5 *a, b*; Pfeiffer, Mon. Pneumon. i. p. 385; Sowerby, Thes. Conch. vol. iii. pl. cclxxv. figs. 349, 350; id. Conch. Icon. figs. 259 *a, b*.

Hab. Round Island in Coral Haven, north of Sudest Island (*MacGillivray*).

19. *Pupinella grandis*, Forbes.

Pupina grandis, Forbes, Voy. 'Rattlesnake,' vol. ii. p. 380, pl. ii. figs. 10 *a-d*; Pfeiffer, Conch.-Cab. ed. 2, Cyclostomacea, p. 238, pl. xxxi. figs. 19, 20; Sowerby, Conch. Icon., Pupinidæ, fig. 4.
Pupina Forbesi, Pfr. Mon. Pneumon. vol. i. p. 140.

Hab. Sudest Island, under dead leaves, chiefly about the roots of trees (*Forbes*).

The peristome of this species is usually of a reddish or orange tint, but occasionally white-lipped specimens are met with.

20. *Pupinella lousiadensis*. (Pl. XIII. figs. 3, 4.)

Testa *P. grandi* paulo major, forma, colore et sculptura similis; incisura labri sinistra levis, marginem externam haud persecans. Longit. 33, diam. $15\frac{2}{3}$ millim., apertura intus $7\frac{1}{2}$ mill. longa et lata.

Hab. Rossel Island.

This species is represented in the collection by seven specimens, which agree in every particular with the exception of the lip being paler in some specimens than others, as is the case with *P. grandis*. It may be said to be the Rossel-Island representative of that species, differing in its somewhat larger size and the slightness of the slit or notch on the columellar margin of the labrum. The slit scarcely cuts through a third of the thickness of the lip, whereas in *P. grandis* the labrum is cut completely through, the incision when viewed laterally forming a distinct loop. It is in the same position in both species.

21. *Pupinella Macgregori*. (Pl. XIII. figs. 1, 2.)

Testa *P. grandi* magnitudine, colore, forma et sculptura fere similis; labrum pallidum vel flavesceus, superne anguste persectum, incisura extus supra regionem umbilici tubulum formante.

Longit. 29, diam. 15 millim., apertura intus 7 longa et lata.

Hab. Rossel Island.

This species is in general character also like *P. grandi*. It has, however, a somewhat shorter and broader aspect and is perhaps a little more strongly pitted upon the back of the body-whorl; it is, however, at once distinguished by the peculiarity of the labial slit, which is formed into a distinct tube over the umbilical region. In *P. grandi* and *P. louisianaensis* the slit is transverse to the lip; in the present species it is almost perpendicular to the axis of the shell and higher up than in the other species referred to.

22. *Pupinella rosseliana*. (Pl. XIII. figs. 5, 6, 6 a.)

Testa *P. grandi* paulo minor, brevior, colore et sculptura subsimilis; incisura labri fere obsoleta; labrum minus incrassatum, antice prominens.

Longit. 25, diam. $13\frac{1}{2}$ millim., apertura 7 longa et lata.

The smaller size and the almost obsolete notch in the labrum readily separate this species from the rest. These characters are quite constant in the sixty specimens examined.

The young shell, consisting of five whorls, is openly and perspectively umbilicated and has no ridge around the umbilicus, as in the adult form.

I have examined the opercula of *P. grandi*, *P. rosseliana*, and *P. Macgregori*, and observe that they all present trifling differences.

23. *Pupinella minor*. (Pl. XIII. figs. 7, 8.)

Testa pupiformis, sublevis, sordide albida (vel pallide rubida?); anfract. 6, regulariter crescentes, ultimus oblique descendens, supra apertura subplanatus; perist. incrassatum, reflexum, margine columellari angustissime persecto, incisura supra umbilici regionem tubulum irregularem formante.

Longit. 19, diam. 9 millim., apertura intus 5 millim. longa et lata.

Hab. Rossel Island.

This is a smaller species than *P. Angasi*, with a labial slit somewhat resembling that of *P. Macgregori*. The single specimen at hand is in worn condition, so it is impossible

to describe with certainty the colour and sculpture; but it appears to be a smoothish shell and slightly tinted with red, like *P. Angasi*.

24. *Pupinella Angasi*, H. Adams.

Pupinopsis Angasi, H. Adams, Proc. Zool. Soc. 1875, p. 389, pl. xlv. figs. 2, 2 a; Pfeiffer, Mon. Pneumon. Suppl. 3, p. 412 (*Pupinella*).

Hab. Louisiade Archipelago (*Adams*). No particular island recorded.

In this species the labial slit is more pronounced than in *P. lousiadensis*, but smaller than in *P. grandis*. *P. moulinsiana*, Fischer and Bernardi, from Woodlark Island, situated north of the Louisiade group, is a closely allied form.

25. *Auricula tornatelliformis*, Petit.

Auricula tornatelliformis, Petit, Journ. de Conch. 1853, vol. iv. p. 412, pl. xii. figs. 5, 6; Sowerby, Conch. Icon. fig. 6.

Hab. Pig Island, Louisiade Archipelago (*MacGillivray*, in Brit. Mus.); Philippines (*Petit*).

26. *Pythia scarabæus*, Linné.

Hab. St. Aignan (*Basil Thomson*); Sudest Island (*MacGillivray*).

Widely distributed through the Malay region and the Pacific Islands.

27. *Cassidula sulculosa*, Mousson, var.

Auricula sulculosa, Mousson, Moll. Java, p. 45, pl. v. fig. 8; Sowerby, Conch. Icon. fig. 35 (bad!); Pfeiffer, Mon. Auric. p. 114, as *Cassidula*.

Hab. Sudest Island (*MacGillivray*, in Brit. Mus.).

The specimens from this locality agree with others from Guadalcanar, Solomon Islands, also collected by MacGillivray. They are of a dark olive-brown colour, with a pale zone at the shoulder of the body-whorl, and the basal carina is also light-coloured. The labrum is of a brown flesh tint and is not so deeply notched at the upper part as in typical specimens from Java, the Philippines, Fiji Islands, &c.

28. *Melampus luteus*, Quoy and Gaimard.

Auricula lutea, Q. & G., Voy. 'Astrolabe,' pl. xiii. figs. 25-27; Küster, Conch.-Cab. p. 39, pl. vi. figs. 1-3; Sowerby, Conch. Icon. pl. iii. fig. 19.

Hab. Louisiade Archipelago (fide *Kobelt*).

This species is widely distributed, occurring in some of the islands in the Indian Ocean, in the Malay Archipelago, and in many islands in the Pacific.

29. *Melampus caffer*, Küster.

Auricula caffa, Küster, Conch.-Cab. p. 36, pl. v. figs. 6-8; Sowerby, Conch. Icon. fig. 53 (bad!).

Hab. Pig Island, Louisiade Archipelago, under logs a few feet above high-water mark (*MacGillivray*, in Brit. Mus.); coast of Natal and Ohetaroa Island (*Küster*); Philippines (*Adams*); Samoa Islands (Brit. Mus.).

There is little doubt that this species is the *Auricula sciuri* described by Lesson in the Voyage of the 'Coquille.' The specimens from Pig Island I at one time (Proc. Zool. Soc. 1885, p. 600) referred to *M. fasciatus*.

B. FRESHWATER SPECIES.

Neritina diadema, Récluz, is the only species recorded from these islands; but *MacGillivray*, in the Voyage of the 'Rattlesnake' (vol. i. p. 213), mentions having met with "three kinds of *Melania*, a *Navicella*, and five species of *Neritina*," but he does not name them specifically. All of these are in the collection of the British Museum with the exception of two *Neritinæ*. The following is a list of the species at present known to me from this archipelago. Most of them are found in the Solomon and other neighbouring groups of islands, but some have a still wider range. No references or distribution are added, as these can be obtained in Brot's monograph of *Melania* and in Martens's works on *Neritina* and *Navicella*.

1. *Neritina Petiti*, Récluz.

Hab. St. Aignan (*Basil Thomson*).

2. *Neritina MacGillivrayi*, Reeve.

Hab. St. Aignan (*Thomson*).

3. *Neritina adumbrata*, Reeve.

Hab. St. Aignan (*Thomson*).

4. *Neritina variegata* Lesson.

Hab. St. Aignan (*Thomson*)

5. *Neritina subsulcata*, Sowerby.*Hab.* St. Aignan (*Thomson*).6. *Neritina powisiana*, Récluz (dark var.).*Hab.* St. Aignan (*Thomson*).7. *Neritina olivacea*, Récluz.*Hab.* St. Aignan (*Thomson*).8. *Neritina Turtoni*, Récluz.*Hab.* Sudest Island (*MacGillivray*).9. *Neritina diadema*, Récluz.*Hab.* "Isola St. Stephens (Arcipelago Luisade)" (*Cuvfiri*).10. *Neritina brevispina*, Lamarck, var.*Hab.* St. Aignan and Rossel Island (*Thomson*); Sudest Island (*Thomson and MacGillivray*).

The specimens from these islands agree with the form of this species named *subgranosa* by Récluz.

11. *Neritina tahitensis*, Lesson.*Hab.* Sudest Island (*MacGillivray*).12. *Septaria Bougainvillei*, Récluz.*Hab.* Sudest Island (*MacGillivray*).13. *Melania amarula*, Linné.*Hab.* Sudest Island (*MacGillivray*).14. *Melania salomonis*, Brot.*Hab.* Sudest Island (*MacGillivray*).15. *Melania maurula*, Reeve.*Hab.* Louisiade Archipelago (*MacGillivray*).

"South-east coast of Guinea," the locality given by Reeve, is evidently an error, and doubtless New Guinea was intended, as suggested by Brot (*Mon. Melan.* p. 196). The specimen collected by MacGillivray, probably on Sudest or South-east

Island, as it is termed in the Voyage of the 'Rattlesnake,' agrees precisely with Reeve's types, excepting that the aperture is not quite so reddish within.

16. *Melania Petiti*, Philippi.

Hab. Rossel Island (*Thomson*).

Dr. Brot has kindly identified this species. All the specimens are small and have only the last and penultimate whorls remaining, producing a remarkably truncated appearance.

EXPLANATION OF PLATE XIII.

- Figs. 1, 2. Pupinella Macgregori.*
Figs. 3, 4. Pupinella lousiadensis.
Figs. 5, 6, 6 a. Pupinella rosseliana.
Figs. 7, 8. Pupinella minor.
Figs. 9-11. Trochomorpha nigrans.
Figs. 12, 13. Helix (Geotrochus) Thomsoni.
Fig. 14. Helix (Chloritis) subcorpulentus.
Fig. 15. Nanina rosseliana.
Fig. 16. Nanina inclinata.
Fig. 17. Helicina congener.

XXIII.—On the Habits of certain Bornean Butterflies.

By SYDNEY B. J. SKERTCHLY, F.G.S., M.A.I.*

I. Introduction.

The following notes on the habits of butterflies are chiefly from observations made in British North Borneo. They were mostly written in the jungle, and every observation was recorded at the time. I was often for days amid such a wealth of gorgeous *Ornithopteras* and *Papilios*, &c., that any little point suggested while writing could be observed and any ambiguity be corrected without leaving the open-sided hut. This, however, is unhappily a rare chance, and seldom lasts long at a time.

II. The Hours of Appearance and General Habits.

As a rule our butterflies do not come out until about seven o'clock—that is, an hour after sunrise. By this time the

* [Since I communicated Mr. Skertchly's interesting notes "On Butterflies' Enemies," which appeared in the 'Annals,' ser. 6, vol. iii. p. 477, I have received some further observations of great interest to lepidopterists, which I now forward for publication.—W. L. DISTANT.]

heavy night dews have evaporated and the jungle is as dry as it ever gets in this hot-house climate. They increase in numbers, until about ten or eleven o'clock a maximum is reached, and a lull sets in for a couple of hours, though there are still many about. From one till two o'clock they swarm again, and then gradually decrease in numbers, until soon after four most of them have gone, and the crepuscular forms like *Melanitis* and *Amathusia* appear soon after. A passing cloud or shower causes a sudden disappearance of nearly all the species, though a few brave the gloom and rain.

The most persistent species I know is *Ornithoptera flavi-collis*, which is up earliest, retires latest, scorns the clouds, and may be seen, dripping wet, lazily flapping along in a smart shower. The *Mestias* emulate it with considerable success, and some of the *Danaïs* genus are very early risers, but pitch during cloud and rain, though often on exposed shrubs, where, with folded wings, they patiently get wet. The bright brown *Pandita senora* is another early riser, flies low, and delights to bask in the early morning sun, and in the afternoon mounts high like the *Euplyas* and *Ideopsis*.

North Borneo, especially in its eastern part, where my observations were chiefly made, is practically one unbroken virgin forest, intersected by innumerable creeks and small streams and some fine rivers, such as the Labuk, Kinabatangan, and Segama. The average height of the forest is between 150 and 200 feet, and, save where a tree has fallen, the sun's rays never penetrate, and all is shade, warm, moist, and equable. On the banks of the rivers and their larger tributaries sunshine is abundant, while over the smaller creeks the meeting branches form a canopy almost as dense as in the forest itself. Save along the larger rivers and on the coast there are no inhabitants, and even there the native clearings are very small. Even around the capital, Sandakan, virgin forest begins within a mile, and in the forest there are no clearings whatever, and nature, untouched by man, can be contemplated in its purity.

But in the forest depths butterflies are rare, and the following genera alone supply true forest species, that never seek the sunny river-banks or bright glades and clearings:—

NYPHALIDÆ.

Ragadia.	Thaumantis.
Neorina.	Clerome.
Amathusia.	Xanthotænia.

ERYCINIDÆ.

Abisara.

LYCENIDÆ.

Nacaduba.
Lampides.

Biduanda.
Narathura.

PAPILIONIDÆ.

None.

HESTERIDÆ.

None.

All the other genera and many species of those enumerated delight either in the sunshine or the shady forest edges, forest paths, or clearings, where the light is stronger than in the forest depths and where sunshine is close at hand. Occasionally *Ornithoptera* and *Hestia* make excursions into the jungle; but their haunts are the forest by the river-sides. *Euthalia* and *Tanæcia* are still more frequent explorers of the forest depths, but they chiefly affect the more open places. Other genera are not unfrequently observed, but they are stragglers.

The most plentiful butterflies in the forest are the blues and purples, which frequent the higher undergrowth and have a strong tendency to settle in the middle of leaves which turn their upper surface horizontally. The purples perhaps, such as *Narathura*, are more arboreal than the blues and fly higher, even up to 60 feet; but as a rule the forest butterflies keep pretty low down.

It has been suggested that the rarity of butterflies in the deep forest shade is more apparent than real and that the mass of the individuals are high overhead on the tree-tops. This is certainly not the case in North Borneo, for I have had ample and unusual opportunities of seeing over the forest. Some of the mountains, about 3000 feet high, run up in long ridges and terminate in a pinnacle, and on several occasions their summits were chosen as stations for getting bearings during jungle surveys. The trees on the summit were felled and a station rigged up, upon which the observer more than once sat from dawn to dusk for days together. The tree-tops were all around and insects as easily seen as when down below. In every case butterflies were rarer than on the river-banks below. The only species at all common were small blues, and only now and then did others come sailing by. Nowhere, even where trees were in flower, were butterflies seen playing about in numbers, though swarms of bees, all flying up the wind, were common, and wasps, flies, and beetles were far from rare.

The conclusion I have come to is that the great bulk of the butterflies are confined to the river-valleys, that they only take occasional journeys into or over the forest, and that clearings, by opening up the forest, give rise to an actual increase in the number of butterflies which prefer sunshine and partial shade.

The majority of butterflies still fly near the ground, possibly all did originally, and certainly in this tropical primeval forest very few, if any, habitually frequent tree-tops. This is instructive, as our forest is very peculiar in one feature—it is never swept by storms. The north-east coast of Borneo enjoys perpetual calm weather, nothing approaching a gale is known, a stiff breeze is a rarity and seldom endures for an hour. Butterflies therefore are not debarred from the forest-top by heavy weather; they voluntarily avoid it.

We have many flowering creepers which ascend the tree-trunks, and most of our orchids live high up on the trees; yet as a rule they do not attract butterflies, though bees swarm over them. This seems to point, as many other facts do, to butterflies being still as much terrestrial as aerial creatures.

III. *Habits of particular Species.*

There is an infinite variety in the general habits of butterflies; but as a special paper is in preparation on their flight, I will here only give a few particulars on other points.

Most butterflies in settling do so more or less deliberately; they fly direct to the object, slow down their speed, pitch quietly, and adjust their wings slowly. But the leaf-mimickers, like *Amathusia*, *Thaumantis*, *Discophora*, *Precis*, and *Kallima*, behave quite differently; they fly rapidly along, as if late for an appointment, suddenly pitch, close their wings, and become leaves. It is generally done so rapidly that the insect seems to vanish. *Amathusia phidippus*, a crepuscular species, has been frequently observed on a forest-path over which depend many creepers. It hurries along, suddenly pitches, always head downwards, and is a dead leaf. Many leaf-butterflies have escaped our nets because, though we have carefully marked them down, we have hesitated too long as to which leaf to catch.

It may here be remarked that the degree of verisimilitude as observed in the cabinet has no relation to the real powers of concealment. *Kallimas* are the most perfect leaf-butterflies; but they are not really more difficult to detect than the apparently much less leaf-like *Zeuxidias* or *Amathusias*. So

innumerable are the shapes, markings, and fractures of dead leaves that but a very sketchy likeness to a good, well-preserved, dead leaf is sure to appear perfectly natural in the jungle.

Our Borneo butterflies are proof against the seductions of sugar, even when flavoured with square-faced gin. We often tried to tempt them, but they took no notice, and we never had any chewed sugar-cane, which Mr. Pryer says they like. Even the bees generally despised our sugar, though they would come in swarms to our dried salt fish and even to plain salt. This love of salt was shared in a modified degree by butterflies of the genera *Papilio*, *Catopsilia*, *Charaxes*, and others, chiefly whites. The *Papilios* were of the *serpedon* types, and I never saw the dark *memnon* types touch it. When camped on a stream our dyaks always took their fish to soak and wash in the running water before cooking it; and the spots where the fish were laid on the sand were often perfectly smothered with butterflies. They showed no fear and would come while the dyaks were at work. *Euretis* will often settle on the salt fish when it is drying, and be so intent on feeding that it can be picked up. Generally these salt-resorts were smothered with the following species:—

- Papilio serpedon*. Most common.
- *agamemnon*. Common.
- *evemon*. Less common.
- *mecisteus*. Fairly common.
- *telephus*. Fairly common.
- *bathycles*. Fairly common.
- *arcyles*. Less common.
- Hebomoia* —? Rare.
- Catopsilia crocale*. Common.

Of the *Papilios*, *arcyles* and *agamemnon* are the most restless and stay but a short time in one place. The contrast between their sluggish movements when drinking and their swift ordinary flight is very great.

The different species of *Terias*, though fond of drinking in groups, did not mix with the above species, nor did *Charaxes*.

Ornithoptera Brookeana is a rare butterfly in this part of Borneo; but I have seen it in several parts of the interior of the Darvel Bay peninsula. Once in the mountain region of the head-waters of the River Segama I saw a pair hovering about an orange-blossomed tree and watched them courting for twenty minutes. The male was sipping the flowers, vibrating its wings rapidly like a hawk-moth, the vivid green markings flashing out as the sun played on them. Then the

female sailed down with stately flight, showing her white spots clearly, and commenced to woo. For a long time they circled over us about 6 inches apart, the female always uppermost and a little behind, so that she could see the emerald feathers of her mate. She did all the wooing. The flight was a sailing motion with a peculiar tremour of the wings, very unlike the quivering while feeding. The female during the whole time pointed her abdomen downwards. A solitary *O. flavicollis* was about and made several feeble attacks on the lovers, which they totally ignored. At length they settled high up in a tree and united, the female still uppermost.

Darwin, dealing with the courtship of butterflies, draws the conclusion that where the males are the brighter they are chosen by the females and where the females are the handsomer the males are the selecting parties*. He says: "Now the males of many butterflies are known to support the females during their marriage-flight; but in the species just named [*C. edusa*, *H. janira*, *Pieris*, *Thecla*] it is the females which support the males; so that the part which the two sexes play is reversed, as is their relative beauty. Throughout the animal kingdom the males commonly take the more active share in wooing, and their beauty seems to have been increased by the females having accepted the more attractive individuals; but with these butterflies the females take the more active part in the final marriage ceremony, so that we may suppose that they likewise do so in the wooing; and in this case we can understand how it is that they have been rendered more beautiful."

The case of *O. Brookeana* is the exact opposite of this. The female is so much rarer than the male that Künstler, who has caught over a thousand males, has taken only fifteen females. Distant says "it is still exceedingly scarce"†. The female is quite dull in comparison with her splendid mate, yet she does all the wooing, or did in the case described, which is probably a typical one. If sexual selection be really a fact of evolution, this is a case in which it can work. The females have unlimited chances of selection, and the males may be supposed to be only too glad to accept any lover. Indeed, I can only imagine sexual selection acting where there is a disparity of numbers between the sexes. Selection implies rejection, and where the sexes are practically equal in number, though the handsomer individuals may choose or be chosen

* 'Descent of Man,' ed. 2, p. 319.

† Rhop. Mal. p. 331.

first, the less favoured are just as certain to be married and leave offspring.

If one may judge by human analogy, it would seem more probable that the more numerous sex would be the more eager, and it is difficult to see why the rare female *Brookeana* should act in such a leap-year fashion. One would expect the amorous swains to swarm around coy maidens instead of behaving like lepidopterous Josephs.

In *Hestia lynceus* and *H. leuconœ* v. *labuana* we have other cases in which the female woos the male, and the allied *Idropsis daos* I believe does the same. These butterflies fly about in pairs for days together, with a slow flapping flight, the female about a foot above the male. The female follows every turn and movement of the male, keeping a little behind him. In these cases the sexes are alike in decoration, black spots and nervures on a white or transparent ground. Why these females should court the male is a difficult problem to solve, especially as I believe there is no great disproportion in the numbers of the sexes. The equality of numbers may be a reason for the sexes being alike in decoration.

As Darwin has well said, if one sex always preponderated in numbers sexual selection would be easy to understand: "if the males were to the females as two to one, or as three to two, or even in a somewhat lower ratio, the whole affair would be simple"*. But this is by no means always the case, for though it frequently happens that the male butterflies are more numerous than the females, and rarely that the females exceed the males, there are many cases in which no such disparity is apparent.

Darwin further makes a valuable distinction between wooing and choosing. The males as a rule woo and the females choose, and probably it is rare for the wooer to be the chooser. In the case of *O. Brookeana*, however, the female was apparently both wooer and chooser. Indeed, among butterflies one can ring a number of changes between wooer and chooser, sexes similar and sexes dissimilar, sexes equal and sexes unequal, as in the following illustrations:—

* 'Descent of Man,' ed. 2, p. 213.

Name.	Woer.	Chooser.	Sexes equal in numbers.	Sexes not equal in numbers.	Sexes alike.	Sexes not alike.	♀ active.	♀ retiring.
<i>Vanessa urticæ</i>	♂	♀	—	..	—	..	—	—
<i>Anthocharis cardamines</i> ..	♂	♀	..	—	..	—	—	—
<i>Apatura iris</i>	♂	♀	..	—	..	—	..	—
<i>Pieris rapæ</i>	♀	♂	—	—	—	—
<i>Hestia leuconoë</i>	♀	♂	—	..	—	..	—	—
<i>Ornithoptera Brookeana</i> ..	♀	♀	..	—	..	—	—	—

If we take species in which the brilliancy or beauty resides in different sexes, we find an equal dissimilarity in the courtship:—

Name.	♂ bright.	♀ bright.	♂ dull.	♀ dull.	♀ active.	♀ in- active.	Woer.	Chooser.
<i>O. Brookeana</i>	—	—	—	..	♀	♀
<i>A. cardamines</i>	—	—	—	..	♂	♀
<i>A. iris</i>	—	—	..	—	♂	♀
<i>H. janira</i>	—	—	..	—	..	♀	♂ ^p

Now, according to the theory of sexual selection,

1. In *H. janira* the female has become bright because the male chose her.
2. In *A. cardamines* the male has become bright because the female chose him.

So far all is clear: in both cases the bright sex was the wooer and the dull one the chooser, and we often see the chooser refuse the wooer, thus exercising a selection. The wooed is

approached by many wooers, and we may reasonably suppose finally selects according to her or his individual taste.

But it is not so easy thus to argue about *O. Brookeana*. That the female wooed the male was evident; she came for him. That she chose him was quite as clear to my mind—the coquetting flight, following his every turn for twenty minutes, the drooped abdomen, said so almost as plainly as words. Can we suppose it was a deliberate choice after visiting many others? That she carried in her mind not only an ideal but the memory of other possible husbands who fell short of her ideal, which this one most nearly approached? Can we also believe the males, more beautiful, more active, more numerous, had lost all eagerness, and, like Shetlanders ashore, were content to be passive and petted, though wives were so scarce and so necessary? It certainly looked to me as though, being mature, she accepted the first male she met.

When, too, as we have seen, there seems so little relation between the habits, beauty, or numbers of the sexes and the sex of the wooer, it becomes difficult to see why we should introduce the complex machinery of sexual selection to perform what the ordinary laws of evolution seem equally capable of carrying out.

It may be I witnessed an abnormal case; but this is unlikely.

Leptocircus curius.—This butterfly is not at all common in British North Borneo, and I have only seen it on streams and rivers in rocky places well open to sunshine.

It is an exceedingly swift flier, darting with rapidly vibrating wings from point to point, dashing backwards and forwards over a particular patch of sand like a dragon-fly, and making considerable journeys in the day. Like many other butterflies it is methodical, frequenting the same places at the same hour; so that when once seen I could always find it again. It is an early riser, and may be caught drinking before nine o'clock. It delights in hot sunshine and is comparatively sluggish on dull days.

When drinking it has a most remarkable habit of ejecting the water from behind. Pushing its proboscis into the wet sand it takes long steady drinks, and pumps the water out astern in rhythmic squirts, forming quite a little stream. It can project the water full 3 inches. At such times it can be approached closely if no sudden movement be made. It does not always pump, and I have often watched for it in vain*.

* My friend Mr. J. Hayward Allard has recently noticed this habit in *P. sarpedon*, but the volume of water is less and the strokes slower than with *Leptocircus*.

Ornithoptera flavicollis was very common at one place on the River Tinkyo, where I camped all May 1888. The male seems to be the wooer, but of this I am not quite certain yet. This insect has one peculiarity of flight which may be used in courting and is certainly used on other occasions. As I have not seen it noticed in books and have had many opportunities of observing it a description may be useful.

The male in basking along the foliage on sunny river-sides often flies slowly along, moving only its fore wings, the hind wings drooping at an obtuse angle to the line of flight, trailing like a rich robe of golden silk. In a freshly caught specimen this position can easily be induced. A furrow in the inner margin of the fore wing allows the notch of the hind wing to be elevated easily without interfering with the partial action of the fore wing. In such flight the fore wings only move through a small angle.

On the inner margin of the hind wing there is a strong fold fringed with hairs, forming a pouch. In normal flight and when at rest this pouch is closed, but when the hind wing is drooped the pouch opens. It may therefore be a scent-pouch and this peculiar flight the normal courting flight.

As a rule it is only where butterflies are plentiful that the various kinds of flight can be studied, and this seldom happens in North Borneo. When it does it is always in broken weather, rain and sunshine, and on the open banks of large streams. Very dry weather produces few insects and many of them crippled; very wet weather prevents any butterflies from appearing.

XXIV.—*Third Contribution to our Knowledge of Reptiles and Fishes from the Upper Yangtze-Kiang.* By Dr. A. GÜNTHER, Keeper of the Zoological Department, British Museum *.

MR. A. E. PRATT has continued to collect at Ichang. The last collection sent by him consisted chiefly of Reptiles, some Batrachians, and a few Fishes. Species not represented in his previous collection were the following :—

REPTILES.

Eumeces xanthi, sp. n.; *Japalura yunnansis*, Anderson;

* For the two previous communications see this Journal, 1888, vol. i. pp. 165, 429.

Achalinus rufescens, Blgr.; *Ablabes chinensis*, sp. n.; *Tropidonotus Swinhonis*, Gthr.; *Trimeresurus xanthomelas*, sp. n.

BATRACHIANS.

Rana Boulengeri, sp. n., *Bufo vulgaris*, *Hynobius chinensis*, sp. n.

FISHES.

Acipenser dabryanus, Dum.; *Mastacembelus chinensis*, Blkr.; *Rhynchocypris variegata*, sp. n.; *Botia variegata*, sp. n.

Mr. F. W. Styan has sent from Kiu-Kiang two large collections of beautifully preserved specimens, principally fishes, and many of large size. Those which are additional to the species enumerated in my former papers are the following:—

REPTILES.

Alligator chinensis, Fauvel.

FISHES.

1. ACANTHOPTERYGII: *Siniperca chuatsi*, Basil.; *Eleotris potamophila*, Gthr.

2. SILURIDÆ: *Pseudobagrus fulvidraco*, Rich.

3. CYPRINIDÆ: *Sclerognathus chinensis*, sp. n.; *Cyprinus carpio*, L.; *Barbus semibarbus*, Gthr.; *Barbus labeo*, Pall.; *Pseudogobio Styani*, sp. n.; *Rhinogobio typus*, Blkr.; *Xenocypris microlepis*, Blkr.; *Mylleucus aethiops*, Basil.; *Hypophthalmichthys nobilis*, Rich.; *Rhynchocypris variegata*, sp. n.; *Scombrocypris Styani*, sp. n.; *Chanodichthys mongolicus*, Basil.; *Parapelecus argenteus*, sp. n.; *Culter hypselonotus*, Blkr.

4. SOMBRESOCIDÆ: *Hemirhamphus*, sp.

5. CLUPEIDÆ: *Coilia nasus*, Schleg.; *Clupea Reevesii*, Rich.

6. SALMONIDÆ: *Salanx chinensis*, Osbeck.

7. MURÆNIDÆ: *Anguilla vulgaris*, Cuv.

I subjoin some notes on known, and descriptions of the new, species:—

1. LIZARDS.

Eumeces xanthi.

This species is of special interest inasmuch as it is most closely allied to the Californian *Eumeces Skiltonianus*, from which it is barely distinguishable by a somewhat different coloration and by the postfrontals being widely separate from each other, whilst they are more or less in contact in the American form.

Snout of moderate length. Nasal small, followed by a postnasal, which forms a suture with the first two labials; anterior loreal forming a suture with the frontonasal; four supraoculars, the three anterior in contact with the vertical; occipitals entirely separated by the central occipital; two pairs of nuchals; seventh upper labial largest; two or three very obtuse tubercles on the anterior border of the ear, which is smaller than a dorsal scale; two azygos postmentals. Twenty-four or twenty-six scales round the body, the dorsal much broader than the lateral and ventral. Limbs overlapping when pressed against the body; the length of the hind limb is contained twice and a half to twice and two thirds in the distance from snout to vent. A median series of transversely enlarged subcaudals. Dark olive above, with a black lateral band extending from the loreal region to the tail; this band is bordered above and below by a light streak, which again has a blackish margin. Four series of dorsal scales separate the two lateral bands. Sometimes a light longitudinal band edged with black runs along the median line of the back and of the tail. Belly greenish blue.

Four specimens were collected by Mr. Pratt at Ichang, of which the largest is $6\frac{1}{2}$ inches long, the trunk and head measuring $2\frac{3}{4}$ inches.

2. SNAKES.

Achalinus rufescens, Blgr.

This snake was described from a deteriorated bleached specimen; in the fresh state it is of a uniform black.

Several specimens were found by Mr. Pratt at Ichang.

Ablabes chinensis.

This species belongs to that group of the genus of which *Ablabes melanocephalus* is the type; it comes nearest to *Ablabes Humberti*, having like that species ten upper labial shields, the eighth of which is excluded from the labial mar-

gin. But it differs by having a longer tail and by its less ornamented coloration.

Scales in seventeen rows. One præocular, two postoculars. The occipital does not touch the lower postocular; temporals 1+2, the anterior in contact with both postoculars. Ventrals 182; of the tail nearly one half has been lost, the mutilated part being protected by fifty-three pairs of subcaudals, so that the whole number may be estimated to have been between eighty and ninety. Upper parts nearly uniform brownish grey, the posterior part of the trunk indistinctly showing a series of whitish spots along each side of the back. No black dots along the vertebral line. The black cross bands between the eyes and on the neck are present as in *Ablabes Humberti* and *Ablabes collaris*, but much less distinct. Abdomen white, each ventral shield with a black dot on each side.

One specimen was found by Mr. Pratt at Ichang; its trunk measures 15 inches and its tail was probably $5\frac{1}{2}$ inches in length.

Tropidonotus Swinhonis, Gthr.

A variety of this species occurs at Ichang which differs from the type in having the scales more obscurely keeled, in possessing only the rudiments of a collar on the side of the neck, and in having the lower parts uniformly black or largely marbled with black.

Trimeresurus xanthomelas.

The second upper labial shield forms the front part of the facial pit; upper part of the snout with three small shields in front. Supraciliary scute large, not divided. Scales in twenty-one rows, keeled. Ventrals 185, 189; subcaudals 59, 68; anal and præanal not divided. Black, each scale with an elongate greenish-yellow spot, the spot frequently including small black specks. By the modification of the extent of the black colour on the scales a chain of subrhombic spots is formed along the vertebral line; the yellow of the scales within each rhombic spot is of a more reddish shade. Upper part of the head black, with a pattern of narrow symmetrical lines; a deep black band from the eye to the angle of the mouth; labial shields yellow, with a series of black spots on the sutures. A rather indistinct row of black spots along the sides of the body. Lower parts yellow, marbled with black, the black colour predominating in the posterior half of the length.

Five specimens of this beautiful snake were obtained at

Ichang by Mr. Pratt, one of the largest being 31 inches long, the tail measuring 5 inches.

3. BATRACHIANS.

Rana Boulengeri.

This species belongs to that division of the genus of which *Rana Kuhlîi* and *Rana Liebigii* are characteristic forms.

Vomerine teeth in two short oblique series, each starting from the inner edge of the choana. Head large, broad, much depressed; snout very short and rounded; canthus rostralis short but distinct; upper eyelid a little broader than the inter-orbital space; tympanum hidden. First finger longer than the second; toes with swollen extremity, entirely webbed; subarticular tubercles well developed; inner metatarsal tubercle elongate; no outer tubercle. The tibio-tarsal joint does not reach the end of the snout when the limb is carried forward. Skin of the upper parts covered with large elongate warts and small rounded tubercles; a strong fold of the skin above the tympanum; no glandular fold on the side of the back. Uniform blackish brown above. Male with two internal vocal sacs.

As in *Rana Liebigii*, the breeding male has extremely thick forearms, but without any special armature. The rudimentary thumb and a large rounded tubercle on the upper side of the first finger are thickly studded with horny spines, the second and third fingers having similar spines, but less numerous. The whole of the chest is covered with smaller and larger rounded tubercles, each armed with a black conical horny spine, and similar but smaller dermal structures are scattered over the abdomen and also over the throat.

Two specimens of this large species were sent by Mr. Pratt from Ichang. The length from the snout to the vent is 4 inches.

Hynobius chinensis.

Allied to the Japanese *Hynobius nebulosus*, but with the series of vomerine teeth much shorter, extending backwards only to the middle of the eyeball. General habit short and stout; head large, nearly as broad as long, its length being rather more than one fourth of the length of the trunk. Tail compressed in its whole length, but without crest; body with eleven lateral folds. The limbs meet when adpressed; fifth toe well developed; no carpal or tarsal tubercles. Skin

smooth; gular fold indistinct. Nearly uniform horny black, the lower parts brownish, finely marbled with darker.

	millim.
Total length	85
From snout to cloaca	46
Length of head	11
Width of head	10
Fore limb	15
Hind limb	16
Tail	39

Two specimens were collected by Mr. Pratt at Ichang.

4. FISHES.

Siniperca chuatsi, Basil.

Mr. Styan has sent specimens 2 feet in length.

Ophiocephalus argus, Cant.

The specimens sent by Mr. Styan are 16-17 inches in length.

Sclerognathus chinensis.

D. 58. A. 16. V. 12. L. lat. 55. L. transv. 12/13.

Mouth small, transverse, inferior, surrounded by a broad, continuous, corrugated lip. Body much elevated, the back being compressed into a sharp edge. The anterior profile ascends steeply from the occiput to the origin of the dorsal fin, which is the highest point of the body. The greatest depth of the body is two fifths of the total length (without caudal). Head small, broad, one fifth of the total length (without caudal). Eye of moderate size, situated in the middle of the length of the head. Dorsal fin very high, the fourth simple ray being as high as the body; also the anal fin is elevated, the longest rays reaching beyond the root of the caudal. Caudal fin emarginate, with the lower lobe pointed and with the upper rounded. Paired fins very large, the pectorals extending beyond the root of the ventrals, which reach to or nearly to the vent. There are nine longitudinal series of scales between the lateral line and the ventral fin. Body light-coloured, with three very broad, irregular, black cross bands, the anterior behind the head, the middle corresponding to the ventral fins, and the third nearly entirely covering the tail. Fins black, with the exception of the caudal, which is only partially tinged with black.

Four specimens of this fine and extremely interesting species were collected by Mr. Styan; the largest is $8\frac{1}{2}$ inches long.

Cyprinus carpio, L.

The carp in its wild state attains a large size; Mr. Styan has sent specimens 33 inches long.

Barbus semibarbus, Gthr.

As I do not acknowledge the generic division *Hemibarbus*, proposed by Bleeker, referring these barbels to *Barbus*, I am obliged to propose another specific name for *Hemibarbus maculatus*, to distinguish it from *Barbus maculatus*, C. V.

Barbus labeo, Pall.

Barbus dissimilis, Blkr., is the same species.

Pseudogobio (Sarcochilichthys) chinensis, Blkr.

Adult specimens have the lower jaw protected by a sharp horny sheath.

Pseudogobio Styani.

D. 11. A. 8. L. lat. 55. L. transv. 7/10.

Body elongate, its greatest depth being equal to the length of the head and one fifth of the total (without caudal). Head small, broad and depressed, with the snout elongate and sub-conical. Eye of moderate size, with broad circular eyelid, one seventh of the length of the head and two fifths of that of the snout. Mouth narrow, transverse, with pendent lateral lips, the lip of the upper jaw being continuous with that of the lower; front of the lower jaw without any labial fold. Barbel long, as long as the snout. Origin of the dorsal fin much nearer to the extremity of the snout than to the root of the caudal. Caudal fin with broad base, deeply forked. Pectoral extending to or nearly to the ventral, which does not reach the vent. Coloration uniform silvery, with blackish tinges on the fins.

Several specimens were collected by Mr. Styan, of which the largest exceed 12 inches in length.

Rhinogobio cylindricus, Gthr.

This name was given to a young specimen which is specifically identical with *Rhinogobio typus*, Blkr. This species

attains a length of about 10 inches and is common at Kiu-Kiang.

Xenocypris argentea, Gthr.

I am unable to distinguish from it *Xenocypris Davidi*, Blkr.

Myloleucus æthiops, Basil.

This is a large and common species in the Yangtze-Kiang near Kiu-Kiang. Mr. Styan has sent specimens 40 inches long. The pharyngeal teeth are five molars in the specimen examined.

Hypophthalmichthys nobilis, Rich.

This is also a very large Cyprinoid, exceeding a length of 4 feet.

Hypophthalmichthys molitrix, C. V.

Equals the preceding in size.

RHYNCHOCYPRIS, g. n. (Cyprin.).

Scales small, lateral line present. Dorsal fin short, without spine, its origin being immediately behind the root of the ventrals. Anal fin short. Mouth lateral, but overlapped by the conically protruding snout. Intermaxillaries slightly protractile, free from the upper part of the snout in their entire circumference; the labial fold of the lower jaw is lateral only and does not extend across the symphysis; barbel none. Gill-rakers very short and few in number; pseudobranchiæ glandular. Pharyngeal teeth uncinatè, in two rows, 5.2. Intestine short, with one convolution. Peritoneum black.

This genus seems to come nearer to some of the small North-American members of Cyprinina than to any of the Old-World forms.

Rhynchocypris variegata.

D. 10 or 11. A. 9. L. lat. 100.

Body rather elongate, its height being two ninths of the total length (without caudal), the length of the head two sevenths. Head depressed, broad and flat above, snout wedge-shaped and produced. Eye of moderate size, two ninths of the length of the head and two thirds of the length of the snout or of the width of the interorbital space. Origin

of the dorsal fin nearer to the root of the caudal than to the extremity of the snout; the anal fin commences at a short distance behind the dorsal and terminates a long way from the caudal; caudal fin emarginate. All the fins are short-rayed; the pectorals are not much longer than half the length of the head and terminate at a considerable distance from the ventrals. The root of the ventrals occupies nearly the middle between the end of the snout and the root of the caudal fin; they nearly reach the vent. Lateral line complete, well developed, running along the middle of the body. Back greyish, sides and lower parts silvery; numerous scales on the sides blackish.

This small species grows to a length of 5 inches. Several specimens were collected by Mr. Styan in mountain-streams near Kiu-Kiang and others at Ichang by Mr. Pratt.

SCOMBROCYPRIIS, g. n.

Allied to *Opsariichthys*.

Scales small. Lateral line running along the lower part of the tail. Dorsal fin short, with more than nine branched rays, inserted opposite to the ventrals. Anal fin of moderate length. Barbels none. Snout prolonged and pointed; cleft of the mouth wide, extending to below the eye. The intermaxillaries are much dilated at their anterior end and joined in the middle of the snout by a long and firm suture; their lateral edge is sharp, not covered by membrane. Lower jaw with a pointed hook-like projection in front, fitting into a hollow of the upper jaw. Suborbitals not dilated. Gill-rakers short and few in number; pseudobranchiæ. Pharyngeal teeth in a triple series, uncinatæ.

The body of this fish is elongate, compressed. I know of no other Cyprinoid with equally powerful jaws. The jaws are very firmly joined and the sharp bony edge of the intermaxillary and the terminal hook of the lower jaw supply as formidable a weapon as if the jaws were actually toothed. The form of the snout is very similar to that of a mackerel and has suggested the generic name.

Scombrocypris Styani.

D. 13-14. A. 13-14. L. lat. 112. L. transv. 19/10.

The height of the body is nearly one sixth, the length of the head one fourth, of the total length (without caudal). Head flat and rather broad above. The diameter of the eye is two fifths of the length of the snout, one fourth of the post-

orbital portion of the head, and one half of the width of the interorbital space. Mouth subhorizontal, wide, the maxillary extending to below the middle of the eye. The chain of infraorbital bones is very narrow. Suboperculum narrow and long. The anterior dorsal ray is somewhat nearer to the root of the caudal fin than to the end of the snout and immediately behind the root of the caudal. Origin of the anal fin at a distance behind the end of the dorsal. Caudal fin strong, broad, long, and deeply cleft. The length of the pectoral equals that of the postorbital portion of the head. Scales distinctly radiated; there are six series between the lateral line and the root of the ventral fin. The lateral line descends above the pectoral fin gradually to below the median line of the side, runs along the lower half of the tail, but terminates in the middle of the root of the caudal. Coloration uniform silvery.

Mr. Styan collected specimens in the main stream and one young one in mountain-streams near Kiu-Kiang. The largest is 4 feet long.

Chanodichthys pekinensis, Basil.

Mr. Styan has sent a specimen 2 feet long, and of the allied *Ch. mongolicus*, Basil., several attaining a length of 18 inches.

Culter ilishæformis, Blkr.

A large fish, exceeding 3 feet in length.

PARAPELECUS, g. n. (Cyprin.).

Body similar to that of a herring, much compressed, the entire abdominal edge being trenchant. Scales of moderate size; lateral line abruptly bent downwards above the pectoral fin. Cleft of the mouth oblique; barbels none. Dorsal fin short, without spine, placed opposite to the space between ventral and anal; anal fin long, many-rayed; caudal fin forked; pectorals rather long; ventrals well developed. Gill-covers attached by membrane to the isthmus. Pharyngeal teeth in a triple series, hooked, 5 . 4 . 2.

Parapelecus argenteus.

D. 10. A. 25. V. 9. L. lat. 75. L. transv. 10/5.

The height of the body is contained four times and one third in the total length (without caudal), the length of the

head five times and a third. Head very small, strongly compressed, with the cleft of the mouth obliquely ascending upwards and with the jaws equal in front when the mouth is shut. The eye is large, placed in the middle of the depth of the head, one fourth of the length of the head and rather shorter than the snout. Suborbitals narrow. The maxillary does not extend to the vertical from the front margin of the eye. Pectoral fin of moderate length, as long as the head, terminating at a great distance from the ventral fin. The root of the ventral is nearly midway between the extremity of the snout and the root of the caudal fin. The small dorsal fin is inserted nearer to the origin of the anal than to the root of the ventral. The lateral line is abruptly bent downwards in about the twelfth or thirteenth scale, and reascends opposite to the end of the anal fin; the muciferous tubes of each of the thirteen anterior scales emit a vertical branch at a right angle. Coloration uniform bright silvery.

Several specimens, $9\frac{1}{2}$ inches long, were obtained by Mr. Styant at Kiu-Kiang.

Cobitis xanti, Gthr.

This species has a suborbital spine and ought to be removed from the genus *Nemachilus*, to which I erroneously referred it.

Botia variegata.

D. 11. A. 8. V. 9.

Barbels six. The height of the body is one fifth of the total length (without caudal), the length of the head two sevenths; snout elongate, but the small eye is much nearer to the end of the snout than to that of the operculum. The suborbital spine extends to below the hind margin of the orbit. Interorbital space narrow, transversely convex, twice as wide as the orbit. Origin of the dorsal fin midway between the root of the caudal and the orbit. Caudal fin deeply forked. Body covered with minute but regularly arranged scales. Ground-colour yellowish, the body ornamented with five black bands, which are irregular in shape and may be broken up into large blotches; all are continuous across the back and the middle one corresponds in position to the dorsal fin. All the fins variegated with black, the black markings of the dorsal and anal fins sometimes confluent into broad band-like spots.

Two specimens of this fine gigantic species of loach were sent by Mr. Pratt from Ichang. The larger measures 13 inches in length.

Hemirhamphus, sp.

Several young specimens of a species of *Hemirhamphus* cylindrical in shape and only partly covered with small scales on the hind part of the body, with a bright, silvery, well-defined band, were collected by Mr. Styan at Kiu-Kiang on March 27. The determination of these specimens as to species is uncertain at present.

Clupea Reevesii, Rich.

Mr. Styan collected specimens 30 inches long.

Salanx chinensis, Osbeck.

This species ascends the river to Kiu-Kiang, where Mr. Styan obtained a specimen on March 27.

XXV.—*Notes on the Species of Phasmidæ collected by Basil Thomson, Esq., in the Louisiade Archipelago.* By W. F. KIRBY, F.E.S., Assistant in Zoological Department, British Museum (Natural History).

IN addition to Lepidoptera Mr. Thomson collected a small number of other insects, including some extremely interesting Phasmidæ. Among these were three female specimens which I cannot distinguish specifically from the wide-ranging and somewhat variable *Eurycantha horrida*, Boisd. The smallest of these is of a dark reddish-brown and measures 136 millimetres ($5\frac{1}{2}$ inches) in length; it much resembles specimens which we have previously received from Thursday Island. The other two are darker and much larger than any specimens previously in the collection of the British Museum; the largest measures 183 millim. (about $7\frac{1}{2}$ inches) in length and 25 millim. (an inch) across the thorax. The small specimen is from Goodenough Island and the two large ones from Rossel Island.

There is also a series of both sexes of a small *Promachus* taken on Sudest Island, Oct. 10, 1888, and a much larger female, taken on Rossel Island on Oct. 18. These have considerable general resemblance, and I might have considered the small specimens to be only the immature form of the larger one, but that the proportions of the tarsi are very different.

Promachus spinosus, sp. n.

Long. corp. 91 millim.

Female.—Reddish brown; antennæ darker, about as long as the head and thorax; head fully as long as the prothorax; a groove on the hinder half, curving off into two shallower depressions in front to the base of the antennæ; the head is covered with short spines or warts above, and there is a broad slightly dentated spine on each side about the middle; prothorax with two broad slightly diverging spines on an elevation in front and a strong ridge with a bifid elevation in the middle behind; there is also a row of three broad spines on each side and some smaller ones; the hindmost is twice as long as the others and dentated; mesothorax with a large elevation at one third of its length, in front of which are three diverging carinæ; behind this is a strong carina rising into a transverse ridge behind, the middle of which is occupied by another bifid prominence; the surface is studded with small scattered warts, and there are three large spines in front above the lateral line and two more below, above the middle coxæ, the larger ones being again surrounded and studded with shorter spines and warts; metathorax with a strong carina and a large spine on the middle and behind; below the median line there is a large cluster of spines in front of the hind coxæ; abdomen with the first six segments transverse, the remainder tapering; with a longitudinal granular carina, rising into a simple spine at the extremity of each segment, which slopes laterally to the base of a short spine on each side; near the front of each segment is an acute oblique spine on each side, and along the lateral line runs a row of short spines. On the eighth segment the terminal spines on the median line end with a strong raised ridge extending along nearly the whole length of the segment. The median spines, except the last ridge, are usually marked with black, and the ovipositor is also black. The legs are strongly ridged and are moderately spined along the carinæ on the femora and tibiæ. The femora, except at the base and tip, and a great part of the tibiæ and tarsi are blackish. Body beneath testaceous, nearly smooth, with only a row of spiny warts running along each side of the mesothorax and abdomen.

Legs rather short, femora rather shorter than the tibiæ. First four joints of the tarsi short, diminishing in length, the fifth as long as all the others. Antennæ slightly pilose; scape as long as the third joint, but much thicker than the short second joint, which again is thicker than the third.

Hab. Rossel Island, Oct. 18.

The complicated spines of this insect are very difficult to describe. It is not very similar to any previously described species with which I am acquainted.

Promachus insularis, sp. n.

♂, long. corp. 30 millim.; ♀, 47-50 milim.

Head and prothorax of about equal length; mesothorax about three times as long as broad and narrower than the metathorax, which is rather longer than broad; abdomen with the first six segments transverse, broader than long; the terminal segments narrower, raised and carinated. Antennæ a little longer than the head and thorax. Colour brown, slightly inclining to red in the male. Spines arranged as follows:—Median line: head with a pair of spines at the back; prothorax with two pairs; mesothorax with three pairs; metathorax with two single spines; and abdomen with a single spine at the extremity of each segment and diminishing in size hindwards. Lateral spines: mesothorax with four on each side; metathorax with one on each side; female with a row of spines on each side of the abdomen.

Femora with all the carinæ dentated, also the tibiæ slightly in the female, especially at the base; all the coxæ spined at the base (at least in the female), those on the hind coxæ the largest. First joint of tarsi as long as the remainder; first joint of antennæ long, broad, and compressed.

Male with the cerci small, pincer-like; female with the upper spine extending for one third of its length beyond the operculum.

Hab. Sudest Island, Oct. 10, 1888.

Allied to *Acanthoderus* (?) *hystrix*, Kaup.

XXVI.—On some new or little-known Species of Libellulinae from Jamaica in the Dublin Museum of Science and Art.

By W. F. KIRBY, F.E.S., Assistant in Zoological Department, British Museum (Natural History).

THE Dublin Museum of Science and Art contains a valuable series of insects of all orders from Jamaica, and I have lately had the opportunity, through the courtesy of the Keeper, Dr. Scharff, of examining some of the Odonata, among which I found several species of extreme interest, which form the subject of the present paper.

1. *Perithemis domitia*.*Libellula domitia*, Drury, Ill. Ex. Ent. ii. t. xlv. fig. 4 (1782).

Exp. al. 36-38 millim.

Head yellow, browner behind; thorax and abdomen chocolate-coloured, thorax with broad olive-green shoulder-stripes, and the sides entirely olive-green except narrow stripes on the sutures; abdomen with a narrow stripe on each side of the dorsal carina and a broad one on each side of the lateral carinae, all these interrupted by the sutures; wings with six or seven antenodal and from four to six postnodal cross nervures, the last antenodal and first two postnodals not normally continuous; hind wings with five antenodal and four or five postnodal cross nervures, the two first postnodals not continuous; pterostigma reddish, between black nervures, triangles free, followed by two rows of posttriangular cells, increasing; subtriangular space consisting of two cells divided by a perpendicular nervure: wings in the male transparent yellow, the centres of the cells mostly lighter; in the female the yellow colour extends along the costa to the pterostigma, but otherwise ceases a little beyond the nodus, leaving the rest of the wings transparent except a small brown spot at the tips of the hind wings.

2. *Perithemis pocahontas*, sp. n.

Exp. al. 40 millim.

Female.—Intermediate between *P. domitia*, Dru., and *P. thais*, Kirb.; colour and neurulation of the former, but the yellow on the costa ceases two cells before the pterostigma on the fore wings and one cell before on the hind wings; there is a brown blotch above and partly covering the triangles; a brown border, most distinct on the hind wings, runs down below the nodus at the extremity of the yellow portion of the wings; there is a brown spot towards the anal angle of the hind wings, and the hind wings are much more largely tipped with brown; the pterostigma, too, appears to be longer on the hind wings than on the fore wings.

I hesitated at first to describe this insect; but it seems to be sufficiently distinct to rank as a species. There are probably several closely allied species of this group, and it is not impossible that this insect may prove to be the female of the true *domitia* of Drury, the typical figure of which is rather larger than the specimens which I have described above under that name.

3. *Perithemis mooma*, sp. n.

Exp. al. 31 millim.

Female.—Head dull yellow, frontal tubercle brown; thorax reddish brown, with a long pale green oval spot on each side above; sides greenish white, with a reddish-brown stripe on the principal suture. Abdomen yellow, the carinae black, and a broad zigzag brown stripe above, so that the upper surface might either be regarded as brown with yellow markings or yellow with brown markings. Fore wings with seven antenodal and four postnodal cross nervures, the last antenodal and first postnodal not continuous; hind wings with five antenodal and four postnodal cross nervures, the first postnodal not continuous; triangles free, followed by two rows of posttriangular cells, increasing; subtriangular space consisting of one cell; pterostigma brownish yellow, between black nervures. Wings hyaline, with connected brown markings, extending from the base along the lower subcostal space, and then spreading upwards to the costa on both sides of the nodus and to within two or three cells of the pterostigma, and downwards across the sectors of the arculus, and between them to their origin, filling the triangle in the fore wings, and extending to the first cell between its sectors on the hind wings; another curved and pointed tooth extends from below the nodus across the posttriangular space as far as the lower sector of the arculus.

This curious species, which is perhaps most nearly allied to *P. tenera*, Say, has a striking resemblance to the African genus *Palpopleura*.

4. *Cannaphila insularis*.

Cannaphila insularis, Kirby, Trans. Zool. Soc. Lond. xii. p. 341, pl. liii. fig. 1, pl. lvii. fig. 9 (1889).

There are three females and one male in the Dublin Museum from Jamaica; the former differ little from the types of the species from Haiti, the male is pulverulent blue. There are sometimes two cross nervures in the lower basal cell of the fore wings on one side; there are always two on the hind wings on both sides.

XXVII.—*A Note upon the Anatomy of the Perignathic Girdle of Discoidea cylindrica, Lmk., sp., and of a Species of Echinoconus.* By Prof. P. MARTIN DUNCAN, M.B., F.R.S., &c., and W. PERCY SLADEN, Sec.L.S., F.G.S.

A PAPER upon the anatomy of the perignathic girdle of *Discoidea cylindrica*, Lmk., sp., was communicated to the Linnean Society, and was published in the 'Journal' of that Society for October 1886, vol. xx. p. 48.

It was explained (p. 56) that the perignathic girdle is remarkable and unique in shape, being low and surrounding the peristomial opening in the form of a raised, oblique, broad, ridge-like ring. The broad upper surface of the girdle is free and consists of flat or irregular slanting surfaces, the slant being towards the peristome and ending all round and outwards in a continuous and wavy free edge. This edge has the parts which correspond to the ambulacra thin, barely projecting, and reenteringly curved. The parts of the girdle which correspond to the interradia are boldly curved outwards and are large. The outer wavy edge of the girdle overhangs the inner surface of the base of the test.

No sutural lines exist in the specimen (no. 40341) in the British Museum from which the description was taken (see fig. 8, p. 56), upon the interrarial expansion of the perignathic girdle. On the other hand, the median sutures of the ambulacral parts are distinct. It was remarked, "but it is not satisfactorily shown that there are not sutures between the ambulacral and interrarial portions along the line of the slight groovings which are on either side of an ambulacrum high up in the peristome and at the lower edge of the inner surface of the girdle—that is to say, in the usual position of sutures in relation with branchial grooves or cuts."

Mention was made of the pairs of pores which are on either side of the median and more or less vertical suture of an ambulacrum. In ambulacrum III. there are two pairs of pores on one side of the median line and a single pair on the other; and in the other ambulacra, although the pores are not all distinctly shown, they appear to conform to the peristomial arrangement found in other regular Echinoidea.

All these pores are separated from the median sutures and also from the ill-defined sutures between the ambulacral and interrarial portions of the girdle.

In September 1888 one of us received a letter from our friend Prof. Sven Lovén, drawing attention to a paper of his, read Dec. 14, 1887, and published in 1888, "On a Recent

Form of the Echinoconidæ" (Bihang till Kongl. Svenska Vet.-Akad. Handl. Bd. xiii. Afd. iv. no. 10), and explaining why he had not noticed our paper upon the perignathic girdle of *Discoidea cylindrica*, Lmk. Prof. Sven Lovén wrote that he could not reconcile our drawing (fig. 8, p. 56) with the results of his own observations upon several specimens, and that as he disliked animadversion he had thought it best to publish his figures and to leave ours alone and uncriticized. He also sent us his interesting paper, containing beautiful illustrations.

We thank our friend very cordially for his courtesy, but we think that it is due to him that his discoveries should be placed on record in a paper which will also do justice to ourselves.

We have nothing to retract or to add regarding the description given by us of the specimen in the British Museum. Prof. Sven Lovén's beautiful drawing shows, in addition to what may be seen in the specimen we studied, distinct suturing of the interradian expansions of the girdle, some minute plates at the ambulacral edge of the interradian expansion, but one pair of pores on either side of the ambulacral median line, and that the outer pore of each pair is either along the line of the ambulacro-interradian suture or beyond it and in the edge of the interradian expansion. The drawing by Prof. Lovén (*op. cit.* p. 9, fig. 1) gives the impression that the parts of the interradian expansions next to the poriferous zones are ambulacral and therefore relics of "processes" *.

It is perfectly evident that Prof. Lovén intended to convey that these relics are those of "auricles" (ambulacral processes in other terminology), and, indeed, in his description of his fig. 2 he wrote "Four auricles from the aboral side and an ambulacral pair in the middle."

It became necessary for us to examine other specimens, so as to compare our results with those of Prof. Lovén upon

1. The position of the ambulacral pairs of pores.
2. Comparison of the teaching afforded by the original specimen and by those of Lovén.
3. The sutures of the expansions in new specimens.

Numerous specimens of *Discoidea cylindrica* were cut, and without satisfactory results, the girdle being absent or ruined; but, thanks to Mr. Gregory, F.G.S., of the British Museum, we have been able to study a very fairly preserved specimen.

* The terminology will be found explained in Journ. Linn. Soc., Zool. vol. xix. p. 179 (1885), "On the Perignathic Girdle of the Echinoidea."

The perignathic girdle is better preserved in some parts than in the specimen originally described by us; but while the pores of the ambulacra are not so clearly placed as in the early specimen, there are, beyond a doubt, sutures in the interradial expansions (the ridges).

1. Taking the old and this new specimen as examples, it is shown in them that the interrado-ambulacral suture is distinct and that the pairs of pores are between it and the median suture of the ambulacrum.

It appears, then, that no part of the expansions is truly ambulacral; all is interrarial.

Very respectfully we would draw our friend's attention to his drawing, fig. 2. There is a slightly oblique and not quite transverse suture separating the ambulacral plate of zone *b* nearest the peristome from the expansion. In our opinion that suture is the natural limit of the ambulacral region and is interrado-ambulacral. Consequently the plate which this suture bounds actinally is interrarial and not ambulacral.

2. As the evidence of the facts just noticed is clear and the drawing given by Prof. Lovén is doubtless correct, we must admit that variation is possible in the construction of the girdles of these forms, which are considered to be Gnathostomes by some and to be Edentates by other naturalists.

3. In the specimen originally examined by us there is not the slightest vestige of sutures in any one of the expansions, and we had no right to assume that there were any.

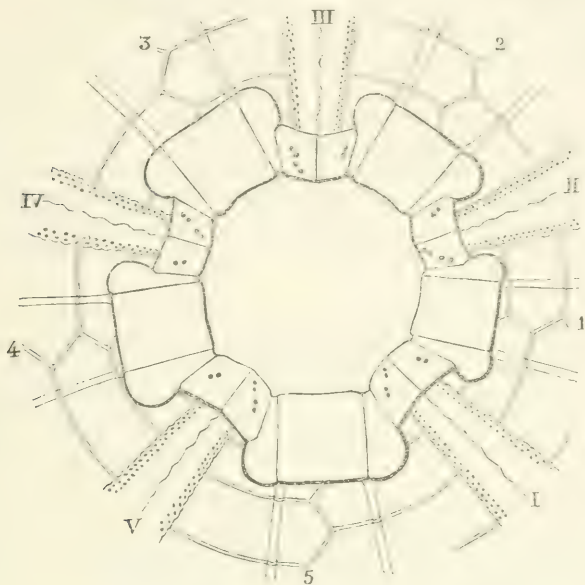
Prof. Lovén shows (*op. cit.* p. 9, fig. 1) that there are certainly three sutures in each expansion, irrespectively of what may be considered as interrado-ambulacral sutures. Possibly there are two others uniting small triangular pieces to the outer edges of expansions.

In the lately cut specimen at the British Museum there are distinct sutures in the interrarial expansions, but their distribution differs from that figured by Prof. Lovén.

Prof. Lovén shows that in each expansion there is (*a*) a median suture, (*β*) a suture on either side of the median suture, being parallel at some distance. Each of these two sutures, which are parallel with the median one, bounds a plate at the side of the median suture which unites the plates. Each one of these two sutures seems to start from close to the interrado-ambulacral suture at each branchial incision, a small space intervening.

According to Prof. Lovén's drawing (fig. 1) the interrado-ambulacral sutures are curved, and they limit a plate, a considerable part of which is free towards the ambulacrum and which has upon its corner the little plate and suture already

mentioned. In the British Museum specimen there is (*a*) no median suture in any expansion. There are (*β*) two sutures in the position of those discovered by Lovén. These sutures are nearly or quite parallel and include a single median plate.



The interrado-ambulacral suture arises close to the other sutures and bounds the ambulacrum, there being a plate between it and the suture *β* triangular in shape, with its point at the branchial incision. The dimensions of these triangular plates varies, and in no instance is there the small additional plate described by Prof. Lovén.

Median sutures are so common in the ridge portion (inter-radial) of perignathic girdles (see Journ. Linn. Soc., Zool. vol. xix. pl. xxxi.) that their presence would have been anticipated in *Discoidea*; but the variability of the girdle seems to extend to the suturing.

According to Prof. Lovén's view the plates on either side of the median suture of the interrado expansion of the perignathic girdle are truly interrado, and the plates on either side of them are ambulacral.

According to the terminology suggested and employed in the researches on the nature of the perignathic girdle of the Echinoidea (Journ. Linn. Soc., Zool. vol. xix.) the plates on

either side of the median line are homologous with the "ridges" and the other plates with the "processes."

According to the inferences which arise after studying the British-Museum specimens, the median plate is one plate of a "ridge" and those on either side of it are other plates of the same structure. There is no ambulacral process.

If it is admitted, as it well may be, that the specimens in the British Museum have had the plates on either side of the median suture so fused that the union is no longer visible, the clear definition of the ambulacral areas indicates that no portion of an ambulacrum exists on the flanks of the interrarial expansions. From the evidence before us, and after studying Prof. Lovén's figures, we hold that ambulacral processes or their homologues are absent and that the expansions are analogous to, and to a certain extent homologous with, the "ridges" of *Cidaridæ*.

It must be remembered, however, that in *Diadema setosum* the "ridges" of the perignathic girdle have a median sutural line separating two plates, on either side of which is a plate clearly belonging to the interradium. The gradual evolution of this arrangement can be appreciated by comparing figures 41, 42, 43, and 49 in Journ. Linn. Soc., Zool. vol. xix. pl. xxxi.

Finally we regret to differ from our friend respecting the presence of jaws and teeth in the genus *Discoidea*. We cannot find any probable or demonstrative evidence in favour of their existence.

Echinoconus (= *Galerites*).

Prof. Lovén believes that a structure similar to that of the perignathic girdle of *Discoidea cylindrica* "maintains in *Galerites albogalerus*," that is to say in *Echinoconus*. He also credits this well-known species with jaws and teeth.

In the 'Geological Magazine,' 1884, dec. iii. vol. i. no. 1, p. 10, one of us enlarged upon the nature of the peristomial structure of *Galerites albogalerus* = *Echinoconus conicus*, and proved that the so-called teeth described by E. Forbes and Wright are buccal plates (p. 18); no jaws or teeth have been found.

It was explained that no auricles have been seen in any specimen preserved in the British Museum, and that whilst the ambulacra are without processes there is thickening of the interradia close to the peristome.

The whole matter has been reconsidered and with the same results. The five ambulacra end distinctly at the peristomial

margin within the test and a definite and clear line of suture separates them from the interrarial edges. The pairs of pores are remote from the interrario-ambulacral suture and there is not a vestige of a "process."

The interrarial swelling sometimes rises to a blunt, raised edge separated by a little space from the peristomial margin. This blunt part is doubtless a degenerated "ridge," and it does not appear capable of affording origin or insertion to muscular structure.

It appears that *Echinoconus* is much lower in the scale of Echinoidea with regard to perignathic structure than the species of *Discoidea*, and certainly these are degraded below those of *Holactypus*, which have a feeble yet fairly perfect girdle, jaws, and teeth.

XXVIII.—On *Atherstonia*, a new Genus of Palæoniscid Fishes from the Karoo Formation of South Africa; and on a Tooth of *Ceratodus* from the Stormberg Beds of the Orange Free State. By A. SMITH WOODWARD, F.G.S., F.Z.S., of the British Museum (Natural History).

[Plate XIV.]

THE only remains of Palæoniscid fishes from the Early Mesozoic Karoo Series of South Africa hitherto described or figured are some detached scales made known by Egerton* under the names of *Palæoniscus Bainii* and *P. sculptus*. However, through the generosity of the Hon. W. Guybon Atherstone, M.D., F.G.S., of Grahamstown, the British Museum is now in possession of a nearly complete fish from the Beaufort Beds of Colesberg; and it is the object of the present notice to describe and discuss the principal characters of this fossil, illustrated in the accompanying Plate XIV. figs. 1-3.

Description.

The specimen is shown, nearly one half nat. size, in Pl. XIV. fig. 1, and a flank-scale of the natural size in fig. 2, while a few scales at the base of the dorsal fin form the subject of fig. 3. The general form of the fish is well indicated; but the head is much crushed and its precise contour probably destroyed, while the extremity of the caudal fin has been

* Sir P. Egerton, "Note on the Fish-remains from Styl Krantz, South Africa," Trans. Geol. Soc. [2] vol. vii. (1856), pp. 226, 227, pl. xxviii. figs. 26-42.

removed by an unfortunate line of joint in the rock. The trunk is elongate-fusiform, the head and opercular apparatus occupying about one fifth of the entire length; and the maximum depth of the trunk before crushing would also bear a similar proportion to the length. The upper lobe of the tail is extremely produced and slender. The mandibular suspensorium is very oblique and the head and opercular bones are externally ornamented with tubercles and rugæ; but no details can be observed of the cranial osteology.

Appendicular Skeleton.—The fins are all tolerably well preserved except the caudal, which, as already remarked, is partly broken away. They all consist of broad, laterally compressed, and closely arranged rays, frequently articulated, and with distal bifurcation; and, most probably, judging from a small specimen mentioned below, there is a series of minute fulcra upon the anterior margin of the preaxial ray. In the pectoral fins at least eight or nine rays are unarticulated in the proximal half of their length; but all seem to be closely jointed distally and are also perhaps bifurcated. The pelvic fins are remarkable for the length of their base-line; each consisted probably of about eighteen or twenty rays, gradually decreasing in length posteriorly, and all are distinctly articulated quite from their point of insertion. The dorsal fin arises behind the posterior extremity of the pelvic pair, and the anal fin is so remote that even its first rays scarcely oppose the hinder portion of the dorsal. Each of these median fins is longer than high, the anal being especially elongated and consisting of not less than forty-five or fifty rays, of which the seventh or eighth is the largest and followed by gradually shortening rays posteriorly.

Squamation.—The trunk is completely invested in a covering of thick rhomboidal scales, united by peg-and-socket joints, except towards the extremity of the tail, and externally ornamented with delicate branching ridges, though with a smooth posterior edge. There is considerable variation in the size and proportions of the scales in different parts, those in the middle of the flank of the abdominal region being largest and those at the base of the insertion of the fins the smallest. The middle flank-scales (fig. 2) are deeper than broad, with a very prominent peg-and-socket articulation; and the usual internal rib appears to be only developed in those situated more posteriorly and upon the caudal region. Ventrally—and also dorsally in the caudal region—the scales become rapidly broader than deep, until the breadth is often twice as great as the depth. At the base of the dorsal and anal fins there is also a singular diminution of the size of the

scales, apparently by the division of each vertical series into two, as suggested by appearances at the base of the dorsal (fig. 3); and it is probable that a similar arrangement occurs in connexion with the pelvic fins. Upon the sides of the extremely attenuated caudal lobe the scales exhibit the usual elongation of one diagonal; but the proportions of the large fulcral ridge-scales cannot be observed, owing to the imperfection of the fossil. The most remarkable feature in the squamation, however, is the enormous development of the ridge-scales along the entire extent of the dorsal margin. The series commences immediately at the back of the head and comprises sixteen or seventeen scales as far as the dorsal fin; and though there is a diminution in size behind the dorsal, they still maintain relatively large proportions. Each of these scales is saddle-shaped, being very slightly arched from side to side; there is considerable overlapping, and the external surface is ornamented with fine ridges, mainly disposed in an antero-posterior direction.

Determination.

The family relationships of the fish thus described are so obvious as to require no detailed discussion, and its generic affinities are likewise readily determinable. In the appearance of the scales, the situation and proportions of the fins, and the recognizable features of the head, this South-African fish most nearly approaches *Gyrolepis**, from the European Trias and Rhætic, and *Rhabdolepis*†, from the European Lower Permian. That it is, however, generically distinct is indicated by the enormous development of the dorsal series of ridge-scales; and as it seems appropriate to employ the name of the discoverer of the first tolerably complete specimen, the genus may be briefly defined as follows:—

ATHERSTONIA.

Trunk robust; mandibular suspensorium very oblique and gape wide. [Teeth unknown.] Fins powerful, with minute fulcra; pelvic fins with an elongated base-line, the dorsal arising between the pelvics and the anal, and the last-named fin remote, much elongated. Scales relatively large, externally marked with coarse oblique striæ and subdivided into smaller scales at the base of the dorsal, anal, and pelvic fins;

* W. Dames, "Die Ganoiden des deutschen Muschelkalks," *Palæont. Abhandl.* vol. iv. (1888), pp. 135-137.

† R. H. Traquair, "On the Agassizian Genera *Amblypterus*, *Palæoniscus*, *Gyrolepis*, and *Pygopterus*," *Quart. Journ. Geol. Soc.* vol. xxxiii. (1877), p. 552.

dorsal margin with a continuous series of very large deeply overlapping ridge-scales.

The single known species described above may be termed *Atherstonia scutata*.

Stratigraphical Position and associated Fish-Fauna.

Dr. Atherstone's fossil was obtained from the Beaufort Beds of Colesberg, Cape Colony, and the imperfectly preserved trunk of a smaller fish of the same genus from a corresponding horizon at Alice, near Fort Beaufort, was long ago recorded by Owen *, without description, under the MS. name of *Hyp-terus Bainii*. The latter fossil is also exhibited in the British Museum (No. 46007), having been presented by the Trustees of the Albany Museum; and it may even be specifically identical with *Atherstonia scutata*, though further specimens are required for satisfactory discussion. The British-Museum collection, moreover, contains fragments of other Palæoniscid fishes from various parts of the great Karoo Series of South Africa, though, like the scales described by Egerton, these cannot as yet be precisely determined; and the only associated fishes of other types hitherto definitely known are *Semionotus capensis* and *Oleithrolepis Extoni* from the Stormberg Beds †, in addition to the tooth of *Ceratodus* described below.

In conclusion, through the kindness of Professor Rupert Jones, F.R.S., the writer is enabled to append a synopsis of the subdivisions of the South-African "Karoo Series" of A. G. Bain, showing the stratigraphical position of the few fossil fishes from that formation already described:—

KAROO SERIES (A. G. Bain).	{	STORMBERG BEDS (UPPER KAROO). Yield <i>Palæoniscus Bainii</i> , Eg., <i>P. sculptus</i> , Eg., <i>Semionotus capensis</i> , A. S. Woodw., <i>Oleithrolepis Extoni</i> , A. S. Woodw., and <i>Ceratodus capensis</i> , A. S. Woodw.
		BEAUFORT BEDS (LOWER KAROO). ["Karoo Beds" of Green, Quart. Journ. Geol. Soc. 1888, and "Upper Karoo Beds" of Dunn's Map and Report.] Yield <i>Atherstonia scutata</i> , A. S. Woodw.
		KIMBERLEY SHALES. ["Olive Shales" of Stow, Quart. Journ. Geol. Soc. 1874.]
		ECCA BEDS. [Including "Koonap Beds" and "Ecca Beds" of T. Rupert Jones, Quart. Journ. Geol. Soc. 1867, the "Lower Karoo Beds" and "Dwyka Conglomerate" of Dunn's Map and Report.]

* R. Owen, 'Catalogue of the Fossil Reptilia of South Africa' (1876), p. ix.

† Smith Woodward, "On two new Lepidotoid Ganoids from the Early Mesozoic Deposits of Orange Free State, South Africa," Quart. Journ. Geol. Soc. vol. xlv. (1888), pp. 138-143, pl. vi.

Note on a Tooth of Ceratodus from the Stormberg Beds of the Orange Free State, South Africa.

Though not hitherto recorded, the occurrence of *Ceratodus* in the Karoo Series of South Africa is a circumstance to be expected, and it is interesting now to be able to make known the discovery of a very typical tooth. The specimen in question was received by the British Museum in exchange from the Bloemfontein Museum, Orange Free State, through the intervention of Dr. Hugh Exton, F.G.S., and the locality being Smithfield, Orange Free State, the fossil was doubtless obtained from the fish-bearing horizon of the Stormberg Beds. The tooth is unfortunately imperfect, as shown in the accompanying figure (Pl. XIV. fig. 4); but sufficient remains to render its approximate determination possible. It is of comparatively small size, thin, and triangular in shape, with the angulation of the inner margin acute and placed opposite the second denticle. When complete the denticles would be at least five in number, and these are all separated by deep notches at the outer margin, while the ridges extending from them are acute and some nearly reach the inner angulation.

In the acuteness and number of the ridges the new South-African tooth most nearly approaches those of *Ceratodus serratus*, Ag.*; *C. Philippsii*, Ag.†, *C. runcinatus*, Plien.‡, and certain forms discovered in the Kota-Maleri Beds of India§. From all these, however, the specimen differs in being as thin as the rounded-ridged teeth of *C. Kaupii*, Ag.; and it may therefore be regarded as indicating a new species—*Ceratodus capensis*.

EXPLANATION OF PLATE XIV.

- Fig. 1.* *Atherstonia scutata*, gen. et sp. nov. Lateral aspect of fish, one half nat. size.—Beaufort Beds, Colesberg, Cape Colony. [Brit. Mus. No. P. 4735.]
- Fig. 2.* The same. Flank-scale: *a*, external aspect; *b*, internal aspect, twice nat. size.
- Fig. 3.* The same. Scales at base of dorsal fin, nat. size.
- Fig. 4.* *Ceratodus capensis*, sp. nov. Tooth; *a*, coronal aspect; *b*, anterior aspect of the same.—Stormberg Beds, Smithfield, Orange Free State. [Brit. Mus. No. P. 4807.]

* L. Agassiz, Rech. Poiss. Foss. vol. iii. (1838), p. 135, pl. xix. fig. 18.

† L. Agassiz, *ibid.* p. 135, pl. xix. fig. 17.

‡ Meyer and Plieninger, Beitr. Paläont. Württembergs (1844), p. 86, pl. xi. fig. 8.

§ T. Oldham, "On some Fossil Fish-Teeth of the Genus *Ceratodus* from Malédi, South of Nagpur," Mem. Geol. Surv. India, vol. i. (1859), pp. 295-309, pls. xiv.-xvi.

XXIX.—*Descriptions of new Reptiles and Batrachians from Madagascar.* By G. A. BOULENGER.

Sepsina frontoparietalis.

Snout obtuse, scarcely projecting beyond the labial margin; eye moderate; lower eyelid scaly; ear-opening smaller than the eye-opening. Frontal divided into an anterior (frontal) and a posterior (frontoparietal) shield of equal length; the frontal proper in contact with the first and second supraoculars, the frontoparietal with the second, third, and fourth; frontal angularly emarginate on each side by the first supraocular; five supraoculars; nine supraciliaries; interparietal longer than broad, shorter than the frontoparietal; fourth upper labial entering the orbit. Twenty-eight scales round the middle of the body, equal. Limbs rather elongate, overlapping when adpressed. The fore limb, stretched forwards, reaches the anterior corner of the eye; hind limb rather more than half the length of the body. Tail twice as long as head and body. Brown above, each scale with the edges darker; nape and anterior part of back with interrupted dark brown cross bands; lower parts whitish.

	millim.
Total length.....	182
Head.....	13
Width of head.....	8
Body.....	49
Fore limb.....	16
Hind limb.....	26
Tail.....	120

A single specimen.

The division of the frontal shield, whether or not an individual character, is particularly interesting as showing that the large frontal of *Sepsina* and allied genera originated through fusion with the frontoparietal.

Chamæleon cucullatus, Gray.

This species has been known for nearly sixty years from a single female specimen. The collection which yielded the novelties described in this paper contained several specimens of both sexes, the females agreeing perfectly with the type preserved in the British Museum.

The male differs in the still more developed occipital lobe, the longer occipital process (the distance between the com-

missure of the mouth and the extremity of the casque exceeding the length of the mouth), the larger tubercles on the canthus rostralis, and the presence of two short, flattened, tuberculate, bony nasal processes, which are directed downwards and slightly outwards.

Total length 37 centimetres.

Rana flavicrus.

Vomerine teeth in two short transverse series just behind the level of the choanæ. Head moderate, as long as broad; snout subacuminate, truncate at the end, as long as the diameter of the orbit; nostril near the end of the snout; canthus rostralis angular; loreal region concave; interorbital space a little narrower than the upper eyelid; tympanum distinct, nearly as large as the eye. Fingers and toes slender, the tips dilated into small disks; first finger not extending quite so far as second; toes nearly entirely webbed; subarticular tubercles small; a small inner metatarsal tubercle. The tibio-tarsal articulation reaches beyond the end of the snout; tibia as long as the vertebral column. Skin smooth, belly and anal region granular; no dorso-lateral fold. Dark olive-grey above, with a few scattered minute white dots and a paler grey dorso-lateral band, bordered below by a blackish lateral band passing through the tympanum; lips pale grey, with black dots; groin with yellow marblings; limbs with black cross bars; lower surface of leg yellow, spotted and marbled with black; the remainder of the lower surfaces greyish, with indistinct brown mottling. Male with internal vocal sacs.

From snout to vent 55 millim.

A single male specimen.

Rana redimita.

Vomerine teeth in two small groups far behind the level of the choanæ. Head moderate; snout subacuminate; canthus rostralis angular; loreal region concave; the diameter of the orbit equals its distance from the nostril; interorbital space as broad as the upper eyelid; tympanum distinct, nearly two thirds the diameter of the eye. Fingers and toes moderate, the tips dilated into small disks; first and second fingers equal; toes half-webbed; subarticular tubercles moderate; a small inner metatarsal tubercle. The tibio-tarsal articulation reaches the eye; tibia three fourths the length of the vertebral column. Skin smooth, granular on the belly and

under the thighs ; no dorso-lateral fold. Dark brown above, with small lighter spots ; two whitish streaks from below the eye to the labial border ; limbs with black cross bands edged with whitish ; throat brown, closely spotted with black and with a black longitudinal streak on each side ; labial border black, with white dots ; belly and lower surface of limbs whitish, with numerous small black spots. Male with internal vocal sacs.

From snout to vent 47 millim.

A single male specimen.

Rana biporus.

Vomerine teeth in two small groups behind the level of the choanae. Habit stout. Head short ; snout rounded, a little shorter than the diameter of the orbit ; nostril a little nearer the end of the snout than the eye ; canthus rostralis obtuse ; loreal region slightly concave ; interorbital space narrower than the upper eyelid ; tympanum distinct, two thirds or three fourths the diameter of the eye. Fingers moderate, first and second equal ; toes moderate, half-webbed ; tips of fingers and toes dilated into small disks ; subarticular tubercles small ; a small inner metatarsal tubercle. The tibio-tarsal articulation reaches the eye ; tibia two thirds the length of the vertebral column. Skin smooth ; no dorso-lateral fold ; a pair of circular flat glands, each with a median impression, under each thigh near its proximal extremity. Dark brown above, with or without a light vertebral line ; a more or less distinct, angular, black cross band between the eyes, light-edged anteriorly ; sides with white dots ; limbs with very indistinct black cross bars ; lower parts white, throat mottled or marbled with black. Male with internal vocal sacs.

From snout to vent 36 millim.

Several specimens.

The name given to this small species refers to the curious femoral glands, which are more developed in males than in females, and may prove homologous with the femoral pores of lizards. Such glands were first noticed in some Madagascar frogs (*Rana ulcerosa*, *guttulata*, *femoralis*) by Dr. Boettger and myself ; these frogs, however, differ from *R. biporus* in having but a single gland on each side. A recent examination of the types of *Polypedates lugubris*, A. Dum., has convinced me of its identity with *Rana femoralis*, which must therefore bear the name *Rana lugubris*.

I also find that *Polypedates dispar*, Bttg., is identical with *P. tephraeomystax*, A. Dum., from Nossi Bé.

PLATYHYLA, g. n. (*Dyscophidarum*).

Pupil horizontal. Tongue large, oval, entire, and free behind. Palatine teeth* in two long, oblique, transverse series, converging posteriorly, separated by a narrow interspace. Tympanum hidden. Fingers and toes webbed at the base, the tips dilated into very large disks supported by a Y-shaped terminal phalanx. Outer metatarsals united. Coracoids strong; præcoracoids very slender, bent nearly at right angles, only the proximal half ossified; omosternum very small, cartilaginous; sternum a small cartilaginous plate. Diapophyses of sacral vertebra moderately dilated.

The following analysis shows the relations of this new genus to the other members of the family *Dyscophidæ*:—

- I. Pupil vertical; palatine teeth in long transverse series.
 - A. Præcoracoids ossified; tips of fingers and toes not dilated.
 - Sternum very large 1. *Dyscophus*, Grand.
 - Sternum small 2. *Calluella*, Stol.
 - B. Præcoracoids not ossified; tips of fingers and toes dilated 3. *Plethodontohyla*, Blgr.
- II. Pupil horizontal.
 - A. Palatine teeth in long transverse series.
 - 1. Præcoracoids ossified; tips of fingers and toes dilated.
 - Fingers and toes free; præcoracoids entirely ossified 4. *Mantipus*, Ptrs.
 - Fingers and toes webbed at the base; præcoracoids semio ssified 5. *Platyhyla*, Blgr.
 - 2. Præcoracoids not ossified; tips of fingers and toes not dilated 6. *Phrynocara*, Ptrs.
 - B. Palatine teeth in one or two small groups; præcoracoids ossified; tips of fingers and toes dilated.
 - Two small groups of teeth on the palate 7. *Platypelis*, Blgr.
 - A single small group of teeth in the middle of the palate 8. *Cophyla*, Bttg.

Platyhyla grandis.

Series of palatine teeth forming together an obtuse angle,

* The so-called vomerine teeth are inserted on the palatine bones in the *Dyscophidæ*.

extending to the vertical of the inner corner of the choanæ. Tongue very large, nearly covering the floor of the mouth. Head much depressed, broader than long; snout very short, rounded, with obtuse canthus rostralis; nostril halfway between the eye and the end of the snout; interorbital space a little broader than the upper eyelid. Fingers with very large truncate disks, that of the third finger rather larger than the eye; first finger shorter than second; a large, oval, compressed inner metacarpal tubercle. Toes one-third webbed, disks smaller than those of fingers; subarticular tubercles and inner metatarsal tubercle small and feebly prominent. The tibio-tarsal articulation reaches the ear. Skin smooth. Brown above, limbs with indistinct dark cross bands; brownish white inferiorly. Male with an internal vocal sac.

From snout to vent 83 millim.

Two specimens.

BIBLIOGRAPHICAL NOTICE.

The Larvæ of the British Butterflies and Moths. By (the late) WILLIAM BUCKLER. Edited by H. T. STANTON, F.R.S. Vol. III. 8vo. Ray Society, London, 1889.

THE Ray Society's contribution to the literature of Natural History for the present year consists of the third volume of figures of the larvæ of British Lepidoptera prepared by the late Mr. William Buckler. The second volume, issued in 1887, included the Sphinxes and the first three families of the Bombycina; the present publication contains the illustrations of the remainder of the group.

As we have already called attention to the general character of the work, which must be of the highest interest to all lepidopterists, we need hardly do more than state that the beauty of the illustrations is fully maintained and that the eighteen plates contained in the new volume assist worthily towards the formation of a permanent monument of the unwearied industry of a naturalist whose labours unfortunately came to a close only too soon. In fact that inexorable tyrant, Death, seems to have determined to do all in his power to diminish Mr. Buckler's credit, for during the preparation of the volume now before us the Rev. John Hellins, who had contributed towards the completion of the manuscript and printed records of observations left by the departed artist, and whose descriptive notes added greatly to the value of the first two volumes, died rather unexpectedly, and the editor has been unable to find any one possessing the requisite knowledge who had also time at his disposal to undertake the task. Nevertheless the artist's own

notes furnish a great mass of information upon the development of the species depicted in his plates; and even if the present difficulty should continue, his work will be indispensable to all students of the British Lepidoptera.

MISCELLANEOUS.

A Contribution to our Knowledge of the Deep-sea Fauna of the British Islands. By Dr. A. GÜNTHER, F.R.S.

THE Rev. W. S. Green at the beginning of July devoted a few days to a dredging-excursion in the deep water off the south-western coast of Ireland. The results have amply justified the expectation of the rich harvest which is to be gathered by a methodical investigation of the fauna inhabiting the deep water surrounding the British Islands. The collections, which were made for the British Museum, are being examined by the staff of the Zoological Department, and will form the subject of a detailed report. In anticipation I may mention that the Sponges include *Aphrocallistes Bocagei* (Wright), the Hydroids *Eudendrium rameum* (Pall.), the Echinoderms some twenty-five species, among which are *Phormosoma placenta* (W. Th.), a new species of *Nymphaster*, and *Brisinga coronata*. Also the Crustaceans and Polyzoa yield additions to the British Fauna, *Ebalia nux* (Norman), *Parapagurus pilosimanus* (Smith), a new species of *Eupagurus*, and *Arachnidium simplex* (Hincks) being represented by several examples in the collection.

The examination of the Fishes has been undertaken by myself; they were taken at various depths between 150 and 350 fathoms. Of the ten species collected five are new to the British Fauna, viz. *Hoplostethus mediterraneum* (C. V.), *Scorpana dactyloptera* (de la Roche), *Macrurus celorhynchus* (Risso), *Macrurus levis* (Lowe), and *Rhombus Boscii* (Risso). One Flat-fish, a Sole (*Solea Greenii*), is new to science. The other species were previously known to occur in deep water of the British seas and are the Boar-fish (*Capros aper*), the Forked Beard (*Phycis blennioides*, Brünn.), the Variegated Sole (*Solea variegata*, Flem.), and the Black-mouthed Dog-fish (*Pristiurus melanostomus*, Raf.).

The new species of Sole is readily recognized by having the elongate body, the small scales (L. lat. 144), and the numbers of fin-rays of the Common Sole, but the rudimentary pectoral fins of the Variegated Sole. D. 81, A. 65, P. dextr. 5, P. sin. 1.

A Correction in British Spongology.

By H. J. CARTER, F.R.S. &c.

Influenced chiefly by the spiniferous ends of the tricurvate (*toxite*, R. et D.) I was persuaded that the British species of *Microciona*
Ann. & Mag. N. Hist. Ser. 6. Vol. iv. 17

described and illustrated by myself in 1874 ('Annals,' vol. xiv. pp. 456 and 457, pl. xxi. fig. 27) was the same as that described and illustrated by Mr. R. Hope, F.Z.S., in February last ('Annals,' vol. iii. pl. vi. A, 5) under the name of "*Microciona spinarcus*:" nor should I have perceived my error, had not Mr. Hope, in March last, kindly sent me preparations of yet another new species from Hastings, which, from the form of *its* tricurvate, we both recognized to be totally different from that of *M. spinarcus*; at the same time it seems to me to be absolutely *identical* with my figure of 1874 (*l. c.*), inasmuch as the arms of the latter are depressed almost to straightness, while in the former they are bent much upwards, bow-like (see Mr. Hope's figure, *l. c.*).

Mr. Hope's second new species of *Microciona*, viz. that in which the arms of the tricurvate are so much depressed, will be described and illustrated by him hereafter; meanwhile this statement will be sufficient to correct my own "error," and serve to record the existence of an unnamed and undescribed British species of *Microciona* chiefly characterized by the form of tricurvate above mentioned.

August 5, 1889.

On the Marine Acarina of the Shores of France.

By M. TROUESSART.

Since my previous note on this subject communicated to the Academy on the 5th November, 1888, I have got together fresh materials which enable me to give more complete information with regard to the Acarological fauna of our shores. Besides my personal investigations I have received important contributions from MM. Chevreux and Le Sénéchal (of Croisic and Caen). Mr. G. S. Brady (of Sunderland) has lent me the types of the species described by him from the English coasts. Lastly, Dr. Lohmann (of Kiel), who has just published an excellent monograph of the Marine Acarina of the Baltic Sea*, has taken the trouble to compare my types with his.

The only truly marine Acarina are the Halacaridæ, which must form a very distinct family, and not a mere subfamily of the Trombidiidæ. In this latter family the last joint of the palpi is always palpiiform, and it is the *penultimate* that acquires the form of a *terminal claw*; in all the Halacaridæ, on the contrary, it is the *last joint* of the palpi which constitutes the terminal claw, and there is no trace of the palpiiform joint. This fundamental difference seems to me to justify the elevation of the Halacaridæ to the rank of a family, as proposed by Murray in 1875.

The Halacaridæ live in the sea from the littoral zone down to the depth of 30-50 fathoms. They walk and climb, rather than swim, upon the bottom, the rocks, the Algæ, and the fixed or slow-moving

* 'Zoologische Jahrbücher,' Bd. iv. (1889) p. 269.

marine animals of which they are commensals. Their food appears to be very varied, according to age and locality. It is the colour of the food which fills their stomach and marks its outlines, which, when seen by translucence, gives the coloration remarked in several species, for the integuments are transparent and of a nearly colourless testaceous-yellow tint. If my observations are correct, *Halacarus spinifer*, Lohm., the largest and commonest species of our coasts, is exclusively carnivorous in its youth; the larvæ and nymphs are of a coral-red colour, identical with that of the ova of Copepods which abound in the region inhabited by them; the adult, on the contrary, is of a darker or lighter brown, and we find in its stomach numerous tests of Diatoms, indicating at least a partially vegetable regime. Like many other Acarina, therefore, these animals are parasites in their youth, and become simple commensals when adult.

The Halacaridæ live well in brackish water, and even resist fresh water for a long time. They can be kept alive for two or three days in an aquarium of the latter kind, while Copepoda die there rapidly. In the canal from Caen to the sea, the water of which has scarcely more than 2 gr. of salt in the litre, M. Le Sénéchal has found *Halacarus spinifer* upon the Hydroids which have become acclimatized there.

But it is in the Laminarian zone, or, more correctly, in the Coral-line zone, and especially upon *Corallina officinalis*, that these animals abound, as is shown by the numerous dredgings which M. E. Chevreux has been good enough to make specially at my request upon the coast of the Croisic. The Halacaridæ occur in great numbers attached by their hooked feet to the delicate fronds of the Corallines. In M. Chevreux's flasks these animals are mingled with hundreds of small Crustaceans (Copepods, Amphipods, and Ostracods), with Pycnogonidæ and specimens of *Amphipura squamata*, collected at the same time. These results agree with those obtained by Dr. Lohmann in the Baltic; of the fifteen species collected by him two occur in the zone of red seaweeds (Corallines) at depths of 5-10 fathoms.

The number of species from the French coasts which I shall make known in a memoir now in course of preparation is comparatively considerable. My collection contains seventeen species, while the English naturalists have only recorded ten, and Dr. Lohmann fifteen. The individuals from the Ocean are superior in size to those of the Baltic, although several species are identical, such as *Rhombognathus* (*Aletes*, Lohm.) *notops*, *R. Seahami*, *Halacarus spinifer* (= *H. etanopus* of my previous note), *H. Murrayi* (= *H. inermis*), *H. Fabricii*, *H. rhodostigma*, and *Leptognathus falcatus*, which inhabit our Atlantic shores.

Two generic types (*Leptopsalis* and *Copidognathus*) characterized in my former note occur in the Ocean and are wanting in the Baltic. A new species of the former genus (*Leptopsalis Chevreuxi*) will enable this type to be better characterized. It occurs at the Croisic. This applies also to *Pachygnathus sculptus*, Brady, a species which is very interesting as having been dredged at a depth of 35 fathoms.

It will form a separate genus very distinct from *Rhombognathus*, to be characterized as follows:—*Simognathus*, g. n. Maxillary palpi dorsal, arranged as in *Leptognathus*; rostrum short and broad. Type *Pachygnathus sculptus*, Brady. This genus is to *Rhombognathus* what *Leptognathus* is to *Halacarus*.

Another type characterized by Dr. Lohmann, although not found in the Baltic, is the genus *Agauæ*. It is a southern type which makes its appearance first in the Bay of Biscay (*Agauæ brevipalpus*, sp. n., from the oyster-beds of Arcachon). In the Mediterranean this type seems to replace the genus *Halacarus*, which there has only two species (*H. oculatus* and *H. levipes*, sp. n.), while the genus *Agauæ* has three species, namely *A. hirsuta*, sp. n., a robust type of considerable size (0.75 millim.), *A. microrhyncha*, sp. n., and *A. brevipalpus*, which is identical with the species from Arcachon. These three species occur upon the Corsican moss (*Sphaerococcus helminthocorton*) and the Corallines which live in the same localities. —*Comptes Rendus*, June 3, 1889, p. 1178.

On a new Species of Chat.

Dehesa de Cologan,
Puerto Orotava,
Tenerife,
25th July, 1889.

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

GENTLEMEN,—

I enclose you the description of a distinctly new species of Chat which I discovered in the island of Fuerteventura in March 1888. This year I spent some weeks in the island and procured several specimens, also its nest and eggs; these also are quite distinct, as are the breeding-habits of the bird.

Yours faithfully,

E. G. MEADE-WALDO.

Pratincola dacotice, sp. nov.

P. ♂. Supra brunneo-nigra, fusco-limbata; cauda brunnea, rectricibus extimis albo-limbatis; loris et capitis lateribus nigris, linea supraoculari et postoculari alba; gula et thorace albis; pectoris cinctura pallide castanea, abdomine albedo; hypochondriis et crisso albis, remigibus brunneis; secundariis majoribus interioribus albis, reliquis albo-marginatis, rostro et pedibus nigris.

♀. Supra brunnea; gula, thorace et abdomine albidis, cinctura castanea pectoris pæne obsoleta, aliter mari similis.

Long. tot. 4.9, alæ 2.5, caud. 2.3, rostr. .62, tars. .9.

Hab. Ins. Fuerteventura, Mauritanicè Dacos.

On the Fore and Aft Poles, the Axial Differentiation, and a possible Anterior Sensory Apparatus of Volvox minor. By Prof. J. A. RYDER.

The Author remarked that he had recently had an opportunity of studying a very large colony of *Volvox minor*, Stein, which appeared in the aquarium jars kept in the Conservatory of the Biological Department of the University of Pennsylvania. As some of the singular features of these Algae which he had noticed were apparently unrecorded, it was desirable that they should be described in order that others should have an opportunity of more fully investigating the facts and their bearings upon the life-history of these singular organisms.

It was noticed that there was an empty pole in every colony or cœnobium. This empty or non-spore-bearing pole was always the anterior one, or that which was directed forwards in the act of locomotion, which is effected by a rotating motion of the whole cœnobium impelled by the flagella of its cells projecting through its envelope of cellulose. The direction of the rotation of the cœnobium is not constant and may be either sinistral or dextral; but the direction of progress always coincides with an imaginary axis passing through the centre of the anterior empty pole and the posterior germ-bearing portion of the nearly spherical colony or cœnobium. These poles are sometimes differentiated before the young Volvoces leave their parent cœnobium, which they do by breaking through the wall of the latter at its hinder pole.

The diameter of a *Volvox*-cœnobium is slightly longer measured along the axis around which it revolves than in the direction transverse to it. It results from this that the cœnobium are somewhat smaller equatorially than axially, so that the form of the whole is that of a very slightly oblong spheroid. These characters are fairly constant and nearly always apparent, while that of the production of the spore in a little more than the posterior hemisphere of the cœnobium is invariable, as well as the uniform direction of the axis of progressive locomotion in relation thereto.

Another very extraordinary fact which was observed was that the so-called "eye-spots" found in the flagellate cells of the anterior pole of the spherical cœnobium were the largest, and invariably occupied a definite position in relation to the flagella and to the axis around which the colony rotated. The anterior cells had the brownish-red "eye-spots" largest; and as one examined row after row of the cells of the cœnobium in succession backward towards what one might term the *caudal pole*, these "eye-spots" were seen to gradually diminish in size, until in the last cells of the hinder pole they were barely distinguishable as minute reddish points, which elevated the protoplasm of the cells into a slight prominence, such as is more marked over the larger anterior "eye-spots." This remarkable fact of the "eye-spots" of the anterior pole being the largest revives in a striking way the query whether these reddish bodies are not really visual organs or sense-organs of some kind

after all, as originally supposed by Ehrenberg. Their gradual diminution in size towards the posterior pole, where they are nearly atrophied, would seem to indicate that they were in some way related to the power of the organism to move in a definite direction, the cells of the anterior end being provided with the best developed visual, sensory apparatus, or whatever it may be. If it should prove possible to show that these "eye-spots" are really sensory organs in *Volvox*, as all the facts which have been here noted would seem to indicate, it would be one of the few instances known of a plant possessed of visual or sensory organs of any kind, unless we except some such plants as the Venus' fly-trap.

The speaker stated that he had been unable to find any notice of any of the features of *Volvox* which are here described; all of the figures to which he had had access in standard works were entirely erroneous from their authors having completely overlooked these very salient and important features of this remarkable plant. This should therefore be regarded as his apology for bringing a very common organism to the notice of the Academy and to the renewed attention of the microscopists who take pleasure in studying it. It is to be hoped that some one who is skilled in such work will be induced to take up the study of *Volvox* anew and publish a well-executed drawing of a colony in which the facts here recorded are adequately represented. This is all the more desirable in that, if *Volvox* is really a plant, its psychological history should be as much a matter of interest as its singular beauty and its intricate methods of reproduction seem to have been.—*Proc. Acad. Nat. Sci. Philad.* May 21, 1889, p. 138.

On a Gall produced in Typhlocyba rosæ, Lian., by a Hymenopterous Larva. By M. A. GIARD.

During last October the trunks of the horse-chestnuts in the Luxembourg Garden were covered with thousands of dead specimens of *Typhlocyba rosæ*, with the wings half open, and slightly attached to the bark, as if they had been killed by an Entomophthorean. The under surface of the leaves also bore a great number of dead specimens of this insect. By microscopic examination I could not detect any trace of Cryptogams. However, as R. Thaxter has lately noted the facility with which *Typhlocyba rosæ* and *malii* when infested by *Entomophthora sphaerosperma*, Fres., completely discharge their spores, I thought I must have come upon the scene too late, and left a more complete observation to the summer of the present year*. I must confess that my curiosity was much excited by the

* *Typhlocyba rosæ* lives usually upon roses, apple-trees, and other Rosaceous plants, and often causes great mischief in gardens. I do not think that it has ever been indicated upon the horse-chestnut. In spite of a careful examination I have been unable to find characters clearly separating the variety *æsculi* from the type. M. Lethierry, whose knowledge of the Hemiptera is so great, ascribes the few differences observed to the action of the parasites upon the *Typhlocyba*. However, the *Typhlocybae* which have become adapted to the horse-chestnut seem to neglect the roses planted in the vicinity.

fact that many of the skins of *Typhlocyba* presented a sort of appendage inserted at the upper part of the abdomen, and at the first glance producing an appearance as if the abdomen had been bifurcated from its origin.

This year, towards the end of June, the horse-chestnuts were again covered with *Typhlocyba*, and I was able to convince myself that we had to do not with an Entomophthorean but with an animal parasite, a Hymenopterous larva the mode of life of which is very remarkable. Almost all the *Typhlocyba* collected on the trunks of the trees bear, either to the right or left of the abdomen, a sac, of which the length and breadth are equal, or nearly so, to those of the abdomen itself. Concealed beneath the wings of the Homopteran, the flight of which it scarcely affects, this sac is inserted in the dorsal part of the second somite of the abdomen. A chitinous thickening in the shape of a V, or, rather, of a reversed circumflex accent, marks on the dorsal surface the point of insertion of the sac. In the interior we find a Hymenopterous larva bent upon itself ventrally in such a way that the mouth and the posterior extremity of the body meet towards the point of suspension. The two parts of the larva are separated from each other by a longitudinal partition which divides the sac into two portions in communication at the two ends. A narrow fissure, the margins and the posterior part of which are tinged with a blackish pigment, starts from the point of the chitinous V and extends longitudinally for a distance equal to the length of a somite of the *Typhlocyba*. When the larva is mature this fissure is extended to the free extremity of the sac, and by means of this kind of dehiscence the parasite is set free and falls either into the crevices of the bark or to the ground, where it speedily becomes transformed into a pupa within a coarse case, like that of some Braconidæ.

The larva greatly resembles that of the Torymidæ and especially of the genus *Misocampus*. Upon each segment it bears a transverse row of long stiff hairs; the mandibles are well developed. The digestive canal is rudimentary and there is no anus; the fatty bodies are very voluminous and filled with rectangular crystals belonging to the right prismatic system with a rectangular base. In a few days I hope to obtain the perfect insect and thus to arrive at a more precise determination of the parasite. But it seemed to me to be useful at once to call attention to this first-known example of a true animal-gall produced on the exterior of an Arthropod by another Arthropod. The sac of the *Typhlocyba* is, in fact, the extreme case of a series of deformations, such as those caused in certain Hymenoptera by *Stylops*, or in the Decapod Crustacea by the Bopyridæ. It may also be compared with the sacs also produced by hyperplasty of the cuticular hypodermis, but in the interior of the host, by the Tachinidæ (*Ocyptera* and *Masicera*) either in Heteroptera or in Coleoptera, or, further, to the sac in which the Entoniscidæ live. It is evident that the *Typhlocyba* were infested in the pupa- or even in the larva-state, and it would be very interesting to follow the development of the sac step by step. The physiological effects pro-

duced upon the infested organism (parasitic castration &c.) are also of much interest, and I hope to make them known in a future communication. It is marvellous to see the infested *Typhlocyba* move, leap, and fly like healthy individuals at the precise moment when the Hymenopterous larva quits the sac and abandons its host reduced to an inanimate skin.

Dr. Thomas, generalizing with great sagacity the old notion of the *vegetable gall*, has given the name of *cecidia* to every morphological manifestation caused by the local reaction of a plant to an animal or vegetable parasite, whence the distinction between *zoocecidie* and *phytocecidie*. It seems to me that we may employ a parallel nomenclature for the animal galls. I propose to call these productions *thylaciæ*. We already know a certain number of *zoothylaciæ*, for example the *carcinothylaciæ* produced by the Bopyridæ upon the Decapod Crustacea, the *entomothylaciæ*, such as the tumours caused by the *Cuterebræ* upon the skin of the Mammalia, or the sac of *Typhlocyba* which we have just been considering. We also know some *phytothylaciæ*, the coccidial tumours of fishes, the anthrax-pustule (*bacteriothylaciæ*), &c.

We must also distinguish from these external thylaciæ the *internal thylaciæ*, such as the sacs of the larva of Tachinidæ, the Entoniscidæ, the cysts of the *Trichinæ*, &c. The thylaciæ of *Typhlocyba* is formed by a gradual dilatation of the hypodermis, which secretes an abnormal cuticle more strongly adorned with undulated striæ than that which covers the actual body of the insect.

I must warn entomologists who may wish to repeat my observations against a cause of error which stopped me for some time. A good many of the *Typhlocyba* of the alleys of the Luxembourg are infested, not by the Hymenopterous larva above-mentioned, but by a Dipterous larva, and as the latter, when mature, issues rapidly from the body of its host when this is placed in a collecting-tube, it gets mixed with the larvæ of Hymenoptera which have also escaped. One might then be tempted, knowing the habits of the Tachinidæ, to believe that the Dipterous larva is the producer of the gall and the Hymenopterous one its parasite.

This has probably been done formerly; but I have been able to ascertain that the Dipterous larva occurs in the body of the *Typhlocyba* itself, with the head directed towards the extremity of the abdomen of its host, which it distends so much as to make it slightly pass beyond the wings, which is not the case in the normal state. This Dipterous larva, after issuing through the dorsal part of the middle abdominal somites, becomes converted into a naked pupa at the surface of the ground, and I hope shortly to be able to describe the perfect insect.—*Comptes Rendus*, July 8, 1889, p. 79.

THE ANNALS
AND
MAGAZINE OF NATURAL HISTORY.
[SIXTH SERIES.]

No. 22. OCTOBER 1889.

XXX.—*On the Genera Nototherium and Zygomaturus, in
reply to Mr. Lydekker.*

Queensland Museum, Brisbane,
May 21, 1889.

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

GENTLEMEN,—

Permit me to offer some observations on Mr. Lydekker's view of *Nototherium* and *Zygomaturus*.

For the behoof of those who may be interested in the dispute I beg leave to place at your disposal a cast of the maxilla twice referred to in my remarks *, and to be

Yours most respectfully,
C. W. DE VIS.

IN the skull to which it is proposed to restore Macleay's name *Zygomaturus* are two premolars—the one on the right side well preserved and complete though worn, the other, taken by itself, in a condition less conducive to safe interpretation. Mr. Lydekker, in his late attempt to set aside my reasons for separating *Zygomaturus* from *Nototherium*,

* [The cast has been presented to the Geological Department of the British Museum (Natural History).—Eds.]

acknowledges that I am right in attributing to the latter a *pm.*⁴ triangular in shape, and is thus driven to admit that the right tooth of this skull is not a *Nototherium* premolar. The former admission he is ready to make probably because it seems to enable him to deal the blow which, as he phrases it, leaves me without a leg to stand on. He claims to have discovered by careful examination a fact which eluded the scrutiny and stultifies the judgment of Sir Richard Owen, namely that the true premolar of the skull is not the right but the left tooth, and this he asserts to be of the triangular shape demanded. Can anything more be required to prove that this skull is beyond doubt *Nototherium*?—possibly, as we may see later on.

But first, What of the unfortunate tooth so ignominiously dismissed? We are gravely instructed that this may be: 1st, an abnormality; 2nd, a pseudohomologue; 3rd, a deception; 4th, a milk-tooth—verily a quartette of the most volatile assumptions ever accruing from the resolution of a “too, too gross” fact! Grant the tooth an abnormality—then, as it occurs again in the maxilla from which I have figured it and a third time in a third example procured of late, we are led by it to the *reductio ad absurdum* “constant abnormality.” If it be not homologous with its fellow of the opposite side, which tooth of the opposite side is in reality its homologue?, in other words, which dilophodont tooth should be made to pair off with this forlorn bunodont? We ought not to be left in the dark on so interesting a point. Is it an “insertion” fraudulent or accidental “from another skull”?

Then, in two examples at least we have evidence that the deception was set afoot by some practical joker or mysterious agency in the Drift period for the confusion of a latter-day disputant. As to its being a milk-tooth retained to old age, the age impressed upon the posterior molars, and that in a family long known to have been without milk-teeth, very good evidence indeed in support of such a notion must be forthcoming before it is likely to be accepted. Moreover, it involves another abnormality—milk-teeth and their successors are in Marsupials always, I believe, of the same type, differing in size, sculptural details, and, to a less extent, in shape, but not in general form and plan of structure, for an oval tubercular tooth to be succeeded by a triangular unicuspidate one would certainly be an anomaly. But, to protect Mr. Lydekker from this particular illusion in the future, I have resorted to the crucial test, and, opening the maxilla at my disposal, find no trace whatever of successional tooth or formative

chamber in the position they should occupy. In proof of this I forward for inspection a cast of the maxilla examined.

Surely the very number and violence of these hypotheses should have warned a judicious observer against the validity of an apparent fact, however specious, which threatened to compel him into their toils.

And now what is the fact? and is it so patent, so specious even, as to leave us no alternative but to accept it at any cost?

Of the original skull in the Australian Museum, Sydney, two editions of casts have been issued, one immediately after its discovery and before the matrix had been efficiently cleared from the surface, the other at a recent date after skilful development of details. The former, as may be supposed, is an unreliable exponent of its original—for example, it obscures by a ridge representing unremoved matrix one of the characteristic features of the very tooth in dispute. Of this edition is the copy in the British Museum, a copy not rendered more trustworthy by having been “restored.”

Waiving this general objection to Mr. Lydekker's source of information, an objection which, had he been aware of it, might have deterred him from his fatal tilt against a difficulty of his own creation, I will take up his parable on his own ground. The left tooth, he says, is triangular (rudely subtriangular I should call it) and shorter than the succeeding molar. Now if Mr. Lydekker accepts my determination of the shape of the *Nototherium* ^{pp. 4}, he must in fairness accept also my description of its structure or give reasons for rejecting it. Of structure in relation to the tooth in question he wisely says nothing. The crown of the *Nototherium* tooth is a single elevated subtriangular cusp rather deeply emarginated on its posterior side and wearing down to a bitriangular tract of enamel-edged dentine. The cast of the *Zygomaturus* tooth (a very young tooth according to Mr. Lydekker's favourite hypothesis) shows a crown flatly depressed and broken up into several eminences; near the fore end of the tooth in its present state one of these eminences is formed by a conical flat-topped tubercle (its flatness the result of wear) corresponding to the anterior of the external tubercles of the fellow tooth; behind it on the outer side is another eminence corresponding to the posterior tubercle of that side in the homologous tooth; the two tubercles of the inner posterior region are concealed by a ridge-like remnant of matrix, as before intimated; the anterior basal tubercle is missing, lost probably by the same accident which removed a large chip from the inner anterior surface below the base. This loss is the main cause of the

apparent shortness of the tooth ; but this again is also partially due to absorption of the posterior basal talon resulting from pressure in the rear. In short, the tooth before me is nothing but the somewhat mutilated, somewhat abbreviated, and somewhat disguised homologue of its fellow. Most assuredly it is not the tooth of *Nototherium* as known to me. Such is the ground, treacherous in itself and sadly misunderstood, which allowed my critic to sink into a veritable slough of surmise.

To my question respecting the maxillary fossils which occur in frequency corresponding to that of the numerous mandibles of undoubtedly *Nototherian* origin, Mr. Lydekker responds somewhat inconsiderately to the effect that these "crushed *Diprotodon*-like skulls" (all these terms are his own and unwarranted) may indicate "young individuals or a small species of *Diprotodon* itself." If this be so, nothing remains for me but to unlearn and relearn, if possible, the means of distinguishing between old and young *Diprotodons*, or, perhaps, in course of time to describe a "small *Diprotodon*" with its posterior incisors on the edge of the jaw.

This would not be a difficult feat for one prepared to say that *Owenia* is probably a "small form of *Nototherium*," that is of *Zygomaturus*, since in Mr. Lydekker's judgment a form with reduced dentition, small narrow nasals, elongated muzzle, and slender jugals may be one generically with a form antithetical to it in these and many other respects. Mr. Lydekker has very liberal ideas of the amount of differentiation sometimes required for the establishment of a genus.

With respect to the name *Owenia*, Mr. Lydekker remarks that it is preoccupied three deep in the Invertebrates, leaving it to be inferred that this also is a discovery of his own ; it is a distinct act of unfairness (unintentional I should be willing to think) not to state that I called attention to the fact while pleading that under the circumstances the name might be accepted.

Minor blemishes, such as terming my rejoinder to his footnote in the B. M. Cat. of Foss. Mamm. a reopening of the question, I pass over, with merely a word on the "untenable proposition," which proposition briefly is that when a type lacks a requisite characteristic that one of the proposer's cotypes which does possess the characteristic required should for practical purposes be taken as the typical example. This seems to me to recommend itself to common sense. It may be observed that Mr. Lydekker himself holds the untenable by resting his case not on the molars of the type, but on the shape of the premolar deduced from that of the cotype.

On the whole I have to thank Mr. Lydekker for his criti-

cism; it has relieved me of a foolish fear that, in spite of improbability, the British Museum might possess some positive evidence in natural association of parts that *Zygomaturus* is *Nototherium*. I am comforted to find that the hypothesis remains in its pristine purity, also to think that if no better attack upon my position can be made than that which I have met it is pretty secure. An utter failure to show that the right tooth is not the $pm.4$ proper to the skull, together with the confession that it is not the premolar of *Nototherium*, might well have released me from any obligation to cut Mr. Lydekker's Gordian knot.

Queensland Museum,
April 15, 1889.

XXXI.—*Note on the Above.* By R. LYDEKKER.

BEING extremely unwilling to enter into any prolonged controversy on this or any other subject, my remarks on the foregoing communication will be of the briefest nature.

If the author be right in his contention that the first cheek-tooth on the right side of the cranium to which the name *Zygomaturus* was applied is homologous with and similar to the corresponding tooth on the left, then there may be evidence that this skull is specifically distinct from the form to which Sir R. Owen gave the name of *Nototherium inerme*. This, however, would be very far from proving that these two forms are widely different and have a totally distinct type of appendicular skeleton. Moreover, if it be assumed that the so-called *Zygomaturus* is widely different from that type of cranium to which the author would restrict the term *Nototherium*, we are confronted with the difficulty that while, with one exception, all the complete maxillæ in the British Museum appear referable to *Nototherium*, all the mandibles seem to be of the type of *Zygomaturus*.

In conclusion, I cannot pass over the author's extraordinary statement that the milk-teeth of Marsupials are always similar in structure to their successors, when, as is well known, precisely the reverse is the case. Thus we have only to cite the case of many of the Kangaroos, where a molariform $mm.4$ is succeeded by a secant $pm.4$. This ignorance of such a well-known feature among existing forms is not calculated to raise one's estimation of the author's acumen when he has to face the more difficult question of the structure and affinities of extinct types.

XXXII.—Notes upon certain Species of *Æolosoma*.

By FRANK E. BEDDARD, M.A., &c.

§ 1. *The Pigmented Vesicles of Æolosoma quaternarium.*

Although this species appears to be fairly common in England, it is capricious in its occurrence. I have lately met with it in abundance among some *Chara* which was sent to me by Messrs. Bolton, and have been able to some extent to compare its pigment with that of *Æolosoma tenebrarum* (Beddard, "On the Green Cells in the Integument of *Æolosoma tenebrarum*," Proc. Zool. Soc. 1889, p. 51, pl. v.) and *Æolosoma Headleyi* (*infra*, p. 264). The colour of the pigmented spots of this species is an orange-brown; they appear more red when examined under a low power; as the colour of these peculiar glandular cells is often so distinctive of the species, it is confusing to find the descriptions of them in species, which appear to be identical with the present, so different in detail. Lankester ("A Contribution to a Knowledge of the Lower Annelids," Trans. Linn. Soc. vol. xxvi. p. 642) speaks of them as "blood-red;" Vejdovsky ("System und Morphologie der Oligochaeten," Prag, 1884, p. 18) describes them as orange-red, but figures them (*loc. cit.* pl. i. fig. 1) as crimson; Maggi ("Intorno al genere *Æolosoma*," Mem. Soc. Ital. Sci. Nat. vol. i. p. 9) differentiates his *Æolosoma balsamo* from other species by the colour of these cells:—"inoltre le macchie, a differenza delle altre, sono di un rosso aranciato;" but I must agree with Vejdovsky in refusing to admit the validity of this species. Schmarda describes a species—*Æolosoma pictum*—which seems hardly to differ from the present, as having purple-red ("purpur-roth") oil-globules; finally Cragin's *Æolosoma Stokesi* ("First Contribution to a Knowledge of the Lower Invertebrates of Kansas," Bull. Wash. Coll. Lab. 1887, no. 8, p. 31), with "bright salmon-red nuclei," is, as I have already suggested (Proc. Zool. Soc. *tom. cit.*), devoid of any characters by which it can be satisfactorily distinguished from *Æolosoma Ehrenbergii* or *Æolosoma quaternarium*. I have observed but little variation in the coloration of the epidermic oil-globules*, such as there is, for example, in *Æolosoma Headleyi*; it is therefore possible that the apparently different colour of the species mentioned above implies specific distinction; but it is on the whole more probable that the variation

* In one specimen some of the spots were smaller and had a purplish colour.

is confined to the terms used by the authors in their several descriptions.

I can confirm the statement of Vejdovsky that there is no nucleus in the cells containing the coloured oil-globules; so far this species agrees with *Æolosoma Headleyi* and differs from *Æolosoma tenebrarum*, where a nucleus appears to be invariably present in the fully mature cell.

I refer the present species to *Æolosoma quaternarium* on account of the fact that there are no nephridia in the œsophageal segment; they begin, in fact, in the second seta-bearing segment. But I cannot agree with Vejdovsky (*loc. cit.* p. 20) that the pigment-spots are less numerous upon the prostomium than elsewhere; I find considerable variation in this particular, but in many specimens—I rather think in the majority—the oil-globules were quite crowded in the lateral regions of the prostomium.

I have just mentioned the fact that the oil-globules of this species, like those of *Æolosoma Headleyi* and unlike those of *Æolosoma tenebrarum*, are not surrounded by any cell-protoplasm or nucleus, except of course when they are just beginning to be formed; correlated with this is the fact that on treatment with iodine solution there is no deposition of black granules around the coloured oil-globules; this might perhaps be expected to occur in the periphery of the smaller oil-globules, but it does not. The absence therefore of this reaction, which is so characteristic of *Æolosoma tenebrarum*, may perhaps not necessarily indicate a profound difference in the pigment of the three species, *Æolosoma quaternarium*, *variegatum*, and *Headleyi*, as compared with *Æolosoma tenebrarum*. If the explanation which I offered in my paper upon *Æolosoma tenebrarum* (*Proc. Zool. Soc.* 1889, p. 53) of the black stain produced by iodine be correct, viz. that it is a precipitation of elemental iodine caused in some way by the coloured oil-globule, it is perhaps a little difficult to see why the supposed influence of the coloured oil-drop in *Æolosoma quaternarium* does not reach the cells immediately surrounding it with which the oil-globule is so nearly in contact. This theory may of course be wrong; but in the meantime it seems to me to be on the whole more probable that there is so far a difference between the several pigments, and that the orange-brown pigment of *Æolosoma quaternarium* and the bright green pigment of *Æolosoma variegatum* and *Headleyi* may be less perfect as respiratory pigments, and therefore in course of degeneration. In this connexion it is interesting to note that *Æolosoma tenebrarum* is on a decidedly higher level of organization than any of the other species at present

known *. It has a more complex brain as well as considerable traces of a ventral nerve-cord; the number of segments is larger and the nephridia are more numerous, and finally the specialization of the setæ points in the same direction.

Treated with ammonia or with potash the brown colouring was at once dissolved and converted into a fine purple; the purple colour rapidly disappeared, and I never succeeded in treating it with a mineral acid sufficiently promptly to see if the brown colour could be restored. This reaction appears to indicate that the brown colouring-matter is nearly related to the green colour of *Æolosoma tenebrarum* and *Æolosoma Headleyi*, as all three pigments were changed to purple by the action of an alkali; in the last two species, however, the purple was not of so vivid a hue as in *Æolosoma quaternarium*, owing apparently to the presence of a granular detritus precipitated by the action of the reagent; this precipitation was not formed when *Æolosoma quaternarium* was treated with this reagent.

It is, however, important to notice that the three colouring-matters have something in common, though researches into animal pigments have shown that it is equally surprising to find the same or quite different pigments in closely allied forms.

In my paper upon *Æolosoma tenebrarum* I mentioned that the pigment was dissolved by turpentine, forming a bright yellow solution, which after a time became bleached. I have treated *Æolosoma quaternarium* with the same substance and found an analogous reaction; the pigment was dissolved, but slightly altered in colour, becoming reddish brown. I have not had the opportunity of applying this test to *Æolosoma Headleyi*. The alteration in colour, which is similar to that produced upon other colouring substances by turpentine (see for example Krukenberg, *Vergl. physiol. Studien*, I. Reihe, 2 Abth. p. 68), may perhaps be due to ozone.

§ 2. Further Notes upon *Æolosoma Headleyi*.

In my paper descriptive of this species ("Observations upon an Annelid of the Genus *Æolosoma*," *Proc. Zool. Soc.* 1888, p. 213) I have pointed out its resemblances to and differences from *Æolosoma variegatum*, with which species it might possibly be confounded; a short time after completing my study of the species, so far as the material at my disposal

* Some of the remarkable forms (e. g. *Æolosoma macrogaster*) too imperfectly described by Schmarda ('*Reise um die Erde*,' Bd. ii. p. 10, pl. xvii. fig. 154) may prove to be exceptions to this statement.

enabled me to do, I found in water from the same tank a great quantity of examples of *Æolosoma tenebrarum* (see Beddard, "Note upon the Green Cells in the Integument of *Æolosoma tenebrarum*," Proc. Zool. Soc. 1889, p. 51), and was able therefore to record the presence of this species in England for the first time*. The appearance of *Æolosoma tenebrarum* in the same water which produced *Æ. Headleyi* suggested to me that I had made a mistake in distinguishing the latter form as a distinct species. I have, however, again met with *Æ. Headleyi* and have been able to compare it with *Æ. tenebrarum*; this comparison establishes, so far as I can see, the justice of separating the two forms. *Æolosoma Headleyi* is nearly as large a species as *Æ. tenebrarum*—much larger than *Æ. quaternarium*—but differs from it in having *only* capilliform setæ; the green spots are quite different in colour from those of *Æ. tenebrarum*, being of a *bright* green, often with a distinct admixture of blue. The nephridia are as numerous as in *Æ. tenebrarum*, much more numerous than in *Æ. variegatum*, and they commence in the *first* setigerous segment. The green cells when treated with iodine do not show the remarkable black precipitation which is so distinctive of *Æ. tenebrarum*; but, as in that species, they become violet when treated with ammonia. When the worm is subjected to pressure and to the action of acids &c. the contents of the coloured epidermic cells are not expelled in long coiled threads, as in *Æolosoma tenebrarum*. All the facts appear to point to the distinctness of *Æolosoma Headleyi* from *Æ. tenebrarum*—at any rate in the present state of our knowledge of this very interesting genus of Oligochaeta.

XXXIII.—*Descriptions of a new Snake and two new Fishes obtained by Dr. H. von Ihering in Brazil.* By G. A. BOULENGER.

Elapomorphus trilineatus.

Rostral as deep as broad, in contact with the anterior angle of the single præfrontal; internasals meeting by their inner angle; frontal not quite so long as its distance from the end

* The occurrence of this form in the Zoological Gardens only is perhaps hardly sufficient to establish it as a British species. I have, however, since my paper was published received examples from Oxford through the kindness of Mr. O. H. Latter, tutor of Keble College. Prof. W. Hatcher Jackson informs me that he has observed an *Æolosoma* with green spots, which is probably the same.

of the snout, much shorter than the parietals; one præ- and two postoculars; temporals 1+1; six upper labials, second and third entering the eye, fifth largest; four lower labials in contact with the anterior chin-shields, which equal the posterior in size. Scales in 15 rows. Ventrals 203; anal divided; subcaudals 26. Cream-colour (in spirit), above with three black streaks, interrupted by the pale borders of the scales, the middle one on the vertebral row of scales, the lateral between the fourth and fifth rows (counting from the ventrals); a blackish transverse band on the base of the tail; ventrals and subcaudals black antero-mesially.

Total length 530 millim.; tail 45.

A single specimen, from the Camapuam-River district.

Pimelodus (Pseudorhamdia) nigribarbis.

D. 1/6. A. 17. P. 1/8.

Head bony above, granulated; occipital process obtusely keeled, twice as long as broad, extending to the basal bone of the dorsal spine. Adipose fin one sixth of the total length (without caudal), about two thirds its distance from the dorsal fin. The maxillary barbel extends to the origin of the anal, the outer mandibular to the extremity of the pectoral. Length of head two sevenths of the total (without caudal); eye rather larger, a little nearer the end of the snout than the extremity of the opercle, its diameter once and a half in the length of the snout. Dorsal fin much higher than long, the spine strong, but little shorter than the anterior branched rays, measuring two thirds the length of the head. Pectoral spine a little longer than dorsal, serrated on both sides. Caudal fin deeply forked, with the lobes pointed, the upper being the longer. Upper parts and fins powdered with black, most closely on the ventrals and anals and on the barbels, which are almost black.

Total length 155 millim.

Two specimens, from the Camapuam River.

Girardinus Iheringii.

D. 9. A. 9. V. 5. L. lat. 28-30. L. transv. 8.

Height of body about two sevenths of the total length (without caudal), length of head one fourth. Diameter of the eye exceeding the length of the snout, less than the width of the interorbital space. Origin of the dorsal above the middle of the anal in the female, a little nearer the end of the

snout than the extremity of the caudal. Anal, in the male, in the anterior third of the total length, half as long as head and body without caudal fin. Twelve or thirteen scales on the median line between the interorbital space and the first dorsal ray. Caudal fin as long as the head. Pale brown, the scales edged with darker; six to eight vertical black lines on each side of the tail.

Male 25 millim. long, female 42.

Numerous specimens, from Rio Grande do Sul.

XXXIV.—Notes on the Palæozoic Bivalved Entomostraca.—

No. XXVIII.* On some Scandinavian Species. By Prof. T. RUPERT JONES, F.R.S., F.G.S., &c.

[Plate XV.†]

SEVERAL fossil Cypridiform Ostracoda, such as *Macrocypris*, *Pontocypris*, and *Bythocypris*, from the Upper-Silurian strata of Shropshire, were described and figured in the Ann. & Mag. Nat. Hist. ser. 5, vol. xix. (1887), pp. 178–189, plates iv.–vii.; and a few species similar to some of the above-mentioned, and of like age, but from Scandinavia, were treated of *op. cit.* ser. 6, vol. i. (1888), pp. 396–398, pl. xxii. figs. 1–3.

Since then my friend Prof. Gustav Lindström, of Stockholm, has sent to me for examination a series of Ostracoda ‡ from a red clay near Wisby, which is referred to in the column marked “a” in Prof. G. Lindström’s Table of Formations, at p. 8 of my ‘Notes on some Silurian Ostracoda from Gothland,’ 8vo, Stockholm, 1887, and is there termed the “Oldest red shale beds with *Arachnophyllum*,” at the base of the *Stricklandinia*-marls. They are regarded as being on the horizon of the Llandovery formation in England, homotaxially a little below the Upper Llandovery §.

* No. XXVII. appeared in the Ann. & Mag. Nat. Hist. for May 1889, pp. 373 &c.

† This Plate has been drawn with the aid of a grant from the Royal Society for the illustration of the fossil Ostracoda.

‡ Mr. C. Davies Sherborn, F.G.S., has helped me in sorting and comparing these little specimens.

§ The provisional list of these Wisby species, given at p. 410, Ann. & Mag. Nat. Hist. June 1888, is now modified as follows:—

Beyrichia Klædeni (with hypertrophied front lobe).

Aparchites, three species.

Macrocypris, one species.

Pontocypris Mawii, three varieties.

Bythocypris, six species and varieties.

Lately Professor G. Lindström has forwarded for my examination some

The specimens are mostly delicate calcareous representatives of the bivalve carapaces. The forms are so very similar among themselves that it is difficult to arrive at conclusions with certainty as to their exact alliances; but rather than leave them unrecorded and unarranged in any serial order, I venture to refer them, as cautiously as possible, to such generic and specific types as we are acquainted with. In the collections made in and about Shropshire by Messrs. J. Smith and G. R. Vine, and described in the Ann. & Mag. Nat. Hist. already alluded to, are to be found the best known of these types.

I. MACROCYPRIIS, G. S. Brady, 1867.

In these Cypridiform species the left is smaller than the right valve of the carapace. See Ann. & Mag. Nat. Hist. March 1887, p. 178.

1. *Macrocypris?* *pusilla*, sp. nov. (Pl. XV. figs. 10 a, b.)

Proportions * :—Length 13. Height 8. Thickness $5\frac{1}{2}$.

Taking the narrowest (lowest) and most compressed end for the anterior, we see that the right valve of this carapace strongly overlaps the other. This character is seen in *Macrocypris*, though the general shape of the carapace in the fossil is not that usually met with in the genus, and though the overlap is stronger all round the valve than obtains in the recent *Macrocyprides*. One other somewhat similar little Ostracod (from the Wenlock Limestone, near Malvern) has been provisionally referred to this genus, namely *M.?* *crassula*†, Jones; but this has very thick valves and is not so reniform as the Gothland specimen under notice.

Macrocypris? *pusilla* has at first sight a strong resemblance

Ostracoda from the Lower Silurian (Caradoc series) of Sweden. They are from the division termed the *Chasmops*-limestone (see page 14 of G. Lindström's 'List of the Fossil Faunas of Sweden: I. Cambrian and Lower Silurian'), and appear to be *Leperditia Keyserlingi*, Schmidt, from Kungs Norrby, Östergötland, and small *L. Keyserlingi*, with smaller *Leperditie*, a *Beyrichia* near *B. bussacensis*, two *Bolice* near to those lately described and figured by Dr. A. Krause in the Zeitschr. d. D. g. Ges. 1889, p. 13 &c., and some other small forms, not determined, from the Westana quarry, Östergötland.

* If these proportional numbers be divided by 20, the results will be the measurements in millimetres and parts of a millimetre.

† Ann. & Mag. Nat. Hist. ser. 5, vol. xix. p. 181, pl. vii. fig. 10.

to *Bythocypris Phillipsiana*; but the overlapping valve is the right instead of the left. The dorsal edge is elliptically arched, the ventral nearly straight, and the ends are neatly rounded, with one of them smaller than the other.

Macrocypris Vinei, Jones, is also found in an Upper-Silurian (Wenlock) shale at Fröjel in Gothland. Ann. & Mag. Nat. Hist. June 1888, p. 396.

II. PONTOCYPRIS, G. O. Sars, 1865.

(Ann. & Mag. Nat. Hist. March 1887, p. 182.)

There appear to be three varieties of *Pontocypris Mawii**, Jones, in the Silurian clay of Wisby.

1. *Pontocypris Mawii*, Jones, var. *breviata*, nov.
(Pl. XV. figs. 4 a, b, c.)

Proportions :—L. 20. H. 11. Th. 8.

Shorter and rather thicker than the published type, but still somewhat compressed; hence appearing in side view irregularly subovate, like an orange-pip. It approaches very nearly in outline to the figure of the thick variety of *P. Mawii*† from Fröjel (Wenlock shale), Gothland; but it is too high and blunt anteriorly and is much less convex on the sides. Its hinder extremity is slightly pinched, but not nearly so much as in *Bythocypris caudalis* (figs. 2 and 3).

2. *Pontocypris Mawii*, Jones, var. *proxima*, nov.
(Pl. XV. figs. 5 a, b.)

Proportions :—L. 21. H. 10. Th. $9\frac{1}{2}$.

This is very similar to the type, but is proportionally thicker, that is, more convex, though still retaining a slight flattening on the sides (faces) of the valves, and the anterior slope is less steep.

3. *Pontocypris Mawii*, Jones, var. *divergens*, nov.
(Pl. XV. figs. 6 a, b, c.)

Proportions :—L. 23. H. 11. Th. 10.

The carapace is here lengthened proportionally, the posterior moiety being contracted above and below, so as to

* *Op. cit.* pp. 182, 183, pl. iv. figs. 4, 6, and 7.

† Ann. & Mag. Nat. Hist. ser. 6, vol. i. p. 397, pl. xxii. fig. 3.

imitate *P. Smithii* (Ann. & Mag. Nat. Hist. l. c. pl. iv. fig. 5) to some extent, but still being much more attenuate and subacute at the ends, although the median convexity is strong.

III. BYTHOCYPRIS, G. S. Brady, 1880.

(Ann. & Mag. Nat. Hist. March 1887, p. 184.)

1. *Bythocypris Hollii*, Jones, var. *oblonga*, nov.
(Pl. XV. figs. 1 *a*, *b*, *c*.)

Proportions :—L. 25. H. 14. Th. 13.

This is rather more oblong in side view than the published type * and also more compressed.

B. Hollii has been found also in the Fröjel shale, Gothland.

2. *Bythocypris caudalis*, sp. nov.
(Pl. XV. figs. 2 *a*, *b*, *c*, and 3 *a*, *b*, *c*.)

Proportions :— { Fig. 2 : L. 23. H. 12. Th. 12.
 { Fig. 3 : L. 19. H. 11. Th. 9.

In both the figured specimens the postero-dorsal region slopes more rapidly than in *B. Hollii* and ends with a blunt projecting angle, with which the hinder ends of the valves, being, as it were, squeezed or pinched together, form a kind of caudal process. The antero-dorsal edge also slopes down with a lower curve than in *B. Hollii*, giving a subovate outline to the valves.

Fig. 2 *a*, however, has a bolder and more uniform curve on its postero-dorsal slope than shown in fig. 3 *a*, where the posterior constriction is more strongly marked; this latter variety, too, is shorter, higher in proportion to its length, and has a somewhat fuller ventral curve. In edge view (figs. 2 *b* and 3 *b*) and in end view (figs. 2 *c* and 3 *c*) there is no specific difference.

3. *Bythocypris symmetrica*, Jones, var. *obesa*, nov.
(Pl. XV. figs. 7 *a*, *b*, *c*.)

Proportions :—L. 17. H. 9. Th. 9.

This carapace is very much like that of *B. symmetrica*, var. *b* (Ann. & Mag. Nat. Hist. l. c. p. 186, pl. vii. fig. 4),

* *Op. cit.* p. 184, pl. v. figs. 1 and 2, and pl. vi. figs. 3 and 4.

but is fuller (more convex) on the sides, in this respect surpassing even var. *a* (*l. c.* fig. 7). It may therefore be taken as var. *d*, or *obesa*, if a subsidiary name be requisite.

B. symmetrica was found also in the Fröjel shale of Gothland by Prof. G. Lindström (Ann. & Mag. Nat. Hist. ser. 6, vol. i. p. 397).

4. *Bythocypris phaseolus*, Jones, var. *elongata*, nov.
(Pl. XV. figs. 8 *a*, *b*, *c*.)

Proportions:—L. 15. H. 7. Th. 8.

This is longer and proportionally lower than the type, and has a straighter back; but its flat sides, rounded ends, incurved ventral margin, and edge view, similar to that in figs. 11 *b*, 12 *b*, pl. vii. Ann. & Mag. Nat. Hist. ser. 5, vol. xix., indicate its close alliance to *B. phaseolus*. We may term it var. *elongata*.

5. *Bythocypris concinna*, Jones. (Pl. XV. figs. 11 *a*, *b*.)

Proportions:—L. 15. H. 8. Th. 8.

This appears to be referable to fig. 6, pl. v. Ann. & Mag. Nat. Hist. ser. 5, vol. xix. pp. 186, 187. It is found also at four other Swedish localities (*op. cit.* June 1888, p. 397).

6. *Bythocypris Phillipsiana*, Jones & Holl, var. *gotlandica*, nov. (Pl. XV. figs. 9 *a*, *b*, *c*.)

Proportions:—L. 14. H. 9. Th. 7.

This is evidently another variety of the persistent * species *B. Phillipsiana*, but is more compressed (that is somewhat flatter on the sides) than either the type or any of the published varieties.

IV. APARCHITES, Jones, 1889. (Pl. XV. figs. 12, 13, 14.)

These specimens have such simply lenticular and round carapaces that at first sight they look as if they belonged to *Polycope*, but they have too much hinge-line for that genus. They are more nearly allied to *Primitia lenticularis*, J. & H. (Ann. & Mag. Nat. Hist. May 1886, p. 408); but differ-

* From Silurian to Carboniferous times. See Ann. & Mag. Nat. Hist. March 1887, pp. 187, 188.

ences are perceptible in outline and contour. This species, however, with other smooth and still more Leperditoid forms, has been lately referred by me to a separate group, with the generic name *Aparchites* (Ann. & Mag. Nat. Hist. May 1889, pp. 384, 385), and this appears to be the best group to which to refer the specimens (from Wisby) here noticed, although such non-sulcate Primitian forms are rarely so very symmetrical as these.

1. *Aparchites decoratus*, sp. nov.
(Pl. XV. figs. 12 a, b, c.)

Proportions * :—L. 18. H. 15. Th. $9\frac{1}{4}$.

Carapace lenticular, almost circular in side view, with the dorsal margin partly straight; equally convex on the sides, as shown by the elliptical outline in fig. 12 b, but rather fuller towards the dorsal than towards the ventral border (fig. 12 c). Surface of valves minutely punctate except along a narrow area all round.

2. *Aparchites simplex*, sp. nov.
(Pl. XV. figs. 13 a, b, c.)

Proportions :—L. 18. H. 14. Th. $9\frac{1}{4}$.

This smooth, convex, lenticular carapace much resembles *Ap. decoratus*, but it is rather more ovate, one end (anterior) being somewhat elliptically curved and with less boldness than in fig. 12 a; the hinge-line takes up a greater portion of the dorsal margin, giving a definite local straightness, and the surface has no ornament. In these features there is some approach to *Aparchites obsoletus*, J. & H. (Ann. & Mag. Nat. Hist. December 1865, pl. xiii. fig. 12).

3. *Aparchites Lindstræmii*, sp. nov.
(Pl. XV. figs. 14 a, b.)

Proportions :—L. 13. H. 10. Th. $4\frac{1}{2}$.

This is rather more Leperditoid than either of the two described above, and, excepting that the ends of its dorsal margin are not sharp and that it is less convex and very much smaller, it much resembles *A. Whiteavesii*, Jones (Ann. & Mag. Nat. Hist. May 1889, pp. 384, 385, pl. xvii. fig. 10).

* For figures 12, 13, 14, the proportions are taken on the same scale as for figs. 1–11.

It is less Leperditoid in shape than *L. suborbiculata* (Münster). I name this species after my friend Prof. G. Lindström, F.C.G.S., who has so carefully and energetically worked at the palæontology of Sweden, and supplied the material for this and other papers on the Ostracoda of that region.

EXPLANATION OF PLATE XV.

[Figs. 1-11 $\times 20$ diameters, figs. 12-14 $\times 25$ diameters.]

- Fig. 1. *Bythocypris Hollii*, Jones, var. *oblonga*, nov. *a*, carapace, showing the right valve; *b*, ventral view; *c*, anterior view.
 Fig. 2. *Bythocypris caudalis*, sp. nov. *a*, carapace, showing the right valve; *b*, ventral view; *c*, anterior view.
 Fig. 3. The same. *a*, carapace, showing the left valve; *b*, ventral view; *c*, posterior view.
 Fig. 4. *Pontocypris Mawii*, Jones, var. *breviata*, nov. *a*, carapace, showing the left valve; *b*, ventral view; *c*, anterior view.
 Fig. 5. *Pontocypris Mawii*, Jones, var. *proxima*, nov. *a*, carapace, showing the left valve; *b*, edge view.
 Fig. 6. *Pontocypris Mawii*, Jones, var. *divergens*, nov. *a*, carapace, showing the left valve; *b*, edge view; *c*, anterior view.
 Fig. 7. *Bythocypris symmetrica*, Jones, var. *obesa*, nov. *a*, carapace, showing right valve; *b*, edge view; *c*, end view.
 Fig. 8. *Bythocypris phaseolus*, Jones, var. *elongata*, nov. *a*, carapace, showing right valve; *b*, ventral view; *c*, end view.
 Fig. 9. *Bythocypris Phillipsiana*, Jones and Holl, var. *gotlandica*, nov. *a*, carapace, showing right valve; *b*, ventral view; *c*, posterior view.
 Fig. 10. *Macrocypris* ? *pusilla*, sp. nov. *a*, carapace, showing left valve; *b*, edge view.
 Fig. 11. *Bythocypris concinna*, Jones. *a*, left valve; *b*, ventral view.
 Fig. 12. *Aparchites decoratus*, sp. nov. *a*, carapace, showing right valve; *b*, ventral view; *c*, end view.
 Fig. 13. *Aparchites simplex*, sp. nov. *a*, carapace, showing right valve; *b*, edge view; *c*, posterior view.
 Fig. 14. *Aparchites Lindstræmii*, sp. nov. *a*, carapace, showing left valve; *b*, edge view.

XXXV.—On a new Genus of Coleoptera (Trogositidæ).

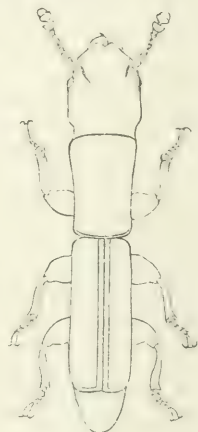
By G. LEWIS, F.L.S.

THE species here described belongs to a genus which I believe is widely spread in its distribution but not yet characterized. There are species in the British Museum from the islands of Tropical Asia, and Mr. Pascoe has one or more from Tropical America. I have not examined these last insects

critically, but I think I am right in saying that they cannot be separated generically. But, however this may be, the generic name I have employed will associate the species with Japan, as having been first characterized from thence, and the specific name will record the colour of the Japanese insect as well as the colour of the others, for all agree in this last particular. The genus is close to *Nemozoma*, Latreille (*Nemosoma*, Curtis), and to assist in its recognition I have given a simple outline of it. From its habits it is difficult to obtain, and I have not sacrificed an example for dissection.

SHOGUNA, n. gen.

Mouth-organs externally similar to those of *Nemozoma*; mandibles robust, dentate within, and bent inwards from their bases; eyes small, almost circular in outline, partly visible from above; antennæ inserted between the eyes and the bases of the mandibles; head, including the mandibles, measures the same as the thorax; epistoma obtusely subfurcate, nearly similar to that figured for *Niponius obtusiceps* (Trans. Ent. Soc. Lond. 1885, p. 335). Antennæ short, 11-jointed, joints 1-2 large, 3-8 moniliform, 9-11 transverse to form a club, 11 fitting closely into 10, 9 freer. Thorax long, a little sinuate on the sides; elytra one fourth longer than the thorax; the sutural striæ are entire and continued round the apices and sides, the other striæ are punctate-striate; pygidium slightly convex, wholly exposed, and somewhat conical in outline when viewed from above; prosternum a little excavated between the coxæ; anterior portion of the mesosternum rather convex, smooth and shining; thighs robust; feet 5-jointed, basal joint but little visible.



Shoguna rufotestacea, n. sp.

Angustata, rufo-testacea, nitida, leviter depressa, subparallela, supra minutissime strigosa et disperse elongato-punctata; fronte utrinque oblique bisulcata; prothorace elongato, lateribus subsinuato; elytris stria suturali integra, 1^a-5^m punctato-striatis; pygidio apice fulvo-hirto.

Long. 4½ mill.

Narrow, reddish yellow, shining, rather depressed, nearly parallel, upper surface minutely strigose, visible only under the microscope; forehead with two oblique sulci between and near to the antennæ; thorax at the sides slightly sinuate; each elytron has a sutural well-marked stria, which continues round the entire wing-case, the other striæ are punctate-striate, the punctures corresponding with those on the head and thorax in being elongate; the pygidium is clothed sparsely and irregularly with fulvous hairs, except at the apex, where they are rather closely set. The mandibles and mouth-organs are darker in colour than the rest of the body.

I found two examples of this species in June 1881 at Nara, near the Kasuga no Miya. One was crawling on a stump of a large oak which had been felled about two years before; the other was close to it, resting in the orifice of a hole made by a wood-borer, with its antennæ and mandibles alone protruding. At the least disturbance it retired out of reach, and a man had to be sent to the village for a large axe, and eight or ten inches of hard timber had to be cut away before it was captured. It seems to me that these insects must enter a hole head first and go to the end of it, where perhaps a cell widens out and within which the beetle can turn and retrace its steps. The structure of the body suggests that it can almost double itself up, and such a form seems compatible with reversing its position in a very small space. It could not turn round in the hole where it rested, as its own girth was nearly the size of the bore in the wood, and I cannot believe that it enters the hole backwards. Facts connected with wood-boring Coleoptera, and those which follow in their tracks, lead up to some of the most interesting problems of natural history.

Note.—I find that the name *Renia*, proposed by me (Ann. & Mag. Nat. Hist. (5) xv. p. 467, 1885), is used in Lepidoptera; I wish therefore to substitute *Reninus* for my genus. The two names will come close together in an alphabetical list.

XXXVI.—On the Myriacanthidæ—an Extinct Family of Chimaeroid Fishes. By A. SMITH WOODWARD, F.G.S., F.Z.S., of the British Museum (Natural History).

AMONG the Mesozoic Ichthyodorulites still awaiting elucidation is a remarkable spine, frequently met with in the Lower Lias of Lyme Regis, described by Agassiz under the name of

Myriacanthus *. It is a fossil evidently having a wide range in Jurassic rocks, for, besides the English Liassic species, others are known from the Upper Jurassic of Bavaria †; and it is thus remarkable that, until the present time, the precise relationships of the "genus" should have remained altogether undetermined. The British Museum now furnishes materials for the solution of the interesting problem; and it is the object of the present paper briefly to record the facts already available, with the zoological inferences that seem deducible therefrom.

Myriacanthus is a long slender spine, somewhat laterally compressed, with a hollow internal cavity opening at the base. There is no indication of an inserted portion in the known specimens, the lateral ornament of small tubercles extending over the whole of the sides, except quite at the distal extremity; a sparse irregular series of large, thorn-shaped, spinous tubercles is arranged along each edge of the somewhat flattened, smooth posterior face, while a few similar tubercles also occasionally occupy the median line of this face; and the anterior edge of the spine is provided with one such series of spinelets, at least in part of its extent.

The first clue to the true nature of this Ichthyodorulite was received by the British Museum in 1870, when the fine Liassic fossil described by Egerton as *Ischyodus orthorhinus* ‡ was added to the collection. In Egerton's memoir, however, there is no allusion to the fact, which seems to have also escaped subsequent observers; and the only palæontologist who has recognized a striking novelty in the fossil is Prof. Dr. K. A. von Zittel §, who proposes to assign to it the generic name of *Metopacanthus*.

The so-called "*Ischyodus orthorhinus*," as made known by the type specimen, is remarkable in many respects. Although dating back to so remote a period as that of the Lias, it exhibits a singular prolongation of the snout precisely similar to that of the existing *Callorhynchus*. In the enormous size of the median frontal spine, however, it still remains unique. The last-named appendage is nearly similar in form to that of *Squaloraja* ||; when not abraded its surface is covered

* L. Agassiz, Rech. Poiss. Foss. vol. i. (1837), p. 37.

† *Myriacanthus franconicus*, G. v. Münster, Beitr. Petrefakt. pt. iii. (1840), p. 127, pl. iii. fig. 8.

‡ Sir P. Egerton, "On a new Chimæroid Fish from the Lias of Lyme Regis," Quart. Journ. Geol. Soc. vol. xxvii. (1871), pp. 275-278, pl. xiii.

§ K. A. von Zittel, 'Handbuch der Palæontologie,' vol. iii. (1887), p. 110.

|| W. Davies, "On the Rostral Prolongation of *Squaloraja polyspondyla*, Ag.," Geol. Mag. vol. ix. (1872), pl. iv. figs. 1-3, 5.

with a fine granulated ornament; underneath it is beset with relatively large pointed tubercles, and its tapering anterior extremity reaches almost as far forward as the end of the nasal prolongation. The dorsal fin-spine, as described by Egerton, exhibits all the essential characters of *Myriacanthus*; and so far as the imperfect type specimen of *M. granulatus*, Ag., is capable of comparison there appears to be a sufficiently close agreement to justify the assumption of specific identity. The left mandibular tooth is exposed from the inner aspect and seems to exhibit three distinctly separated narrow tritoral areas. The palatine teeth are too imperfect to reveal more than the fact that they are thin plates with one lateral margin deflected.

A second and very imperfect specimen of "*Ischyodus orthorhinus*" in the Egerton Collection (no. P. 1158) exhibits a small dermal plate with granulated ornament; and a third fragmentary specimen in the Enniskillen Collection (no. P. 4575), proved by the frontal spine to pertain to the same species, makes known a few further details in regard to the dentition.

The last-mentioned fossil exhibits from the anterior outer aspect the imperfect remains of the mandible, with its two large dental plates in position; and, evidently somewhat displaced, there lies upon the oral margin of the right lower dental plate a small narrow tooth, at first sight suggestive of the incisor of a rodent mammal. This tooth, however, is bilaterally symmetrical, and must have occupied a median position in the jaw; it consists mainly of "cement," though exhibiting a thin band of dentine upon the middle of its inner face, and the gently rounded upper end has obviously been in function. Dental plates that are certainly referable to the upper jaw are also seen; but only one small pair, which appears to be vomerine, displays any recognizable characters. Each of these plates is broad in its posterior two thirds, with traces of tritoral areas; and the narrow anterior third, with parallel sides, is marked by a few large transverse ridges of dentine.

We have already identified the dorsal fin-spine of "*Ischyodus orthorhinus*" with the Ichthyodorulite *Myriacanthus granulatus*, long ago made known by Agassiz; and it now remains to ascertain whether the dentition of the fish, as just described, is identical with, or closely similar to, any type of dentition already discovered.

In this connexion the so-called *Prognathodus** at once

* Sir P. Egerton, "On *Prognathodus Guentheri*, Egerton, a new Genus of Fossil Fish from the Lias of Lyme Regis," Quart. Journ. Geol. Soc. vol. xxviii. (1872), pp. 233-236, pl. viii.

suggests itself as worthy of consideration; but, since the type specimen was entirely misinterpreted by Egerton, and as a new specimen in the British Museum (no. P. 6095) is now available for study, it is necessary, in the first place, briefly to recapitulate the principal features of this singular group of teeth.

As pointed out by Dr. von Zittel *, the mandible of the type species, *Prognathodus Guentheri*, was mistaken by Egerton for the upper jaw, while the upper dentition was ascribed to the lower; and thus arises the necessity for a complete revision of the subject. The mandibular cartilage precisely resembles that of modern Chimæroids in exhibiting no symphyseal suture; and there is likewise a pair of small inferior labials. The right and left lower dental plates (*m* in Egerton's figure) are of the form ordinarily observed in Chimæroid fishes and meet in a narrow facet at the symphysis; but in advance of these is a median, bilaterally-symmetrical, incisor-like element (*p*, Egerton), also without doubt to be assigned to the mandibular dentition, and hitherto unparalleled in the order or subclass to which the fish belongs. The palatine plates (1, Egerton) are large, expanded, and thin, elongated antero-posteriorly, and irregularly triangular in shape; the outer margin of each is somewhat thickened, while both the outer and anterior margins are sharply deflected; the inner and posterior margins are thin edges, and there is no appearance of the close apposition of the right and left plates in the median line. The vomerine dental plates (2, Egerton) are, as usual, much smaller than the palatines and in direct contact both with the latter and with each other; they are triangular in form and comparatively thin, and owe their robust aspect to the sharp deflexion of the margins. Still more anteriorly, in the known specimens, is a pair of small quadrangular, transversely ridged teeth (3, Egerton), which may be either independent elements or merely the accidentally detached front processes of the vomerine dental plates.

Thus interpreted, it is obvious that the dentition of *Prognathodus Guentheri* repeats the two most peculiar features noted above in the new specimen of "*Ischyodus orthorhinus*." There is the same incisor-like median tooth, referable to the lower jaw; and the front portion of each vomerine dental plate is transversely ridged in the same manner. Moreover, "*Prognathodus*" possesses tuberculated dermal plates upon the head, resembling the example alluded to above in the second specimen of "*Ischyodus orthorhinus*;" and a careful comparison of all recognizable characters appears to the

* *Op. cit.* vol. iii. p. 115.

present writer to justify the assertion of the generic identity of these two fishes.

The so-called *Ischyodus* (or *Metopacanthus*) *orthorhinus* thus possesses (i.) a dorsal fin-spine, known in its isolated state as *Myriacanthus granulatus*, and (ii.) a dentition which, if found separately, would be described as a species of *Prognathodus*. Of these names that applied to the dorsal fin-spine is much the earliest, and the small species described by Eger-ton must thus be known as *Myriacanthus granulatus*.

The dentition of *Myriacanthus granulatus* only attains one half the size of that named *Prognathodus Guentheri*; and there need be no hesitation in associating with the latter "species" the group of teeth described as *Ischyodus Johnsoni* by Agassiz *. Moreover, it may be noted that the larger type differs specifically from the smaller in the form of the presymphysial mandibular tooth, the outer face of this element being gently rounded in the former type and longitudinally angulated in the latter, while in the first the inner layer of dentine also exhibits the greatest development.

Now it is interesting to note that the typical species of *Myriacanthus* (*M. paradoxus* †) attains at least twice the size of *M. granulatus*, the basal portion of a very large spine of this form having been named *M. retrorsus* by Agassiz ‡, and fine examples being preserved in the British Museum. If "*Prognathodus*" is the dentition of one species, it also presumably characterizes the other; and the relative proportions of spines and teeth agreeing precisely, it may be inferred that, just as the smaller dentition pertains to *Myriacanthus granulatus*, so is the larger *Prognathodus Guentheri* (= *Ischyodus Johnsoni*) referable to *M. paradoxus*.

Such being the case, the genus *Myriacanthus* may be removed from the Ichthyodorulites and placed in a definite position among the Chimeroid fishes; and to include both this and the closely allied *Chimeropsis* of the Bavarian Lithographic Stone § it seems necessary to institute a new family as follows:—

Myriacanthidæ.

Body elongate; anterior dorsal fin above the pectorals, provided with a long, straight, robust spine. Teeth forming

* *Op. cit.* vol. iii. (1843), p. 344, pl. xl. c. fig. 22.

† *Ibid.* vol. i. (1837), p. 38, pl. vi.

‡ *Tom. cit.* (1837), p. 39, pl. viii. a. figs. 14, 15.

§ K. A. von Zittel, *op. cit.* vol. iii. (1887), p. 113, woode. f. 126. J. Riess, "Ueber einige fossile Chimeriden-Reste," *Paleontogr.* vol. xxxiv. (1887), p. 21, pl. ii. figs. 9-11, pl. iii. figs. 1-10.

two (? or three) pairs of thin dental plates in the upper jaw, the hinder pair attenuated mesially and not closely apposed in the median line; lower dentition consisting of a pair of large dental plates, meeting at the symphysis, and a median incisor-like tooth in front. A few dermal plates present upon the head; males with a large prehensile spine upon the snout.

XXXVII.—*Sketch of the History of known Fossil Sponges in Relation to those of the Present Day.* By H. J. CARTER, F.R.S. &c.

IN this brief "Sketch" I propose to state my impressions as to the relation the species of fossil sponges that have been found bear to those which now exist, since in going over the former I have been forcibly struck with the total absence of any certain representatives of the horny sponges, whose toughness and durability combined with their great abundance would lead one to infer that at least they would be as likely to be handed down through fossilization as the elytra of insects.

To give an idea of the abundance of existing horny sponges and their accumulation in certain localities favourable to future fossilization I may mention, first, that at the beginning of 1845, when I was attached as Medical Officer to the Survey of the South-east Coast of Arabia, I saw on the low sandy coast close to Ras Abu Ashrin, opposite the north-east end of the Island of Masira (where there is a little "bite" which receives the backwater of the current produced by the waves of the south-west monsoon as they rush by it to the mainland during this tempestuous season), a raised ridge, about 50 yards from the margin of the sea (then calm), covered, as I thought, with bushy plants, but which on examination proved to be large Keratophytes, horny sponges, and a host of other *cauvia* mixed up with sand, all of which had drifted into this position (the result probably of many of the monsoons when the sea reached this ridge). Secondly, that Dr. R. v. Lendenfeld, in his "Monograph on the Australian Sponges" (Proc. Linn. Soc. N. S. Wales, vol. ix. pt. ii. p. 311), has stated that the horny sponge *Aplysilla violacea*, L., "covers many thousand metres in Port Phillip," and that of the 348 horny sponges from all parts of the world, which he has enumerated in his Monograph, 258 or 74·1 per cent. "occur in the Australian seas"

(p. 822). And, thirdly, that the quantity of the horny-fibred sponges, particularly from the sea on the south coast of Australia and that about the West-India Islands, in the collection at the British Museum, far surpasses all the rest in bulk and number of species.

Here I must, for the sake of convenient reference, insert a note of my Classification of 1875 ('Annals,' vol. xvi. p. 128 &c.) :—

Class SPONGIDA, Huxley.

Order I. *Carnosa*.

Without evident skeleton.

Order II. *Ceratina*.

Possessing a skeleton composed of horny (now called "spongin") fibre, with a granular, chiefly hollow, core, containing for the most part no foreign bodies.

Order III. *Psammonemata*.

Possessing a skeleton composed of solid fibre more or less cored with foreign bodies (grains of sand, fragments of sponge-spicules, &c.).

Order IV. *Rhaphidonemata*.

Possessing a skeleton composed of horny fibre with a core of "proper spicules" (that is, spicules produced by the sponge itself). Spicules chiefly simple acerate, and chiefly confined to the *interior* of the fibre.

Order V. *Echinonemata*.

Possessing a skeleton composed of horny fibre cored with "proper spicules" internally and echinated with "proper spicules" externally. Form of spicule chiefly acuate.

Order VI. *Holorhaphidota*.

Possessing a skeleton whose fibre is almost entirely composed of "proper spicules" bound together with a minimum of sarcode (spongin). Form of spicule variable.

Order VII. *Hexactinellida*.

Possessing a skeleton charged with "proper spicules," all

based upon a sexradiate type, coring vitreous fibre or held together by spongin only.

Order VIII. Calcarea.

Possessing calcareous spicules only.

Now with reference to the first order, which I divided into Halisarcida (possessing no spicules) and Gumminida (possessing spicules), it could hardly be expected that the first division would be perpetuated in a fossilized state, or if so not recognizably, seeing that in the fresh state they are of gelatinous softness and their sponge nature can only be determined by the microscope before they pass into decomposition (which is very rapid), or when kept under the influence of a preservative fluid.

But this does not apply to the second division, where, to the "gelatinous softness," perhaps a little inspissated, is added an abundance of spicules which more or less resemble those of other sponges, especially some of the HOLO-RHAPHIDOTA in my sixth order. Thus we find *Chondrilla phyllodes*, Sdt., possessing a spiculation that hardly differs from that of *Spirastrella cunctatrix*, Slt., which is a member of my family Suberitida (see also my assimilation of *Suberites domuncula*, Sdt., to *Chondrosia reniformis* in my order CARNOSA, 'Annals,' 1881, vol. viii. p. 255). One could hardly expect under fossilization either one or the other species to present more than a heap of spicules of the same kind, with perhaps a trace of the canal-structure. But who has found "either one or the other," or how could they be distinguished?

When we consider that the spiculiferous CARNOSA may in a fossilized state be hardly more than an almost shapeless mass of the same form of spicules, it reminds me of my *Holasterella conferta* from the Carboniferous Limestone near Glasgow ('Annals,' 1879, vol. iii. p. 141, pl. xxi. figs. 1-8), in which the spicules appear to me to come nearest to those of Schmidt's Adriatic species *Corticium candelabrum* (Spong. Adriat. Meeres, p. 42, Taf. iii. fig. 25); but some of the Suberitida might, if fossilized, present a heap of similarly shaped spicules to those of *Corticium abyssi* ('Annals,' 1873, vol. xii. p. 18, pl. i. figs. 1-9 and 15); and *Corticium Kittoni* (ib. 1874, vol. xiv. p. 24, pl. xv. figs. 48 a, b, c) may be equally confounded with the tetrahedral form of a Lithistid, to which perhaps may be added Schulze's *Pla-*

kina (Zeitschrift f. wiss. Zool. 1880, Bd. xxxiv. Taf. xx.-xxii.).

Next come the CERATINA (Order II.), which, with the exception of the following order, viz. PSAMMONEMATA, appear to be by far the most abundant of all existing sponges, and at the same time may reach a very large size (*ex. gr.* the *Luffaria* from the West-Indian seas, in the British Museum), whose kerataceous fibre is so thick and hard when dry that it breaks with the shining fracture of hard glue.

This horn-like substance, which, as before stated, has lately received the name of "spongin," is in its elementary composition so nearly allied to the chitin of the insect-skeleton that it seems strange that the latter should be handed down in a fossilized state (if such should be the case) and not the former.

According to Krukenberg the elementary composition of spongin and chitin respectively is as follows:—

Spongin.....	C. 30	H. 46	N. 9	O. 13
Chitin	15	26	2	10

Thus (to me) the former is the densest and physically the most solid of the two, especially in *Luffaria*.

What the branched forms in the Quadersandstein of Saxony, called by their discoverer Geinitz "*Spongites saxonicus*," or the net-like figuration on the surface of crooked cylindrical bodies ("*Rhizocorallium*," alluded to by Zittel, 'Handbuch der Palæontologie,' pp. 142, 143), may be remains to be decided.

Again, there is no mention of the PSAMMONEMATA (Order III.) in a fossilized state, although I found them in a recent one in such great abundance in the "ridge" on the south-east coast of Arabia above alluded to—seeming to indicate in this instance the first step towards fossilization, if not also what would probably have taken place and been recognized in former fossilizations if such had occurred.

My *Dysidia antiqua* from the Carboniferous of Ayrshire ('Annals,' 1878, vol. i. p. 139) has been relegated by Dr. Hinde to those kinds of sponges which come under my order HOLORHAPHIDOTA, by the generic name of "*Hapliston*" (Mon. Brit. Spong. Palæontographical Society's vol. for 1887, pt. ii. p. 147, pt. i. pl. v. figs. 2, 2 a).

Of the RHAPHIDONEMATA, whose fibre is again corneous, I found a small branched fragment, apparently of a *Chalina*, having the usual form of acerate spicule presented by that family, in a detrital piece of chert from the remains of the Upper Greensand so abundant in this locality (Budleigh

Salterton, Devon); but beyond this nothing identifiable with the sponge-structure of this family.

Nor have I ever found any remains of the (equally corneous) ECHINONEMATA, in which the echinated fibre, if well preserved, could hardly pass unrecognized. That of *Dirrhopalum* (*Plocamia*), to which Dr. Hinde has alluded in his Monactinellidæ (Cat. Foss. Spong. Brit. Mus. p. 20), and which I had placed in my order ECHINONEMATA, requires further investigation, as Dr. Hinde himself has intimated, before this can be confirmed.

But when we come to my HOLORHAPHIDOTA (Order VI.) we *do* see that accumulations of Monaxonid spicules have been found heaped together as well as in separate spicules—e. g. *Pulvillus Thomsoni*, Crtr., from the Carboniferous of Dumfries in Scotland ('Annals,' 1878, vol. i. p. 137, pl. x. figs. 1–6), also *Rhaphidhistia vermiculata*, Crtr., from the Carboniferous of Ayrshire (*ib. ib.* p. 140), which has been described by Dr. Hinde under the name of "*Hapliston vermiculatum*" (Palæont. Society's Publ. vol. for 1887, *l. c.*), *Climacospongia radiata*, Hinde (Cat. Foss. Spong. Brit. Mus. p. 18, pl. i. figs. 1, 1 *a*), *Lasiocladia compressa* (*ib.* p. 19, pl. i. fig. 2), and *Acanthorhaphis intertextus* (*ib.* p. 20, pl. i. figs. 3, 3 *a*); to which may be added Zittel's two species of his *Scoliorhaphis* from the Upper Cretaceous of North Germany (Foss. Sponges, Abhandl. der k. bayer. Akad. d. Wiss. ii. C. xiii. Bd. ii. pp. 94, 95, Taf. xii. figs. 1 *a*, *b*, and 2).

The layer of pin-like spicules discovered by Dr. Harvey B. Holl on the surface of the Calcsponge *Verticillites helvetica*, de L. ('Annals,' 1884, vol. xiv. p. 27, pl. i. figs. 6–10), appears to me to have consisted of those of a parasitic species of Suberite, of which there are many existing instances on other sponges. The boring sponge, *Cliona*, whose existing species are chiefly characterized by a pin-like spicule, has also been recognized in several cases more by the peculiar form of its excavations in fossilized casts than by that of the spicule, which has not been described if ever seen.

We next come to the third and fourth families of my HOLORHAPHIDOTA, viz. the Pachytragida and Pachastrellida, now called "Tetractinellida," of which the only *entire* specimen among the three groups of the former that has been described is that of a *Stelletta*, viz. *S. inclusa*, Hinde, which, as it occurs in the interior of a flint, is easily recognized by being *unaccompanied* by the coating of siliceous spheroids which chiefly separates that genus from *Geodia* (Cat. Foss. Spong. Brit. Mus. p. 24, pl. i. figs. 6, 6 *a*); while in the first division of the latter, viz. the Pachastrellina (group 17), four specimens have been described,

viz. *Pachastrella primæva*, *Tethyopsis Steinmanni*, *P. convoluta*, and *P. plana*—the former two by Zittel (Foss. Spong. l. c. p. 100, Taf. xi. figs. 3 and 4) and the latter two by Dr. Hinde (Cat. Foss. Spong. Brit. Mus. p. 26, pl. ii. figs. 1, 1*a*, and pl. i. figs. 7, 7*a* respectively).

This brings us to the other division of the Pachastrellida, viz. the Lithistina, which in time and space so far surpasses any other group of sponges, extending from the Silurian—*Aulocopium*, *A. aurantium*, Zitt. (*op. cit.* p. 136, pl. viii. fig. 1, and 'Handbuch,' pp. 159, 160, fig. 72*a*); also *Hindia*, Hinde, *H. fibrosa* (Cat. Foss. Sp. Brit. Mus. p. 57, pl. xiii., and for spiculation, 'Annals,' 1887, vol. xix. p. 76, figs. 1 and 2)—down to the present day inclusively, but abounding most in the Oolitic and Cretaceous periods, as may be seen by reference to the table in Prof. Zittel's 'Study on Fossil Sponges,' more particularly given in his illustrated descriptions (Abhandl. der k. bayer. Akad. der W. ii. Cl. xiii. Bd. i. Abth. pp. 67 &c.; translated into the 'Annals' by W. S. Dallas, F.L.S., in 1878, vol. ii. pp. 113, 235, 324, 385, and 467 respectively), wherein an amount of sagacity and ability is exhibited that is almost beyond all praise.

Happening to reside in a locality (viz. Budleigh Salterton, on the south coast of Devon) where the hardened remains of the Upper Greensand and Chalk, which once extended across the country for many miles between "Haldon Hill" on the west and "High Peak Hill" on the east, now bestrew the surface in great abundance, I can state from actual observation that almost every chert-flint contains the remains of a Lithistid sponge or consists of chertified Lithistid spicules &c. in layers which once formed the bed of an ocean, so abundant were these sponges at that period.

Thus it would appear that the maximum development of Lithistid sponges took place during the Upper Cretaceous period, although the existing species are still very numerous.

Among the separate spicules which are so abundant in the Upper-Greensand chert may also be seen those of many other sponges, especially those of *Geodina*, whose little siliceous spheroids seem to be always present in great numbers. In the Upper Greensand of "Haldon Hill," near Exeter, where there is a bed several feet in thickness composed of grains of sand and sponge-spicules, these ingredients are so loosely held together that the latter can be easily picked out, as may be seen by my illustrated paper on the subject in the 'Annals' of 1871 (vol. vii. p. 112, pls. vii., viii., ix., and x.).

That many originally came from the spiculiferous sponges of my Orders IV., V., and VI. generally, may be fairly

assumed; but in no instance, except the end of a branch of a *Chalina* mentioned, have I been able to find the spicule *in situ*, that is in the entire structure of which it formed part, and this *only* conjecturally.

I also noticed the occurrence of sponge-spicules from the Carboniferous strata of Ben Bulbin in the north of Ireland, near Sligo, wherein the chert appears to be composed of them in a transitionary state from the entire spicule to a homogeneous mass; also in the Carboniferous of Scotland near Glasgow ('Annals,' 1880, vol. vi. p. 209, pl. xiv. B. figs. 1-17); but the latter case has been much more elaborately dealt with by Dr. Hinde in his paper on the "Organic Origin of the Chert" ('Geological Magazine,' dec. iii. vol. iv. no. 10, p. 435, October 1887), where, at p. 442, he observes that in thin slices of this chert and that from other localities examined with the microscope by transmitted light, "it is resolved into microscopic spicules, confusedly intermingled together, whose individual outlines can be traced with varying degrees of clearness."

Hence the chert in the Carboniferous period appears to indicate a similar condition to that in which it is found in the Upper-Greensand detritus at this place (Budleigh Salterton), and in the spiculiferous sand-bed at "Haldon Hill" to which I have alluded.

Among the fossil spicules which I have figured (*l. c.*) are undoubted forms that originally came from the Monaxonid group, *ex. gr.* the bihamate, Bk. (sigma, R. & D.), no. 43 (*l. c.*), which, although it can be seen with the naked eye, being 1-400th inch in length, is exceeded by the largest existing form that I have observed, viz. in *Esperia villosa*, where it is fully 1-64th of an inch (Journ. Roy. Micr. Soc. 1879, vol. ii. pl. xvii *a.* fig. 12 *b.*). But while recent specimens of the bihamate exceed in length the fossil one that I have mentioned, the largest of several tricurvates (toxa, R. & D.) that I have just found among other sponge-spicules, chiefly Tetractinellid, in a transparent portion of Upper-Greensand chert from this locality, measures from 1-16th to 1-7th inch in length, the largest recent specimen that I have seen, viz. that which I described and figured in 1874 ('Annals,' vol. xiv. p. 457, pl. i. fig. 27), being only 1-60th inch long, although in other respects, that is in the straightness and length of the arms, relative smallness and abruptness of the bow, together with its semicircular form, it closely resembles the fossil; moreover, the arms appear to have been spined for two thirds of their length. Of the longest specimen only about three fourths remain, so that the measurement from

the unbroken end to the centre of the bow *doubled* has to be taken for the total length, which is 1-7th inch, as above mentioned, while that of the other largest specimen, which is perfect, is 1-16th in. There are several specimens in the piece of chert mentioned which are very near together, and being close to the surface of the fractured portion of the chert are satisfactorily seen, while the bow in some of the smaller ones appears to be higher and wider, *i. e.* more like that of *Microciona armata*.

Doubtless hereafter there will be more fossilized spicules found which can be identified with those of recent Monaxonida; but at present they are all confined to what I have delineated, with the exception of the tricurvates just mentioned and what have been added by Prof. Zittel and Dr. Hinde in their works respectively, viz. those by the former in the Abhandl. der k. bayer. Akad. der W. ii. Cl. xii. Bd. iii. Abth. Taf. iii.-vii., and those by the latter in his Mon. Brit. Foss. Sponges (Palæont. Soc. Publ. vol. for 1886, pt. i. p. 66).

We now come to my seventh order, viz. the HEXACTINELLIDA, which, from Salter's *Protospongia fenestrata* in the Cambrian, have been continued down to the present day, manifesting themselves plentifully in a Hyalonematoid form from the Carboniferous Limestone of Ayrshire, viz. *Hyalonema Smithii* ('Annals,' 1878, vol. i. p. 129, pl. ix. figs. 1-14), subsequently called "*Hyalostelia*" by Zittel (Hinde, Cat. Foss. Spong. Brit. Mus. p. 150, pl. xxxii. figs. 1, 1 g). But it is not until the Cretaceous period is reached that the vitreous Hexactinellida or so-called "Glassy Sponges" appear to have come into prominence, and here their maximum of development, like that of the Lithistida, seems to have taken place, as may be seen by a reference to Zittel's illustrated description of this order (Abhandl. der k. bayer. Akad. der W. ii. Cl. xiii. Bd. i. of 1877, translated by Mr. Dallas into the 'Annals' of that year, vol. xx. pp. 237, 405, and 501; also Dr. Hinde's illustrated description of the Fossil Sponges in the British Museum, p. 91 &c.).

Among the detritus of the Upper Greensand in this locality to which I have alluded, the remains of the Hexactinellida that I have found are very scarce, in comparison with those of the Lithistida, so that we may fairly infer that the former were not so plentiful as the latter, as shown by Zittel's splendid researches (*l. c.*). While at the present day they appear to bear a similar proportion, so far as my observations extend, which would have been more complete had I been able to refer

to a copy of Prof. Schulze's Report on the 'Challenger' dredgings of the Hexactinellida.

Lastly, we come to my eighth order, viz. the CALCAREA; and here, again, we have to fall back upon the masterly researches of Professor Zittel, coupled with those of his intelligent pupil Dr. G. J. Hinde—the former to be found in the *Abhandl. der bayer. Akad. W. ii. Cl. xiii. Bd. ii. Abth.*, and the latter in Dr. Hinde's 'Catalogue of the Fossil Sponges in the British Museum,' p. 157 &c. Referring to Prof. Zittel's observations on the "Occurrence, Distribution in Time, and Pedigree" of the Calcispongiæ (translation 'Annals,' 1879, vol. iii. pp. 375–378), we learn, from the tabular view given at p. 378, that, so far as is known, they at least date from the Devonian period, are already numerous in the Triassic, increase rapidly in the Jurassic, and culminate like the Lithistida in the Cretaceous, after which isolated spicules only have been found.

At first (like all who attempt to generalize from insufficient data) I was inclined to think, from the small delicate forms and rapidly decomposing nature of the British species, that it was impossible they could be subjected to the ordeal of fossilization without disappearing altogether; and if this had been the case generally I might have been right; but when I found that Prof. Zittel had demonstrated the reverse, by proving to me, from actual slices of what he considered to be fossil calcareous sponges, that they possessed the peculiar radiate spicules of a Calcisponge, and when, from the characters of the South-Australian sponges of the present day which Mr. Bracebridge Wilson, of Geelong, kindly sent me ('Annals,' 1886, vols. xvii. and xviii. p. 503 &c.), I could acquiesce in this from recent specimens, the absurd notion inferred from the characters of the British representatives of this order could no longer be entertained. Meanwhile several specimens from the Coral Rag (Jurassic system) of Farrington, in Berkshire, from which I made as many microscopically thin slices, fully justified Prof. Zittel's announcement.

Furthermore, Dr. Hinde, in his "Notes on Fossil Calcispongiæ" ('Annals,' 1882, vol. x. p. 185, pls. ix. and x.), describes not only specimens of his *Verticillites d'Orbigny* from the Greensand at Warminster, in which the radiate spicules could be seen with a simple lens in abundance on the surface, but a new species of *Sestrostomella* from the Upper Greensand of "Vaches Noires," near Havre, in France (*S. rugosa*, H.), in which he found the "tuning-fork"-like form of spicule that characterizes a recent species which Mr. Bracebridge Wilson

sent me from the neighbourhood of Port Phillip on the south coast of Australia, first represented by Dr. Bowerbank (B. S. vol. i. fig. 237) and subsequently called "*Lelapia australis*" by Dr. Gray (Proc. Zool. Soc. 1867, p. 557). I have said "species" because the upper part of the specimens which Mr. Bracebridge Wilson sent me ('Annals,' 1886, vol. xviii. p. 148) bore a close resemblance to the heads of *Sestrostomella* represented by Dr. Hinle, as well as to those of a fossil group from the Jura which Prof. Zittel kindly sent me, in which, in microscopic slices, I also found the form of spicule mentioned; all of which demonstrates the accuracy of Prof. Zittel's observations.

I wish also to note here that, although I have considered Dr. Sollas's "*Pharetrospongia Strahani*" (Quart. Journ. Geol. Soc. May 1877, p. 242), from which Professor Zittel has taken the name of his third family of this order, viz. "Pharetrones," among his Calcispongiæ ('Handbuch,' p. 189), to be a siliceous sponge like an Australian species of *Reniera* (Monaxonina) whose spicule Dr. Sollas has introduced among his illustrations for comparison (*op. et loc. cit.* pl. xi. figs. 11 and 12), yet from subsequent facts which have come to my knowledge,—such as the existence of a Calcisponge with the same kind of fusiform, sharp-pointed, acerate spicule, viz. *Leucyssa spongilla*, Hæck. ('Die Kalkschwämme,' Bd. ii. p. 137, Atlas, Taf. xxv. figs. 11–13), evidently designated after the characteristic spicule of *Spongilla* (although it should be also stated that the spicule of *Leucyssa spongilla* is not curved as in *Spongilla* and *Pharetrospongia Strahani*, &c., but straight, still it is the only form of spicule in this sponge),—together with the statements of Dr. Hinde (Cat. Foss. Sp. B. M. pp. 202, 203) in support of Prof. Zittel's view that *Pharetrospongia Strahani* was a Calcisponge, I must now yield to their opinion, who for a while made the study of fossil sponges their special object.

Thus, in conclusion, I have given a short sketch of the known history of sponges in time and space from the earliest geological periods up to the present day, among which we notice the absence of any fossil representative of the Horny Sponges, which are now so abundant and whose fibre in many instances (ex. gr. *Luffaria*) is almost entirely composed of spongin, which, in elementary composition, as shown in the first part of this paper, only differs from chitin (the elytra of insects) in quantity, while the quality of resistance would appear to be in favour of the former; and yet fossilized insects have been handed down to us in almost every geolo-

gical period from the Upper Silurian strata to the Miocene inclusively.

Whether this non-existence of the Horny Sponges must be left for further investigation to verify or whether it can be explained by deferred development, that is to the present era, or in any other way, I will not go further here than the fact that the Horny Sponges are by far the most abundant at the present day and yet have no fossil representative.

XXXVIII.—*On the possible Origin of the Malpighian Tubules in the Arthropoda.* By FRANK E. BEDDARD, M.A., F.Z.S.

THERE are two sets of structures in the Arthropoda which have been proved to possess a renal function and which have been regarded as possibly equivalent to the nephridia of worms.

The "green glands" of the Crustacea are commonly regarded as nephridia, and researches now in progress will, I believe, establish the nephridial nature of these organs upon a very firm basis of fact.

Among the Arthropoda another class of renal organs exists in the so-called Malpighian cæca. These occur in a few Crustacea, *e. g.* the Amphipoda (Spencer, "The Urinary Organs of the Amphipoda," Quart. Journ. Micr. Sci. xxv. 1885), and in Tracheata; in the latter group they consist of a variable number of glandular cæca which grow out from the proctodæum; in the Amphipoda, on the contrary, Spencer finds reasons for believing that the tubes in question are diverticula of the mesenteron.

The only known Arthropod with unmistakable nephridia, paired and metamerically arranged, is *Peripatus*. The existence of these organs was originally pointed out by Balfour ("On some Points in the Anatomy of *Peripatus capensis*," Quart. Journ. Micr. Sci. xx. 1880), and has been since carefully studied from the developmental as well as from the structural point of view by Sedgwick ("A Monograph of the Development of *Peripatus capensis*," Stud. Morph. Lab. Cambridge, vol. iv. pt. i.). Lankester had previously pointed out that the "coxal glands" of *Limulus* were in all probability to be regarded as modified nephridia, and this position is strongly supported by Sedgwick's results. So far as our present knowledge goes it may be safely assumed that the

"coxal glands" and "green glands" are modified nephridia. Sedgwick remarks (*loc. cit.* p. 119) that with the exception of these structures there are no nephridia in Arthropods recognizable as such; and this conclusion probably represents the opinion of most comparative anatomists. The claim of the Malpighian tubules to be looked upon as nephridia has been more and more ignored. Gegenbaur (*Comp. Anat.*, Engl. transl. by Bell, p. 276) carefully abstains from discussing the morphology of these organs. Lankester ("Notes on Embryology and Classification," 1877, p. 33) remarks that "in tracheate Arthropods the Malpighian filaments possibly are the nephridia." Balfour (*Comp. Embr.* vol. ii. p. 568) doubtfully compares them to the anal vesicles of the Gephyrea. Now these structures are so widely spread among the Tracheata (even if the tubes of the Amphipoda are not of the same nature) that they must be regarded as among the most characteristic organs of that group. The fact that they do not occur in *Peripatus* might perhaps be regarded as evidence that the Malpighian tubes have arisen within the group; but, on the other hand, their absence from *Peripatus* may be reasonably accounted for by the persistence of unmodified nephridia performing the same function: in any case a similar argument must be applied to account for the great reduction in the nephridia of the Crustacea; they are nephridia, and they are reduced in number, in accordance with the reduction of the coelom.

If, then, the absence of the Malpighian tubules in the most primitive known Arthropod, *Peripatus*, is not necessarily a real break of continuity, the segmented worms are naturally the animals in which one might expect to find the beginning of these organs, especially in the more primitive segmented worms, for the Gephyreans must be regarded as greatly modified Annelids.

In a species of *Acanthodrilus*, which I refer, at present with some little doubt, to *Acanthodrilus multiporus* (Beddard, "On the Specific Characters and Structure of certain New-Zealand Earthworms," *Proc. Zool. Soc.* 1885, p. 813), the last segments of the body are almost entirely filled with nephridial tufts, which, as I have elsewhere stated, open by numerous pores on to the surface of the body and by numerous ciliated funnels into the coelom. The gut in this region of the body has a very narrow lumen and is lined by tall columnar cells, which are *not* ciliated, as in the intestine generally, but covered with a delicate chitinous cuticle. This region of the gut is probably proctodæum. At irregular intervals *minute caecal diverticula arise from the gut*; these

are at first tubular in character and are lined by an epithelium identical with that of the intestine; as they get further away from their point of opening into the intestine *these tubes* lose their tubular character and *become continuous with undoubted nephridial tubules*, with a duct excavated in the substance of cells; the lumen, at first *intercellular*, becomes afterwards *intracellular*; these tubules were absolutely undistinguishable from the nephridia, and, indeed, appeared to join the general nephridial network of their segment. Their lumen, which was here and there much swollen, contained a granular detritus identical with that occupying the tubes of the general nephridial network. These nephridial appendages of the proctodæum are branched and anastomose one with another; they may certainly be compared to the anal nephridia of the Gephyrea. All that is necessary to convert these structures into Malpighian tubules is to limit their number and arrange them in a regular fashion; the branching and anastomosis even may be retained, as these conditions are met with among the Malpighian tubules of the Tracheata.

If these inferences do not commend themselves to morphologists, I may at least point out that the above facts, of which I give here only a preliminary account, have some bearing upon the origin of the nephridia in Oligochaeta. I have put forward an opinion that the original state of the nephridia in this group was a continuous network with numerous irregularly-disposed external pores and coelomic funnels, such as is now largely persistent in certain species of *Perichaeta*; and that *Lumbricus*, with its paired metameric nephridia, is the last term in the series which is partially filled up by intermediate conditions. The connexion of the nephridia with the gut is probably secondary, as the orifices were originally external and were carried in by the involution of epiblast to form the proctodæum; *hence the polystomial condition of the nephridia is probably in ontogeny, as in phylogeny, archaic*. An analogous series of facts have been lately brought forward by Spencer, who found ("The Anatomy of *Megascolides australis* &c.," Trans. Roy. Soc. Victoria, vol. i. pt. 1) numerous nephridial openings into the anterior, probably stomodæal, part of the gut. I should refer these facts to the same category as my own, as evidence of the archaic nature of the diffuse condition of the nephridia.

XXXIX.—*The Copepod Fauna of the "Maare" of the Eifel.*
By Dr. JULIUS VOSSELER*.

SINCE Leydig's † investigations upon the fauna of the crater-lakes of the Eifel, the so-called "Maare," scarcely any naturalist has given any close attention to the lower animal world of those basins. Of the lower Crustacea only the Cladocera were investigated to some extent, while of the Copepoda only the occurrence of *Cyclops* in several lakes was mentioned. When in August of last year Dr. O. Zacharias ‡ undertook the study of the microfauna of these waters, which are interesting in many ways, I took upon myself the task of working up the Copepoda, and the more willingly as in so doing valuable information upon the distribution of species, the adaptability of the group under consideration, and various other interesting questions was to be expected.

As Dr. Zacharias was permitted to make his captures in part by means of a boat (on the Laacher See and Gemünder Maar), and, further, the pelagic fauna was pursued also at night, the following catalogue may furnish, at least for that time of the year, a tolerably complete picture of the distribution of the species and genera of Copepoda in the "Maare." The greatest number of species is harboured in the

I. LAACHER SEE.

By far the greater part of the Copepoda found here belong to the *littoral* fauna. Of Cyclopidae the material placed at my disposal contained:—

1. *Cyclops viridis*, Fischer;
2. — *tenuicornis*, Claus;
3. — *signatus*, Koch;

and of these three large species *Cyclops viridis* was the most abundant. Most of the animals were adult, but ovisacs only occurred very rarely in the females. The most numerous represented was

* Translated from the 'Archiv für Naturgeschichte,' Jahrg. 55, Bd. i. p. 117, Tafel vi.

† Verhandl. Ver. d. preuss. Rheinlande und Westfalen, Jahrg. 37 (1881).

‡ See his "Bericht über eine zoolog. Exkursion an die Kraterseen der Eifel" (Biol. Centrallb. Bd. ix. 1889), to which this paper forms a supplement.

4. *Cyclops agilis*, Koch,

and that in all ages. A species very nearly allied to this, which, as an inhabitant of all the "Maare" examined, is characteristic of these waters, and which has not yet been described, I name

5. *Cyclops maarensis*, sp. n.

The thorax (embracing the first four segments) is elongate ovate. Its last (fourth) segment bears five hairs at the postero-lateral margin. The abdomen has a slender appearance owing to the delicate furca. The first antennæ are twelve-jointed and do not reach to the extremity of the long cephalothorax (first body-segment). In the first third of the fourth joint of these antennæ a strong seta is remarkable for its length. The last three joints gradually increase, but all three are of small size. The second antennæ are short and stumpy. The labrum is deeply incised in the middle and bears eight larger and four smaller teeth (the latter two on each outer side). The buccal organs are remarkable for their feeble development. The swimming-feet are long and bear at the tips of their branches stiff spines, resembling lance-heads serrated on both sides. The fourth pair of feet, when laid close to the body, reaches beyond the genital aperture. The last joint of the outer ramus bears three spines in the first pair of swimming-feet, four in the second, four in the third, and three in the fourth. The rudimentary foot consists of a single joint, with a strong spine on the inside, and furnished with a seta at the apex and on the outside. The last segment of the abdomen, which bears the furca, is finely hairy at the hinder margin; the preceding segments are toothed. This species is very easily recognizable by the furca, which is remarkably slender and longer than the three preceding abdominal segments. The external lateral seta is placed about the last (posterior) fourth of the length of the furca. Above it a half-circlet of small hairs winds spirally forward and outward. Of the terminal setæ I found only the two middle ones hairy. In the male these setæ are characterized by remarkable inflations in the first half. The adult female measures 1·8 millim. including the caudal setæ, the male 1·2 millim. The ovisacs are borne in the same way as in *C. agilis*.

This new species is distinguished from *C. agilis*, Koch, by absolutely and relatively shorter antennæ, fully developed buccal organs, and an extraordinarily elongated furca. While the latter in *C. agilis* is serrated at the outer margin, in *C.*

maarensis it bears above the outer lateral seta an obliquely placed half-circlet of fine hairs.

Besides these five Cyclopidae, a Harpactide, namely

6. *Canthocamptus minutus*?, Müll.,

belongs to the littoral fauna. Of this Copepod I had only quite young specimens and the much injured body of a full-grown animal. I therefore do not venture to refer the animal in question with perfect certainty to *Canth. minutus*.

The *pelagic* fauna of Copepoda seems to be sharply separated from the littoral fauna, and is represented by two species, which, however, elsewhere scarcely ever wander from the shore in the larger basins, and still more seldom exclusively form the pelagic fauna, as here in the Laacher See. These are:—

7. *Cyclops strenuus*, Fisch., and

8. *Diaptomus cæruleus*, Fisch.,

the latter a pretty little variety about 1·8 millim. in length.

Although in number of species the Copepoda are abundantly represented, the number of individuals is too small for these Crustaceans to play an important part in the fauna of the Laacher See.

The examination of the material from the

II. GEMÜNDER MAAR

gave four Cyclopidae, namely

1. *Cyclops strenuus*, Fisch. (pelagic),

2. — *tenuicornis*, Claus,

3. — *agilis*, Koch,

4. — *maarensis*, sp. n.,

and the Calanid, now for the first time found in Germany,

5. *Diaptomus graciloides*, Lillj.

The first description of this species was given by Prof. Lilljeborg in the summer of last year*. It was, however, not very detailed nor illustrated with figures. In what follows I endeavour to fill up this deficiency to the best of my power,

* Bull. Soc. Zool. France, tome xiii. p. 156.

and in this I have been aided by the kindness of Prof. Jules Richard, of Paris, to whom I am indebted for correctly determined specimens of this species, which would be difficult to recognize from Lilljeborg's description.

The slender ovate thorax is not strikingly distinguished from the short abdomen. The lateral angles of the fourth segment are not produced. The first antennæ extend the whole length of the body and are very strongly constructed, by no means slender. Lilljeborg's statements as to the geniculate male antennæ, namely "articulus antepenultimus plane dearmatus," I do not find to be correct. In my investigations I always found seated upon the joint in question two setæ, one of which is very long.

The following numbers show the comparative lengths of the individual joints in the female antennæ:—

I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
30.	25.	15.	12.	18.	18.	20.	18.	18.	18.	20.	13.	25.	15.
XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XXI.	XXII.	XXIII.	XXIV.	XXV.			
25.	25.	25.	28.	30.	25.	25.	30.	35.	33.	20.			

The mandibles are armed with six distinct teeth, besides which there are towards the emargination some rudimentary ones. The inferior maxilliped is more stumpy than in *D. gracilis*, Sars. Its first joint has, on the anterior margin, four ridges, of which the first bears one seta. On the second there are two, on the third three, of which the middle one is the shortest, and on the fourth four setæ. One of the most important characters of this species, as in the other species of the genus *Diaptomus*, is furnished by the structure of the rudimentary pair of feet. The rudimentary foot of the female consists of a short basal joint upon which are seated a two-jointed outer and a one-jointed inner ramus. The first joint of the outer branch is long; the second cleft at the apex into two dissimilar parts. Of these the inner one forms a spine bent inwards; the tip of the other bears a short and a long seta, the latter extending as far as the end of the above-mentioned spine. Opposite the base of the spine on the outer side of the joint there is a fine setule. The inner ramus is longer than the first joint of the outer one and furnished at the end with two setæ of nearly equal length, besides which there is a smaller one seated more towards the inner side. The right rudimentary foot of the male consists of a basal joint which is but little longer than broad. The first joint of the outer ramus is short and produced into a small projection on the outer margin. The second joint is about as long as

the basal joint. In the last quarter of it, on the outer margin, is seated a spine which is as long as the joint. At the apex is geniculated a spine formed by the transformation of the third joint of the ramus, which is at least as long as the three preceding joints. At its base it is dilated into a vesicular form, and about the middle it makes a bend, so that its two halves stand nearly at right angles to each other. The one-jointed inner ramus bears some fine hairs at the extremity. The left rudimentary foot of the male is a little shorter than the right one. The basal joint is larger than that of the right foot. The apex of the second joint is produced into a short stiff spine, close to which, on the inside, another more slender one is attached. In the small ovisac I always found only two eggs. The length of the female including the caudal setæ is 1 millim. and that of the male 0·8–0·9 millim., or rather less than found by Lilljeborg.

This species comes very near *Diaptomus gracilis*, Sars, and it is quite possible that it is only a form of that species produced by adaptation and isolation. I have obtained, also from Dr. Zacharias, an abundance of *Diaptomus gracilis* from the "Faulen See," near Frankfort on the Oder. Some of the specimens of normal size showed small variations which partly agree with the characters of *Diaptomus graciloides*. I hope shortly to be able to make a more exact investigation of these conditions, by which, perhaps, some light may be thrown upon the causes of the variations. *Diaptomus graciloides* was found by Lilljeborg chiefly in the great freshwater lakes of Sweden and the Russian Kola peninsula to near the shores of the northern icy sea.

Of all the species cited from the "Gemünder Maar" I obtained only very few sexually mature animals, and especially in the case of the *Diaptomus* I had much trouble in finding in the rich material a sufficient number of adult specimens for the investigation.

All the Copepoda were strongly coloured red, the *Diaptomus* most intensely. The colouring-matter was chiefly combined with fat and could be extracted with this by ether.

The group of the Copepoda inhabiting the

III. HOLZMAAR

is again differently constituted from that in the fauna of the two "Maare" described. There are still the three Cyclopidae found in all the "Maare":—

1. *Cyclops tenuicornis*, Claus.
2. — *agilis*, Koch.
3. — *maarensis*, sp. n.

The Calanidæ are represented by

4. *Diaptomus castor*, Jurine.

In my Inaugural Dissertation *, like most of my predecessors, I identified *D. castor*, Jur., and *D. caruleus*, Fisch. Mr. A. Poppe, of Vegesack, had the kindness to call my attention to my error and sent me examples of *Diaptomus castor* from which I was able to convince myself that the description in the above-mentioned memoir was founded upon *Diaptomus caruleus*, Fisch., the two species being sharply distinguished from each other.

In the Maar last investigated, the

IV. PULVERMAAR,

there were only the three species of *Cyclops*:—

1. *Cyclops tenuicornis*, Claus.
 2. — *agilis*, Koch.
 3. — *maarensis*, sp. n.
-

Of the three genera of Copepoda which, according to the foregoing statements, occur in the "Maare," we find:—

1. *Cyclops*, with six species.
2. *Canthocamptus*, with one species.
3. *Diaptomus*, with three species.

The singular mode of occurrence of *Diaptomus caruleus* and *D. castor* merits special mention. The former occurs usually in the larger accumulations of water. But hitherto I know of no case in which it belongs, as in the great "Laacher See," to the pelagic fauna, nay, so far as the Copepoda are concerned, forms this almost exclusively. *Diaptomus castor* which, from accordant statements, rather belongs to the smaller stagnant waters, ventures, however, in the "Holz-

* "Die freilebenden Copepoden Württembergs und angrenzender Gegenden" (Jahreshefte d. Vereins für vaterl. Naturkunde in Württemberg, 1886, p. 167).

maar" into a comparatively large basin, while as regards the small *D. graciloides*, Lilljeborg's statements, according to which it particularly affects large pieces of water, are confirmed.

As no doubt in most cases, all the waters in the district of the Eifel have probably been peopled with Copepoda by passive immigration. Moreover active immigration could only occur in those lakes which are connected with the river-system of the Moselle and Rhine, *e. g.* in the Laacher See. I think, however, that we may assume with good reason that the lake just mentioned owes its richness in species to the greater concourse of aquatic birds and insects induced by its more extensive surface. These, according to Migula's recent investigations*, evidently play a most important part in the peopling of closed basins with the lower animals. The completely closed Gemünder Maar obtained its Copepod fauna, which nevertheless is considerable, solely by such transportation.

From the results obtained it seems very desirable that those "Maare" which have not yet been investigated should be carefully studied. Those which have already been examined will also furnish much of interest to renewed investigation, perhaps at different seasons of the year. Even the remarkable circumstance that in most "Maare" at the season apparently most favourable for the reproduction of the Copepoda so few animals with mature sexual products were found is an inducement to further investigation.

On a Cyclops with a defective Furca.

In my repeated examination of the Copepod material from the Laacher See my attention was attracted by a specimen of *Cyclops agilis*, Koch, of which the furca was crippled in a remarkable manner. The right half of the furca is thinner and about one fifth shorter than the left half. Curiously enough the setæ are as strongly developed on the smaller member as on the normal one; only the outer apical seta is removed to the place which in the normal form is occupied by the outer lateral seta. The latter, in the right division of the furca, is seated nearly in the middle of the outer surface, and is therefore displaced towards the head. Further deviations from the normal structure are also shown by the last three abdominal segments, inasmuch as they do not lie straight behind one another, but form a slight curve towards the right.

* 'Biologisches Centralblatt,' 1888, no. 17.

The last of them, which bears the furca, is also unsymmetrically developed. In correspondence with the relative sizes of the two halves of the furca, the left side of the segment in question is considerably broader than the right. The serration characteristic of the furca of this species terminates regularly on each side just above the lateral seta, but on the right side it commences, not as on the left immediately beneath the hinder margin of the last segment, but somewhat further back. This malformation may be original, but is more probably produced by a subsequent accident (perhaps in change of skin). In the reproduction of the lost part of the furca it was not again completed of the normal size; but in this way certainly the displacement of the above-mentioned seta is not easy to explain.

XL.—*Considerations on the Structure of Rhizopod Shells.*

By FRIEDRICH DREYER*.

IN the course of my investigations upon Rhizopoda, and especially upon the Radiolaria, various considerations of a general character have impressed themselves upon me. In part similar ideas have been already touched upon by previous authors and occur scattered in the most various parts of the copious literature; several points to be referred to in what follows I have already incorporated with the special investigations in the first part of my 'Radiolarienstudien'†; nevertheless I regard it as a not unprofitable task to reproduce in the following pages in a connected form the complete train of thought of my considerations upon the structure of the Rhizopod shells, as I hope that it will be of interest even for many who do not occupy themselves specially with the Protistan group in question.

Even on a superficial consideration of the enormous number of forms of the Rhizopoda we may recognize in them an essential difference in the general habit of the shell, and, in accordance therewith, distinguish two groups of forms. One

* Translated from the 'Biologisches Centralblatt,' Bd. ix. pp. 333-352 (1st August, 1889).

† F. Dreyer, 'Morphologische Radiolarienstudien,' Heft I. "Die Pylombildungen in vergleichend-anatomischer und entwicklungsgeschichtlicher Beziehung bei Radiolarien und Protisten überhaupt, nebst System und Beschreibung neuer und der bis jetzt bekannten pylomatischen Spumellarien" (Jena, 1889).

portion of the Rhizopoda possesses a shell which is perforated by numerous uniformly distributed pores or by several—at any rate more than two—pores, and shows in the majority of cases a spherical or polyaxonic fundamental form without any clearly marked elongated main axis. Another portion of the Rhizopoda shows a distinctly marked, usually elongated, main axis of the shell, at one or sometimes at both poles of which there is an aperture. This aperture is either the sole opening which exists in the shell, or when the wall of the shell is perforated it is distinguished from the pores of the shell by its greater size and frequently by marginal ornamentation and similar differences of various kinds. In accordance with the characters just mentioned we may distinguish two kinds of structure in Rhizopod shells in general, which may be suitably designated the perforate-polyaxonic and the pylomatic*-monaxonic form-types. The principal and characteristic point in these two types of form is the constitution of the shell-apertures, whether uniformly perforated or pylomatic. It is only in the second place that the proportions of the promorphological axes come into consideration; these are in most cases dependent upon the nature and distribution of the shell-apertures and correlated therewith, as is very natural, seeing that the latter on the whole agree with the distribution and direction of flow of the sarcode passing outwards. The Rhizopods belonging to the pylomatic type are, from the nature of the case, without exception, monaxonic—the pylom is placed at one pole of the principal axis. The Rhizopod shells of the perforate type are in general spherically homaxonic or polyaxonic; in many cases indeed even here an abbreviated or elongated principal axis is developed; but this never presents a pylom at its poles.

The more or less uniform perforation, in accordance with its indifferent character, exerts no persistent influence of importance upon the form of the shell, and there is consequently nothing further specially to be said upon the perforate type.

* In my 'Radiolarienstudien' I have proposed the name of "Pylom" for the principal orifice of the Rhizopod shell. I have there employed it in the first place for the orifices occurring in the Radiolarian skeleton, especially in order to avoid any confusion with the "osculum" (Häckel) of the central capsule of the Nassellaria and Phæodaria (Osculosa, Häckel). As hitherto no unitary designation exists for the principal orifice even of the Thalamophora, it may be desirable to embrace the structures in question in the Rhizopoda generally under the term "Pylom." Upon the comparative morphology of the pyloms and allied structures, which is interesting in many respects, see the detailed exposition in my 'Radiolarienstudien.'

It is otherwise, however, with the pylomatic type. Hand in hand with the development of a chief aperture or pylom a series of transformations and differentiations occur in the Rhizopod shell, and these become particularly interesting because they are independent of the material of which the shell is composed and are developed independently in the most different groups of the Radiolaria and Thalamophora. From this it follows that here we have to do with purely analogical structures, which, standing in correlation with the formation of the pylom, occur only in the Rhizopod shells which are distinguished by a principal orifice. It may therefore be profitable to go somewhat in detail into these peculiarities of the monaxonic-pylomatic type.

The most usual accompaniment of the formation of the pylom is an elongation of the shell in the direction of the principal axis—more rarely this axis is abridged. If the shell possesses radial skeletal elements, spines, &c., a corresponding influence makes itself felt even in these—they arrange themselves, following the direction of the principal axis, in such a manner that those of the oral half of the shell are directed towards its oral pole and those of the aboral half towards the aboral or apical pole. Generally this process of differentiation goes still further, inasmuch as on the equatorial parts of the shell no spines are developed, but they are confined to the two poles. Then is produced an elongated, elliptical, or oval shell, one pole of which is occupied by the principal aperture. Further, the two poles of the principal axis are distinguished by radial spines or other structures; at the oral pole these surround the pylom as radial marginal ornamentations of various kinds, while the opposite apical pole is furnished either with a tuft of spines or with some generally regularly grouped spines, or with a single strong apical spine. This development of the shell is extraordinarily diffused in the most different divisions of the Rhizopoda, and it may be regarded as characteristic of the monaxon-pylomatic type. Corresponding forms occur in *Diffugia*, *Euglypha*, *Quadrula*, *Campascus*, *Lagena*, in numerous polythalamous Thalamophora, and most generally diffused in the Nassellaria, pylomatic Spumellaria, Challengerida, Circoporida, Tuscarorida, Medusettida, and Castanellida.

Instead of the marginal spinosity the pylom is sometimes produced into a tube. In many a pylom occurs also at the aboral pole, so that the shell, perforated by a mouth at both poles of the principal axis, acquires an amphistomous character. All these morphological characters of the monaxon-pylomatic type are allied phenomena and stand in close corre-

lation both with each other and with the formation of the pylom. This is easily explained by the fact that all depend upon the same physiological cause in the soft body secreting the shell. All the peculiarities of the monaxon-pylomatic type, including even the formation of the pylom, are to be referred to a uniaxial differentiation of the sarcode-body, which no longer emits its pseudopodia equally distributed on all sides, but for the most part, or even exclusively (imperforate forms), from one point, namely through the pylom; next to this principal effluent point the flow of sarcode is strongest at the opposite pole, and, indeed, sometimes, as in the amphistome Rhizopoda, it is equally strongly developed at both poles. By this orientation of the soft body in the direction of a primary axis its formative or secretory activity is no longer equally great in all directions, but localized in a corresponding manner, so that the two poles of the principal axis are distinguished in the way above indicated by radial appendages of various kinds from the more indifferent equatorial parts of the shell.

In a very great number of cases it is proved by observation that a strengthened main flow of sarcode takes its course through the pylom, quite apart from the imperforate Thalamophora and Radiolaria, in which, from the very nature of the case, the whole of the pseudopodia must pass through the pylom as the only aperture present. We may therefore without hesitation regard such an arrangement as a general rule, without requiring direct proof for every pylomatic Rhizopod shell. From analogy, *i. e.* supported by the numerous actually observed cases and the harmonious intimate relation of the different parts of an organism which no one can very well doubt, this assumption is justified.

It might perhaps be objected, however, that the pyloms of the Rhizopoda being traversed by a stronger flow of sarcode does not prove that the latter is also the *cause of the formation* of the apertures; on the contrary, the opposite causal nexus might exist and the sarcode cords principally issue there, because a more convenient course is offered to them. In answer to this objection it will suffice to indicate simply that the soft *protoplasmic body* is the *original thing*, and the *hard structure* a *secondary secretion* from it. The soft body forms the shell for itself in accordance with its wants, instead of arranging itself to suit the shell; the apertures of the shell of course serve for the passage of the pseudopodia outwards, the small pores for single ones, the great pylom-aperture for a larger number of pseudopodia.

In a number of pylomatic Rhizopoda the development of

a primary axis is not the only thing, but their fundamental form undergoes further differentiations. In the first place a difference of the transverse axes makes itself felt in such a way that a long and a short transverse axis may be recognized, these being perpendicular to each other and to the principal axis. The result represents the fundamental form of the amphitect pyramid (Häckel); the forms belonging here are lenticularly flattened laterally, *i. e.* parallel to the primary axis. In such Rhizopod shells, moreover, the pylom is frequently no longer round, but drawn out in the form of a slit; any spines present at the aboral pole are generally orientated in the direction of the longer cross-axis; sometimes the periphery of the monaxon-lenticular shell is keeled. Such more or less distinctly amphitect-pyramidal promorphs occur in *Hyalosphenia*, *Quadrula*, *Diffugia*, *Euglypha*, *Gromia*, *Lagena* (*Fissurina*, Rss.), and *Lingulina*, in some pylomatic Spumellaria *, in various Nassellaria, and throughout in the Phæodarian family Challengerida.

A further step towards higher differentiation is the transition to the eudipleural (bilaterally symmetrical) fundamental form, which may start either from amphitect or from simply monaxonic forms. This takes place in general in consequence of an elongation of the pylom (which in monaxonic and amphitect Rhizopoda is situated at one pole of the primary axis, and, indeed, directly perpendicularly beneath the apical pole of the shell) forward or backward, by which means a front and back and right and left become distinguishable. It is interesting to mark the agreement of this process with the transformation of the primary form in the hypothetical development of the Turbellaria from Ctenophora (A. Lang). The Ctenophora and earliest Turbellaria are perfectly amphitect in structure; the mouth is placed in the middle of the underside perpendicularly beneath the apical pole of the body, front and back, right and left are not yet distinguishable, and this distinction is only produced by elongation of the mouth forward or backward, which occurs in most Turbellaria (Pyclada), and by which the eudipleural fundamental form is given. Moreover, many Rhizopoda become eudipleural by a corresponding arrangement of the oral and aboral radial appendicular structures or by a bending round of the apertural neck of the shell. Eudipleural development of the shell occurs in *Diffugia*, *Trinema*, *Cyphoderia*, *Campascus*, *Lieberkühnia*, *Microgromia*, *Platoun*, *Plectophrys*, and *Lecythium*, in many

* The pylomatic Discoidea and Laroidea are, however, to be excepted from this series of phenomena. For further details upon this point see my 'Radiolarienstudien,' Heft i. pp. 98, 99.

polythalamous Thalamophora, some pylomatic Spumellaria*, and the Phæodarian families Challengerida, Medusettida, and Tuscarorida.

Close to the eudipleural forms come the spirally-wound Rhizopod shells, which are to be regarded essentially only as a continuation of the eudipleural ground-form by the process of terminal growth, which will presently be referred to more particularly. There are therefore, especially in freshwater Rhizopoda, very gradual transitions from simply eudipleural to spirally twisted shells. In this respect the *Diffugia* are particularly instructive, as in them all transitions from monaxonic to eudipleural and from these to spiral shells are represented; thus, for example, *Diffugia corona* is typically monaxonic, *D. marsupiformis*, with the pylom displaced forward, eudipleural, while, finally, *D. spiralis* already shows distinctly the half-turn of a spiral†. In the same way as in these first and perhaps still individually varying commencements in the freshwater Rhizopoda, the highly developed marine Thalamophora, often showing many spiral windings, have been developed, as is indicated, among other things, by the monaxonic central first chamber (the so-called embryonal chamber).

Having in the preceding submitted the Rhizopod shell to a short consideration with regard to its *form*, we may now proceed to examine it somewhat more closely from another point of view, namely as to the mode of its *growth*. In this, at the first glance, we meet with an interesting parallelism with the two form-types just referred to. Just as in the case of these form-types we can also distinguish in the mode of growth of the Rhizopod shell two principal types, which may be placed side by side with the two form-types, and on the whole are to be conceived as a continuation of the latter caused by growth. Thus the perforate form-type corresponds to the concentric type of growth, and the pylomatic form-type to the terminal type of growth.

The concentric growth-type, as implied by its name, consists in that the soft body during its further growth around its first spherical perforate shell, which gradually becomes too small for it, separates externally successive larger concentric spherical shells. The shells of such a system of latticed spheres nested one within the other are bound together

* The bilaterality indicated in a great number of Nassellaria by the relations of the basal and apical spines is original and does not belong to this category. See 'Radiolarienstudien,' Heft i. p. 100, note 2.

† See 'Radiolarienstudien,' Heft i. Taf. vi. figs. 88, 89, 90.

by radial rods, the so-called radial beams. The growth of the hollow spheres following upon the first shell in a great number of cases (perhaps always?) even proceeds from the radial beams, the ends of these, which radiate freely outwards as radial spines, emitting a system of lateral apophyses, which grow together and complete the next shell. This is the typical and original form of the concentric shell-growth; it occurs, like concentric growth in general, only in Radiolaria, and, indeed, in Sphæroidea, many Prunoidea, the Phacodiscida, and the Phractopeltida. This original course undergoes modifications by the growth taking place no longer on all sides, but instead of this in definite directions. Thus the disciform Discoidea grow only in one plane by the addition of concentric rings; many Prunoidea only in the direction of one axis, as in them a series of dome-shaped segments of spheres are added successively at the two poles. Both modifications, however, may be easily referred to a system of concentric spheres and explained naturally as follows:—That in the Discoidea only those parts of the latticed spheres which are situated in the plane of growth are developed as rings, while in the Prunoidea only the sphere-segments placed at the two poles of the principal axis in which growth takes place are developed.

As we have seen, in the concentric growth-type an addition of new portions of shell originally takes place uniformly in all directions, or in the last-mentioned modified modes of the phenomenon at least in more than one direction. In opposition to this the shells of the terminal growth-type grow only in one direction. Just as the concentric growth-type is associated with the perforate form-type, so is the terminal type of growth with the pylomatic form-type. Terminal shell-growth takes place in this manner:—The sarcode-body of a pylomatic shell, as soon as the latter becomes too small for it, swells forth in part from the pylom, and in front of this forms a second shell (here usually called a chamber or joint), which opens outwards by a new terminal pylom. In the further growth of the soft body this process is repeated again and again; in advance of the pylom of the second chamber a third chamber is formed, in front of this a fourth, and so on. In this way longer or shorter series of chambers are produced, which continue to grow at their extremity, the orificial pole of the youngest chamber. The series of chambers is either straight, as in Cystoidea and Nodosariæ, or curved, as in *Dentalina*, or rolled into a spiral (e. g. *Cristellaria*), like the shells of the Nautiloidea and Ammonites, only in the latter the soft body is exclusively in the last or youngest chamber,

whereas in the Rhizopoda all the chambers are filled by the sarcode-body.

While the whole of the Rhizopod shells may be brought under the two form-types, this is not the case with the growth-types, for the simple reason that in many Rhizopoda no supplementary growth of the shell takes place. These are the one-shelled or single-chambered forms without secondary growth*, which are to be recognized in considerable numbers both in the perforate and the pylomatic types and both in Radiolaria and Thalamophora; these stand in a certain opposition to the shells with secondary further growth occurring in one or other of the two growth-types. It is interesting to see that, apparently, there is a physiological difference to be placed side by side with this morphological distinction. Verworn† has observed that artificial injuries to the shell of a monothalamous Rhizopod (*Diffugia urceolata*, Carter) were not repaired, while in the polythalamous Rhizopods this takes place to the fullest extent, as shown by that author's investigations upon *Polystomella crispa* and Carpenter's on *Orbitolites tenuissima* and *O. complanata*. From these results we may conclude with Verworn that the faculty of the soft body of secreting shell-material only continues as long as the normal growth of the shell itself, from which then the above-mentioned different behaviour of the mono- and polythalamous Rhizopoda may be explained.

As already mentioned, the two form- and growth-types are associated in this way:—the shells of the perforate type are further developed in accordance with the concentric growth-type, and the pylomatic shells, on the contrary, after the terminal growth-type. To this rule, so far as I know, only one exception is known, namely that of the Phæodarian family Canosphærida. The members of this interesting group possess a small, pylomatic-monaxonic, central shell, surrounded at a considerable distance by a large, spherical, homaxonic, latticed ball, the two shells being held together by long radial beams. Here, certainly, the sarcodic stream in one direction which existed at the time of the secretion of the central shell is suppressed during the course of the succeeding development, to give place to a uniformly radial arrangement.

* Even some monothalamous Thalamophora show a secondary shell-growth, such as, especially, the Cornuspirida. These pylomatic forms of course belong to the terminal growth-type, and are therefore to be excepted here.

† "Biologische Protistenstudien," in Zeitschr. f. wiss. Zool. Bd. xlvii. pp. 455-470, Taf. xxxii. Translated in 'Annals,' ser. 6, vol. ii. p. 155.

Having now briefly indicated the relation of the polythalamous to the monothalamous forms, the question naturally occurs to us which of the latter, the shells without secondary growth, are to be regarded as the most primitive. A careful investigation of the conditions coming under consideration shows us that a positive answer to this question cannot be given. The perforate, more or less homaxononic Monothalamia in almost all cases show a primitive character; but this may also be assumed with a very high degree of probability for many pylomatic Monothalamia. On the other hand, it is exceedingly probable that a great part of the pylomatic Monothalamia have only arisen secondarily from perforate spherical forms. This view is supported especially by some important transition-forms which occasionally occur. Thus the number of pores in the spherical shell of *Microcometes* varies from 5 to 1, so that in the latter case we have already the indication of a monaxon-pylomatic development; and in *Thurammina* and *Orbulina* one shell-pore is sometimes distinguished from the rest by its greater size. In Radiolaria the secondary origin of a pylom occurs very widely, and with regard to this I may refer to the detailed treatment of the point in my 'Radiolarienstudien.'

Whilst, therefore, one form-type may pass over into the other, this is by no means the case with the growth-types. It never happens that a form which has grown terminally for a time afterwards adopts the concentric growth, or the reverse. According to extant observations at least it may pass as an unexceptional rule that the same form always remains true to the growth-type which has once been adopted. The behaviour of the pylomatic Spumellaria is particularly instructive upon this point. Not only in many single-shelled Spumellaria, but also in many in which several concentric spherical or annular systems are already present, a pylom is developed; but nevertheless these forms continue without disturbance to grow concentrically, the influence of the pylom not being of sufficient importance to suppress the concentric growth and cause the shell to continue its growth terminally. The Rhizopoda in question are able to change their form-type, but not their growth-type.

In what has been said mention has several times been made of developmental or transformational processes in the Rhizopod skeleton; with regard to these the following must also be brought to mind. For the genetic explanation of the innumerable phenomena of differentiation three possibilities have been given in accordance with the different particular results. A great number of structures are referable to simple

appositional growth; other changes, on the contrary, are only to be explained by the disappearance of previously existing parts of the skeleton; while, finally, certain alterations are intelligible only by flexion of the skeletal parts involved in them. If we now take into consideration that the hard parts of the Rhizopoda consist of rigid mineral material, it is clear that ontogenetic developmental processes are possible only in the first mentioned way by the addition of new material. It is true that a process of resorption has already been repeatedly assumed to take place in the shells of Thalamophora, and such a process might really be conceivable, perhaps by local production of acid by the soft body; but this appears so problematical that we cannot deal with this factor until its existence has, at least once, been demonstrated with certainty. In the case of the siliceous skeletons of the Radiolaria a process of resorption is to be rejected *à priori* upon easily intelligible grounds. So also, of course, a flexion of rigid calcareous and siliceous parts is impossible. Hence it appears that the ontogenetic development of the hard parts of the Rhizopoda can take place only by appositional growth, and all structures which cannot be explained thereby must be ascribed to phylogenetic development, as of course by means of phylogeny any conceivable alteration of form is possible.

The circumstance that in the case of the hard parts when once secreted, subsequent re-solution or alteration by total or local resorption, flexion, extension, and the like is no longer possible, involves another exceedingly important consequence. As in the higher Protista, in which already we may speak of a true individual development, and which therefore have their genealogy behind them, and to which, of course, the biogenetic fundamental law applies as to plants and animals, so also the ontogeny of the skeleton of the Rhizopoda furnishes a more or less exact reproduction of their phylogeny. But while, in the higher organisms after the completion of the ontogeny, the individual stages passed through during the latter have generally long since disappeared, in the Rhizopod skeleton the entire development which has been passed through is still completely preserved in the adult specimen. In order to obtain an accurate picture of the development of the shell, it is only necessary to examine the earlier-formed parts back to the youngest, therefore in shells with concentric growth to pass from the centre to the periphery, and in those with terminal growth, from the so called embryonal chamber along the series of chambers to the end. Therefore, as in the known example of the Cephalopod shell, it is very often possible also in the Rhizopod shell to compare directly the

initial parts of differentiated skeletons with adult primitive forms. With the shells of Thalamophora this has been carried out in several special cases; and in the case of the Radiolaria, from their much greater differentiation it is possible to a much greater extent and with more profit. In these cases comparative anatomy and ontogeny coincide, an advantage in morphological investigation which cannot be too highly appreciated, but which, unfortunately, like the comparative treatment of the Rhizopoda in general, has hitherto by no means received sufficient attention.

Having now become acquainted with some of the most important points in the structure of the shells of the Rhizopoda, it remains for us to give an explanation of these phenomena. Here, of course, we can only have to do with a preliminary attempt to throw some light upon the aetiology of the enormous form-labyrinth of the Rhizopoda, for even an approximately complete solution of this difficult problem still lies in the far distance.

The chief cause of the form-types of the soft body and of the shell is to be sought in the mode of life of the Rhizopoda under consideration. Rhizopoda with shells belonging to the perforate form-type and with pseudopodia radiating uniformly on all sides will live free and rotating in the water. The monaxonic and amphitect shells of the pylomatic form-type will belong to Rhizopoda which, in swimming or creeping, maintain a definite, perpendicular principal axis. The eudipleural development, lastly, owes its origin to creeping in a particular direction, just in the same way as in the example of the Polyclada already adduced in this connexion.

The morphological evolution or the specific character of the form-types recurs, as has already been mentioned, in exactly analogous development throughout, independently of conditions of relationship and shell-material. With regard to the perforate form-type, on account of its undifferentiated character, there is not much to be said in this respect; and here we have chiefly to consider the above-mentioned associated phenomena of the formation of the pylom, such as oral marginal ornaments of the pylom, apical spinosity, &c. The specific evolution of the form-type once selected is, as has been said, independent of the shell-material; in the selection of the form-type itself, however, the latter plays an important part, and this applies in a still higher degree to the growth-type, inasmuch as the structural material plays a positively determinant part with respect to the mode of growth of the Rhizopod shell.

The most important materials here coming under con-

sideration as being employed by the Rhizopoda in the construction of their shell are of threefold nature*. A part of the Thalamophora construct their shells of agglutinated foreign bodies, partly inorganic (sand, mud), partly of organic nature (Thalamophoran and Radiolarian shells, sponge-spicules, &c.), while the greater part of the Thalamophoran shells are formed by secretion of carbonate of lime; and, thirdly, the skeletons of the Radiolaria consist of silica. The two first-mentioned materials of the Thalamophoran shells have this in common, that they possess far less firmness than the silicic acid of the Radiolaria. This distinction has also as its consequence a corresponding difference in the habit and mode of construction of the two great primary groups of the Rhizopoda.

Even upon a superficial examination one is struck with the fact that the shells of the Thalamophora with much less multiplicity of form and differentiation are far more massive and stouter than the Radiolarian skeletons, which are often exceedingly complicated, graceful, and elegant. The comparatively soft material which is employed by the Thalamophora in the construction of their shells does not permit these Rhizopoda without injuring the stability of their dwellings to make such airy and complicated structures as the Radiolarian skeletons, composed of solid more or less elastic siliceous rods.

The distinctions, however, are of a still more profound nature, and extend not only to the external habit, but also to the whole structural plan of the shells and skeletons. Even in the single-shelled forms, this, as already indicated, may be distinctly recognized in the selection or distribution of the form-types in the two great sister-groups of the Rhizopoda. The monothalamous Thalamophorous shells are almost all pylomatic, and only a few forms, such as *Orbulinella*, *Orbulina*, and some sandy-shelled forms, belong to the perforate form-type. On the other hand, among the Radiolaria the

* The primary chitinous shell of many freshwater Rhizopoda plays too subordinate a part in the matters here under consideration to need any special mention. The shell-material of the Phaeodarian families Circoporida, Tuscarorida, and Challengerida requires closer investigation. It appears, however, to have a similar consistency to the calcareous material of the Thalamophoran shells, and the mode of construction of these Phaeodaria is like that of the Thalamophora. Acanthin appears, with regard to its solidity, to hold a middle place between carbonate of lime and silicic acid, at least this holds with regard to the habit of the Acantharian skeletons, which, on the one hand, are more differentiated and elegant than the Thalamophoran shells, without, however, on the other, attaining the light construction and great complication of the siliceous skeletons of the Polycystina and Phaeodaria.

majority of the single-shelled forms are perforate, and the pylomatic-monaxonic forms are in the minority, although they do not fall so far behind the others as does the perforate form-type among the monothalamous Thalamophora. This distinction in the distribution of the two growth-types becomes still more strongly marked, however, in the many-shelled forms with secondary growth. Thus in the Radiolaria both growth-types occur widely distributed side by side, but still in such a manner that a preponderance of the concentric growth is unmistakable, while, on the contrary, in the Thalamophora the terminal growth-type is exclusively* represented.

The cause of this different behaviour of the Thalamophora and Radiolaria is to be found in the fact that the two modes of construction in question make different demands upon the solidity of the material. The perforate-concentric shell-construction requires much finer material than the pylomatic-terminal, and therefore it happens that, while in the siliceous skeletons of the Radiolaria both shell-constructions are represented in the highest completeness and complication, the Thalamophora are under the necessity of producing exclusively pylomatic-terminal shells, for with their material of construction, which is softer in comparison with silica, it would not be possible for them without impairing the solidity of their shells to form concentric and airy skeletons like those of the Radiolaria; they must make their shells thicker and more massive in order to give them the necessary solidity.

It is in the essence of the perforate-concentric mode of construction that it requires to be carried out more lightly. As there is no principal orifice, the passage of the sarcode to the outer world, and in many shell-forms also between the different interspaces of the shell, is consigned exclusively to the pores of the shell, which for the purpose of ready communication must not be too narrow nor the intervening skeletal parts too massive; further, the union of the latticed spheres concentrically nested one within the other is only possible by means of free radial rods, which, again, must not exceed a certain thickness. The conditions of the pylomatic-terminal mode of construction are very different. Here the

* Only one remarkable exception to this rule is furnished by *Thuramina papillata*, Brady, the agglutinated shell of which is composed of two concentric spherical shells united to each other by some radial beams (Brady, 'Challenger' Report, pl. xxxvi. fig. 12). The stout and rather irregular character of this form shows us, however, that we have here to do as it were only with an unsuccessful attempt to imitate the light construction of the siliceous skeleton with a less solid material.

pores pass much into the background, both in importance and development, in the presence of the principal orifice, the pylom; in the Imperforata they are even entirely wanting, and the shell-wall can therefore be made more compact and solid. Further a union of the different shells in polythalamous forms by means of free radial beams is unnecessary, but they lie with their walls directly upon each other. In the pylomatic siliceous shells of the Nassellaria the pores certainly are not inferior in their development to those of the perforate-concentric Spumellaria, but this is simply because the silica of the skeletons of itself gives them such firmness that by it a strengthening of the shell-wall and the consequent reduction of the pylomatic form-type is rendered superfluous. It is otherwise with the shells of the Challengerida, Medusettida, and Tuscarorida, which are indeed of siliceous nature, although not of homogeneous consistency, but possess a more or less complicated internal structure, or consist of a mass of separate siliceous spicules cemented to each other. The forms belonging here therefore show distinctly a recurrence of perforation, while the wall is at the same time thick.

The character of the Spongopylida, spongy Discoidea in which a pylom has been formed secondarily at the margin of the disk, and which I have united under this character in the genus *Spongopyle*, is exceedingly instructive, and in fact demonstrative of the conception of these conditions here developed. Thus *Spongopyle aspera*, which consists of an irregular tangle of thin siliceous rods, shows, as indicated by its name, a rough irregular surface; in *Spongopyle osculosa*, *S. setosa*, *S. craticulata*, and *S. Stöhrü* a more uniform external closure is perceptible; and this process finally attains its highest point in *Spongopyle circularis*, *S. ovata*, *S. elliptica*, and *S. variabilis*. In these forms the spongy tissue of the interior is shut off externally by a continuous shell, in which there are only some very small pores. At the margin of the disk is placed the pylom as a single larger orifice. By the development of this as the principal opening for the outflow of the sarcode a compact closure of the other parts of the spongy disk has been rendered possible, and this again, by the external fixing of the spongy skeletal web, and by giving protection against injurious external attacks, is of service. The phylogenetic development of an external shell-mantle indicated by the comparative anatomy of the species of *Spongopyle* is completed and confirmed by my observations upon the ontogeny of *Spongopyle osculosa*. The young stages of this species possess a rough surface open on all sides, and an

external, continuous shell-closure is developed only after the completion of the growth of the spongy disk *.

As we have seen, the agglutinated and calcareous materials agree in that, as compared with the silica, they possess less firmness, the consequence of which is that the Thalamophoran shells are more compactly and simply constructed than the siliceous skeletons of the Radiolaria. On closer examination, however, a distinction may be recognized between the agglutinating and calcareous Thalamophora, consisting in the fact that the former are more coarsely and simply constructed than the latter, and this is certainly due to the agglutinated constructive material being inferior in solidity to the homogeneous calcareous mass. Although this difference is not so great as that between Thalamophoran and Radiolarian shells, it nevertheless exists, and to all appearance its importance must not be undervalued. Quite recently Neumayr has specially called attention to this circumstance, and made use of it for a phylogeny of the Thalamophora, assuming the more highly differentiated calcareous-shelled forms to have become developed from the simple arenaceous-shelled types as their stem-forms †. It will be most convenient, in the first place, to reproduce this theory of Neumayr's in the author's own words. He says:—"The low forms furnished with the most imperfect shell-structure which form Brady's very well-founded family Astorhizidæ are exclusively sandy; the most highly developed Foraminifera, furnished with a branched canal-system, double septa, an intermediate skeleton, &c., are exclusively calcareous; while the forms standing between the two are partly sandy, partly calcareous, and show many transitions from one development to the other. This condition of things leads to the supposition that arenaceous forms, without any trace of a complicated structure, such as we find in the Astorhizidæ, represent the stem-types from which the other Foraminifera have been developed. . . . In favour of the notion that the arenaceous Foraminifera in reality represent the original type, we have in the first place their geological occurrence, inasmuch as they occur in old deposits in comparatively much greater number than subsequently; it is true that in the comparison of the living with the Tertiary and Mesozoic species this does not appear so strikingly, but it is perfectly distinct

* See for further details my 'Pylombildungen,' Abschnitt v. Taf. v. figs. 64-69, and Taf. vi. figs. 97-100.

† Neumayr, "Die natürlichen Verwandtschaftsverhältnisse der schalen-tragenden Foraminiferen," in Sitzungsber. Wien. Acad. Bd. xcv. Abth. I (1887), and also in 'Die Stämme des Tierreichs,' Bd. i (1889).

when we turn to the Palæozoic formations, and especially the Carboniferous, which here alone has furnished a rich Foraminiferan fauna. . . . In another phenomenon we find a further confirmation of the opinion that the calcareous Foraminifera have been developed from the arenaceous forms. It has already been mentioned that in both divisions there often occur parallel forms which show a great similarity to one another in their whole conformation; but on closer examination, at least in a number of groups, the circumstance that the differentiation and individuality of the different types are much less in the arenaceous than in the calcareous series becomes exceedingly striking. . . . Moreover, when we can trace the same types in the two divisions the characters appear much more distinctly and clearly in the calcareous forms; although transitions are present, the different types do not melt into each other so completely as in the arenaceous forms, and the multiplicity is much greater than in the latter." (*Stämme des Thierreichs*, pp. 168-169.)

This most recent conception of the natural system or phylogeny of the Thalamophora is decidedly to be characterized as a very happy idea, and deserves to be greatly preferred to the various attempts previously made at a natural grouping of the Thalamophora. A special advantage of Neumayr's theory is to be found in the fact that it does not lay the principal stress upon any single character selected more or less arbitrarily, such as the perforate or imperforate constitution of the shell, the shell-material, or the number and arrangement of the chambers, which fault, as the author justly points out, affects all previously established so-called natural arrangements of the Thalamophora; but it takes equally into account all the conditions which come under consideration. In this way we get a phylogeny which agrees better with both the morphological and the palæontological facts than is the case with the older systems. In accordance therewith the Thalamophora are divided up into a great number of more definitely limited groups, which, on the whole, agree with those established by Brady. These are distributed upon a small number (four) of great stems, which run parallel and independently side by side, and are connected only at the root by the primitive agglutinating *Astrorhizidæ*, the common stock-form of all the four stems. On the irregularly agglutinant *Astrorhizidæ* follow the regularly agglutinant forms, the simplest of which directly approach the common stock-group, while the more highly developed forms already take on a divergent direction and become distributed over the four main-stems established by Neumayr; with them

corresponding isomorphous calcareous forms are directly connected, while the most highly developed and most differentiated terminal types of the stems are exclusively of calcareous nature.

This phylogeny of the Thalamophora of Neumayr's harmonizes perfectly with our conception of the significance of the structural material of the Rhizopod shell, and the two theories lend each other a support which must not be undervalued. The lower and lowest forms find the coarse agglutinated material quite sufficient for the construction of their simpler shells; the forms of medium complication already for the most part have recourse to carbonate of lime; while, finally, the most differentiated types construct their shells exclusively of lime, because this finer and firmer material alone renders possible that complicated structure which could not be carried out with the coarse and less solid agglutinated material. Only in the case of one of Neumayr's assumptions I should consider a certain limitation necessary. As appears from the last of the passages above cited, Neumayr regards the more imperfect and coarser construction of the arenaceous forms in comparison with the isomorphous calcareous ones as a primitive condition, and a special proof that the arenaceous forms are to be regarded as forerunners of the calcareous. In most instances, in all probability, this is the case, but not without exception. It is possible, nay, highly probable, that, as at the present day, the shell-material varies in certain forms with changes of the external conditions under which the Rhizopoda in question live; this has also occurred now and again during the phylogenetic development, and calcareous forms may thus be compelled to make their shells of sand. These will then, in consequence of the coarser material, appear ruder and less differentiated than the calcareous stem-form. Although the sarcode-body of such forms will have inherited the tendency to secrete hard parts equally well-developed morphologically, it will be unable, on account of the coarser nature of the sandy material, to bring this faculty to full development, as was the case with the calcareous material. Just as the Thalamophora in the course of their phylogenetic development were compelled, for the purpose of the higher morphological development of their shells, to pass, independently in the different stems, from the agglutinated material, which no longer sufficed for this purpose, to carbonate of lime, a form which is under the necessity of going back from the calcareous to the arenaceous development will also show a corresponding retrogression in respect of morphology. Such a change of material, as also the existence of

isomorphous arenaceous and calcareous forms, occurs, however, only in Thalamophora moderately high in development, and, indeed, is possible only in them because here the corresponding morphological change extends only to unimportant peculiarities, but impossible in the highest and most differentiated types, such as the Nummulites for example, in which a reversion to the arenaceous grade of development would need to be accompanied by a profound change in the whole structure of the shell.

Thus, then, we have seen that in the three principal materials which come under consideration in connexion with the hard structures of the Rhizopoda, so many degrees of firmness and fineness may be recognized, which exert a very considerable influence upon the structure of the shells and skeletons. If we would illustrate these conditions by an example out of everyday life, we may fairly compare the agglutinated arenaceous material, the carbonate of lime, and the silicic acid, as the materials of the Rhizopod shells, on the one hand, with mud, stone, and iron, the three most important substances in the buildings made by man. The mud-structures, like the arenaceous Rhizopod-shells, can be carried out only in a rough and more or less primitive manner, like the birds' nests (such as those of the Swallows) built of mud, owing to the coarse texture and want of solidity in the material employed; in fact, the mutually adherent chambers of many "Agglutinantia" among the Rhizopoda possess a remarkable resemblance to the Swallows' nests aggregated together on the wall of a house. Stone-buildings and the calcareous Rhizopod shells take an intermediate position; while the siliceous skeletons of the Radiolaria and the infinitely varied iron structures of everyday life, from the great solidity of the materials, give the greatest room for complication and differentiation, and at the same time for multiplicity of form. It is not only the inherited faculty of the soft body to construct more or less complicated and differentiated skeletal parts that regulates the shell-structure, but, like human architects, the Rhizopoda are also more or less dependent upon their material, and must deal with its peculiarities.

As we have already seen, the concentric growth makes greater demands than the terminal upon the firmness of the material, and it is therefore met with only in the siliceous Radiolarian skeletons, while it does not occur among the Thalamophora. But at the same time the concentric skeletal structure has an advantage of which the terminal is destitute. A system of several nested spherical shells or parts of such shells forms an externally closed rounded whole which presents

the smallest possible surface to external mechanical attacks; it is just otherwise with the products of the terminal growth-process, in which the different chambers are arranged one after the other in the form of a longer or shorter chain. Leaving out of consideration that such a series of chambers of considerable length is very obstructive to locomotion, it is comparatively very frangible, and from the statical or mechanical point of view disadvantageous. The Thalamophora avoid these disadvantages of the terminal growth and combine the advantages of the concentric shell-system with the terminal growth by generally not leaving their series of chambers in an extended state, but rolling them up spirally in the majority of the forms. As a further carrying out of the spiral convolution we must regard the reciprocal embracing of the chambers which occurs in a more or less marked manner in many Thalamophora. This embracing process occurs particularly typically in the Miliolida, and, indeed, we may here recognize a gradual increase from *Cornuspira* and *Spiroloculina*, in which all the whorls lie freely exposed, through *Quinqueloculina*, *Triloculina*, and *Biloculina* to *Uniloculina*. In the last-mentioned genus the process has attained its highest point, for here only the youngest chamber is freely exposed externally, while all the preceding chambers are completely enclosed by it. Here consequently exactly the same final result is attained as in the concentrically formed shell-systems of the Radiolaria, although in a quite different way. If the embracing of the chambers takes place only in one plane, this leads to the so-called cyclical growth, such as occurs in *Orbiculina*, *Orbitolites*, *Cycloclypeus*, and similar forms. There is thus produced within the terminal growth-type an apparently concentric growth, just as a number of discoid Radiolaria appear to grow spirally, that is terminally. These apparent exceptions to the rule above established, that no Rhizopod shell can change its growth-type, always turn out, however, on closer examination to be secondary convergences or analogical structures, although certainly sometimes deceptive*. In the same way that the Thalamophoran shells produced by general embracing may be compared with the concentric sphere-systems of the Radiolaria, the cyclical Thalamophoran shells represent the concentric ring-systems of the Discoid Radiolaria.

In conclusion may be mentioned the extremely interesting and significant fact that, according to the investigations of Naumann and v. Möller, Molluscan and Thalamophoran shells

* See 'Pylombildungen,' pp. 112, 113, and p. 101, note 1.

follow the same laws of circumvolution. From this it follows quite definitely that the spiral convolution which occurs in the same specific manner independently in two quite different groups of organisms having absolutely nothing to do with each other is not founded in the nature of the organisms in question, but has its cause in the circumstance of the external world, and is dependent on statical and mechanical requirements. We have a perfectly analogous case in the statically and mechanically adaptive structure of the "substantia spongiosa" of the bones of Vertebrates; and a series of my own observations make me regard it as very probable that the siliceous rods of a number of spongy Radiolaria are not arranged irregularly, as would appear to be the case at the first glance, but, in part, in accordance with definite laws. The next question which forces itself upon us in considering these results is whether this adaptive structure of animal skeletons has been produced by functional (Roux) or selective (Darwin, Weismann) adaptation. A discussion of the arguments which may be adduced for and against these two possibilities would, however, lead us too far, and pass beyond the bounds of these observations, especially as, without noticing it, we have got upon the question, at present so much in dispute, of the heritability of acquired peculiarities. The primary object of the preceding observations was more particularly to indicate the great fertility of a comparative treatment of the enormous abundance of forms of the Protista. The elegant and manifold hard structures of the Rhizopoda, which here particularly come under consideration, are by no means, as is sometimes supposed, mere *lusus naturæ*, but even they follow definite laws of structure. Only when we have advanced further in the recognition of the latter by means of more detailed investigations will the morphology of the Protista no longer be regarded (as is at present unfortunately often the case) as a mere playground of unscientific species-making, but will take its place as of equal importance by the side of the physiology of the unicellular organisms, which is much more cultivated and developed.

XLI.—*Third Contribution to the List of Birds collected by Mr. C. M. Woodford in the Solomon Archipelago.* By W. R. OGILVIE GRANT.

AMONGST a small collection of birds made at Guadalcanar and Rubiana by Mr. Woodford subsequent to the last collection, which was recorded in the 'Proceedings of the Zoological Society' for 1888 (pp. 185–204), is a very fine Rail, which is apparently quite new to science, and I propose to name it in honour of the collector

Rallina Woodfordi, sp. n.

Whole upper surface, cheeks, and suborbital region very dark brown, washed with rufous, especially on the scapulars, edges of the outer webs of the quills, rump, and tail. Inner webs of the bastard-wing and first two primary-quills with three or four transverse white spots; rest of primaries with one or two small white spots near their base. Postorbital region and under surface dark greyish black, becoming almost quite black towards the under tail-coverts and flanks. Chin and an indistinct stripe down the throat whitish. Under wing-coverts and under surface of bastard-wing and quills blackish, the former barred with white, while the two latter are spotted with the same colour as described above and edged with dull olive-brown. First digit with a well-developed hooked nail $\cdot 3$ of an inch long.

"Bill black; legs grey; iris red. Aola, Guadalcanar. 6. xii. 88."

	inches.
Wing	6·5
Tarsus	2·3
Middle toe (with nail)	2·3
Culmen	1·6
Total length.....	14·0

This species, so far as I can discover, is most nearly allied to *Rallina xaciloptera*, Hartl. (Finsch and Hartlaub, Beitr. z. Fauna Centralpol. p. 156, pl. xii. fig. 1), which was discovered in Fiji, but is easily distinguished by being generally very much darker in the tone of the plumage, and by having the inner webs of the primaries spotted with white instead of rufous, the bill black, and the legs grey.

XLII.—On the Weevil Genus *Centrinus* and its Allies. By FRANCIS P. PASCOE, F.L.S. &c., formerly President of the Entomological Society.

IN Lacordaire's 'Genera des Coléoptères' *—a work without an equal of its kind—*Centrinus* is one of the seven genera of "Centrinides," which, again, form one of the eight subtribes of "Baridiides vrais;" but all these divisions, as well as the genera, are subject to exceptions, so as to be incapable of being rigidly limited. *Centrinus*, as defined by Schönherr †, is elastic enough to include almost any ordinary Curculionid with a slender rostrum; it has for its type *Baris bicuspis*, Germ. In the 'Munich Catalogue' 166 species are enumerated; but probably these are not half the number that exist in collections.

Writing in 1866 Lacordaire defined the genus, but only provisionally, and excluding the species having the claws united at the base; and for these, in a note, he pointed out that at least three genera were required. The characters on which Lacordaire relies in his table of the genera of "Centrinides" are the rostrum longer than the prothorax and the massive rhombic or elliptic body; he admits exceptions in regard to the first, and the second is wanting in precision. Yet, looking to the immense number of forms ‡ differentiated by all sorts of characters, passing into one another without any definite limitation, I doubt if anything more satisfactory can be devised.

The pectoral canal in this group is evidently a survival, for it is never capable, as in all the normal apostasimerous Curculionidæ, of receiving the rostrum, which, owing to its curve, in many cases very considerable, or to the contiguity of the anterior coxæ, is prevented from lying in the canal, which thus becomes either completely obliterated or remains more or less distinct, sometimes continued as far as the mesosternum, but never impinging on it. In some species the canal is replaced by a round cavity, which Lacordaire calls a *cul-de-sac*.

The species are confined to America, the greater number to the tropics. Drs. Leconte and Horn § describe twenty-five

* Tome vii. p. 233.

† 'Curculionidum Dispositio Methodica,' p. 309 (1826).

‡ M. Jekel estimates the number of species of Curculionidæ in collections at 30,000.

§ "The Rhynchophora of America north of Mexico," p. 306 (separate copy), from the 'Proceedings of the American Philosophical Society,' vol. xvi. (1876).

from the United States. According to their description of the genus *Centrinus*, as applicable to those species, the anterior coxæ are "rather widely separated," the femora "unarmed," and the tarsi "with stout divergent claws." They add, "In the males of several species the prosternum [pectus] just in front of the coxæ is armed with a slender process, which varies in length according to the individual, but not according to the species."

The table below is only intended to be suggestive of some of the genera that will be necessary when the group is more extensively examined. For the present it will be best to continue the old name. The majority of the species are unknown to me, and in the identification of those described in Schönherr's great work much is lost by the neglect of the characters afforded by the claws, the comparative length of the funicular joints, and the underpart generally, while the invariable reference to some other species for the size is very trying.

Claws free.

Canal nearly obsolete or absent.

Anterior coxæ separated.

Prosternum lower than the coxæ.

Elytra broader than the pro-
thorax *Centrinus*. *C. bicuspis*, Germ.

Elytra not broader than the pro-
thorax *Geræus*. *C. senilis*, Gyll.

Prosternum on a level with the

coxæ *Salmites*. *C. querulus*, n. sp.

Anterior coxæ approximate *Balbus*. *C. conicollis*, Boh.

Canal distinct.

Scrobes lateral.

Femora toothed *Lydamis*. *C. angulus*, Boh.

Femora mutic.

Canal prolonged between the
anterior coxæ *Rhianus*. *C. mexicanus*, Boh.

Canal not prolonged between
the anterior coxæ *Ortycus*. *C. perdix*, n. sp.

Scrobes oblique, united beneath .. *Dimesus*. *C. geminus*, n. sp.

Scrobes oblique, running beneath
but not united *Optatus*. *C. palmaris*, n. sp.

Claws united at the base.

Canal nearly obsolete or absent.

Pectus with a circumscribed central cavity *Camelodes*. *C. Leachii*, Kirby.

Pectus entire.

Mesosternum raised, more or less

bilobed in front *Diastethus*. *C. tumidus*, Boh.

Mesosternum depressed *Pardisomus*. *C. guttatus*, n. sp.

Canal distinct.

Coxæ approximate.

Corbels of posterior tibiæ cavernous

..... *Telemus*. *C. cestrotus*, Germ.

Corbels of posterior tibiæ open .. *Sympages*. *C. egregius*, n. sp.

Coxæ separated *Orissus*. *C. Meigenii*, Boh.

To the genera above not represented by new species the following characters will apply:—

Centrinus.—Canal obsolete or replaced by a circumscribed cavity; anterior coxæ separated; femora mutic; claws free; elytra broader than the prothorax.

Geraeus.—Canal obsolete; anterior coxæ separated; femora mutic; claws free; elytra not or scarcely broader than the prothorax.

Bulbus.—Canal obsolete; anterior coxæ separate; prosternum on a level with the coxæ; femora mutic; claws free.

Lydamis.—Canal distinct; anterior coxæ approximate; scrobes lateral; femora toothed; claws free.

Rhianus.—Canal distinct, prolonged between the anterior coxæ; femora mutic; claws free.

Camelodes.—Canal replaced by a circumscribed cavity; anterior coxæ separated; mesosternum raised; femora toothed; claws united.

Diastethus.—Canal absent; anterior coxæ separated; mesosternum raised, often emarginate anteriorly; femora toothed; claws united.

Telemus.—Canal distinct; anterior coxæ approximate; mesosternum depressed or sloping towards the prosternum; femora mutic; corbels of the posterior tibiæ cavernous; claws united.

Orissus.—Canal distinct; anterior coxæ separated; mesosternum depressed or sloping; femora toothed; claws united.

In some species of *Centrinus*, *Camelodes*, &c. the males are armed with horizontal spines projecting from the pectus, on each side of where the canal is or should be; but I hesitate to consider this a generic character. *Xenisus* and *Euops*, new genera, are allies.

The following species are believed to be hitherto undescribed.

Centrinus ferinus.

C. ovatus, niger, prothorace elytrisq[ue] basi squamis piliformibus aureis dense tectis; rostro ferrugineo, arcuato, capite cum prothorace multo longiore, basi paulo compresso. Long. 2 lin.

Hab. Parana.

Ovate, black, prothorax and base of the elytra closely covered with golden-yellow piliform scales; rostrum ferruginous, slender, strongly arched, base slightly compressed; scrobes lateral, beginning at about a third from the base; antennæ pale brownish yellow; funicle slender, elongate, first joint as long as the next two together, the last three turbinate; club ovate; prothorax moderately convex, ridged in the middle from the base, the apex with a linear transverse impression; scutellum densely scaled; elytra cordiform, slightly broader at the shoulders than the prothorax, deeply striate, interspaces flat, obscurely punctured; body beneath black, closely covered with silaceous scales; legs pale ferruginous.

Centrinus auricollis.

C. ovatus, niger, prothorace squamis aureis; elytris sutura albosquamosis; rostro ferrugineo, fere longitudine elytrorum, modice arcuato, basi valde compresso. Long. 2 lin.

Hab. Amazon (Santarem).

Ovate, black, prothorax closely covered with dark golden piliform scales, elytra with the suture covered with white scales; rostrum ferruginous, as long as the elytra, moderately curved, more compressed at the base; the scrobes beginning behind the middle; antennæ yellowish ferruginous, slender, funicle and club as in the preceding; prothorax slightly ridged, scutellar lobe somewhat produced; scutellum oblong; elytra scarcely broader at the shoulders than the prothorax, striate, the interspaces indefinitely punctured; body beneath black, covered with silvery white piliform scales. The males have short pectoral horns.

This and the above are not to be distinguished by their technical characters from *Centrinus* proper.

Centrinus querulus.

C. ovalis, glaber, nitide niger; prothorace rufo, fere impunctato; rostro prothorace haud longiore, dimidio basali sulcato; elytris

inæqualiter convexis, anguste striatis, interstitiis fere impunctatis.
Long. $1\frac{1}{4}$ lin.

Hab. Parana.

Oval, smooth, glossy black, head, base of the rostrum, and prothorax chestnut-red; rostrum rather stout, not longer than the prothorax, a well-marked oblique lateral groove on the basal half; scrobes lateral, antemedian; antennæ blackish; funicle short, gradually thicker towards the club, the last joint being closely conjoined to it; eyes small, round; prothorax nearly impunctate, tubulate at the apex, the base bisinuate; scutellum round; elytra scarcely broader than the prothorax, very slightly rounded at the sides, transversely impressed near the base, narrowly striate, the interspaces flat and nearly impunctate; body beneath and legs black; claw-joint as long as the preceding joints together.

Type of *Salmites*. Pectus short, entire; anterior coxæ (widely) apart; prosternum on a level with its coxæ; mesosternum depressed; first abdominal suture nearly obsolete; femora mutic; claws free.

Centrinus perdis.

C. late ovatus, squamulis silaceis maculatim indutus; antennis rufo-ferrugineis; tibiis anticis rectis; tarsis articulo ultimo elongato.
Long. $1\frac{2}{3}$ lin.

Hab. Parana.

Broadly ovate, black, irregularly spotted with approximate silaceous narrow scales; rostrum rather longer than the head and prothorax together, compressed at the base; scrobes lateral, beginning in the middle; antennæ reddish brown; funicle short, first two joints of equal length, the last four transverse; club shortly ovate; prothorax transverse, moderately convex, in the middle a short raised line, at the sides minute oblique grooves; scutellum bilobed at the apex; elytra cordiform, broader at the base than the prothorax, deeply striate, the interspaces sharply raised; body beneath black, with scattered silvery-white hairs; femora stout, mutic; anterior tibiæ straight, the intermediate and posterior curved at the base; tarsi slender, except the third joint, claw-joint as long as the rest together; claws free.

Type of *Ortycus*. Pectus canaliculate; anterior coxæ widely apart; mesosternum depressed; first abdominal suture distinct; femora mutic; claws free.

Centrinus geminus.

C. subovatus, glaber, niger, nitidus; elytris singulatim macula

fulvo-squamosa in medio ornatis; antennis ferrugineis; scapo brevi; prothorace apice tubulato. Long. $2\frac{1}{2}$ lin.

Hab. Parana.

Subovate, smooth, shining black, in the middle of each elytron a round patch of fulvous scales; rostrum longer than the head and prothorax together, compressed at the base, strongly curved; scrobes beginning behind the middle, oblique, meeting beneath; antennæ ferruginous; scape not nearly reaching the eye; funicle with the first joint as long as the next four together, the last two closely applied to the club; prothorax slightly transverse, convex above, tubular at the apex, finely and sparingly punctured; scutellum subquadrate, expanded at the base; elytra subtriangular, shoulders not prominent, the base not much broader than the prothorax, finely striated, the interspaces flat and nearly impunctate; body beneath black, smooth, irregularly punctured; legs dark brown, with here and there a minute whitish setiform scale; tibiæ straight; tarsi narrow, except the penultimate joint; claw-joint elongate.

Type of *Dimesus*. Scrobes oblique, meeting beneath the rostrum; pectus elongate, canaliculate; anterior coxæ apart; femora mutic; claws free; two basal segments of the abdomen large, the suture obsolete. Differs from *Rhianus* (*Centrinus mexicanus*) in its shortly ovate facies and obsolete suture. The latter is a semiglobose form like *C. tardigradus*. *Rhianus* has the well-developed suture and semiglobose form.

Centrinus palmaris.

C. breviter ovalis, niger, prothorace utrinque apiceque ad latera miniato-squamoso; elytris triangularibus, striatis, interstitiis transversim undulatis; tarsis anticis dilatatis, fimbriatis. Long. 4 lin.

Hab. Mexico.

Shortly ovate, black, opaque, thinly covered with minute, ovate, whitish scales, the prothorax with a stripe of yellowish-red piliform scales on each side continued downwards at the apex; rostrum much longer than the prothorax, slightly curved, compressed at the base; scrobes nearly median, oblique; antennæ black; funicle elongate, first two joints longest, the third and fourth gradually shorter, the last three turbinate; club elliptic-oval; prothorax moderately convex, the base broad and strongly bisinuate, the middle lobe truncate, a raised median line not extending to the base, and obliquely grooved on the sides; scutellum very short and very broad, glossy black; elytra at the base broader than the

prothorax, cordiform, rather slightly convex, deflexed at the sides, narrowly striate, interspaces broad, flattish, crossed by minute, waved, raised lines, between them whitish piliform scales; body beneath black, shining; mesosternum, epimera, and sides of the abdomen covered with yellowish-red piliform scales; fore legs much longer than the others, their tarsi dilated and fringed with long blackish hairs.

Type of *Optatus*. Pectoral canal distinct; anterior coxæ contiguous; mesosternum raised, nearly vertical in front; first abdominal suture distinct; scrobes oblique, the posterior half passing beneath the rostrum, but not united to its fellow; femora toothed; claws free, but approximate.

Centrinus cupreus.

C. rhombicus, nitide cupreus, glaber, prothorace modice convexo, obsolete punctato; elytris leviter striato-punctatis; corpore infra valde nitido, maculis quatuor aureo-squamosis decorato. Long. $3\frac{1}{2}$ lin.

Hab. Parana.

Rhombic, glossy copper-coloured; rostrum slender, moderately curved, finely and remotely punctured; scrobes postmedian; antennæ ferruginous; scape rather short; funicle twice as long as the scape, first two joints equal in length; club short, subpyriform; prothorax slightly convex above, obliquely punctured, except at the apex, the base bisinuate, scutellar lobe moderately broad; scutellum transverse, the apex mucronate; elytra broader than the prothorax at the base, shoulders rounded, finely striate-punctate, interspaces impunctate, near the apex on each elytron a shortly elevated callus; body beneath glossy brown, with a large dense patch of rich golden-yellow scales on each side of the metasternum and another on the pectus, the metasternum with minute but distinct scattered punctures; legs rather stout, tibiæ short, sulcate; second joint of the tarsi as broad as the third.

This species is nearly allied to *C. lucens* and *C. cupratus*, but these have the body beneath entirely glabrous, and have more of a golden tint; the former has the second joint of the funicle half as long again as the first, the anterior coxæ more approximate, a coarser and closer punctuation on the metasternum, &c. They belong to the *Diastethus* division, which has for its type *C. tumidus*, Boh.

Centrinus guttatus.

C. ovatus, niger, albo-guttatus, capite prothoraceque antico aureo-squamosis; pedibus ferrugineis, squamis oblongis separatim in-

dutis; rostro modice arcuato, antennisque fulvo-ferrugineis. Long. 3 lin.

Hab. Nauta.

Ovate, black, with distinct round white spots; head and apex of the prothorax covered with golden-yellow scales; rostrum longer than the prothorax, slightly curved, yellowish ferruginous, the basal half with five well-marked raised lines; scrobes oblique, beginning considerably beyond the middle of the rostrum; antennæ pale ferruginous; funicle elongate, the second joint longer than the first; club shortly ovate; prothorax transverse, rounded at the sides, convex, and with five spots (three basal) above; scutellum broadly transverse; elytra broader than the prothorax at the base, gradually narrowed at the sides, finely striate, interspaces minutely granulate, the side from the shoulder with two and the posterior third with several elevated lines, on each elytron five larger and a few smaller spots; body beneath chestnut-brown, the sterna and sides of the abdominal segments covered with whitish scales; legs pale yellowish brown, with narrow approximate whitish scales; tibiæ grooved, inner margin ciliated; tarsi broad, fringed with blackish hairs.

Type of *Pardisomus*. Scrobes oblique, the distal half passing beneath the rostrum; pectus short, entire; anterior coxæ approximate; mesosternum declivous; femora toothed; claws united at the base; first abdominal suture distinct.

Centrinus egregius.

C. breviter ovatus, niger, prothorace in medio nigro, carinato, macula magna læte sanguinea ornato; elytris carinulatis. Long. 1½ lin.

Hab. Pará.

Shortly ovate, black, somewhat opaque, the prothorax with a large bright spot of blood-red scales on each side; rostrum not longer than the prothorax; scrobes beginning at about the middle; antennæ yellowish brown; funicle rather short, first joint longest; club broadly ovate; prothorax convex, a glossy raised line from the apex to the base, closely punctured on each side; scutellum subquadrate, smooth; elytra cordiform, striate, the interspaces punctured and raised more or less sharply, especially towards the apex, where there is also a sprinkling of greyish scales; body beneath black, strongly punctured; legs black, with scattered white narrow scales; tibiæ slightly curved; tarsi with the two basal joints narrow, claw-joint not half so long as the rest together.

Type of *Sympages*. Pectus very short, canal distinct;

anterior coxæ approximate; mesosternum depressed; first abdominal suture distinct; femora toothed; claws united.

Of the two genera described below, *Enops* is perhaps somewhat doubtful as an ally of *Centrinus*.

XENISUS.

Rostrum longissimum, filiforme, arcuatum; scrobes laterales; antennæ tenues, clava elongata, cylindrica; prothoracis basi vix bisinuata; elytra triangularia: pectus ampliatus, haud canaliculatus; mesosternum latum, elevatum, antice verticale; abdomen segmentis duobus basalibus valde ampliatis, conjunctis: coxæ anticæ separatae; femora mutica; unguiculi liberi.

The cylindrical club differentiates *Centrinus* from *Cylindrocerus*, from which it was at first separated by Schönherr as a subgenus; the character, however, is confined to the males, and is present in the genus before us, whose remarkably slender rostrum throughout is almost unique among the Curculionidæ.

Xenismus curvirostris.

X. subellipticus, glaber, niger, nitidus; prothorace castaneo; elytris in medio flavis; rostro corpore longiore, valde arcuato; antennis piceis, articulis 2^o–7^m apice setosis. Long. $3\frac{1}{4}$ lin.

Hab. Columbia.

Subelliptic, smooth, glossy; prothorax chestnut-brown; elytra flavous in the middle; rostrum longer than the body, the curve semicircular; scrobes lateral, beginning at one third from the base; antennæ black, slender; funicle elongate, the first joint as long as the club, the second to the seventh with setiform hairs at the apex; prothorax transverse, constricted at the apex, the base slightly bisinuate, nearly impunctate; scutellum subquadrate; elytra subtriangular, as broad as the prothorax at the base, the shoulders generally rounded, striate-punctate, punctures oblong, approximate, interspaces very convex, a broad fulvous band across the middle, nearly extending to the apex; body beneath glossy black, metasternum at the sides covered with golden-yellow scales; legs glossy; femora subelavate, mutic; tibiæ straight; tarsi with the third joint broadly bilobed; claws free.

ENOPS.

Rostrum elongatum, basi vix incrassatum, arcuatum, apice paulo latius; scrobes laterales; antennæ tenues, clava ovata; prothorax transversus, ad latera in medio dilatatus, basi bisinuatus; elytra late triangularia; pectus breve, profunde canaliculatum;

coxæ anticæ basi contiguous; mesosternum depressum, leviter excavatum; sutura prima abdominis distincta; femora dentata; unguiculi bifidi.

A very distinct genus, well differentiated from all the forms of *Centrinus* by the dilated sides of the prothorax, and bifid claws. The anterior coxæ diverge so as to form a continuation of the pectoral canal.

Enops interruptus.

E. breviusculus, rufo-brunneus, sat dense griseo-pubescent; antennis concoloribus; funiculo articulis duobus basalibus elongatis; prothorace fere impunctato; elytris interrupte carinatis, interstitiis biserialim punctatis. Long. 3 lin.

Hab. Parana.

Rather short, yellowish brown, thinly covered with a greyish pubescence; rostrum nearly as long as the elytra, moderately curved, the basal half with somewhat indefinite raised lines, the apex dilated; scrobes lateral, beginning rather beyond the middle; funicle elongate, the first two joints as long as the rest together, club oblong ovate; prothorax slightly transverse, the base with a raised line, the dilated part forming a spinous angle anteriorly; scutellum smooth, round; elytra triangular, convex, nearly twice as broad as the prothorax at the base, the shoulders obliquely truncate, each elytron with three interrupted raised lines, the outermost abbreviated, a fourth marking the abruptly vertical side, interspaces with two rows of large punctures; body beneath pitchy, covered with a greyish pubescence; legs somewhat slender; femora subclavate, armed with a small tooth.

MISCELLANEOUS.

On the Proper Generic Name of the Tunny and Albicore.

By THEODORE GILL.

IN 1817, in the first edition of the 'Règne Animal,' Cuvier proposed two subgenera of *Scomber*, which he employed, however, in a generic sense: one, *Thynnus*, was based upon the common tunny (with which were associated other and smaller species), having moderate pectoral fins; and the other, *Orcynus*, was based upon the *Alalunga* of the Mediterranean and characterized by the long pectoral fins. Subsequently by many ichthyologists these two genera were combined into one under the name of *Thynnus*. In 1861 the

present writer replaced the name *Thynnus* by the term *Oryzenus*, which was substituted, inasmuch as *Thynnus* was used for a genus of Hymenopterous insects by Fabricius in 1775. This name *Oryzenus* was simply due to a misreading of the name *Orcynus*, and was subsequently replaced by *Orcynus* in its correct form. Nevertheless in 1863 Dr. J. G. Cooper, in the 'Proceedings of the California Academy of Natural Sciences' (vol. iii. p. 77), proposed to revert to the old groups of Cuvier in the following terms, describing a supposed new species related to the Alalunga of the Mediterranean, which he called *Orcynus pacificus*:—

"This species is one of several confounded by sailors under the Spanish names of Albicore and Bonito. The English name Tunny is applied to an allied species on the coast of Europe, the *Thynnus vulgaris*, Cuv., and to its near representative, the *T. secundi-dorsalis*, Storer, of the eastern American coast. These, however, are evidently of a different genus, and, as *Thynnus* is preoccupied in insects, the name *Oryzenus*, applied by Gill to the same type, may perhaps be retained, although founded on a mistake."

Without reference to the reality of what was so evident to Dr. Cooper, we need only recall that here the name *Oryzenus* was specifically proposed to be retained at the same time that *Orcynus* was used for a related genus.

In 1888 Professor Jordan, in the 'Proceedings of the Academy of Natural Sciences of Philadelphia' (reprinted in the 'Annals and Magazine of Natural History' for 1888, ii. p. 356), apparently overlooking this specific application of the name *Oryzenus* by Cooper, proposed the new name *Albacora* for the same genus, inasmuch as *Orcynus* had been used in 1815 for a genus of Carangids by Rafinesque, while *Thynnus* of Cuvier, as is well known, had been preoccupied for a genus of Hymenopterous insects.

The present author would have been glad if the name *Oryzenus* could have fallen into "innocuous desuetude;" but inasmuch as it had been specifically and with *malice prepense* resurrected and proposed for retention by Cooper, it must surely be retained for the genus comprising the Tunny and Albicore. It belongs to a category of which there are many illustrations, being an anagram of another name, and numerous such have been proposed deliberately and generally adopted, such as *Panulirus* and *Linuparus*, anagrams of *Pulchellus*, and various others.

If it is represented that the word *Oryzenus* is merely due to a slip of the pen or typographical error, and therefore should not be retained, we can, in reply, refer for an analogous retention of an incorrect form to no less an authority than Professor Jordan. In the fifth edition of his excellent work 'A Manual of the Vertebrate Animals of the Northern United States,' published a couple of months ago (1888, p. 92), we find the word *Athlennes*, which was originally proposed in 1886 as a designation for the *Belone hians* of Cuvier and Valenciennes. As we suspected at the time of publication, this name is really derived from an ancient Greek synonym of the common *Belone belone* of Europe, "ἀβλεννης, without mucosity."

Nevertheless in a footnote to the 'Manual' we are informed that "this name was inadvertently printed '*Athlenes*,' and may remain so; '*Ablennes*' was intended." Surely then, in strict analogy with such usage, the name *Orycnus* can be retained as the generic designation of the Tunny.—*Proc. U. S. Nat. Mus.* 1888, p. 319.

On Polyodontes maxillosus. By M. REMY SAINT-LOUP.

The author remarks that large Annelides are rare in the Gulf of Marseilles, but notices the occurrence of a *Eunice* (*E. Rousseaui*) about 1 metre in length. Recently a gigantic Aphroditacean has been captured, which he identifies with the *Polyodontes maxillosus* of Audouin and M.-Edwards and of Claparède, a species which is probably identical with *Phyllodoce maxillosa*, Ranzani, and with *Eumolpe maxima*, Oken. The specimen measured 2 metres in length, but it was broken during capture, and only the anterior portion, about 0.30 m. long, was preserved. The animal was caught by means of one of the deep-sea lines which the fishermen call *palangrottes*, the hook being baited with the abdomen of a large hermit-crab, which is interesting as indicating the diet and the voracity of the Annelide. It was taken at a depth of 50 metres.

The body near the head is 20 millim. in diameter, slightly thinner further back. The segments are red-brown above, marked off by narrow streaks of bright green. The ventral surface is rosy yellow and the proboscis salmon-coloured. In the region near the cephalic lobe the elytra completely cover the dorsal surface, which is free and naked in the rest of the fragment. The elytra are inserted upon feet which alternate with others having only a dorsal cirrus. In this the author agrees with Claparède, but not with Delle Chiaje's figure. The proboscis, which is not described by Claparède and not very well figured by Delle Chiaje, is extensible to a length of 0.03 m., and then presents a diameter somewhat greater than that of the body. In front it bears four denticulate jaws, each terminated by a larger tooth or claw, 4 millim. in length. When the aperture is enlarged for the purpose of biting the organ presents the aspect of a viper's head; its infero-superior diameter is then about 0.02 m. When closed its greatest diameter is transverse and reaches 15 millim. A small living Dorado presented to the *Polyodontes* was seized by it, held for a few seconds, and then released; but it soon died, and the author could not decide whether this was caused mechanically or by a venomous action of the bite. The cephalic lobe bears the eyes on two peduncles which are united and soldered together; their projection is sufficient to enable the *Polyodontes* to see in front of it even when the proboscis is protruded. The delicate fringes of the extremity of the proboscis bear ultramarine-blue granules, which are phosphorescent at night.—*Comptes Rendus*, September 2, 1889, p. 512.

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XLIII.—*On two new British Species of Sponges, with short notices of an Origerous Specimen of Hymeniacion Dujardinii, Bowk., and of a Fossil Toxite.* By ROBERT HOPE.

[Plate XVI.]

OF the two sponges which are treated of in the following pages one is believed to be new to science, the other, a species of *Microciona*, has been already shortly described by Mr. H. J. Carter, F.R.S. (Ann. & Mag. Nat. Hist. (4) xiv. pp. 456 and 457), as a form of *Microciona armata*, Bowk.*; but, as Mr. Carter did not specifically distinguish it, and only figured the toxite in embryo, it seems desirable now to redescribe it somewhat more fully, with illustrations of the spiculation, from a fresh specimen which I have been so fortunate as to obtain.

The specimen referred to was taken about the middle of March of the present year (1889) from a heap of scallops fresh landed on the beach at Hastings. They were said by a fisherman to have been dredged in about 25 fathoms off Beachy Head; however that may be, it is certain that they came from the English Channel at no very great distance from Hastings.

This sponge has the spiculation and skeletal arrangement

* Cf. Mr. Carter's note, Ann. & Mag. Nat. Hist. (6) iv. pp. 249 and 250.

of Bowerbank's genus *Microciona*, taken in a strict sense, that is to say, of that section of the genus which agrees with the type, *M. atrosanguinea*, in the possession of monactinal megasclera of three kinds, with "navicular" isochelæ and toxites as microsclera. It is in this stricter sense alone that the generic term *Microciona* is used throughout this paper. In all other respects the classification followed is that of Messrs. Ridley and Dendy, to whose diagnoses of the genera &c. in their Report on the 'Challenger' Monaxonida I refer.

I propose for this sponge the specific name of *strepsitoxa* (Gr. στρέφω, I twist), from a peculiarity of the toxa referred to below.

Microciona strepsitoxa, n. sp.

The sponge coats about four square inches of the flat valve of a scallop-shell (*Pecten*, sp.), attaining in the furrows of the shell a maximum thickness of about 1 millim. Its colour, when fresh, was scarlet, but in spirit it rapidly and completely faded to a dead white. Surface, when fresh, smooth; in the dry state hispid, from the projecting ends of the spicular brushes of the skeleton. The oscula are numerous and run deep into the sponge; the pores small and generally distributed over the surface.

The skeletal columns, as usual in the genus, rise vertically from the base to the surface; they are slender at the base and rarely branched, and they end in thick brushes of spicules which, spreading out obliquely in contact with each other, are traversed horizontally by sheaves of long slender styles imbedded in the sponge-substance. As usual also in *Microciona*, the main skeletal spicules increase in length towards the surface of the sponge, the shortest, as a rule, forming the base of the columns.

Spiculation.—*Megasclera*, three:—

1. Styles, sometimes straight, but generally slightly curved, constricted about one diameter above the base, sometimes smooth, but usually basally spined or tuberculated. They vary greatly in length, ranging from .480 to .636 millim., with a few much shorter; breadth .0105 to .012 millim. (figs. A, 1 and 2).

2. Straight or slightly curved, tapering, entirely spined styles and tylostyles, varying in length from about .1 to .2 millim.; average breadth about .006 millim. (fig. A, 3).

3. Long, smooth, slender, subclavate styles, from about .25 to .31 millim. long by about .004 millim. broad. With a high power the heads frequently appear slightly roughened (fig. A, 4).

Microsclera, two :—

1. Toxa, very slender, with a short, abrupt, spiral curve in the middle, the extremities long and straight. The tips are generally smooth and very sharp, but in some cases a few very minute spines may be detected on the spicule generally. These spicules range from $\cdot 250$ up to $\cdot 412$ millim. in length, the majority measuring between $\cdot 3$ and $\cdot 4$ millim., by an average breadth of only $\cdot 0015$ to $\cdot 002$ millim. (figs. A, 5 and 6).

There are also a few much smaller toxa, among which are some in which the central curve is comparatively large and the long straight ends absent (fig. A, 7). These last spicules are as stout as the longest; their tips are generally microspined. Two measured were respectively $\cdot 091$ and $\cdot 143$ millim. long.

2. Isochelæ, of the usual navicular type, minute, $\cdot 017$ to $\cdot 019$ millim. long (figs. A, 9 and 10).

The columns are composed of the larger kind of styles, No. 1, and are sparsely echinated by the entirely spined spicules, No. 2. The slender subclavate styles, No. 3, lie imbedded in the substance of the sponge, as above stated, generally parallel with and near to the surface. The chelæ and toxites are distributed throughout the sponge-substance, and do not lie in any particular direction as regards the columns or the surface.

The megasclera of this sponge agree very closely in character with those of the other species of *Microciona* proper, and the chela is of the well-known shape which is characteristic of a very considerable number of species in that and other genera; the toxite, on the contrary, is of a peculiar and striking form, which seems to call for a few remarks.

In the other species of the genus, and, so far as I have been able to ascertain, in all the species (with one exception) of similar spiculation in other genera, the toxa lie flat in one plane from end to end; here and there perhaps one may be found with a barely perceptible twist; but in this sponge I have not been able to find one which can be focussed under a $\frac{1}{4}$ -inch objective from end to end at the same time. In the long straight-armed form the twist is nearly confined to the central sinus, and the conformation of this spicule may be roughly imitated by laying a straight piece of wire along a lead pencil and taking one turn round the middle; if then the pencil be drawn out and the wire turned on its axis, it will be found to present in different positions as regards the eye the appearances shown in the figures of the toxites (figs. A, 5 and 6). The wire model would differ from the actual form of

the spicules in one particular, namely, that in the latter the turn of the spiral is usually more or less compressed laterally; that is, the imitation would be closer, if we suppose the pencil to have an elliptical instead of a circular section and the wire to be laid along one of the thinner ends of the ellipse at right angles to the long diameter.

The central twist of these toxa is admirably shown in a photograph from one of my preparations of the sponge, for which I am indebted to the kindness and skill of my friend Mr. J. Howard Mummery, F.R.M.S., and of which the figure A, 8 is a copy.

The smaller toxa (fig. A, 7) do not show this central twist, but neither do they lie in one plane, one turn of a very slack spiral apparently being completed in the whole length, or nearly so, of the spicule.

The only other sponge which, so far as I know, possesses this (that is, the long-armed) form of toxite is *Amphilectus foliatus* (Vosmaer), Bowk. (= *Halichondria foliata*, Bowk., Mon. Brit. Spong. iii. p. 198, pl. lxxiii. figs. 1-5, and iv. p. 106; and Carter, Ann. & Mag. Nat. Hist. (4) 1876, xviii. p. 310, pl. xiii. fig. 10, and pl. xv. figs. 29 a, b). *Halichondria mutulus*, Bowk. (Mon. Brit. Spong. iii. p. 209, pl. lxxiv. figs. 4-8, and iv. p. 96), in which this toxite is also found, has the same spiculation as *A. foliatus*; and examination of the type preparations (there is no type specimen of *H. mutulus*) in the British Museum leads me to conclude that, if not the same sponge, which I think they are, the two forms must be considered merely as varieties of the same species.

Through the kindness of Mr. Carter in lending me his preparation of *A. foliatus* from the N.W. coast of Shetland (*op. et loc. cit.*) I have been enabled to examine its spiculation and compare it deliberately with that of *M. strepsitoxa*. The toxites of the former are a little longer on the average and convey an impression of more luxuriant growth—that is, they are frequently flexuous, and the central twist is often sharper and not seldom even reversed, so as to form a loop, as described by Dr. Bowerbank (*op. cit.* iii. pp. 200 and 211) and figured by Mr. Carter (*l. c.* pl. xii. fig. 10 b); the spiral also is often more compressed laterally, and in some few cases it is doubtful if it is present at all. With these slight modifications the spicule is *identical* in the two species.

In his description of *Halichondria foliata* (Ann. & Mag. Nat. Hist. *l. c.*) Mr. Carter mentions that the tricurvate of that sponge was also found in *Microciona armata*, as he knew from a specimen taken at Budleigh Salterton; it is clear that

the specimen there alluded to was that which was described and conjecturally referred to *M. armata* by Mr. Carter in 1874 (Ann. & Mag. Nat. Hist. (4) xiv. p. 457). This statement thus concurs with Mr. Carter's figure (*l. c.* pl. xxi. fig. 27) in fixing the shape of the toxite, and, together with the practical coincidence of the spicular measurements, clearly identifies the sponge described in 1874 with *Microciona strepsitoxa*.

The occurrence of so marked and striking a spicular form in these two sponges cannot but arrest the attention. Its connexion with other forms of toxæ seems plain, and it is easy to imagine how it may pass into them; indeed the smaller form of toxite in *M. strepsitoxa* (which I have not observed in *A. foliatus*) appears to be an intermediate form between it and the spined toxæ, which are of frequent occurrence in sponges of similar spiculation; yet the long-armed form is sufficiently distinct to make it highly improbable that the two sponges which contain it should be otherwise than closely related to one another, more closely, perhaps, than is either to any other known sponge. At present these two sponges find themselves not only in different genera but in different subfamilies; the skeletal structure of *A. foliatus*, however, but for the absence in it of the spined echinating spicule, agrees most closely with that of some forms of *Clathria* (e. g. *C. compressa*, O. S., Sp. des A. M. Taf. vi. fig. 1), and no doubt *A. foliatus* would find its most natural place in that Ectyonine genus, the presence or absence of the echinating spined style being apparently in this case also, as it is stated by Messrs. Ridley and Dendy to be in the genus *Myxilla* ('Challenger' Monaxonida, p. 129), of comparatively little importance.

The intimate interconnexion which exists between the genera *Clathria*, *Microciona*, and *Rhaphidophylus* is obvious from the remarkable correspondence of their spiculation, independently of the points of resemblance in their skeletal structure. It is perhaps a question of appreciation and convenience (*cf.* 'Challenger' Monaxonida, p. 151) whether their generic separation should be maintained; to unite them, if permissible on other grounds, would be to get rid of some of the difficulties which beset this group of sponges, and the consolidated genus would form a nucleus, around which it may be that other sponges of not very different spiculation would be found to group themselves naturally.

Returning to the peculiar toxite of *M. strepsitoxa*, I have to mention the interesting fact that Mr. Carter has quite lately found at Budleigh Salterton a piece of chert from the Upper

Greensand containing spicules which appear to be identical in shape with the toxa of our sponge, but of much larger size. By Mr. Carter's kindness I am afforded the opportunity of inspecting this specimen.

The spicules in question are five in number and appear as opaque white bodies in the semitransparent matrix; in no case does the full length of both arms appear to be preserved, and the ends are by no means sharply defined, but apparently fade away into the stone in consequence of the disappearance of the white matter which renders them visible. One of these spicules measures about 1·6 millim. in length from the centre of the sinus to the end of one arm; assuming that it possessed another arm of equal dimensions, of which now but a portion is visible, the total length would reach 3·2 millim., or about eight times that of the toxa of *M. strepsitoxa*. The arms are straight and horizontal and the central sinus abrupt and semicircular in shape; the conditions of preservation are not sufficiently good for smaller details to be clearly seen. The other spicules preserved in the stone, which are numerous, are mostly Tetractinellid in character.

It is proposed to deposit a portion of the specimen of *Microciona strepsitoxa* above described, together with microscopical preparations of it, in the Natural-History Department of the British Museum.

The other sponge to be described I received from Mr. H. J. Carter. I regret much that Mr. Carter is unwilling to describe it himself, and it is only because he positively refuses to do so that with much diffidence I undertake the task at his request. In this undertaking I have the great benefit of Mr. Carter's advice and assistance; but he is not responsible, except when it is expressly so stated, for any views which may be put forward.

I refer this sponge very doubtfully to the genus *Trachytedania*, Ridley*; it will be most convenient to describe it first and discuss afterwards the points in which, as it seems to me, it agrees with, and those in which it differs from, the characteristics of this genus.

Trachytedania (?) *echinata*, n. sp.

The specimens sent me are three, all in the dry state, viz. one, the largest, in a cup-shaped hollow of a piece of red sandstone rock, measuring 23 × 18 millim.; another, smaller, also

* Proc. Zool. Soc. 1881, p. 122, and 'Challenger' Monaxonida, p. 57.

on the same rock; and the third on the valves of a small bivalve shell.

Mr. Carter writes:—"I found this sponge first beside a patch of *Microciona spinarcus* on a clay boulder which had fallen from the New Red Sandstone cliff" [at Budleigh Salterton] "into the landwash close to low-water mark, and afterwards on a mass of small *Pecten*-like shells drawn up about ten miles off Budleigh Salterton by a fishing-hook. When fresh it presents the appearance of a thin, sooty-black, shiny layer, extending irregularly in leprous-like patches, almost as thin as silver paper, on the surface of clay boulders; becoming brown-black when dry and assuming the form of a thin cuticle with glistening surface irregularly papillated and pierced by the pointed ends of spicules; vents very small, scattered over the surface here and there."

The pores now visible are few, minute and generally scattered; on the specimen on the shell one or two areas of small extent are observable in which the surface is reticulated; whether the intervals of the rete are occupied by pores or not I cannot determine.

In the dry state the ectosome is tough, comparatively thick, and very dark coloured.

The *skeleton* consists of branched columns of slightly curved styles rising vertically from the base to the surface. At their origin these columns are formed of compact bundles of spicules pointing straight upwards and entirely imbedded in fibre; very shortly the points of the spicules begin to protrude at a small angle, and the columns are echinated besides by smaller entirely spined styles (hence the proposed specific name); finally the columns terminate by the main spicules spreading out in somewhat scanty brushes, which support and partly penetrate the ectosome. In the branches the spicules spread out in flattish somewhat fan-shaped brushes. The ectosome contains large numbers of smooth tylota lying in horizontal bundles parallel to the surface; these last also occur at the base of the sponge and sparingly throughout the choanosome in the intervals of the columns.

Spiculation.—*Megasclera*, three, viz. :—

1. Styles curved, chiefly towards the larger end, spined at the base and, more slightly, for about halfway up the spicule; average measurements about $\cdot 26 \times \cdot 009$ millim. (fig. B, 1).

2. Smaller, entirely spined, straight styles, tapering from base to point; average measurements $\cdot 097 \times \cdot 009$ millim. (fig. B, 2).

3. Smooth straight tylota, rounded and slightly inflated

at each end; measuring on the average about $\cdot 188 \times \cdot 005$ millim. (fig. B, 3).

Microsclera (?).—There are present in places, chiefly near the surface of the sponge, a few long and exceedingly fine styles, sometimes microspined at the base. They are very few and appear to be local in their distribution in the sponge and wanting altogether in many parts of it; probably they are to be looked upon rather as varieties or immature forms of the megasclera.

From what has been stated it will be seen that this sponge agrees with the species of the genus *Trachytodania* in the possession of a skeleton composed mainly of spined styles and smooth tylota; that genus also already comprises as one of its two species a thin incrusting sponge, *T. spinata* (P. Z. S. 1881, p. 122), with a skeletal structure of the kind which is frequently present, with some comparatively slight modifications, in sponges of that habit, and closely similar to that of the sponge under consideration. There is, however, no echinating spicule in *T. spinata*, and it is by the possession of a special spicule of this nature, the straight, entirely spined styles, that *T. (?) echinata* differs most markedly from the other two species of the genus.

In some groups of the family Desmacidonidæ, R. & D., this seems to be a feature of minor importance (see 'Challenger' Monaxonida, p. 129, and *suprà*, p. 337); whether it is so also in this case, the data afforded by so small a series of forms appear to me insufficient to base a decision on them. The absence of trichites would present another point of divergence from the diagnosis of the family Tedaniinæ, R. & D. ('Challenger' Monaxonida, p. 50), if the few long and fine spicules which are present here be, as seems most likely, merely modifications of the megasclera; this difference, however, seems of less importance, as the same doubt as to the nature of the "rhopides" in the closely allied genus *Tedania* is expressed by Messrs. Ridley and Dendy ('Challenger' Monaxonida, p. 56); the oxcote spicules, smooth or microspined, which are present in some of the species of *Tedania* and which are noted in Dr. Gray's original diagnosis (P. Z. S. 1867, p. 520), are absent both in this sponge and in the other species of *Trachytodania*, the fine spicules in the latter, whatever their nature, being respectively stylote (P. Z. S. 1881, *l. c.*) and "oxcote slightly thicker at one end than the other" ('Challenger' Monaxonida, p. 57). It may be remarked that what may perhaps be homologous spicules abound in some species of the Clavulinæ (e. g. *Suberites*

(*Halichondria*) *farinaria*, Bowk., *Cliona celata*, Hancock) and are also to be found, though sparingly, in *Iophon* and *Myxilla*.

On the whole it seems best, notwithstanding these discrepancies, to refer this sponge provisionally to *Trachytodania*; the only alternatives, apparently, would be either to create a new genus for its reception or to consider it an abnormal form of *Myxilla* or *Iophon*: there is not, I think, sufficient warrant for the first course, and for the last it would be necessary to assume the loss of two forms of microsclera.

Mr. Carter has pointed out to me the general resemblance of this sponge to, and the partial correspondence of its spiculation with that of, *Hymeniacidon Dujardini*, Bowk., which latter he is disposed to identify with *Myxilla*? *rubiginosa*, O. S. (Sp. des Adriat. Meer. p. 72), of which again *M. olivacea*, O. S. (*op. cit.* pp. 11 and 83) is in all probability only another name. In specimens of *Hym. Dujardini*, Bowk., from the English Channel, the long cylindrical spicules are exceedingly numerous, while the only other kind of spicule, the spined style, is rare. That the latter nevertheless represents the main skeletal spicules and the former those of the dermal skeleton seems probable from their respective positions in the sponge-substance, as well as from their forms. This view seems to receive confirmation from a preparation of a sponge of this species which Mr. Carter has kindly lent me, labelled "*Hymeniacidon Dujardini*, Bk., ovigerous, Vigo Bay." It contains dark yellow circular bodies, which Mr. Carter informs me are embryos, still in the substance of the sponge. The embryos contain numerous spicules, but of one form only, namely, entirely spined styles similar in character to those of the sponge, but not above one quarter of their length and breadth. In the rest of the sponge the tylota are as numerous and the styles as rare as in the British specimens above mentioned. The fact seems worth recording; I do not know whether the inference may be drawn from it that the styles are the oldest, and therefore the main skeletal spicules of *Hymeniacidon Dujardini*, which it is in process of losing altogether. If so, it would be a degenerate form, the nearest affinities of which would, I suppose, be difficult to determine. Prof. Oscar Schmidt apparently places his *Myxilla rubiginosa* in the neighbourhood of *Tedania* and between that genus and the Desmacidinae (Atlant. Sp.-Fauna, p. 44)—that is, in very much the same position as appears to be occupied by *Trachytodania*? *echinata*.

The foregoing pages testify *passim* to the obligations I am under to Mr. H. J. Carter, F.R.S., for the liberal loan of speci-

mens and preparations and valuable assistance and advice; my thanks are also due to Dr. Albert Günther, F.R.S., for kind permission to refer to the British Museum Collection, as well as to Mr. R. Kirkpatrick, in charge of the sponges therein, for ready and effectual assistance in doing so.

EXPLANATION OF PLATE XVI.

A. *Microciona strepsitoxa*.

Figs. 1 & 2. Main skeletal spicules.

Fig. 3. Echinating spicule.

Fig. 4. Subclavate style.

Figs. 5 & 6. Long toxites.

Fig. 7. Smaller form of toxite.

Fig. 8. Long toxites; from a photograph, to show central twist.

Figs. 9 & 10. Isochelæ, front and side views.

[*Figs. 1-7* magnified 260 diameters; *figs. 9 & 10* magnified 850 diameters.]

B. *Trachytedania* (?) *echinata*.

Fig. 1. Main skeletal spicule.

Fig. 2. Echinating spicule.

Fig. 3. Tylote spicule.

[*Figs. 1-3* magnified 260 diameters.]

XLIV.—On a Method of Defence among certain Medusæ.

By J. WALTER FEWKES*.

THE Siphonophora, in common with other Medusæ, as is well known, possess a very powerful organ of defence in the stinging-cells, also called lasso-cells and nematocysts. There is reason to believe that there may be at least one other method of protection adopted by these animals. I propose this evening to lay before you the evidence of the existence of this second method of defence made use of by these animals, and to open the discussion of the homologies of the structures in which this new means of protection is lodged.

It may be well to anticipate what follows by the statement that the new method of defence is that of discolouring the water by the emission of coloured pigment from certain chromatic cells on the bracts, and that these cells bear relationships and perhaps are homologous with the nematocysts in

* From the Proc. Bost. Soc. Nat. Hist. vol. xxiv. pp. 200-208.

other genera of the groups in which they exist. The new method of defence is found, as far as known, only among the Siphonophores, and is limited to one or two genera.

Let us, on the threshold of our study, consider the history of the discovery of the structures in which this peculiar power is thought to be lodged.

In the year 1880, while engaged in the study of an *Agalma*, found at Villa Franca, South France, I noticed on the covering-scales certain coloured bodies which resembled in distribution in longitudinal rows the nematocysts which are ordinarily found on these structures. In the same year (1880) I described and figured these bodies, and called attention to the fact that when the covering-scale is broken from its connexion with the axis a coloured fluid is emitted from these organs. A covering-scale, ruptured from its connexion, was seen to pour out a considerable quantity of yellow fluid and to discolour the water in the immediate vicinity. When irritated, even while the bract is attached, the animal was supposed to discharge the colouring-matter in the same way although not in the same quantity. A similar phenomenon, connected with other organs, had already been described, for a discharge of colouring-matter from the tasters of *Forskalia* had been observed and mentioned by Kölliker; but, as far as known, no one had spoken of a like power of the chromatic "cells" or glands of the covering-scales of any Siphonophore.

My observations were not verified, or, at least, were not mentioned, by those who studied the Mediterranean Physophores up to the close of last year, when Dr. M. Bedot* again took up the subject, and from a study of what he regards a new species of *Agalma* (*A. Clausi*), possibly the same as mine, or, at least, found in the same locality, described and figured these glands again, generously quoting my description of eight years ago. His additions to our knowledge of the subject are so important that I have taken the liberty of quoting from his account somewhat at length.

Bedot says (p. 79):—"Ce qui donne un aspect particulier au bouclier, c'est la présence, à sa surface, d'un grand nombre de petites taches d'un rouge-carmin foncé (fig. 13, *gl*). Lorsqu'une de ces Agalmes est capturée, elle rejette une quantité très considérable de matière colorante d'un rouge jaune très intense. Pour l'observer facilement, on est obligé de changer plusieurs fois l'eau du bocal où elle se trouve. Au premier abord, j'ai cru que cette matière colorante provenait

* 'Tirage à part du Recueil Zoologique,' t. v. fasc. 1. "Sur l'*Agalma Clausi*."

des tentacles comme on le voit souvent chez les *Forskalia*. Mais j'ai pu me convaincre plus tard que ce n'était pas le cas. Cette couleur est produite par les boucliers; les taches rouges qui se trouvent à leur surface sont des espèces de petites glandes, qui éclatent et laissent échapper la matière colorante.

"Lorsqu'on observe ces glandes au microscope, on voit (fig. 2, *gl*) qu'elles sont formées par une agglomération de cellules contenant un noyau et un protoplasme rempli de grosses granulations. Elles ont une forme sphérique ou allongée et sont implantées dans la substance gélatineuse, de telle sorte que la moitié de la glande, à peu près, dépasse la surface du bouclier. Elles sont recouvertes par l'épithélium. Lorsque le contenu de la glande s'est déversé au dehors, toute trace de cellule glandulaire a disparu et il ne reste plus, sur le bouclier, qu'une petite excavation entourée d'un léger nuage jaune.

"On remarque encore une quantité de petits corps sphériques qui forment une bordure autour de la glande et s'étendent ensuite en trainée jusqu'au bord du bouclier, parallèlement à son grand axe. Ces corps sphériques (fig. 14, 27, et fig. 2, *ct*) ne disparaissent pas après l'explosion de la glande (fig. 37). Ils sont formés d'une enveloppe creuse à paroi épaisse (fig. 14, *e*) et à l'intérieur se trouve un corpuscule également sphérique (*s*) accolé à la paroi. Sa structure est difficile à observer; néanmoins on peut distinguer à l'intérieur une figure qui rappelle le fil d'un nematocyste. Ces corps se rencontrent sur les boucliers d'autres espèces de Siphonophores. Ils ont été déjà mentionnés comme étant des nematocystes, mais, je crois, sans qu'on en ait fourni la preuve, sans qu'on ait pu observer le fil déroulé. Il est très possible que cette opinion soit fondée, ou, tout au moins, que l'on ait affaire ici à une forme spéciale de cellule urticante. On les trouve souvent accumulés au bord du bouclier de l'*Agalma Clausi*, parfois aussi, ils y forment seulement de petits amas placés de distance en distance."

There is little doubt that while the bodies mentioned above have sometimes been mistaken for nematocysts, and while there is nothing to show that they have not in their interior the "fil d'un nematocyste," a distinction ought to be made between them and true nematocysts. We find similar rows of bodies not only among the Siphonophores, but also on the bell of many Hydromedusæ. It is doubtful, for example, whether the meridional lines on the external bell-walls of *Ectopleura* are rows of nematocysts, as they are generally considered, and the same is possibly true of the peculiar nematocyst-like bodies on the outer surface of the

bell of genera like *Gemmaria* and *Willia*. In *Athorybia* also the rows of so-called nematocysts on the outer walls of the covering-scales do not in many cases show the "fil d'un nematocyste," and therefore we may well question whether they are functionally nematocysts, lacking as they do this characteristic internal organization of these organs. Still the homology of these structures with nematocysts is an open question, and it remains yet to be seen whether they might not be regarded as lasso-cells in which certain parts have suffered a change in form.

There seems nothing to prevent our accepting the theory that the "corps sphériques" of the above description are homologues of nematocysts, and Bedot's figure, as far as it goes, does not disprove that they are these organs even if the central "thread" is absent.

Between these spherical bodies, however, and the pigment-pouches or glands Bedot thinks it necessary to recognize a distinction, and certainly their form is very different and justifies his views in this regard. Moreover the pigment-glands discharge their contents, whereas the spherical bodies do not have this power. Is there, however, anything to show that the pigment-glands are not more completely developed clusters of the so-called spherical bodies? and may not the pigment-gland be formed by an aggregation and maturation of the spherical bodies? Such an interpretation was given the coloured bodies when I studied them, and there is no new evidence to lead me to abandon my former opinion. The "pigment-spots" were at that time regarded as remotely represented in *Apolemia* "by elevations composed of clusters of cells on the surface of the tract." My use of the word cell with two meanings, one as a lasso-cell and the other as a histological cell, has led to a confusion and a just criticism by Bedot. I consider the pigment-glands to be formed of an aggregation of nucleated cells, and each pigment-spot to be comparable to a nematocyst (lasso-cell).

In some genera irritation of the animal leads to a change in colour of the covering-scale, which may be akin to the discharge of pigment from these bodies. This phenomenon seems also to be connected with pigment-cells in the organs, although the character of these structures has not been fully described.

Dr. Carl Chun mentions a change of colour of the covering-scales in *Ceratocymba spectabilis* from the Canaries. He speaks of this phenomenon in the following manner:—

"Sehr eigenthümlich verhält sich das Deckstück bei stärkerer Berührung, insofern auf einen Reiz hin zuerst in der

Umgebung der beiden hornförmigen Canäle des Oelbehälters und späterhin auch von den Ecken beginnend in der gesammten Gallerte eine weissliche Trübung auftritt. Dieselbe beruht auf dem Erscheinen ausserordentlich feiner Körnchen, die wieder (nach etwa einer halben Stunde) verschwinden, wenn die Eudoxie der Ruhe überlassen wird. Die eigenthümliche Trübung erinnert an eine analoger Erscheinung bei Hippopodius nur dass hier die auf einen Reiz erfolgende und später verschwindende milchige Färbung an die Ektodermzellen der Schwimmglocken gebunden ist. In gewissem Sinne muss selbst die structurlose Gallerte des Deckstückes einem Reize zugänglich sein, wie das allmähliche Auftauchen und ebenso langsame Verschwinden einer ziemlich intensiven Trübung beweist."

We might possibly compare this phenomenon with the cutaneous circulation and change of colour in pelagic fish-embryos and in Cephalopoda; but we know so little of the organs by which it is produced that one can as yet hardly venture an explanation.

The excretion and discharge of a coloured fluid from those organs which are known as "cystons" or tasters with a terminal opening has been noticed by several authors. Both Kölliker and Leuckart speak of it, although they seem to regard the discharge as due to a rupture of the wall rather than [as taking place] through a normal terminal opening. Kölliker says, "Ohne Zweifel ist diese Substanz ein Excretionstoff, doch wird ohne genauer Kenntniss ihrer chemischen Beschaffenheit nichts Näheres über ihre Bedeutung beizubringen sein."

Hæckel describes the structure of these Cystons or "anal vesicles," showing that they are excretory organs with a terminal anus and glandular walls often highly coloured. They are, according to him, confined to the Physophores, mainly to the Apolemidae, Agalmidae, and Forskalidae.

The "cystons" or hydrocysts with "mouths" in the Agalmidae are often, according to Hæckel (*op. cit.* p. 219), coloured red or brown, and "the fluid secretion, or the pigmented granular or crystalline masses secreted by it, are ejected by the distal mouth, or, rather, the anal opening, which is closed by a muscular sphincter." In the genus *Forskalia* the same author says, "When a quietly floating *Forskalia* is touched it suddenly discharges the contents of the chromadenia [pigment-glands] and makes the surrounding water dark and intransparent."

Hæckel offers the following explanation of the phenomenon in *Forskalia*:—"The excretion of the pigment-masses and

the darkening of the water by it have probably the same physiological function as in the *Cephalopoda*—to protect the attacked animal from its persecutors and facilitate the capture of food-animals."

The character of the "cystons" in a genus of *Apolemidae* called *Dicymbia* is described by Hæckel. Each "cormidium" or cluster of the stem is said to have in this genus a single deep-red cyston, and the secreted pigment is accumulated in a "head-like terminal expansion of the distal proboscis, and thrown out by a small terminal opening, the anus."

In *Apolemia uvaria**, which often reaches a great size, I have repeatedly observed the so-called "cystons" in specimens from Villa Franca. Hæckel simply mentions the fact that each cormidium of this genus has several cystons, but gives no special description of them.

The cystons of *Apolemia* are brick-red in colour and easily distinguished from the remaining appendages of the cormidium. Their general relationship to the covering-scales may be seen in my figure of the axis of the well-known *A. uvaria* from the Mediterranean. I have not seen them discharge their excretions †, but the intensity of their colour varies in different individuals and in different cormidia on the axis. Although I have repeatedly watched the well-known "lana di mare" *Apolemia*, I have never been fortunate enough to discover one which ejected colouring-matter from these reddish bodies, and have not been able to produce it by an irritation of the animals.

There is a peculiarity in the tasters of the genus *Nanomia* which would seem to have a bearing on the discussion of the pigmented bodies of the cystons.

A. Agassiz, in his description of *Nanomia*, called attention to the pigment at the base of the taster of this genus, which he designated as an "oil-globule." He supposed that this body formed the float of the young *Nanomia* which budded from the parent. From a comparison of this oil-globule with the float of the adult I have shown that a derivation of the young from the adult by budding is improbable. Still oil-globules are very conspicuous structures on the stem of the *Nanomia*, and have not been observed by me in other genera. Consequently, although the tentacular knobs and most of the

* The existence of what I have called "nectotasters" or tentacular appendages to the nectostem in *Apolemia* is not mentioned by Hæckel (*op. cit.*), although it is an exceptional feature in *Apolemia*. These appendages and the stem which bears the nectocalyces of *Apolemia* are easily seen and have been figured and described. Kölliker speaks of them as the "Fühler zwischen den Schwimmglocken."

† Bull. Mus. Comp. Zool. vol. viii. no. 7.

other structures of *Nanomia* are identical with those of *Agalmopsis pictum*, a genus to which I formerly referred *Nanomia*, the exceptional character of the cystons seems to me to separate it from Sars's genus.

The "oil-globule" forms a swelling at the proximal end of the "cyston," and was not observed to be ruptured. There seems, in point of fact, to be no opening through which it can be discharged. Its regular form, its constancy, its position, all stamp it as an organ of some kind. If we regard it as a float of a new individual it differs very greatly from the adult float of *Nanomia*. If we consider it a pigmented accumulation of excretory matter we disregard completely its character as far as the examination which has been made goes. It seems as if it should be regarded as connected in some way or another with the function of the cystons, but how I am unable at present to say.

Reviewing the data which have been brought forward, we have the following facts bearing on the discharges of a coloured fluid from organs of the body or the modification in colour due to irritation in Siphonophores.

1. Certain Agalmidæ, Forskalidæ, and Apolemidæ discharge a coloured fluid from their cystons. This fluid is regarded as an excretion and is supposed by Hæckel in one case to be the means of protection, as the sepia of the Cephalopoda.

2. A typical genus of Agalmidæ (*Agalma*) has pigment-glands on the bracts which discharge their contents when the covering-scales are broken from the stem. This discharge probably takes place on simple irritation.

3. Certain Hippopodidæ and a single known monogastric Calycephore change colour somewhat on irritation (see Chun's description above).

4. *Nanomia* has a prominent pigmented "oil-globule" at the base of the cyston, which has never been seen to discharge its contents.

What conclusions may be drawn from the above statements? Are we dealing here with phenomena of a similar character, or have we organs with two or three different functions? Are these discharges when they occur simply the throwing off of excretions, or do they also serve for protection of the Medusa from its foes?

It seems not improbable that the physiological function of certain of the tasters, which are known as cystons in *Forskalia*, is that of excretion. This power of throwing off excretions may also serve for protection. Yet it must be borne in mind that all the Calycephoridæ, the Pneumatophoridæ, and Hippo-

podidæ have no cystons or similar excretory organs, nor has the function of excretion yet been referred in them to any special organs. Is it possible that the discharge of coloured matter from the pigment-cells of the bract of *Agalma* is also a method of excretion? and is it the same as that of the cystons of *Forskalia*? It seems to me improbable that we have to deal with excretions only in this case, although we may have an instance of a novel means of protection, which is in part accomplished by the discharge of the excretion in *Forskalia*. Upon this theory, however, we need much more light, which can best come from more observation.

It is legitimate to conclude that the discharge of a highly coloured fluid by the scales of *Agalma* is in part a means of protection for the Medusa, and it would seem natural to connect it with the function of excretion; but we know so little about the character of the excretions and the manner in which they are produced in Medusæ, that at present we can hardly definitely ascribe the special function to these glands. Possibly similar glands are found in other Physophores, and the excretion has not been recognized from the fact that it is not so highly coloured as in *Agalma Clausi* and *Forskalia*. The discharge of this fluid from a living animal, if it take place without rupture of the wall of the scale, would imply special excretory openings somewhere on the bract; and one is tempted to search for such openings, if they exist, on the distal tip of the scale, when they would be homologous with the excretory openings known to exist on the bell-margin of certain Hydromedusæ, as Metschnikoff and others have shown.

If we accept the theory that the discharge of a coloured fluid is a method of defence, the question arises, How is that defence accomplished? Does the fluid darken the water in the immediate vicinity of the Medusa which possesses this power and in that way conceal it from its foes, as in the case of the Cephalopoda? or does it serve, as is possibly the case with the rattle of the rattlesnake, to warn away its enemies? May it not even bewilder its prey and thus be rather a means of capturing its food than of self-protection? Has it possibly a poisonous nature fatal to its prey or foes? Our knowledge of its nature is all too small to give us an answer to these questions. Its bright colour would indicate that even if it is poisonous this is not its only property, or its sole function that of killing its enemies or prey. The ability to change the colour mentioned in *Ceratocymba* by Dr. Chun might come in the same category as a similar power in fishes and Cephalopoda. In that case we might have a kind of cutaneous

pigment-circulation. The discharge of pigment, however, is something different and possibly capable of a very different interpretation.

Is the discharge normal or abnormal? Is it a result of extraordinary conditions under which the animal is placed in confinement in our aquaria, or is it an habitual mode of protection? It seems to me that the latter interpretation will best satisfy our limited knowledge; and although when the bracts are broken the discharge is more voluminous, since the glands are wholly emptied of their contents, the method of its discharge shows it to be a function which is perfectly normal.

It seems to me that we have in these "glands" the homologues of nematocysts, the thread of which is wanting and the cells of the interior of which have degenerated or rather specialized into pigment-bodies, instead of functioning as an urticating-thread. These modified nematocysts throw off a coloured fluid which, while it serves in a similar way in protection or in killing its prey, bears little morphological likeness to the well-known lasso-cell.

XLV.—On the so-called *Cretaceous Lizard*, *Rhaphiosaurus*.

By A. SMITH WOODWARD, F.G.S., F.Z.S., of the British Museum (Natural History).

IN 1840 Prof. Sir Richard Owen described a small portion of mandible from the Lower Chalk of Cambridgeshire under the name of *Rhaphiosaurus* *, regarding the fossil as referable to a Lacertilian Reptile and provisionally associating with it a series of undoubted Reptilian vertebræ from the Lower Chalk of Burham, Kent. Ten years later the vertebræ proved to pertain to a distinct generic type named *Dolichosaurus* †; and the original jaw thus remained as the sole evidence of the existence of *Rhaphiosaurus*. In 1865 Prof. Seeley ‡ stated incidentally that the specimen so determined probably belonged to a fish; and still more recently the genus has been recorded § as one requiring further elucidation.

* R. Owen, "Description of the Vertebral Column &c. of a small Lacertine Saurian from the Chalk," Trans. Geol. Soc. [2] vol. vi. (1840) p. 413, pl. xxxix. fig. 3. *Rhaphiosaurus subulidens*, Owen, Brit. Assoc. Rep. 1841, p. 190. *R. lucius*, Owen, in Dixon's 'Geol. Sussex' (1850), p. 385, pl. xxxix. figs. 1-3. *R. subulidens*, Owen, "Foss. Rept. Cret. Form." (Pal. Soc. 1851), p. 19, pl. x. figs. 5, 6.

† R. Owen, "Foss. Rept. Cret. Form." (Pal. Soc. 1851), p. 22.

‡ H. G. Seeley, Ann. & Mag. Nat. Hist. [3] vol. xvi. p. 145.

§ Smith Woodward, "A Synopsis of the Vertebrate Fossils of the English Chalk," Proc. Geol. Assoc. vol. x. (1888) p. 281.

The fossil in question was discovered by Mr. James Carter, F.R.C.S., and presented by him to the Woodwardian Museum, Cambridge; and, through the kindness of Prof. Hughes, the present writer has lately had the privilege of examining and comparing the specimen with fossils in the British Museum. As a result of the study it may be definitely asserted that "*Rhaphiosaurus*" is founded upon the anterior half of the dentary bone of a small species of the characteristic Cretaceous fish, *Pachyrhizodus*, and the resemblance of the dentition to that of the pleurodont lizards is merely a case of analogy.

The jaw exhibits the characteristic fibrous texture of fish-bone, and the dentition is such as might from present knowledge be assigned either to fish or reptile; the bone does not taper anteriorly, but, when viewed from beneath*, it shows the marked inflexion at the symphysis observed in all species of the genus just mentioned. The arrangement of the teeth agrees precisely with that described by Cope† and the present writer‡ in *Pachyrhizodus*; and the dentition is so closely paralleled by that of a maxilla in the British Museum associated with scales and detached bones (no. P. 1808), that there can be no doubt as to the generic determination. With regard to its specific characters, the slenderness and form of the dentary bone are sufficient to distinguish it from all described species of *Pachyrhizodus*, and it may therefore retain the name of *subulidens* originally proposed by Owen. The British Museum fossil just mentioned is also interesting as extending the known range of the form to the Chalk of Sussex.

The intricate history of the acquisition of our knowledge of *Pachyrhizodus* has already been summarized and discussed in the 'Synopsis' quoted above. Other supposed Saurians—*Mosasaurus gracilis* and *Acrodonosaurus Gardneri*—have likewise been recorded through a misinterpretation of portions of jaws of this great predaceous fish; and it is unfortunate to have to add one more of the few Reptilian generic names in the list from the European Chalk to the synonymy of the same deceptive generic type.

* Pl. xxxix. fig. 1, in Dixon's 'Geol. Sussex.'

† E. D. Cope, "Vertebrata of the Cretaceous Formations of the West" (U. S. Geol. Surv. Territ. 1875), p. 220.

‡ Smith Woodward, *loc. cit.* p. 313.

XLVI.—On a true *Leuconid* Calcsponge from the Middle Lias of Northamptonshire, and on detached Calcsponge Spicules in the Upper Chalk of Surrey. By GEORGE JENNINGS HINDE, Ph.D.

[Plate XVII.]

I. On a true *Leuconid* Calcsponge from the Middle Lias of Northamptonshire.

MR E. A. WALFORD, F.G.S., of Banbury, kindly sent to me some time since for study and description several specimens of a small sponge which he had discovered in the Marlstone beds of the Middle Lias at King's Sutton, near Banbury. The specimens, though small or almost microscopic in size, appear to be perfect and full-grown, and their state of preservation is so remarkable as to permit of ready determination of their minute skeletal structures. This is the more surprising since the specimens prove to be Calcsponges, as delicate and fragile as any existing representatives of this group. Though occurring in strata of such a comparatively remote geological period, the structure of these specimens so fully agrees with that of existing sponges of the genus *Leucandra*, Hæckel, that I propose to include them therein. Only a single species has as yet been determined, which is described below under the name of *Leucandra Walfordi*.

Leucandra Walfordi, sp. n. (Pl. XVII. figs. 1-9.)

Sponges small, club-shaped, subcylindrical or compressed, slightly contracted at the base, which is attached to small grains of sand or fragments of other organisms. Usually growing single, but occasionally two or three individuals are attached together at their bases. The specimens range from 2 to 3·5 millim. in height and from ·6 to 1 millim. in thickness. The outer surface is slightly hispid, with obliquely projecting spicules; the summits are obtusely conical or truncate, without any distinctive neck or spicular collar. The cloacal tube extends nearly to the base of the sponge; it opens by a circular or, in the compressed forms, elliptical aperture, from ·2 to ·5 millim. in width. The inner or cloacal surface of the wall is apparently smooth and without any special layer of spicules. The walls of the sponge are about ·2 millim. in thickness; they are composed of cylindrical or fusiform acerates or rod-shaped spicules and three- or four-

rayed spicules of varying dimensions, which, for the most part, are indiscriminately intermingled together. Most of the acerate spicules are nearly straight, approximately cylindrical rods, with styliform, slightly inflected extremities (figs. 9 *a*, *b*). Of the largest of these I have not met with a complete form; the longest fragments measure $\cdot 43$ millim. in length and from $\cdot 005$ to $\cdot 01$ millim. in thickness. Other acerate spicules are straight or curved and either fusiform, gradually tapering to an acute point at both ends (figs. 9, *d*, *e*), or nearly of an even thickness for the greater portion of their length, and then terminating acutely (figs. 9, *c*, *g*). These latter range from $\cdot 09$ to $\cdot 29$ millim. in length and from $\cdot 0037$ to $\cdot 007$ millim. in thickness. The rod-shaped spicules apparently form the majority in this species; some of the longer forms are disposed either parallel with the wall or in an oblique direction, so that their distal ends slightly project beyond its general surface.

Of the three-rayed spicules (fig. 7) some are regular in form, that is with the rays of equal length, in others the rays appear to be unequal; but as one or more are usually broken, it is not easy to determine how far they may have been similar originally. The rays are smooth, straight, or rarely with a slight curvature, and very gradually tapering to an acute point. Sagittate forms appear to be absent. There is a great difference in the size of these spicules; in a small specimen the rays are not more than $\cdot 03$ millim. in length by $\cdot 004$ millim. in thickness, whilst the rays of a large spicule are $\cdot 26$ millim. in length and $\cdot 01$ millim. in thickness at the base. In the four-rayed spicules (fig. 8) the facial or plane rays resemble those of the three-rayed forms and the additional apical ray appears to be usually shorter than the facial rays, and in some it is distinctly more robust and somewhat abruptly pointed. The rays in some instances are also decidedly elliptical in section at their bases. The three- and four-rayed spicules are, so far as can be ascertained, irregularly intermingled with one another and with the acerate spicules in the structure of the wall, and no special arrangement either on the dermal or cloacal surfaces is apparent; but it is quite possible that the stout apical ray of the four-rayed spicules may project into the cloacal cavity, though not now recognizable in position.

Of the canal-system in the walls of this species very little can be ascertained; there are here and there minute circular holes on the outer surface, which may be apertures of incurrent canals, and in fractured portions of the wall there are traces of anastomosing canals; also on the inner or cloacal surfaces

there are indications of the larger apertures of excurrent canals. As, however, the intermediate spaces in the spicules of the wall are generally filled with an extremely fine powdery matrix, the courses of the canals, even on the supposition that they were similar to those of existing *Leucones* of corresponding dimensions, would be to a great extent unrecognizable.

The examples of this species occur detached and free in a decayed rusty rock, mingled with sand and oolitic grains and broken-up fragments of Crinoidea or other Echinoderms. Many retain their outer form as perfectly as any specimen of *Grantia* which might be met with on our coasts at the present day; others have been fractured, and small portions of their wall are found separately. The sand-grains &c. now attached to the bases of some of the specimens are probably the original materials on which the sponge fixed itself during its growth. Not only do these sponges retain their outer form, but the structure of their walls with their loosely arranged interfelted spicules is apparently undisturbed. As already mentioned, the sponges are now infilled with a powdery rusty matrix, much in the same way as recent specimens will get charged with muddy sediment; and this matrix can be partially removed by gentle washing, leaving the loose spicular wall exposed nearly in its pristine condition (fig. 6). By breaking off a fragment of the sponge and still further treating it with water or with a drop or two of spirits of wine, aided by gently touching with a needle or camel's-hair brush, the spicular felt-work becomes disentangled, and its individual constituents separated from each other as readily as those of recent *Calcisponges* by the action of caustic potash. In reality the structure of these fossil sponges has been preserved almost unaltered and uninjured, in spite of the fact that the spicules of which they consist are exceedingly slender, fragile, and minute, and that they are only loosely and irregularly intermingled together.

As regards brittleness, however, the spicules of the Lias sponges now fracture much more readily than those of existing analogues, and it is exceptional to find perfect forms in microscopic mountings from them. Under the microscope the spicules vary but slightly in appearance from recent forms; their lustre is hardly so brilliant, but their surfaces are equally smooth and even, and show no traces of erosion. In polarized light they behave the same as recent *Calcisponge* spicules. I have not noticed any traces of axial canals; but even in recent spicules of similar dimensions it is very rarely that the canals can be distinguished.

The figures of the spicules on the accompanying Plate (Pl. XVII. figs. 7, 8, 9), which have all been drawn to a uniform scale of 200 diameters, will convey a better idea of their relation in size and form to those of recent Calcsponges than a verbal description. Judging by the standard proposed by Hæckel (Kalkschw. Bd. i. p. 209) for recent spicules, these fossil forms are included in the four lowest grades of minute, small, medium-small, and medium-large forms; that is to say, the rays of the smallest fossil three-rayed spicule are only $\cdot 03$ millim. in length, and thus within the sixth or lowest scale, whilst the rays of the largest observed are $\cdot 26$ millim. in length, and thus of the fourth or medium-small scale. The length of some of the largest acerate spicules would bring them into the scale of the third or medium-large forms. Spicules of the first or second dimensions do not occur in this fossil. When compared with the spicules of recent species of *Leucandra* or of other genera of Leucones, as depicted in Hæckel's Monograph (mostly on the scale of 100 diameters), the fossil forms are seen to be as a rule smaller and more delicate than the recent ones. In some recent species, such as *Leucandra Gossei*, Bowbk., sp., and *L. crambessa*, Hæck., the rays of the three-rayed spicules are of about the same length, but somewhat more robust than the fossil forms; but the acerate spicules in the same sponges are of unmistakably stouter proportions than those in the fossil, and they further differ in not being inflected near the point. In the fossil the simple acerate spicules are more numerous than the three- and four-rayed forms, whilst in most of the recent species of the genus the reverse proportions exist.

Owing to the small size and state of preservation it is not practicable to ascertain the details of the canal-system sufficiently, so as to compare the fossil with its recent analogues; but the evidence, so far as it goes, tends to show that there is the same system of irregular anastomosing canals as in recent Leucones.

The significance of this discovery of fossil Leuconid sponges, structurally similar to the existing genus *Leucandra*, in strata of Liassic age, may be understood from the fact that hitherto no fossil sponge of this family has been met with, though detached spicules, probably belonging to sponges of the same group, have been detected in the Tertiary deposits of St. Erth, Cornwall (Quart. Journ. Geol. Soc. vol. xlii. (1886) p. 214). With the single exception of *Protosycon punctatum*, Goldf., sp., from the Jurassic Limestones of Streitberg, in Franconia, which has been placed by v. Zittel in the Sycones family, no member of either of the three existing families of Calcsponges

established by Hæckel has previously been known. So fragile and apparently unfitted to be preserved as fossils are the structures of recent Calcsponges, that Hæckel did not think entire forms would ever be found in the rocks, though possibly their microscopic detached spicules might be met with (Kalksch. Bd. i. p. 341). And yet, by some most favourable combination of circumstances, this remarkable fossil Calcsponge, as fragile as any of its existing relatives, has been preserved since Liassic times. Since Hæckel's Monograph appeared in 1872 numerous fossil Calcsponges have been determined by v. Zittel and others; but all of them, with the exception mentioned above, belong to the extinct family of the Pharetrones, characterized by having a skeleton of *solid* spicular fibres. This structural type of Calcsponge appears to have been singularly well adapted for fossilization, since sponges of this group are recorded from Devonian strata upwards; but as regards some of the older forms, from the Devonian to the Triassic, further evidence of the nature of their fibrous skeletons is still required. The skeletal fibres in the Jurassic and Cretaceous Pharetrones, however, consist of spicules closely resembling those of existing Leucones and other recent Calcsponges, and on this ground v. Dunikowski placed them as a mere subfamily of the Leucones ('Palæontographica,' Bd. xxix. (1883) p. 34 sep. Abdr.), and believed that the solid fibres were of secondary origin, produced by fossilization. This view is clearly untenable, since the spicules in the solid fibres of the Pharetrones have oftentimes a very definite arrangement, quite impossible to have been produced by mechanical influences from the irregularly intermingled spicules of Leuconid sponges. We now know from this Lias fossil that sponges with true Leuconid structure date as far back in geological time as any Pharetrones with definitely ascertained spicular fibres; and it is not improbable that both groups may have coexisted from the Palæozoic era. It is worthy of note that whilst the Leuconid type still flourishes and is world-wide in its distribution, the Pharetronid type seems to have wholly died out, the latest known * occurring in the Upper Chalk.

Distribution. The fossils were obtained by Mr. E. A. Walford, F.G.S.†, in a bed belonging to the Marlstone of the

* An Australian Calcsponge, *Leucetta clathrata*, Carter (Ann. & Mag. Nat. Hist. ser. 5, vol. xi. (1883) p. 33), was originally described by Mr. H. J. Carter, F.R.S., as possessing solid spicular fibres: but he has since discovered that the fibres are really tubular (*ib.* vol. xvii. (1886) p. 508).

† I wish to state that the keen observation of Mr. Walford has also brought to light numerous other small Calcsponges in the Inferior Oolite of Dorsetshire, which are now under examination. They are all Pharetrones, and include many new species.

Middle Lias, in the zone of *Ammonites spinatus*, at King's Sutton, Northamptonshire. Associated with the sponges are numerous specimens of well-preserved Foraminifera, Corals, Mollusca, and Polyzoa; these latter have already been described by Mr. Walford (Quart. Journ. Geol. Soc. vol. xliii. 1887, p. 636).

II. *Detached Calcsponge Spicules in the Upper Chalk of Surrey.* (Pl. XVII. fig. 10.)

In some mountings of the finer material of the Upper Chalk (zone of *Micraster*) from Croydon and Sutton, Surrey, there are, in addition to the common Foraminiferal species of *Textularia*, *Globigerina*, &c., some minute three- and four-rayed spicules, very similar in appearance to those of ordinary Calcsponges. The spicules are of calcite, their forms are fairly complete, but their surfaces are rough and uneven, as if covered by the finest particles of the Chalk. The rays are conical, with blunt terminations; they vary from $\cdot 04$ to $\cdot 13$ millim. in length and from $\cdot 007$ to $\cdot 02$ millim. in thickness. Some are regular forms with rays equal in length; in others the rays are unequal. Beyond some rod-like fragments of the same thickness as the three-rayed forms no other spicules are present in the material. As these spicules correspond in form, size, and mineral structure with those of Calcsponges, it seems reasonable to conclude that they are detached from sponges of this group. The only other inference is that they may be spicules of siliceous Tetractinellid sponges which have been replaced by calcite. But against this supposition is the fact that even the larger forms of true siliceous spicules are very rare in the Chalk of these areas (unless included in the cavities of flints); they have been dissolved, leaving empty moulds in the chalky matrix. Further, in these spicules the three facial rays are approximately in the same plane, the same as those of Calcsponges generally, whereas in the Tetractinellid *Calthrops* spicules the rays are generally disposed in the form of a tripod. It would also be very unusual to find such very small detached forms which had undergone mineral replacement. As Calcsponges of the genus *Elasmostoma* are found in the Chalk of Kent, the occurrence of detached spicules might have been anticipated; but they do not appear to have been noticed previously.

EXPLANATION OF PLATE XVII.

Leucandra Walfordi, figs. 1-9.

- Figs. 1-4.* Four specimens of the sponge, enlarged to the same scale of ten diameters.
- Fig. 5.* A transverse section of a specimen, showing the thickness of the wall and the cloacal cavity. Enlarged ten diameters.
- Fig. 6.* A fragment of the inner surface of the sponge-wall, showing the irregular disposition of the spicules and traces of canals. Enlarged sixty diameters.
- Fig. 7.* Entire and fragmentary three-rayed spicules of the sponge-wall. Enlarged two hundred diameters.
- Fig. 8.* Entire and fragmentary four-rayed spicules. Similarly enlarged.
- Fig. 9.* Entire and fragmentary rod-like and acerate spicules. Enlarged two hundred diameters.

[The above are from the Marlstone of the Middle Lias at King's Sutton, Northamptonshire.]

- Fig. 10.* Detached three- and four-rayed spicules of Calcsponges from the Upper Chalk of Croydon and Sutton, Surrey. Enlarged two hundred diameters.

XLVII.—*Mr. A. G. Butler's Remarks upon distasteful Insects.* By EDWARD B. POULTON, M.A., F.R.S.

My attention has only just been directed to Mr. Butler's paper in the August number of this Journal. My only object in replying to the extraordinary statements and inferences therein contained is the enlightenment of readers who may mistake the expression of Mr. Butler's conviction that his notes occupy an altogether unique position for a comprehensive guide to the literature of the subject.

Mr. Butler tells us that the attention which a paper of his published many years ago "has since received has been interesting, as showing how very little has since been done by naturalists either to prove or disprove the truth of the theories based thereon."

From this remark any reader who was not acquainted with the subject might reasonably suppose (1) that the theories alluded to were thought out by Mr. Butler; (2) that Mr. Butler's observations formed the first basis on which the theories rested, and that very little or nothing has been added in the way of proof or disproof since 1869, when Mr. Butler's paper appeared.

All these suppositions would be erroneous. (1) The important hypothesis that conspicuous and gaudy colours in larvæ are attended by qualities rendering their possessors inedible is entirely due to A. R. Wallace (Proc. Ent. Soc. 1867, p. lxxx). (2) This suggestion received confirmation on March 1st, 1869, when papers were read by J. Jenner Weir and A. G. Butler (Proc. Ent. Soc. 1869, p. vi); but the former paper was by far the more important and attracted more attention in the discussion which ensued. Both papers subsequently appeared in the 'Transactions.' Mr. Butler's paper, which he regards as the almost exclusive authority on the subject, records experiments with *three* species of conspicuous larvæ, and contrasts the behaviour of insect-eating animals towards them with their behaviour towards less conspicuous species.

Since that date Mr. Jenner Weir contributed another important paper (Trans. Ent. Soc. 1870), Professor Weismann published many interesting observations ('Studies in the Theory of Descent,' part ii. pp. 336-340, English translation by Prof. Meldola), and in 1887 (Proc. Zool. Soc. pp. 191-274) I brought together all that had been done, with many new observations of my own and Mr. J. Jenner Weir. A few new notes by Mr. Butler were also included. Experiments upon considerably over one hundred species or stages of insects and other Arthropoda are described, observations made by Mr. Butler being recorded in sixteen of these. The attention which this small proportion of the total work has received is simply due to the fairness of biological writers in giving credit to one of the first two experimenters in this direction, and not because either the importance of the results or the care with which the work was conducted call for any special mention.

Finding that the comparison of all experiments had produced many interesting results (recorded in the paper mentioned above), I determined to renew the work in the following years, and I was glad to avail myself of Mr. Butler's help. I have continued experimenting up to the present time (I even made an experiment yesterday) and have a large body of notes. Most of my experiments and all those contained in Mr. Butler's notes were made in 1887, and although they have not been published in full, an account of the most interesting results was read before the British Association at Manchester, and is published in abstract in the Report of that meeting (pp. 763-765), where Mr. Butler will find his assistance fully acknowledged.

If I had no more notes than those supplied by Mr. Butler

their preparation for publication would be only a work of a few hours; but these notes are a very small fraction of the whole. I wonder that Mr. Butler did not write to me and ask for his notes, instead of for the first time intimating his dissatisfaction in this extraordinary manner. Since, however, he prefers this mode of procedure, I will mention that I am returning his notes only a few hours after first seeing his paper.

There is nothing in Mr. Butler's notes of 1887 or in the few remarks he makes in the paper to which I am replying which tends to "mystify" the subject. It has always been admitted that one animal may eat what another refuses. The effect which such colours and patterns as those of *Zeuzera asculi* would have upon an insectivorous animal has been abundantly shown in my paper (*l. c.* p. 236). Mr. Butler's conclusions as to the larva of *Stauropus fugi* seem to me to be quite valueless in the absence of direct evidence, while the presumption is the other way. Insect-eating animals certainly keenly relish spiders, but they are nevertheless often afraid of spiders of a size such as *S. fugi* suggests. It is characteristic of the whole spirit of Mr. Butler's paper that he should ridicule my extension of H. Müller's interpretation of the attitude assumed by *S. fugi* so far as it may be supposed to apply to birds—a supposition to which I did not even allude—and that he should omit to mention the actual proofs which I obtained that alarm is caused by its attitude in the case of other animals (marmoset and lizard). Those who are interested in investigating a specimen of Mr. Butler's method of controversy would do well to compare his remarks on the spider-like attitude of *S. fugi* with my experiments and conclusions on the same subject (*Trans. Ent. Soc.* 1888, pp. 583–586).

Oxford,
Oct. 4, 1889.

XLVIII.—*Descriptions of new Typhlopidae in the British Museum.* By G. A. BOULENGER.

Helminthophis Petersii.

Rostral half the width of the head, extending to between the eyes, truncate posteriorly, and forming a broad suture with the frontal; two superposed præoculars and a subocular; eye

distinguishable under the ocular; four upper labials, first largest, third in contact with the ocular. Diameter of body 55 times in the total length; tail a little longer than broad, ending in a spine. 20 scales round the body. Brown, each scale darker in the centre; snout and anal region yellowish.

A single specimen, 110 millim. long, from Guayaquil, collected by Mr. Fraser.

Helminthophis Guentheri.

Rostral one third the width of the head, extending to the level of the eyes, rounded posteriorly, and forming a suture with the frontal, which is very broad; eye distinguishable under the ocular; four upper labials, first largest, third in contact with the ocular. Diameter of the body 50 times in the total length; tail twice as long as broad, ending in a spine. 20 scales round the body. Olive-brown above, head white; yellowish inferiorly, with small scattered olive spots.

A single specimen, 170 millim. long, from Porto Real, Province Rio Janeiro, collected by M. Hardy du Dréneuf.

Typhlops leucoproctus.

Snout rounded, moderately projecting; nostrils lateral. Rostral about one third the width of the head, extending to the level of the eyes; nasal nearly completely divided, the cleft proceeding from the second labial; præocular present, a little narrower than the nasal or the ocular, in contact with the second and third labials; eye distinguishable; upper head-scales moderately enlarged; four upper labials. Diameter of body 40 to 65 times in the total length; tail once and a half to twice as long as broad, ending in a spine. 20 scales round the body. Dark brown, somewhat lighter inferiorly; labial and anal regions yellowish.

Fly River (New Guinea) and Murray Island (Torres Straits), collected by the Rev. S. Macfarlane; Queensland. The largest specimen measures 220 millim.

Typhlops comorensis.

Snout depressed, rounded, strongly projecting; nostrils lateral. Rostral two fifths the width of the head, extending to the level of the eyes; nasal semidivided, the cleft proceeding from the second labial; præocular present, as broad as the ocular, in contact with the second and third labials; eye distinct; upper head-scales feebly enlarged; four upper labials. Diameter of body 54 times in the total length; tail

once and a half as long as broad. 20 scales round the body. Dark brown; labial and anal regions yellowish.

A single specimen, 245 millim. long, from the Comoro Islands, collected by Sir John Kirk.

Typhlops socotranus.

Snout rounded, very prominent; nostrils lateral. Rostral about one third the width of the head, not extending to the level of the eyes; nasal incompletely divided, the cleft proceeding from the second labial; præocular present, broader than the nasal or the ocular, in contact with the second and third labials; eye distinct; upper head-scales slightly enlarged; four upper labials. Diameter of body 37 to 50 times in the total length; tail as long as broad, ending in a spine. 24 scales round the body. Whitish, with pale brown lines running between the dorsal series of scales.

Two specimens, the largest 200 millim. long, from Socotra, collected by Prof. J. B. Balfour.

Typhlops torresianus.

Snout prominent, rounded; nostrils inferior. Rostral about one third the width of the head, not extending quite to the level of the eyes, the portion visible from below half as broad as long; nasal incompletely divided, the cleft extending from the second labial to the upper surface of the snout; præocular present, narrower than the nasal or the ocular, in contact with the second and third labials; eye distinguishable; præfrontal, supraoculars, and parietals enlarged; four upper labials. Diameter of body 40 to 43 times in the total length; tail a little longer than broad, ending in a spine. 22 scales round the body. Dark olive or brown above, the scales edged with lighter; whitish inferiorly.

Two specimens, the largest 400 millim. long, from Murray Island, Torres Straits, collected by the Rev. S. Macfarlane.

Typhlops reginæ.

Snout prominent, rounded; nostrils inferior. Rostral nearly half the width of the head, not extending to the level of the eyes, the portion visible from below longer than broad; nasal incompletely divided, the cleft extending from the first labial to the upper surface of the snout; præocular present, nearly as broad as the nasal or the ocular, in contact with the second and third labials; eye distinguishable; præfrontal, supraoculars, and parietals much enlarged; four upper labials.

Diameter of body 37 to 50 times in the total length; tail a little longer than broad, ending in a spine. 22 scales round the body. Greyish olive above, whitish inferiorly.

Three specimens, the largest 410 millim. long, from Queensland, collected by Colonel Beddome.

Typhlops Blanfordii.

Typhlops Eschrichtii (non Schleg.), Blanf. Geol. and Zool. Abyss. p. 457.

Snout very prominent, depressed, rounded, with inferior nostrils. Rostral large, more than half the width of the head, extending to between the eyes, the portion visible from below nearly as long as broad; nasal semidivided, the cleft proceeding from the first labial; præocular present, much narrower than the nasal or the ocular, in contact with the second and third labials; eye distinct, below the suture between the præocular and the ocular; præfrontal much enlarged, supra-oculars and parietals feebly enlarged; four upper labials. Diameter of body 40 times in the total length; tail broader than long, ending in a spine. 30 scales round the body. Olive-grey, basal half of each dorsal scale blackish; a narrow whitish stripe along the middle of the lower surface.

A single specimen, 320 millim. long, from Senafé, Abyssinia.

Typhlops affinis.

Under this name I propose to designate a small *Typhlops*, 170 millim. long, which has been regarded by Peters (Monatsb. Berl. Akad. 1867, p. 709) as the young of his *T. unguirostris*, with which it agrees in every respect except in having only 18 scales round the body (instead of 22 or 24) and a somewhat longer tail.

Queensland.

XLIX.—*Descriptions of two new Rhynchophorous Coleoptera from the Louisiade Archipelago.* By CHARLES O. WATERHOUSE.

A SMALL series of Coleoptera from the Louisiade Archipelago has recently been presented to the British Museum by Mr. Basil Thomson. Among them is a new species of Mr. Pascoe's genus *Apirocalus* and a new *Rhinoscapa*. There is also a

species of *Rhinoscapa* which agrees admirably with Herr Kirsch's description of *R. viridula* except that in that species the interstices of the elytra are said to be flat, whereas in the specimen before me they are distinctly convex. This may be a mere individual variation.

Rhinoscapa Thomsoni.

Elongato-obovata, nigra, squamis glaucis parce tecta; rostro medio sulcato utrinque obtuse carinato; thorace rugoso, medio impresso; elytris punctato-striatis, interstitiis vix convexis, granulis numerosis nigris nitidis sparsis, singulis elytris maculis duabus ante medium fasciaeque pone medium flavis ornatis.

Long. 11 lin.

Hab. Aignan Island.

Black, sparingly clothed with fine, very pale bluish-grey scales. The rostrum has a broad median channel, with an impressed line in the middle. The antennae are clothed with grey scales, with the apex of the joints of the funiculus black, beset with a few black hairs; the scape reaches to the middle of the eye; the second joint of the funiculus is a little longer than the first. The thorax is as long as broad, distinctly narrowed at the base, broadest in front of the middle, convex, transversely impressed in front, with a well-marked discoidal impression; covered with black shining granules, which are variable in size and shape and are sometimes confluent. The elytra are punctate-striate, the punctures small and not very close together; the interstices are only slightly convex about the middle, studded with very numerous, small, black, shining granules, with a few of a rather larger size round the yellow spot and bordering the yellow fascia; each elytron has a transversely ovate yellow spot at a short distance from the base and a little removed from the suture, and another below the shoulder; the transverse fascia (which does not reach the margin of the elytron) is a little dilated about the middle. The legs are clothed with grey scales and are studded with black shining granules; the tibiae are beset with hairs, which are chiefly blackish on the outer and pale fulvous on the inner edge.

Apirocalus Thomsoni.

Fuscus, sat dense sordide cinereo-squamosus; antennis longis; thorace latitudine per paulo longiore, convexo, tuberculoso, antice et postice angustato, lateribus arcuatis; elytris latitudine per paulo brevioribus, striato-punctatis, ad basin thoracis basi haud

latioribus, ad latera expansis nigro-fimbriatis, ante apicem subita oblique angustatis, declivis, apice ipso obtuso.

Long. $9\frac{1}{2}$, lat. elytr. $5\frac{1}{2}$ millim.

Hab. Aignan Island.

This species is near *A. Gestroi* (Pascoc, Ann. Mus. Genova, 1885, t. i. fig. 3), but has the thorax narrower and more narrowed behind, and the elytra are dilated before the middle, with the expanded margin fringed with long black hair. The rostrum is marked off from the forehead by a curved impressed line and has also a median impressed line. The antennæ are two thirds the length of the whole insect; the funiculus has seven elongate joints, gradually decreasing in length towards the club, which is also elongate. The thorax is nearly as much narrowed at the base as in front, covered with round depressed tubercles. The elytra at their base are not wider than the thorax, but at one quarter from the base the margin is expanded to rather more than twice the width of the base, then slightly narrowed posteriorly to one quarter from the apex, where it is turned in at a right angle; the dorsal surface is rather flat, slightly convex at the suture; the apical part is sloping down, obliquely narrowed. The femora are much thickened; the anterior coxæ are scarcely separate. The basal segment of the abdomen has a small velvety spot in the middle of the posterior margin. The elytra, legs, and underside are studded with short, stiff, pale setæ.

L.—*Monograph of Phyllothelys, a Genus of Mantodes peculiar to the Oriental Region.* By J. WOOD-MASON, Superintendent of the Indian Museum, and Professor of Comparative Anatomy in the Medical College, Calcutta.

Genus PHYLLOTHELYS, Wood-Mason.

Phyllothelys, Wood-Mason, Proc. As. Soc. Beng. 1876, p. 176; Ann. & Mag. Nat. Hist. 1876, ser. 4, vol. xviii. p. 507; Proc. Ent. Soc. 1877, p. xviii; Journ. As. Soc. Beng. 1884, vol. liii. pt. ii. p. 206, pl. xi, ♂ ♀.

Distribution. Indo-Chinese, Ceylonese and South Indian, and Malayan subregions of the Oriental Region.

1. *Phyllothelys Westwoodi*.

Phyllothelys Westwoodi, Wood-Mason, Journ. As. Soc. Bengal, loc. cit. figs. 1, 1 b, 2, 2 b, 2 c, and 2 d, ♂ ♀.

♂ ♀. Protuberance of vertex trilobed.

Ann. & Mag. N. Hist. Ser. 6. Vol. iv.

♂. Horn rudimentary.

♀. Horn well-developed, tapering very slightly and gradually from its base to its truncated apex, which is divided by an angular notch into two points, with the edges of its foliaceous expansions entire.

♂ ♀. Axillary or plicate vein of tegmina 1-branched. Discoidal or anterior ulnar vein of wings 2-branched.

Hab. Sibsagur and Cachar districts, Assam; Buxa, Bhutan; Upper Tenasserim; and Mergui.

2. *Phyllothelys taprobanæ*, n. sp. (Fig. 1, p. 368.)

♂. Unknown.

♀. Protuberance of vertex simple, without lateral lobes; horn long-lanceolate, with its edges minutely notched, the teeth formed by the notches appearing to be the free ends of obscure branch-like thickenings which pass off from the primitive horn, as in the following species.

Organs of flight of the same proportions and structure and of much the same colour as in the preceding, differing only in details; the tegmina having the space intervening between the radial veins and the dark mottling of the disk opaque, whitely brown; the wings, their very bases, their anterior margin from the base to rather beyond the middle, their longitudinal veins for varying distances from the base, and their transverse veinlets to within a short distance of the apex in both areas yellow or yellow-brown, the last-named being in addition very narrowly lined with hyaline on both sides. Axillary or plicate vein of tegmina 2-branched; discoidal or anterior ulnar vein of wings 1-branched.

The legs differ only in matters of minute detail from those of the preceding species; owing to the dark marbling being more developed the yellow marks on the inside of the fore femora are smaller; the fore tibiæ are armed on the outside with 16 and 17 teeth and on the inside with 16 and 16; the free margins of the foliaceous lobes of the four posterior femora are minutely and decreasingly from the base denticulate, with a single seta inserted in the distal side of each denticle.

Total length, from apex of horn to apex of abdomen, 73 millim.; height of head 17, of which the horn is 12·75; length of pronotum 27, of which the anterior and posterior lobes are respectively 5·75 and 21·25; length of tegmina 30, breadth 6·5; length of wings 26, breadth 14; length of abdomen 24; length of fore coxa 15, femur 16·5.

Hab. Ceylon. Collected by Mr. A. P. Green, of Colombo.

3. *Phyllothelys paradoxum*.

Phyllothelys paradoxum, Wood-Mason, op. et loc. cit. fig. 3, nymphal ♂.

♂, nymph. Protuberance of vertex trilobed; horn deeply indented or branched at the sides, so as to resemble a narrow pinnately-cleft leaf.

♀. Unknown.

Hab. Burmah; precise locality unknown, but probably Pegu.

4. *Phyllothelys malayæ*, n. sp. (Fig. 2, p. 368.)

♂. Protuberance of vertex trilobed; horn curled (? normally), tapering at first rather rapidly, then very slowly, to its acute apex, with the lateral foliaceous expansions folded back (? normally) against the primitive horn and the median foliaceous expansion, and with its front face deeply fluted.

Organs of flight when closed extending by about one seventh of the length of the tegmina beyond the end of the abdomen, iridescent, pellucid, very pale fuscous, with the anterior margin in the tegmina and the anterior margin with the apex in the wings semiopaque, fuscous, concolorous with the longitudinal veins, which are obsoletely annulated with darker in the tegmina and in the anterior area of the wings; transverse veinlets of posterior area of wings indistinct, pale. Axillary or plicate vein of tegmina 2-branched. Discoidal or anterior ulnar vein of wings 3-branched.

Fore legs on the inside jet-black throughout from the base to the apex of the tarsi; tibiæ armed on the outside with 17 and 16 and on the inside with 17 and 16 teeth.

Four posterior tibiæ not swollen dorso-laterally in the basal half and obsoletely carinated, as in all the preceding species, but curved and very distinctly carinated, each being provided with three dorsal carinæ, none of which are crested, and with two ventral carinæ, of which the lower or anterior is only slightly crested, while the upper or posterior is conspicuously expanded into an arched foliaceous plate, marked symmetrically, like the longer of the femoral lobes, with translucent yellow fenestræ; the posterior legs, in fact, much resemble those of the Ethiopian genus *Phyllocrania*, only differing therefrom in having no dorsal lobes.

Total length, from apex of horn to apex of abdomen, 47 millim.; height of head 9.5, of which the horn is 6; length of pronotum 17, of which its anterior and posterior lobes are respectively 3.25 and 13.75; length of tegmina 27, breadth

6; length of wings 26·5, breadth 13·25; length of abdomen 15; length of fore coxa 11·75, femur 12·5.

Hab. Perak, Malay Peninsula. Collected by Mr. W. Doherty.

Fig. 1.

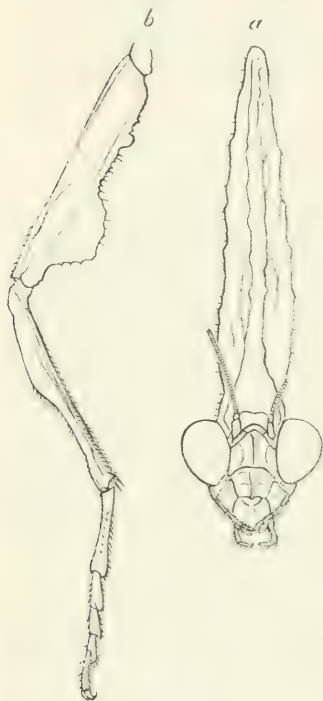


Fig. 2.



Fig. 1.—*P. taprobanae*. *a*, head, from in front; *b*, intermediate leg of left side, from above, $\times 4$.

Fig. 2.—*P. malayae*. *a*, head, from in front; *b*, intermediate leg of left side, from above, $\times 4$.

LI.—*Notes on the Early Life-history of the Herring.* By
ERNEST W. L. HOLT, Marine Laboratory, St. Andrews.

PROFESSOR M'INTOSH having kindly placed at my disposal a series of young herrings obtained in St. Andrews Bay during the last five years, I have been able to ascertain some facts as to the life-history of the herring which may be of interest.

I do not propose to enter here into any minute structural details.

As is well known, all herrings do not spawn at the same time, some selecting the spring and others the autumn for that purpose. Professor M'Intosh is of opinion that by far the greater number spawn in the spring; and this seems confirmed, so far as regards this locality, by the greater abundance of young forms obtained here in that season.

Mr. Brook ('Fourth Annual Report Scotch Fishery Board') gives January to March as the spring spawning-season, the time varying with the locality, Anstruther and Buckie being the earliest.

The egg of the herring is demersal, differing thus from the pelagic egg of the sprat. The intraovarian development of the herring has been worked out by Kupffer and subsequently by Brook (3rd and 4th Ann. Rep. S. F. B.).

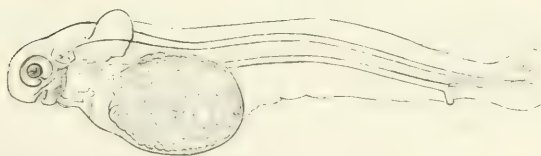
Eggs were obtained here on Feb. 5, 1885, from Anstruther, and hatched out in the laboratory in twenty-five days.

Newly hatched forms occurred on March 7, 1887, and larval and post-larval forms in March and the beginning of April in 1887 and 1889.

The period of incubation varies with the temperature*. It is probably never less than three weeks in the early spring, but it may be barely a week in the autumn. Thus, except in very early localities, young herrings cannot be expected before the beginning of March. In 1889 great numbers of young herrings were obtained, the first being early postlarval forms on March 22 and larval and postlarval on March 28.

The newly hatched herring (figure 1), about $\frac{7}{16}$ inch long†,

Fig. 1.



is in the larval condition‡, *i. e.* the yolk is still unabsorbed. The absorption of the yolk takes three or four days, when the

* See Mr. Brook's account of Meyer's experiments with regard to temperature, 3rd Annual Report Fishery Board for Scotland, 1884, p. 49.

† Kupffer gives the length of the newly hatched Baltic herring at 5.2-5.3 millim. (3rd Ann. Rep. S. F. B. 1884, p. 47).

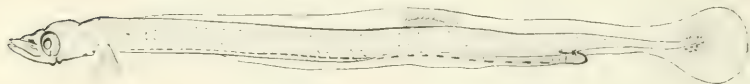
‡ Mr. J. T. Cunningham gives a figure of a larval herring in Trans. R. S. E. vol. xxxiii. pt. 1. It differs slightly from my own figure.

postlarval condition is reached. The mouth is from the first widely open and the eyes a brilliant silvery blue, the newly hatched herring being thus in advance of its ally the sprat.

For the first few days of its life the herring is unable to rise from the bottom, lying on its side and occasionally lashing out with its tail; and even when able to rise it seems to keep near the bottom for some time, larval and early postlarval forms being taken together in great abundance in the bottom trawl-net used at this laboratory on the 30th March, 1889. The postlarval herring is very voracious, not disdaining cannibalism, whilst it is preyed on doubtless by larger fishes. The growth of the herring is at first slow, there being an increase of about $\frac{1}{24}$ inch in the first ten days of free life.

Becoming more vigorous, the postlarval herrings ascend into midwater; specimens (fig. 2) $\frac{5}{12}$ inch long were taken

Fig. 2.



with the midwater-net on March 22, 1889, being thus somewhat earlier than their fellows.

At this length the permanent dorsal fin is clearly indicated, the cartilages of the hyoid and branchial arches are well developed, the pectoral fins are pediculate, the tail shows an indication of the heterocercal condition. The continuous embryonic (median) fin is still retained; the maxillæ are well developed, and bear sharp-pointed teeth on their anterior edges.

On April 14, 1889, the herrings were still in midwater, a little over half an inch in length; the embryonic median fin was nearly or quite lost, and the hypural elements of the tail were well marked.

Pigmentation* other than that of the eyes appears before the postlarval condition is reached and is retained unchanged for a considerable period. It is entirely black, and consists of one or two median chromatophores below the heart, a chain of about ten chromatophores commencing behind each pectoral fin and running backwards on each side of the gut for about half its length; an irregular, sometimes double, chain ventral to the posterior half of the gut; two (sometimes one) stellate

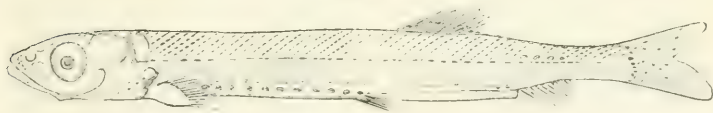
* Cf. Prof. McIntosh and E. E. Prince, "Development and Life-histories of Food-fish," Trans. R. S. E. vol. xxxv.

chromatophores on each side a little in front of and above the vent. Stellate chromatophores are also developed above the posterior end of the notochord, and more abundantly below it. Still in midwater the young herrings appeared next on May 16, 1887, and May 22, 1889, about $\frac{3}{4}$ inch long; the embryonic fin was now entirely lost. Then they were lost sight of till July 20 *, when the length was $1\frac{1}{6}$ inch. They have now something of the appearance of the adult. The gill-cover is developed; the caudal and dorsal fins are in the adult condition, and pelvic and anal fins have appeared. The dorsal fin is immediately anterior to the anus. The body is transparent and scales are absent. The early pigmentation is faint and additional black pigment is appearing at the bases of the dorsal fin-rays, along the back behind the dorsal fin, on the caudal fin, sparingly on the gill-cover, and in the pia mater of the cerebellum.

The herring now seems to desert the deep water for the neighbourhood of the shore, being taken in August in the seine-net on the sands in company with sprats and sand-eels (*Ammodytes tobianus*). It also probably roves about the bay in the same company, forming the "herring sile" known to fishermen and offering great attractions to guillemots and sea-gulls. It is now $1\frac{1}{4}$ inch long; the dorsal pigment extends forward to the head, the lateral line is pigmented, and the pigment of the head and tail is more profuse.

In September the young herring is still on the sands (fig. 3), $1\frac{1}{2}$ to $1\frac{3}{4}$ inch long; the body is still transparent and scale-

Fig. 3.



less, the silvery pigment of the peritoneum is visible. The early pigmentation is almost lost; pigment-dots mark the divisions of the myomeres dorsal to the lateral line. The sides of the body and operculum gleam with a silvery green; the dorsal surface of the head is blotched with yellow, the upper and lower jaws are black, and the pigmentation of the pia mater forms two well-marked pyriform patches over the cerebellum.

In January the young herring is found again in midwater

* Prof. McIntosh and Mr. Prince mention a herring $1\frac{1}{16}$ inch taken on the 1st July (*op. cit.*).

$1\frac{3}{4}$ inch long; scales are now developed, but seem confined to the anterior and ventral parts of the body. The vertebrae are well ossified.

Ewart and Matthews (3rd Ann. Rep. S. F. B.) found a few herrings, $1\frac{1}{2}$ inch long, amongst the shoals of sprats forming the Forth Whitebait in January. From January we must pass to September, when the herring is found on the sands, about $2\frac{1}{2}$ inches long, in the usual company. It has now all the characters of the adult, external and internal, but is probably sexually immature.

One specimen of the herring $4\frac{1}{2}$ inches long was obtained in company with the last, and is probably a year older.

The career of the young herring has now been traced from the spring of one year to the autumn of the next, and perhaps a year longer, with fair continuity, and its rate of growth noted. (Dr. Meyer was enabled to trace the growth of the herring of the Baltic both in confinement and under natural conditions for five months. He gives 65–70 millim. as the size of a five-months' herring (3rd Ann. Rep. S. F. B. p. 50).) Of its subsequent proceedings the specimens here afford no evidence. It probably goes into deeper water. The record of autumn-hatched herrings is less satisfactory. Eggs came under my notice in the middle and end of August; but, as pointed out by Prof. McIntosh and Mr. E. E. Prince (*op. cit.*), there must be considerable variability in the autumn spawning-period, some forms being hatched perhaps in July, whilst others, as appears below, are but a few days old on the 20th September. Incubation is shorter, as the temperature is higher, than in the spring. Eggs were hatched in this laboratory during this September in from seven and a half to eight and a half days. On Sept. 20 we found in midwater postlarval forms varying from $\frac{7}{8}$ to $1\frac{1}{8}$ inch, that is, from a few days to a month old. In November 1888 we found them $\frac{3}{4}$ inch long, and in March 1889, on the bottom, $1\frac{1}{2}$ inch long. Beyond this I have not been able to trace them.

L.II.—Description of a new Species of Water-Shrew from Unalaska Island. By G. E. DOBSON, M.A., F.R.S.

THE type of the very interesting species of Water-Shrew about to be described* was found by me in the excellent

* This species would have been described, as I had hoped, long ago in the third part of my 'Monograph of the Insectivora;' but the state of my health having prevented the appearance of that part, I am anxious to obviate further delay by immediate publication of the following description.

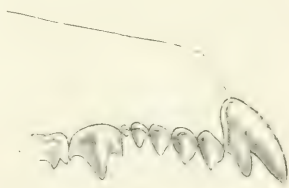
collection of specimens representing the family Soricidae in the Zoological Museum of the Imperial Academy of Sciences at St. Petersburg, which, owing to the kindness of Dr. Strauch, I have been enabled to examine.

Sorex hydrodromus.

Scarcely larger than *S. minutus*, and therefore much smaller than *S. palustris*, which it also differs from in dentition, but resembles in the fringed condition of the digits of the manus and pes. The tail is nearly as long as the head and body and is clothed rather thinly with moderately long hairs, which do not form a fringe; in the form of the muzzle and ears there is nothing peculiar or different from that of *S. minutus*; the feet, however, differ remarkably in the possession of fringes to the digits both of the manus and pes, as well as or even better developed than in *Crossopus foliatus*; a thick comb-like fringe of stiff hairs also extends along the outer and inner margins of both manus and pes, being especially dense and well developed along the outer margins.

Fur reddish brown above, yellowish brown beneath; chin, throat, and chest with greyish-tipped hairs; the base of the hairs both above and beneath dark bluish grey.

The teeth closely resemble those of *S. vulgaris*; as in that species the third incisor is the largest and longest of the unicuspidate teeth; the first maxillary tooth is very nearly equal to the second incisor and quite intermediate in size between the third incisor and the second maxillary tooth; the third maxillary tooth is even more internal than in *S. vulgaris*, in this respect resembling the American representatives of that species, and its long axis is at right angles to the direction of the jaw, its inner and posterior convex margin fitting into the concavity on the inner and anterior side of the fourth maxillary tooth. The mandibular teeth closely resemble those of *S. vulgaris*.



× 7.

Length: head and body 53 millim.; tail 43; eye from end of muzzle $9\frac{1}{2}$; ear, length $6\frac{1}{2}$; elbow to end of middle digit, without claw, 13, manus 6, pes 13; distance between tips of first upper incisor and last premolar $3\frac{1}{2}$.

Hab. Unalaska Island, Aleutian Islands.

Type in the collection of the Zoological Museum of the Imperial Academy of Sciences at St. Petersburg.

This species is evidently aquatic, like *Crossopus fodiens*, the fringes of the manus and pes being even better developed than in that species; but in all generic characters it agrees with those of the genus *Sorex*. While agreeing with *Sorex palustris* from the adjoining continent of America in external characters, it differs from it in the proportions of its teeth, resembling in this respect the section of which *S. vulgaris* is typical, while *S. palustris* agrees with those represented by *S. vagrans*. No better proof could be afforded of the uselessness of retaining *Neosorex* as a distinct genus for the American species characterized by the possession of swimming-fringes in the digits, while the tail is simple, as in *Sorex*. These species are in fact aquatic forms of the genus *Sorex*.

LIII.—*Note on the Variation of the Mandibles in the Males and Descriptions of the Females of the Prionidous Genera Priotyrannus and Cacosceles.* By C. J. GAHAN, M.A., Assistant, Zoological Department, British Museum.

THE variation in the form of the mandibles within the same species of certain genera of Prionidæ has doubtless been known to many entomologists who have studied the family, though no special attention seems to have been called to it. The variation itself is probably of greater degree than has been hitherto suspected. Lacordaire, at least, in his treatment of the Prionidæ, does not give evidence of his knowledge of any great variation.

The subject has lately been brought under my notice while working out the Longicornia of a collection made by G. F. Hampson, Esq., in the Nilghiri Hills, South India.

One species was represented by four specimens, three of which have mandibles so different in form from the fourth, and in other respects are in such complete agreement with it, that I was at first led to believe that I had to deal with the two sexes. But all four proving to be males, it then seemed to be a case of variation in the mandibles parallel to that which occurs in many genera of Lucanidæ (*Odontolabis*, for example). The species was referable to the *Prionus mordax* of White, on which Thomson has founded his genus *Priotyrannus*. The single specimen with incompletely developed mandibles agrees with the male type from which White described the species.

The other three agree with the figure and description which Thomson has given of the species.

Thomson and Lacordaire must have either overlooked or misunderstood White's description of the mandibles, for no mention is made by them of the difference in form.

The first form is well shown in the figure given by Thomson (Arch. Entom. i. pl. x. fig. 1) and is fully described in Lacordaire's characterization of the genus.

The second form fully resembles that of the female, but is somewhat larger in size.

The female of the species was unknown to Thomson and Lacordaire, while White's reference to it is both inaccurate and incomplete. The following are its characters, taken from some fine specimens from the Animallai Hills:—

Mandibles broader than thick, narrowed to an edge on the inner side, provided with teeth along their whole inner edge, strongly curved in and terminating in a sharp point at tip, meeting along their whole length when closed. Head and prothorax coarsely rugosely punctured as in the male; the lateral spines of the prothorax exactly as in the male, but with the spine at the anterior angle somewhat feebler. (White's description in this respect is quite misleading.) Elytra as in the male. Antennæ much slenderer than in the male, not surpassing three fourths the length of the elytra, with the first six joints smooth, glossy, and sparingly punctured, the remaining joints dull and marked with fine longitudinal striations. The last ventral segment of the abdomen is slightly elongated and is rounded at the apex. (In the male this segment is much shorter and broader and is narrowly and sinuately truncated at the apex.)

In addition to the four specimens mentioned there is in the Museum collection a very small male from Bombay with mandibles of the female form. It is much darker in colour, nearly black, but does not otherwise seem distinct. I have not seen any specimens of this genus with distinctly intermediate forms of mandibles.

On extending my observations to allied genera I found a variation of precisely the same character in the African genus *Cacosceles*, as exemplified by some specimens of *C. Lacordairei*, Bates. Here were males with the female forms of the mandibles and males with intermediate forms. This was the more interesting as Lacordaire had, apparently with great confidence, described as females some of the intermediate male forms. The female is in fact very different from the male*.

* For excellent figures of both sexes and descriptions of the females see Peringuey, Trans. S. African Phil. Soc. iii. p. 145, pl. iv. figs. 1-4. These descriptions had escaped my attention before writing the above.

These are its characters:—Mandibles short and broad, narrowed to a thin edge and feebly toothed on the inner side, sharply incurved and pointed at the tip, with their edges superposed along nearly their whole length when closed. Antennæ scarcely reaching to half the length of the elytra. The four posterior tibiæ differ from those of the males in being simple and not dilated. The last ventral segment of the abdomen is narrowly rounded and somewhat pointed at the apex; in the male this segment is transversely truncated. The hind coxæ are rather widely separated and the intercoxal process of the abdomen is obtusely rounded in front; in the male the coxæ are closer together and the intercoxal process is sharply pointed in front.

In the Indian genus *Acanthophorus*, as represented by *A. serraticollis*, Oliv., the same kind of variation is found.

LIV.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander Alfred Carpenter, R.N., D.S.O., commanding.*—No. 13. *On the Bathybial Fishes of the Bay of Bengal and neighbouring waters, obtained during the seasons 1885–1889.* By ALFRED ALCOCK, M.B., Surgeon-Naturalist to the Survey*.

CONTENTS.

- § 1. Outline of the Hydrography of the Region.
- § 2. List of the Fishes, with Descriptions of the new Species.

§ 1. *Outline of the Hydrography of the Region.*

THE bathybial fishes hitherto collected by the 'Investigator' are all from the arm of the Indian Ocean which intervenes between the Indian and Malayan peninsulas—the sea which is generally spoken of as the Bay of Bengal. This vast stretch of water, which occupies roughly the meridians between 78° and 98° E. and the parallels between 5° and 22° N., consists of three distinct basins, namely the Bay of Bengal proper in the centre, the Gulf of Manar to the south-west, and the Andaman Sea on the east. And it will be fitting to prelude the account of the fish-inhabitants of their

* Communicated by the Superintendent of the Indian Museum, Calcutta.

depths with a short outline of the hydrography of the basins themselves.

Bay of Bengal.—The boundaries of the Bay of Bengal on the north and west are too well known to need mention; but the exact delimitation of its basin from that of the Andaman Sea has only recently been fixed with exactitude by Commander Alfred Carpenter, R.N., D.S.O., in charge of the Indian Marine Survey, to which highly scientific officer I am indebted for much more than the facts alone.

On looking at a chart of the Bay of Bengal, a chain of islands (the Prepara, Ceros, Andamans, and Nicobars) is seen to extend, with a slight western convexity, from north to south between Cape Negrais in Burmah and Acheen Head in Sumatra. And on referring to Captain Carpenter's Contour Map of the Bay (*vide* 'Administration Report of the Marine Survey of India for 1888-89') all the contour-curves are seen to converge ultimately within a hundred miles of the western coast of this chain. Quite close to the eastern shore of the chain we find, in the Andaman Sea, depths of from 1100 to 1200 fathoms, while in the channels between the islands, which connect the two seas, the depths range from 150 to 760 fathoms. This is conclusive proof of the existence of two distinct basins, separated by a comparatively narrow ridge rising into the isolated island peaks of the Andamans and Nicobars.

The Bay of Bengal thus defined touches in its extremes the meridians between 80° and 94° E. It has a maximum depth at its mouth of nearly 2400 fathoms, and its minimum temperature hitherto recorded (at 2105 fathoms) is $33^{\circ} \cdot 7$ Fahr., corrected for pressure (Carpenter, "Mean Temperature of Deep-waters of Bay of Bengal," Journ. As. Soc. Beng. vol. lvi. pt. ii. no. 2).

In the northern part, into which the great rivers of India and the eastern ultra-Himalayan region pour their muddy waters, and almost as far south as the 1600 fathom contour, the specimens of the bottom obtained by the 'Investigator' consist of varying grey, green, blue, and brown muds, with comparatively few constituents of direct organic origin; but in the southern and more open part the 'Investigator' has almost always found *Globigerina*-ooze (*Globigerina*, *Orbulina*, and large *Pulvinulina*). Running through the shoal-water at the extreme northern end, opposite the middle of the Brahmaputra-Gangetic Delta, is the Swatch of No-ground. This, which has a direction fairly N.N.E. and S.S.W., is a narrow deep channel of over 300 fathoms in a sea of under 100 fathoms, and is reasonably regarded by Captain Carpenter as the "scour" of the rivers.

According to the researches of the same observer the southern half of the Bay is not a simple basin, for, about three and a half degrees west of the Nicobars, running almost north and south, a remarkable ridge, which may be fitly named, after its discoverer, Carpenter's Ridge, marks off on the south-east, between itself on the one side and the Nicobars and South Andamans on the other, a small basin almost symmetrical with the Gulf of Manaar on the south-west. This ridge is well seen on the contour-map (Admin. Rep. Mar. Surv. Ind. 1888-89), where the contours up to 1600 fathoms sweep across the bay in main directions of west and east or north-west and south-east, while the contours from 1700 to 2200 fathoms, within the parallels of 16° to 6° N., after taking semicircular curves, with their convexities northwards, across the western half of the bay, run down southwards in deep loops in the eastern half round the ridge, turning northwards again to their final convergence off the Nicobar-Andaman coasts. The minimum depth yet found on the ridge is 1340 fathoms.

The Andaman Sea is a good deal land-locked. To the south it passes into the shallow Straits of Sumatra and to the north into the far shallower Gulf of Martaban, which receives the River Irrawádi.

On the west it communicates with the Bay of Bengal by three main channels, the shallowest of which (South Preparis Channel) to the north is 150 fathoms in depth, the deepest being 760 fathoms, between the Nicobars and Sumatra. On the east it is crowded with small islands. Except in its centre and in its south-western part it is shallow. So far the greatest depths known are in the centre (1200 fathoms), close to the east coast of Middle Andaman Island (1159 fathoms, bottom-temperature $39^{\circ}\cdot 5$ Fahr.) and near the same coast of Great Nicobar Island (1284 fathoms). The only specimens of the bottom which I have examined are from 1159 and 1130 fathoms off Middle Andaman Island, and these were dark mud, with but little matter of direct organic origin.

The Gulf of Manaar, between India and Ceylon, communicates with the Bay of Bengal by the shallow Palk Strait. On the south-east its basin is very abrupt. The greatest depth yet found in the more open part of the Gulf is 1466 fathoms (bottom-temperature $34^{\circ}\cdot 8$ Fahr.), and the bottom appears to be green mud throughout. It was in this gulf that the 'Investigator' in 1886 trawled some curious baryta-nodules (Jones, "On some Nodular Stones obtained off Colombo in 675 fathoms," Journ. As. Soc. Beng. vol. lvi. pt. ii. no. 2, 1887).

It would be premature to indulge in any speculations concerning the bathybial fishes of the Bay of Bengal region; but the occurrence in this region of forms so long considered characteristic of the deeper waters of Madeira and the Mediterranean, many of which have also been found more lately to exist in Japanese waters and in the Pacific, must be considered highly interesting. It is interesting also, from another point of view, to find species common to this region and to the American side of the South Atlantic.

§ 2. *List of the Fishes, with Descriptions of the new Species.*

PLAGIOSTOMATA.

SELACHOIDEI.

Family Spinacidæ.

PARACENTROSCYLLIUM, gen. nov.

Allied to *Centroscyllium*.

Two dorsal fins, each with a strong spine. No anal fin. Mouth crescentic, with a direct oblique groove at each angle. Teeth equal in both jaws, minute, simple, monocuspid, straight. No membrana nictitans. Gill-openings rather wide. Integument smooth.

Paracentroscyllium ornatum, sp. n.

All the tissues fragile. Head broad and depressed, the branchial region conspicuously prominent. Body subcylindrical. Tail long. Snout short, broad, depressed. Eyes large, their major diameter being one third of the head-length (branchial region included). Nostrils a little wider than the spiracles, borne at and on the under surface of the edge of the snout. Mouth crescentic and rather wide. Minute, simple, straight, monocuspid teeth in both jaws. Integument absolutely smooth. Dorsal spines very strong, the second much the larger. The first dorsal fin begins an interval behind the pectorals equal to the interval of the second behind the ventrals. Pectorals, ventrals, and caudal all large.

Colours "deep violet-black, lighter between the eyes; head with minute white spots arranged in the shape of a lute; ventrals with pale tips" (*Dr. G. M. Giles*).

Length $5\frac{1}{4}$ inches.

Two males and one female, in bad preservation.

Hab. Bay of Bengal, Swatch of No-ground, 405 to 285 fathoms; bottom Pteropod-ooze and green mud.

BATOIDEI.

Family Rajidæ.

RAJA, Cuv.

Raja mamillidens, sp. n.

All the tissues fragile. Snout short. Disk, including the ventrals, half the total length, its breadth the same; in shape subquadrangular, with rounded pectoral angles and snout; the whole of its upper surface, including eye-covers and fins, densely covered with acuminate granules. The tail similarly covered, on its upper surface and sides in the anterior half, everywhere, including the dorsal and rudimentary caudal fins, in its posterior half. Large recurved spines, one above each angle of each orbit, one inside each inner spiracular angle, one or two on each shoulder-girdle, and thirty in a row down the middle dorsal line as far as the first dorsal fin. Under surface of disk, ventrals, and anterior half of tail perfectly smooth. Width of the interorbital space equal to the length of the orbit and nearly twice the major diameter of the spiracle. Interval between the outer edges of the nostrils greater than the interval between the nostrils and the tip of the snout. Mouth crescentic. Teeth in a pavement, showing twenty-four oblique rows in the upper and eighteen in the lower jaw; each tooth with a broad globular base and a gently pointed mamillary summit. Dorsal fins adjacent but separate.

Colour "uniform jet-black throughout" (*Prof. Wool-Mason*).

One female specimen, $11\frac{1}{2}$ inches long.

Hab. Gulf of Manaar, lat. $6^{\circ} 29'$ N., long. $79^{\circ} 34'$ E., 597 fathoms.

ACANTHOPTERYGII.

Family Berycidæ.

TRACHICHTHYS, Shaw.

Trachichthys intermedius, Hector.

Trachichthys intermedius, Hector, Tr. New-Zealand Inst. vol. vii. p. 245, pl. xi. fig. 18 a; Günther, Zool. 'Challenger' Exp. vol. xxii. p. 24, pl. v. fig. D.

One specimen, from the Bay of Bengal, lat. $19^{\circ} 35'$ N., long. $92^{\circ} 24'$ E., 272 fathoms; bottom-temperature 50° Fahr.

POLYMIXIA, Lowe.

Polymixia nobilis, Lowe.

Polymixia nobilis, Lowe, Cambr. Phil. Trans. 1838, vol. vi. p. 198; Günther, Fishes, vol. i. p. 17.

Nemobrama Webbii, Valenci. in Webb & Berthel. Ichthyol. Iles Canar. p. 41, pl. viii.

Polymixia Loweii, Günther, Fishes, vol. i. p. 17; *Poey, Rep. Cub. ii. p. 158.

**Dicemus venustus*, Poey, Mem. Cub. 1860, pp. 161, 352, pl. xiv. fig. 1.

Polymixia japonica, Günther, Ann. & Mag. Nat. Hist. 1877, vol. xx. p. 436; Steindachner, Denkschr. Ak. Wien, 1883, xlvii. p. 261, tab. iv. fig. 2.

Polymixia nobilis, Günther, Zool. Chall. Exp. xxii. 34, pl. i. fig. B.

One specimen, from the Andaman Sea, off Ross Island (Middle Andaman), 271 fathoms.

Family Trachinidæ.

CHAMPSODON, Günther.

Champsodon vorax, Gthr.

Champsodon vorax, Günther, P. Z. S. 1867, p. 102; Zool. Chall. Exp. vol. i. pt. vi. pp. 43, 52, 56, pl. xxiii. fig. A, vol. xxii. p. 49; Alcock, Journ. As. Soc. Beng. vol. lviii. pt. ii. no. iv. 1889.

Several specimens from the Bay of Bengal, 40 miles southwest of Akyab, 100 fathoms.

Family Pediculati.

CHAUNAX, Lowe.

Chaunax pictus, Lowe.

Chaunax pictus, Lowe, Trans. Z. S. vol. iii. p. 339, pl. li.; Günther, Fishes, vol. iii. p. 200; Goode, Proc. U. S. Nat. Mus. vol. iii. 1881, p. 470.

**Chaunax fimbriatus*, Hilgendorf, Sitz. Gesellsch. naturf. Freunde, 1879, p. 80; Steindachner & Döderlein, Denkschr. Ak. Wien, xlix. 1884, p. 194.

Chaunax pictus, Günther, Zool. Chall. Exp. xxii. p. 53, pl. x. fig. A.

Several specimens, from the Bay of Bengal, lat. 20° 17' 30" N., long. 88° 51' E., 272 fathoms.

* These references I give on the authority of Dr. Günther, to whose great work I am entirely indebted.

HALIEUTÆA, C. & V.

Halieutæa coccinea, sp. nov.

D. 5. A. 4. C. 9. P. 14. V. 1/5.

Discriminated at once from *Halieutæa stellata* by the less depressed head, the fine needle-pointed spines, which also extend over the under surface, and the bilobed supraoral tentacle. Head much as in *H. stellata*, but with its surface more convex from side to side and rising more from behind forwards, so that anteriorly it forms a wide dome. Disk and body uniformly covered above and below with spines having stelliform bases and simple, tapering, acute points, except round the edge of the disk, where they are trident; those on the under surface are small. Skinny filaments round the disk and mouth few and inconspicuous. Supraoral tentacle with two fleshy lobes. Eyes large, their major diameter one ninth the disk-length. Interorbital space widest behind, where it is equal to two eye-lengths, slightly concave in front, flat behind; its surface covered with small stelliform spines. No prominent supraorbital edge. Nostrils situated as in *H. stellata*, but proportionately larger. Mouth as in *H. stellata* and with similar teeth; its cleft nearly half as broad as the disk, its floor up to the root of the tongue coloured (sepia-brown in spirit).

Other external characters as in *H. stellata*.

Colours:—"Dorsum bright pink, with fine black vermicular lines; under surface dark crimson" (*Prof. Wood-Mason*). In spirit quite white, with the dark vermicular lines showing.

Branchial and peritoneal cavities lined with a thick, jet-black, velvety membrane. Intestine long and coiled. No pyloric cæca.

One specimen, $7\frac{1}{8}$ inches long.

Hab. Andaman Sea, 7 miles south-east by south of Ross Island (Middle Andaman group), in 265 fathoms.

One more Acanthopterygian remains to be described—an apparently mature bathybial fish, which does not wholly conform to the diagnosis of any described family of the suborder. In the majority of its characters it agrees with the Trachinidæ, differing, however, from the members of that family in the entire absence of teeth. It appears, in short, to be a toothless Trachinid. I describe it, leaving its exact determination to more experienced ichthyologists.

BREPHOSTOMA, gen. nov.

Soft tissues, except the dermal productions, rather delicate. Head large, quite unarmed. Body low, rather elongate, with large ctenoid scales. Mouth small, oblique, weak. Teeth entirely absent. Eyes large, lateral. Two dorsal fins, the spinous the less developed; anal similar to the soft dorsal; ventrals thoracic, with one spine and five rays. Gill-opening very wide; seven branchiostegals; pseudobranchiæ. No anal papilla. No air-bladder. Long pyloric cæca, in moderate number.

Brephostoma Carpenteri, sp. nov.

B. 7. D. $5\frac{1}{10}$. A. $\frac{1}{9}$. L. lat. 30. L. tr. 12.

Soft tissues, except the dermal productions, rather delicate. Body low, rather elongate and compressed, gently diminishing from the shoulder to the base of the caudal. Head pyramidal, entirely unarmed; cranial bones, but not the other head-bones, firm. Snout short, broad, depressed, wedge-like, barely two thirds of the diameter of the eye in length. Eyes lateral, large, circular, their diameter more than one third the length of the head. Supraorbital margin in the dorsal profile. Pre-orbital a broad triangular plate, almost overlapping the closed mouth.

Infraorbitals apparently not articulating with the preoperculum. Nostrils small. Mouth lateral, small, its cleft oblique, barely reaching to the level of the anterior border of the orbit. Jaws weak, edentulous, but with semicartilaginous cutting-edges, that of the lower jaw the more prominent and ending just inside the angle of the mouth in an oval plate. The lower jaw closes inside the upper, except anteriorly, where it projects slightly; its rami are so broad that their lower edges are in contact with each other through the greater part of their extent. Vomer and palatines edentulous. Tongue free, smooth. Floor of the mouth black. No barbels. Gill-cover complete, its constituent bones almost membranous and quite unarmed; the preoperculum with a double edge. Seven branchiostegals. Gill-openings very wide, the gill-membranes entirely separate. Four gills, with well-developed laminae. Four gill-clefts. Large pseudobranchiæ. Gill-rakers of the outside of the first arch numerous, close-set, and long, elsewhere very short. Gill-chamber black.

The entire head and body covered with strong, thick, oblong, adherent, imbricating, ctenoid plates, those on the body from $\frac{2}{16}$ to $\frac{1}{4}$ inch in their major diameter, those on the opercles and

cheeks a little larger. There are thirty rows between the gill-opening and the caudal base and twelve between the first dorsal fin and the median abdominal line. The lateral line follows the dorsal profile, at two rows of scales distance, uninterruptedly from the shoulder to the caudal base. Two normally situated dorsal fins, separated by a snout-length, the second much the higher; the first has five stout sharp spines, the three anterior a little longer than the snout; the second has one short spine and ten branched rays, and is invested at its base with scales. Anal with one spine and nine branched rays, situated opposite the second dorsal, and similar to it in every respect. Caudal short, forked; its proximal half scaly. Pectorals well developed, as long as the head without the snout. Ventrals thoracic, with one spine and five rays with scaly bases.

Colour:—Head, body, fins, and iris uniform black.

No air-bladder. Long pyloric cæca in moderate number. No prominent anal papilla.

One specimen, measuring 4 inches from the tip of the snout to the base of the caudal.

Hab. Bay of Bengal, summit of Carpenter's Ridge, lat. 6° 18' to 16' N., long. 90° 40' to 44' E., 1370 to 1520 fathoms.

The probability that this fish came actually from the bottom is increased by the fact that it was imbedded in the head of one of the swabs. Such a position, in the case of an active animal like a fish, would result from the swab settling over the fish as it lay on the bottom, and can hardly be accounted for otherwise.

ANACANTHINI.

The Indian deep-sea representatives of this suborder hitherto obtained are remarkable for their small size. The largest Ophidiid measures 11½ inches and the largest Macrurid 11 inches, while most of our specimens of both these families are much smaller. That this is not due to immaturity is proved by the fact that a majority of the specimens are females with enlarged ovaries full of apparently ripe ova.

Family Ophidiidæ.

SIREMBO, Bleeker.

Sirembo nigripinnis, sp. nov.

B. 8. D. circ. 95. A. circ. 85. C. ? P. 28. V. 1.

Head small, scaly, a good deal lower than the body, which

is compressed, elongate, and tapering, with a maximum height nearly equal to the length of the head. Snout as long as the eye, or $4\frac{3}{4}$ in the head-length, rounded, scaly. Interorbital space wider than the eye, and, like the crown of the head, flattened. Operculum with one spine above. Preoperculum excised at its angle. Nostrils of moderate size, the anterior near the end of the snout. Mouth wide, the maxilla reaching behind the posterior border of the orbit. No barbel. Villiform teeth in bands in the jaws, palatines, and vomer. Tongue small. Gill-cleft wide; four gills, with narrow laminae. Pseudobranchiae thick and fleshy. Gill-rakers numerous and almost as long as the eye on the first arch; elsewhere almost tuberculate. Scales small, smooth, deciduous. Lateral line running about nine rows of scales below the dorsal fin. Vertical fins united with the caudal; the dorsal begins in the vertical to the base of the pectoral, the anal a head-length behind the same level. Pectorals fine, pointed, not quite as long as the postorbital portion of the head. Ventrals simple filaments arising at the symphysis of the pectoral arch; in length equal to the postorbital portion of the head.

Colours in spirit uniform sepia-brown, with black fins.

Stomach siphonal: one rudimentary and nine medium-sized caeca in a ring round the pylorus. Air-bladder present.

A single rather mutilated specimen $6\frac{1}{2}$ inches long.

Hab. Andaman Sea, $7\frac{1}{2}$ miles east of North Cinque Island, 490 fathoms.

NEOBYTHITES, Goode and Bean.

Neobythites macrops, Gthr.

Neobythites macrops, Günther, Zool. Chall. Exp. vol. xxii. p. 102, pl. xx. fig. A.

Several specimens from the Andaman Sea, off Ross Island, in 265 to 271 fathoms.

DIPLACANTHOPOMA, Gthr.

Diplacanthopoma brachysoma, Gthr.

Diplacanthopoma brachysoma, Günther, Zool. Chall. Exp. vol. xxii. p. 115, pl. xxiii. fig. C.

A female $4\frac{1}{4}$ inches long, with gravid ovaries.

Hab. Andaman Sea, $7\frac{1}{2}$ miles east of North Cinque Island, 490 fathoms.

PYCNOCRASPEDUM, gen. nov.

Allied to *Barathrodemus*.

Head large, body compressed, both covered entirely with small, thin, smooth, rather deciduous scales. Head-bones and opercles spineless. Snout short, broad, and not overhanging the jaws, which are equal in front. Eye of moderate size. Mouth very large; teeth in villiform bands in the jaws, palatines, and vomer. No barbel. Gill-openings wide, gill-membranes entirely separate; four gills; eight branchiostegals; no pseudobranchiæ. Lateral line incomplete on the tail. Vertical fins invested with thick scaly skin. Caudal free, united with the verticals at its extreme base only. Pectoral fins entire. Ventral fins in the form of bifid filaments.

Pycnocraspedum squamipinne, sp. nov.

Head large, flattened a little laterally and very much at its crown; body broad immediately behind the head, where its height is $5\frac{1}{4}$ in the total length; its posterior portion and the tapering tail compressed. Head in length $3\frac{2}{3}$ in the total (with caudal); its height $1\frac{5}{8}$ in its length; its width a little over $\frac{2}{3}$ its height; all its bones strong and smooth. Snout broad, rounded, rather depressed, flattened at the tip, and not overhanging the jaws; its length is hardly more than that of the eye, which is one sixth of that of the head. Interorbital space flat and wider than the long diameter of the eye. Operculum with a bony ridge above, ending in a blunt point. Preoperculum slightly emarginate at its angle. A large open nostril in front of the eye and a smaller valved one near the edge of the snout. Cleft of mouth obliquely ascending, its gape enormous. The maxilla, which extends behind the vertical from the posterior border of the orbit, is much expanded posteriorly, and there covered with scales. The premaxillaries are protractile and not closely approximated. All the jaw-bones very strong. Teeth in villiform bands in the jaws and palatines and in a V-shaped patch on the vomer.

Gill-openings very wide; gill-laminæ rather broad; four long gill-rakers on the outer edge of the middle of the first arch, elsewhere in the form of short knobbed styles. Body and head covered with small, thin, smooth, rather deciduous scales, fifty-two in a transverse line through the anus. The lateral line ends in the posterior fourth of the tail. Vertical fins with stout rays invested with thick integument and covered with scales smaller than those on the body; the dorsal begins just in front of the base of the pectorals. Caudal ex-

panded posteriorly, with a vertically straight edge, its base united with the vertical fins. The pectorals, which have fleshy free bases, are as long as the postorbital portion of the head and are scaly through their basal third. The ventrals are bifid filaments, inserted at the symphysis of the pectoral arch.

Colours in life :—"Head slate-coloured ; body uniform dirty green-chocolate, the vertebral line showing through as a lake-coloured stripe" (*Dr. G. M. Giles*). Vertical fins black in spirit.

Abdominal cavity large, parietal peritoneum black ; stomach siphonal, with a bulbous pyloric portion ; the first part of the intestine passes straight forward, and has on each side, in a row, six large long cæca, and at the pylorus a single median one ; it then turns abruptly back, and is thrown into a wide coil held by stout mesentery, beyond which it is straight. Air-bladder large and saccular.

Three specimens, the longest being $11\frac{1}{2}$ inches.

Hab. Bay of Bengal, lat. $20^{\circ} 17' 30''$ N., long. $88^{\circ} 50'$ E., 193 fathoms ; temperature at bottom 52° Fahr.

PARADICROLENE, gen. nov.

Allied to *Dicrolene* and *Pteroidonus*.

The lower pectoral rays detached from the upper part of the fin, free, and prolonged. Body elongate and compressed ; it and the head covered with small thin scales. Snout short, broad, and not overhanging the jaws. Eye moderate. No supraorbital spines. Mouth wide ; teeth in villiform bands in the jaws, palatines, and vomer. No barbel. Operculum and preoperculum armed. Gill-openings wide ; gill-membranes entirely separate ; four gills ; eight branchiostegals ; no pseudobranchiæ. Lateral line incomplete on the tail. Vertical fins invested by the integument, but not scaly. Caudal free, joined at its base only to the vertical fins. Ventral fins in the form of bifid filaments.

Paradicrolene multifilis, sp. nov.

B. 8. D. circ. 100. A. circ. 85. C. 4. P. 18/8-10.

V. 2. L. tr. 34 above vent.

Head conoid, body elongate and compressed, tail finely tapering. Height of the body a little over one sixth of the total length (with caudal). Length of head about $4\frac{1}{2}$ in the total (with caudal) ; its height nearly two thirds its length,

its width four fifths of its height; all the bones strong. Snout as long as the eye, which is nearly one fifth of the length of the head, broad, rounded, and not overhanging the jaws. Supraorbital margin sharp; interorbital flat from side to side, in width equal to three half-diameters of the eye. Operculum with a strong horizontal bony stay, ending in a long spine, and with an obliquely vertical stay not ending in a distinct spine. Preoperculum with three radiating flat spines at its angle. Nostrils large and open, their longer diameter, which in the anterior is nearly horizontal, in the posterior nearly vertical, is equal to half the diameter of the eye. Cleft of mouth oblique, its gape wide. The dilated scaly extremity of the maxilla reaches half a diameter of the eye behind the posterior border of the orbit. The lower jaw is included within the upper and has a large open pore on each side behind the symphysis. Narrow bands of villiform teeth in the jaws and palatines and in a V-shaped patch on the vomer. About eleven gill-rakers nearly three fourths the length of the eye along the outer edge of the first arch; elsewhere they are short and truncated. Head and body covered with small, thin, smooth scales. The lateral line runs six rows of scales below the dorsal fin and ends in the last third of the tail. The vertical fins are invested by the integument, but are not scaly; the dorsal is the higher, and begins behind the vertical through the root of the pectoral, the distance of the origin of the anal from the same point being equal to the length of the head without the snout. The caudal is nearly half as long as the head and very narrow; its base only is adherent to the vertical fins.

The pectoral, which has a broad fleshy base, is slightly longer than the head without the snout; its eight to ten lower rays are stronger than the others, detached, and free throughout, decreasing in length from above downwards, the longest being one third longer than the fin. The ventrals are bifid filaments, arising in advance of the vertical from the posterior edge of the operculum, and one third the length of the head.

Colours in life:—"Head slate-coloured, body uniform dirty green-chocolate, the vertebral line showing through lake-coloured" (*Dr. G. M. Giles*).

Parietal peritoneum black; stomach siphonal, with a bulbous pyloric portion; a few rudimentary villiform pyloric cæca. Air-bladder moderate. Many of the specimens with gravid ovaries and apparently mature ova.

Average length $6\frac{1}{2}$ inches.

Hab. Bay of Bengal, lat. $20^{\circ} 17' 30''$ N., long. $88^{\circ} 50'$ E., 193 fathoms; temperature 52° Fahr.

A single specimen, $7\frac{1}{4}$ inches long, from the Andaman Sea, east of Port Blair, 271 fathoms, has the abdominal region equal to the length of the head and the ventral filaments half as long as the head.

SACCOGASTER, gen. nov.

Allied to *Catolax*.

Body compressed, little elongate, partly invested by minute, membranous, non-imbricating scales. Abdomen large. Head with loose scaleless skin. Snout a little inflated, not projecting beyond the equal jaws. Bones of the head firm, without spines, the mucous channels well developed but without conspicuous external openings. Opercles unarmed. No barbels. Eyes small. Mouth wide. Bands of villiform teeth in jaws, palatines, and vomer, and an inner row of enlarged teeth in the mandible. Vertical fins confluent with the caudal. Ventrals simple filaments. Four gills; eight branchiostegals; no pseudobranchiæ. No pyloric cæca.

Saccogaster maculatus, sp. nov.

B. 8. D. circ. 82. A. circ. 55. P. 18. V. 1. C. 12?

Head with aspect of *Collichthys*; body deep, with an inflated abdomen abruptly constricted at its junction with the low, compressed, tapering tail. Length of head $3\frac{3}{8}$ in the total, three fourths as broad as high, abruptly convex behind the broad depressed interorbital region, covered with a loose scaleless skin. Snout half as long again as the diminutive eye, broad, depressed, inflated laterally, but not overhanging the jaws. Operculum with a bony stay, not ending in a distinct spine above. Preopercular border full, sloping backwards, rounded and smooth. Preorbital broad. The eyes, which are deep-set and covered with loose tough skin, are placed far forward, and by the flattening of the fore part of the head occupy an almost superior position, but with a lateral visual axis; their long diameter is rather less than one ninth the length of the head and less than their distance apart. Nostrils inconspicuous. Cleft of mouth wide and oblique; the maxilla is half as long as the head, and has a much dilated posterior extremity; rami of the lower jaw broad, with sharp lower edge. Villiform teeth in the jaws, palatines, and vomer, and an inner close-set row of uniformly enlarged teeth in the mandible. Tongue large, thick, and fleshy. Gill-openings very wide, the membranes united at their extreme anterior limit; gill-laminæ narrow; gill-rakers almost tuber-

culate. A broad bridge of loose skin connects the gill-cover with the base of the pectoral fin. Integument loose, thin but tough, covered along the flanks of the body only with minute, membranous, irregular, non-imbricating scales. Lateral line, if present, only on the anterior part of the trunk. Vertical fins confluent with the caudal, which is pointed and half as long as the head; the dorsal begins behind the vertical through the base of the pectoral, the anal a head-length and a quarter behind the same level. Pectoral with a thick, fleshy, free base, constituting one third the entire extent of the fin. Ventrals simple filaments arising in the vertical from the posterior border of the preoperculum.

Colours in life:—"Head dark chocolate; body light chocolate, with minute white spots along its sides" (*Dr. Giles*).

Abdominal cavity large; stomach siphonal; no pyloric cæca. An air-bladder.

Two specimens, both females with gravid ovaries, one $3\frac{3}{8}$ inches, the other 4 inches long.

Hab. Bay of Bengal, lat. $20^{\circ} 17' 30''$ N., long. $88^{\circ} 50'$ E., 193 fathoms.

GLYPTOPHIDIUM, gen. nov.

Allied to *Bathyonus*.

Head large, body compressed, with a long tapering tail. Scales deciduous and very thin. Bones of head soft and cavernous, with prominent outstanding crests. Operculum small, with one feeble spine. Snout obtuse. Jaws equal in front. Mouth wide. Villiform teeth in narrow bands in the jaws, palatines, and vomer. No barbel. Eyes large. Caudal free. Ventrals simple filaments. Gills four, with short laminae. Branchiostegals eight. Pseudobranchiae. Pyloric appendages small.

Glyptophidium argenteum, sp. nov.

B. 8. D. 98. A. 75. C. circ. 15. P. 23. V. 1.

Head and body compressed, tail long and tapering, with a long, narrow, free caudal. Length of head nearly $4\frac{1}{2}$, maximum body-height $5\frac{1}{5}$ in the total (caudal included). In spirit nine frill-like, membranous, longitudinal crests stand out on the head, namely an interrupted median one from snout to occiput, and on each side a supraorbital, a temporal, an infra-orbital, and a submandibular. Snout as long as the eye, or $4\frac{1}{5}$ in the head, broad, rounded, and not overlapping the equal

jaws. Interorbital space wider than the eye. Operculum very small, with a feeble flat spine above; preoperculum expanded, with a rounded margin. Teeth in narrow bands on the jaws, palatines, and hyoid, and in a V-shaped patch on the vomer. Mouth large, its cleft oblique. Jaws slender. Gill-opening wide; gill-laminae very narrow; gill-rakers numerous and elongate on the outer side of the first branchial arch, elsewhere very short. Scales deciduous and extremely thin. Lateral line undistinguishable. The dorsal fin begins in front of the vertical through the base of the pectoral, with the anal at a distance behind equal to the length of the head behind the middle of the orbit. Caudal nearly half as long as the head, united with the vertical fins at its base only. Pectorals pointed, as long as the head without the snout. Ventrals arising at the pectoral symphysis.

Colours in spirit :—Head and body silvery, with minute black specks; fins silvery grey.

A siphonal stomach, with a bulbous pyloric portion; it and the long coiled intestine invested in black peritoneum; six small pyloric caeca in a ring round the pylorus. An air-bladder.

One specimen, rather mutilated, $7\frac{3}{4}$ inches long.

Hab. Andaman Sea, off Ross Island, in 271 fathoms.

Family Macruridæ.

MACRURUS, Bloch.

Subgenus CÆLORHYNCHUS (Giorna).

Macrurus parallelus, Gthr.

Macrurus parallelus, Günther, Ann. & Mag. Nat. Hist. 1877, vol. xx. p. 439; Zool. Chall. Exp. vol. xxii. p. 125, pl. xxix. fig. A.

Two young specimens, in bad preservation, believed to be this species.

Hab. Gulf of Manaar, lat. $6^{\circ} 29' N.$, long. $79^{\circ} 34' E.$, 597 fathoms.

Subgenus MACRURUS (Bloch).

Macrurus investigatoris, sp. nov.

B. 7. D. 12. A. circ. 100. P. 21. V. 9.

The whole of the head except the maxilla, the upper part of the mandible, and the glosso-hyal region densely scaly

Snout not quite so long as the eye, with a median and two lateral, rough, marginal knobs; overhanging the mouth.

Diameter of the eye $3\frac{3}{4}$ in the head-length, and exceeding the width of the flat interorbital space. Nostrils, especially the posterior, very large, joined by a broad loop of skin which gives the anterior a subtubular appearance. Mouth inferior, small, its cleft hardly passing behind the level of the anterior border of the orbit. Barbel barely half as long as the eye. Teeth in villiform bands in the jaws, only the outer row in the premaxillæ enlarged. Gill-membranes rather broadly united. Scales uniform, moderate-sized on the body, smaller on the head, very small on the snout. A scale from the abdomen has nine parallel longitudinal rows of long accumbent spinelets, the last in each row projecting beyond the edge of the scale; there are about eight spinelets in the middle row, and two in the outermost. To the naked eye, and even with the hand-lens, these rows of spinelets appear like unbroken keels. The scales along the edge of the snout and the supra-orbital ridge are thorny. The lateral line runs six rows of scales distant from the base of the first dorsal fin. Second dorsal spine somewhat prolonged, its front edge with about eighteen equal semirecumbent barbs. The second dorsal fin arises less than a head-length behind the first; its anterior rays inconspicuous. Pectoral pointed, as long as the head behind the middle of the eye. Ventrals with the outer ray produced into a filament longer than the fin itself.

Colours in life:—"Body dull grey; abdomen slate-coloured; sides of head and lower jaw silvery; operculum violet-black; first dorsal black, with white root and tip" (*Dr. G. M. Giles*).

A cluster of about twelve long filiform appendages round the pylorus. A large thin-walled air-bladder.

Several specimens with gravid ovaries.

Greatest length 8 inches.

Hab. Andaman Sea, all along the Andaman chain, in 265 to 490 fathoms; Bay of Bengal, from 193 to 405 fathoms.

The commonest apparently of the Indian Macrurids.

Many specimens carry parasitic Copepods.

Macrurus semiquincunciatus, sp. nov.

B. 7. D. 12. P. 21. V. 11. (A. ?)

Head squarish. Snout barely longer than the eye and not greatly overhanging the mouth; a single median marginal tubercle. Diameter of the eye rather over one fourth the

length of the head and exceeding the width of the flattened interorbital space. Nostrils very large, the anterior separated from the posterior by a broad loop of skin. Cleft of mouth hardly extending behind the anterior border of the orbit. Barbel as long as the eye. A broad band of villiform teeth in each jaw and in the upper an outer row of considerably enlarged teeth. Gill-laminae broad. Head and body covered with spinigerous imbricating scales, those on the body of a uniform moderate size, with about fifteen longitudinal parallel rows of spinelets, the last in each row projecting far beyond the edge of the scale; and towards the distal end of each interspace between these rows is a short series of similar spinelets only slightly projecting beyond the edge of the scale. Eight series of scales between the first dorsal fin and the lateral line. Dorsal fins separated by an interval equal to the length of the base of the first. Second dorsal spine as long as the head, with fifteen equal semirecumbent barbs along its front edge. Outer ventral ray produced into a long filament.

Colours in spirit :—Sepia-brown; first dorsal, pectoral, and ventral fins black, anal edged with black.

Twenty-two long vermiform pyloric caeca. A large air-bladder.

One specimen, 8 inches long, the tail a healed "stump."

Hab. Bay of Bengal, south by west of North Sentinel Island (Andamans), in 130 to 250 fathoms.

Macrurus brevirostris, sp. nov.

B. 6. D. 12. P. 19. V. 10.

Snout conspicuously short, with a prominent median marginal tubercle. The horizontal diameter of the eye is nearly one third the length of the head, nearly twice the length of the snout without the nasal tubercle, and much in excess of the width of the interorbital space. Mouth inferior, its cleft just reaching the level of the anterior border of the orbit. Barbel slender, not so long as the eye. Teeth in a broad villiform band in each jaw, and in the upper two outer rows of enlarged teeth, those in the outermost row regular and much enlarged, those in the more internal row irregular and less enlarged. Gill-membranes broadly united. Scales small on the head, uniformly large on the body. A scale from the abdomen has more than twenty approximated rows of close-set conical spinelets, of which five arrangements can be easily distinguished, according to the point from which the scale is

viewed, namely : in oblique rows from above and before downwards and backwards, or from below and before upwards and backwards ; in less oblique rows converging from above and below to an incomplete horizontal median row ; in regular equidistant concentric curves, of which the outer are interrupted at the edge of the scale, round a central horizontal row ; and in a deep, close-set, diminishing series of quincunxes. There are seven and a half rows of scales between the base of the first dorsal fin and the lateral line. The interval between the dorsal fins is equal to the length of the postorbital portion of the head. The second dorsal spine, which is prolonged into a short filament, is longer than the head and edged in front with twenty-two semirecumbent barbs. The outer ventral ray is produced into a filament nearly as long as the fin.

Colours in spirit :—Grey ; abdomen, throat, and paired fins black.

About thirty-five very large, long, pyloric caeca. Liver large, its right lobe occupying the whole of that side of the abdominal cavity. An air-bladder.

One specimen, 11 inches long.

Hab. Andaman Sea, $7\frac{1}{2}$ miles east of North Cinque Island, in 490 fathoms.

Macrurus macrolophus, sp. nov.

B. 6. D. 11. A. 66. P. 21. V. 8.

Head conspicuously long, $3\frac{1}{2}$ in the total. Snout rounded, with a small low nasal tubercle, overhanging the mouth, hardly longer than the eye. Eye large, its diameter $4\frac{1}{4}$ in the head-length and considerably exceeding the width of the bilaterally-flattened interorbital space. Nostrils moderate-sized. Mouth inferior, its cleft not reaching the vertical from the anterior border of the orbit. Barbel less than half the length of the eye. A broad band of villiform teeth in each jaw, and in the upper an outer row of slightly enlarged teeth. Gill-openings rather narrow ; the gill-membranes not directly united, but attached on each side to the broad isthmus ; gill-laminae rather broad. Head and body covered with scales, those on the body uniformly large. A scale from the abdomen has about seventeen series of semierect conical spinelets, arranged similarly to those of *M. brevirostris*. There are five rows of scales between the base of the first dorsal fin and the lateral line. The dorsal fins are separated by an interval equal to the length of the postorbital portion of the head.

The second dorsal spine is produced into a long filament and is nearly twice the length of the elongated head, or about half the total length of the fish; the basal portion has twenty close-set semirecumbent barbs and the filament several distant more upright spinelets. The outer ventral ray produced into a filament not quite so long as the fin.

Colours in spirit:—Grey; first dorsal, pectorals, and ventrals black, the dorsal filament white.

Ten large, long, pyloric caeca; intestine much coiled. An air-bladder.

One specimen, a female, $9\frac{1}{2}$ inches long, with gravid ovaries.

Hab. Andaman Sea, south-east by south of Ross Island, in 265 fathoms.

Macrurus lophotes, sp. nov.

B. 6. D. 13. V. 9.

Head rather square. Snout with a very prominent nasal tubercle, a little longer than the eye, which is $4\frac{1}{2}$ in the head-length and wider than the interorbital space. Mouth inferior, its cleft reaching the vertical from the middle of the orbit. Barbel very small. Teeth in broadish villiform bands in both jaws, the upper jaw with a slightly enlarged outer row. Scales very small, with five short, longitudinal, parallel series of long, rather recumbent spinelets, the distal ones projecting far beyond the edge of the scale. Six rows of scales between the first dorsal fin and the lateral line. The second dorsal spine, which is produced into a long filament, is nearly twice as long as the head and armed along its entire extent with thirty semirecumbent barbs. Ventrals with the outer ray produced into a filament.

Colours in spirit:—Pinkish grey; opercles black.

Two specimens, 5 inches long, in fragments.

Hab. Bay of Bengal, the "Swatch," in 285 to 405 fathoms.

The specimens are far too much spoilt for complete description.

Macrurus polylepis, sp. nov.

B. 7. D. 11 (12). A. circ. 140. P. 19. V. 10.

Head deep, compressed, rather square, rising steeply from behind the orbits to the first dorsal fin, much higher than the low tapering body. Tail extremely long, filiform. Snout shorter than the large eye, with a prominent spiny nasal tubercle, flanked on each side by a rough marginal knob.

Diameter of the eye $3\frac{1}{2}$ in the head-length, much exceeding the width of the flattened interorbital space. Nostrils large, contiguous. Mouth inferior; the maxilla reaches the vertical from the middle of the orbit. Villiform teeth in the jaws, the outer row in the upper jaw enlarged. Barbel about as long as the eye. Opercular region square, very deep and broad. Gill-openings wide, the membranes united only in front. Gill-laminæ very broad. Scales rather deciduous and uniformly minute, each with about seven short, longitudinal, parallel series of spinelets, the last in each series projecting well beyond the edge of the scale. Eight rows of scales between the first dorsal fin and the lateral line. Second dorsal separated from the first by an interval equal to the length of the latter's base. Second dorsal spine with large semirecumbent distant barbs. First ventral ray produced into a filament longer than the fin.

Colours in life:—"Body dull grey; abdomen slate-coloured; sides of head and lower jaw silvery; operculum violet-black; dorsal fin black, with white root and tip" (*Dr. G. M. Giles*).

Two specimens, $5\frac{1}{4}$ and $6\frac{1}{8}$ inches long respectively, both much damaged.

Hab. Bay of Bengal, lat. $20^{\circ} 17' 30''$ N., long. $88^{\circ} 51'$ E., in 193 fathoms, and lat. $19^{\circ} 35'$ N., long. $92^{\circ} 24'$ E., in 272 fathoms.

Subgenus MYSTACONURUS, Gthr.

Macrurus heterolepis, sp. nov.

B. 6. D. 11. A. circ. 100. P. 14. V. 10.

Head much exceeding the trunk in all three dimensions, its mucous-cavities and its bony ridges, except the infra-orbital, well developed. The short trunk falls abruptly to the long filiform tail. Snout truncated, much shorter than the eye, hardly overlapping the upper jaw. Diameter of the eye $3\frac{1}{4}$ in the head-length and less than the width of the inter-orbital space. Mouth wide, hardly inferior, its cleft reaching the vertical from the middle of the orbit. Jaws slender. A ciliiform barbel about half as long as the eye. Teeth in both jaws in a narrow villiform band. Gill-cleft wide; the membranes united only quite anteriorly. Gill-laminæ very narrow. Integument thin. Head scaleless. Body covered with very thin and deciduous scales of two forms, those immediately behind the head being large and perfectly smooth, those on

the rest of the body being small and covered with semierect spinelets arranged quincuncially—six deep in the middle line of the scale. Seven rows of scales between the first dorsal fin and the lateral line. The interval between the dorsal fins is equal to the length of the postorbital portion of the head. First dorsal spine almost invisible, second long and smooth throughout. Outer ventral ray produced into a filament longer than the fin. Pectorals long and slender.

Colours in spirit:—Silvery, with small black dots; throat and abdomen black; iris silvery.

Eight pyloric cæca. An air-bladder.

Maximum length $6\frac{1}{2}$ inches.

Five specimens, two of which are females with gravid ovaries.

Hab. Andaman Sea, off Ross Island, in 265 to 271 fathoms; Bay of Bengal, between North and South Sentinel Islands, in 220 to 240 fathoms.

Subgenus CHALINURUS (Goode and Bean).

Macrurus hispidus, sp. nov.

D. 11. P. 19. V. 8.

Head compressed. Tail long and tapering. Snout slightly overhanging the upper jaw, short, truncated, with a small abrupt nasal tubercle. Eye in diameter $3\frac{3}{4}$ in the head-length, one fourth longer than the snout, and exceeding the width of the interorbital space. Cleft of mouth lateral, extending to the vertical from the middle of the orbit. Barbel stout, as long as the eye. Teeth in four ranks in the premaxilla, those in the outer rank large, those in the inner ranks minute; mandibular teeth uniserial, large. Opercular region very long and deep; preoperculum almost square. Gill-openings wide; the gill-membranes united only at the very front. Attachment of the first branchial arch to the wall of the gill-cavity narrow. Scales thin, deciduous, of a uniform rather small size on the body. A scale from the abdomen has from fourteen to eighteen weak, semierect, yielding spines, arranged in five short, very oblique, equidistant rows. Six rows of scales between the first dorsal fin and the lateral line. The interval between the dorsal fins is equal to the length of the head behind the middle of the orbit. Second dorsal spine with numerous small semirecumbent spines.

Colours in life uniform blackish; cheeks and iris silvery.

One specimen, $6\frac{3}{4}$ inches long, much injured.

Hab. Bay of Bengal, between North and South Sentinel Islands, in 220 to 240 fathoms.

Subgenus MALACOCEPHALUS, Gthr.

Macrurus lævis.*Macrurus lævis*, Lowe, P. Z. S. 1843, p. 92.*Malacocephalus lævis*, Günther, Fishes, vol. iv. p. 397; *Lütken, Vid. Meddel. nat. Foren. Kjöbenhavn, 1872, p. 1.*Macrurus lævis*, Günther, Zool. Chall. Exp. vol. xxii. p. 148, pl. xxxix. fig. B.

One specimen, from the Andaman Sea, off Ross Island, in 265 fathoms.

Family Pleuronectidæ.

SCIANECTES, Alcock.

Scianectes, Alcock, Journ. As. Soc. Beng. 1889, vol. lviii. pt. ii. no. 3, p. 284.*Scianectes macrophthalmus*.*Scianectes macrophthalmus*, id. ibid. p. 292, pl. xvi. fig. 4.

One specimen, from the Bay of Bengal, 40 miles southwest of Akyab, in 100 fathoms.

APHORISTIA, Kaup.

Aphoristia Masoni.*Aphoristia Masoni*, id. ibid. p. 294, pl. xvii. fig. 1.

One specimen, from the Andaman Sea, $7\frac{1}{2}$ miles east of North Cinque Island, in 490 fathoms.

Aphoristia Gilesii.*Aphoristia Gilesii*, id. ibid. p. 293, pl. xvii. fig. 2.

One specimen, from the Bay of Bengal, lat. $20^{\circ} 17' N.$, long. $88^{\circ} 51' E.$, in 193 fathoms.

PHYSOSTOMI.

Family Sternoptychidæ.

POLYIPNUS, Gthr.

Polyipnus spinosus, Gthr.*Polyipnus spinosus*, Günther, Zool. Chall. Exp. vol. xxii. pp. 170-172, pl. li. fig. B.

* Dr. Günther, in Zool. Chall. vol. xxii.

I have little hesitation in referring our specimen to this species (described from a single specimen obtained by the 'Challenger' between the Philippine Islands and Borneo), with which it agrees in almost every detail. In our specimen, however, the height of the body is contained once and one third in the total length, without the caudal; the eye is half the length of the head; the occipital spine is unsymmetrically bifid; each denticulation of the abdominal ridge is armed with several small vertical spines; the adipose dorsal fin is hardly visible; and the pectoral fins point backwards in the usual way.

Total length $2\frac{1}{2}$ inches.

Hab. Bay of Bengal, between North and South Sentinel Islands, in 220 to 240 fathoms.

GONOSTOMA, Rafin.

Gonostoma microdon, Gthr.

Gonostoma microdon, Günther, Ann. & Mag. Nat. Hist. 1878, vol. ii. p. 188.

Cyclothone lusca, Goode and Bean, Bull. Mus. Comp. Zool. vol. x. 1883, p. 221.

Gonostoma microdon, Günth. Zool. Chall. Exp. vol. xxii. p. 175.

Hab. Bay of Bengal, 30 miles west of Middle Andaman Island, in 485 fathoms; Andaman Sea, 7 miles south-east by south of Ross Island, in 265 fathoms.

CHAULIODUS, Bl. Schn.

Chauliodus Sloanii, Bl. Schn.

Chauliodus Sloanii, Catesby, Carol. Suppl. p. 9, pl. ix.*; Bl. Schn. p. 430*; Cuv. & Val. vol. xxii. p. 383.

Chauliodus setinotus, Bl. Schn. tab. lxxxv.*

Esox stomias, Shaw, Zool. vol. v. p. 120, tab. iii.

Chauliodus Schneideri, Risso, Eur. Mérid. vol. iii. p. 442, fig. 37.

Chauliodus setinotus, Bonap. Faun. Ital., Pesc. c. fig.

Stomias Schneideri (*Stomias boa*), Cuv. Règne Anim. Ill. Poiss. pl. xvii. fig. 3.

Chauliodus Sloanii, Günth. Fishes, vol. v. p. 392 (to which I am indebted for the above references, marked with an asterisk, where I have not had the opportunity of referring).

Chauliodus, Cuv. Règne Anim., Poissons, p. 232.

Chauliodus Sloanii, Günth. Zool. Chall. Exp. vol. xxii. p. 179.

Hab. Bay of Bengal, Carpenter's Ridge, lat. $5^{\circ} 56\frac{1}{2}'$ N., long. $91^{\circ} 05'$ E., in 1590 fathoms; Gulf of Manaar, lat. $6^{\circ} 29'$ N., long. $79^{\circ} 34'$ E., in 597 fathoms.

[To be continued.]

LV.—On three undescribed Species of the Genus *Hemignathus*, *Lichtenstein*. By SCOTT B. WILSON, F.Z.S.

As I believe that my investigation of the species of the above-named genus, specimens of which are so rare in collections, may have some interest for the ornithologists who, both in Europe and America, are studying the subject, I beg leave to lay the results before the public.

In the island of Hawaii I found two species—a large and a small one. The former is unquestionably the “Hook-billed Green Creeper” of Latham (Synops. i. p. 703), on which Gmelin founded his *Certhia obscura*, as by favour of Mr. T. J. Moore and the other authorities of the Liverpool Museum I have been able to examine the type specimen, which, forming lot 4750 at the sale of the Leverian Museum, whence Latham described it, was bought by the then Lord Stanley, and at his death in 1851, when Earl of Derby, it passed into the Liverpool Museum. This specimen was accurately figured by Vieillot (Ois. Dorés, pl. liii.), and the species will stand as *H. obscurus* (Gmelin).

The second and smaller species from the island of Hawaii agrees so accurately with the figure and description of *Heterorhynchus olivaceus*, Lafresnaye (Mag. Zool. 1839, pl. x.; Rev. Zool. 1840, p. 321), that though I have not seen the type specimen, no doubt can exist on the subject. By those who do not acknowledge the genus *Heterorhynchus*, on behalf of which something is to be said, this species will be recognized as *Hemignathus olivaceus* (Lafresnaye).

On the island of Kauai I met with two other species—again a large and a small one. One of these has been already mentioned by Dr. Stejneger (Proc. U.S. Nat. Mus. 1887, p. 93), who, though noticing some difference in it, referred it to *Hemignathus obscurus* (Gmelin). The dimensions given by Dr. Stejneger show that it is the larger of the two which he had before him; and it is indeed at once distinguishable from the true *obscurus* by its larger size (wing 86 to 83 millim., tarsus 26 to 25), its longer bill (chord 64 to 60·5 millim.), very distinct black lores, and generally brighter coloration. This species I propose to name, in honour of Dr. Stejneger, to whom the first known examples were sent, *H. Stejnegeri*. The second and smaller species from Kauai has in colour and size a general resemblance to *H. olivaceus* from Hawaii; but its lower mandible, instead of being straight as in that species, follows the curve of the upper. This I pro-

pose to designate *H. hanapepe*, from the name of the district in which alone I found it.

Lastly, I have to mention that there are two other well-marked species of *Hemignathus*, both found by Deppe in the island of Oahu, where I, however, did not meet with a single example of the genus, owing, no doubt, to the destruction of the forests there. These, again a large and a small one, were described and figured by Lichtenstein (Abhandl. k. Akad. Berlin, 1838, pp. 449-451, pl. v.)—the larger one being thought by him to be the *Certhia obscura* of Gmelin and Latham, and therefore identical with the *H. obscurus* above named, and the smaller announced as new under the title of *H. lucidus*. Of this last two specimens, obtained by Townsend, who was for a time collecting with Deppe—see the former's 'Narrative of a Journey across the Rocky Mountains and a Visit to the Sandwich Islands' (Philadelphia, 1839, p. 269)—were sent to Audubon, and from him acquired by Jardine, at the sale of whose collection they were bought for the Museum of the University of Cambridge. One of these has recently been submitted by Prof. Newton, at my request, to Prof. Cabanis for comparison with the type in the Berlin Museum, with the result that they are found to be identical. It will therefore stand as *H. lucidus*, Lichtenstein; but it is obvious that the larger species is equally distinct from *H. obscurus* (Gmelin) and from my new *H. Stejnegeri*. According to both figure and description it is intermediate in size between them; but, from the specimen described and figured being apparently a female, the other differences are not so manifest. That they would be more evident in the other sex may be safely inferred; but almost on the ground of size alone I am prepared to assert that Lichtenstein's example is specifically distinct from the rest, and I propose to name it *H. Lichtensteini*, reserving further details for the work on the birds of the Sandwich Islands which I have in contemplation.

It thus follows that there are in all *six* species of *Hemignathus*:—

- | | |
|------------------------------------|-----------|
| 1. <i>H. obscurus</i> (Gmel.). | } Hawaii. |
| 2. <i>H. olivaceus</i> (Lafr.). | |
| 3. <i>H. Lichtensteini</i> , mihi. | } Oahu. |
| 4. <i>H. lucidus</i> , Licht. | |
| 5. <i>H. Stejnegeri</i> , mihi. | } Kauai. |
| 6. <i>H. hanapepe</i> , mihi. | |

Of which nos. 2, 4, and 6 may be regarded as belonging to the subgenus *Heterorhynchus*.

P.S.—I have now seen the type of Lichtenstein's *H. obscurus*, which has been most kindly entrusted to Prof. Newton for my use by Prof. Möbius, the Director of the Royal Zoological Collection at Berlin, and the opinion above expressed and arrived at some months since as to its distinctness from the true *Certhia obscura* of Gmelin and Latham (with the type of which I have compared it) has been fully confirmed. I therefore confidently name it *H. Lichtensteini*, sp. n. Prof. Möbius has also had the goodness to transmit two specimens of "*Hemignathus procerus*, Cab. n. spec." I am not aware of any published description of this species; but the specimens sent seem to be immature males of that which I have above called *H. Stejnegeri*.

BIBLIOGRAPHICAL NOTICES.

A Monograph of the Marine and Freshwater Ostracoda of the North Atlantic and of North-western Europe.—Section I. *Podocopa*. By GEORGE STEWARDSON BRADY, M.D., F.R.S., F.L.S., and the Rev. ALFRED MERLE NORMAN, M.A., D.C.L., F.L.S. *The Scientific Transactions of the Royal Dublin Society*, vol. iv. (series ii.) pp. 63–270, plates viii.–xxiii. March 1889.

CARCINOLOGISTS have now in this complete Monograph a careful, masterly, and admirably illustrated account of all the Cyprididæ, Bairdiidæ, Darwinulidæ, Cytheridæ, and Paradoxostomidæ—that is, of all the Podocopa known from the Arctic Seas, the North Atlantic Ocean (limited by 35° N. lat.), and North-western Europe, including Scandinavia, Denmark, Holland, Belgium, Germany, Austria, France, and the British Isles. The Mediterranean is not included.

Observers at home and abroad, living and deceased, are enumerated, and a list of the principal memoirs is given.

Prof. G. S. Brady's "*Monograph of the Recent British Ostracoda*" (from the '*Transactions of the Linnean Society*,' 1868), noticed in the *Ann. & Mag. Nat. Hist.* for November 1868, is now supplemented by this more elaborate work by himself and Canon Norman. Some of the species are refigured and some redescribed; the full synonymic lists are not repeated here, but the most important synonyms are clearly indicated. The families are defined anew, and the characters of the new and the revised genera are given in detail.

In the CYPRIDIDÆ are *Cypria*, Zenker (5 spp.), *Cyclocypris*, nov. (1 sp.), *Scottia*, nov. (1 sp.), *Cypris*, Müller (19 spp.), *Erpetocypris* [*Herpetocypris*], nov. (7 spp.), *Cypridopsis*, Brady (6 spp.), *Potamocypris*, Brady (1 sp.), *Agluia*, Brady (1 sp.), *Paracypris*, Sars (1 sp.), *Notodromas*, Lilljeborg (1 sp.), *Cyprois*, Zenker (1 sp.), *Candonu*, Baird (11 spp.), *Nyocypris*, nov. (1 sp.), *Pontocypris*, Sars (4 spp.), *Anchistrocheles*, nov. (1 sp.), and *Argillæcia*, Sars (1 sp.).

In the BAIRDIIDÆ are *Bairdia*, McCoy (13 spp.), *Macrocypris*, Brady (3 spp.), and *Bythocypris*, Brady (1 sp.).

The DARWINULIDÆ are represented by *Darwinula* (1 sp.).

The CYTHERIDÆ have *Metacypripis*, B. & R. (1 sp.), *Cythere*, Müller (70 spp.), *Limnicythere*, Brady (4 spp.), *Cytheridea*, Bosquet (9 spp.), *Eucythere*, Brady (1 sp.), *Krithe*, B., C., & R. (5 spp.), *Loxoconcha*, Sars (7 spp.), *Xestoleberis*, Sars (4 spp.), *Cytherura*, Sars (20 spp.), *Cytheropteron*, Sars (18 spp.), *Bythocythere*, Sars (8 spp.), *Pseudocythere*, Sars (1 sp.), *Sclerochilus*, Sars (1 sp.), *Cytherideis*, Jones (2 spp.), and *Cytherois*, W. Müller (1 sp.).

The PARADOXOSTOMATIDÆ comprise *Paradoxostoma*, Fischer (17 spp.), and *Machærina*, nov. (2 spp.).

Of all the foregoing, 61 are freshwater species and 188 marine. A Table at page 257 gives moreover the distribution of each of these in the different areas concerned, and indicates that 20 of the former and 99 of the latter (marine) occur in the Post-tertiary deposits. The numbers for the Tertiary occurrences will be about 3 for freshwater and 27 for marine forms, if corrected more nearly by the 'Supplemental Monograph of the Tertiary Entomostraca of England,' by Jones and Sherborn, Palæont. Soc. 1889.

The geographical distribution of each species is shown in the elaborate Table at pp. 250-256.

The chief emendations of species are:—

Bairdia formosa, 'Challenger' Report, p. 52, is *B. subcircinata*, sp. n., pp. 113, 240.

Cythere Stimpsoni, 'Chall.' Rep. p. 85, is *C. runcinata*, Baird, p. 160.

— *irpex*, ibid. p. 107, is *C. echinata*, Sars, p. 150.

— *pellucida*, Monogr. Rec. Brit. Ostr. p. 397, is *C. confusa*, nov., p. 127.

— *laticarina*, ibid. p. 412, is *C. marginata*, Norman, p. 142.

Cytherura lineata, ibid. p. 441, }

— *affinis*, ibid. p. 443, } are *C. cornuta*, Brady, p. 192.

— *gibba*, ibid. p. 444, }

— *cuneata*, ibid. p. 442, is *C. sella*, Sars, p. 194.

— *Sarsii*, ibid. p. 442, is *C. similis*, Sars, p. 203.

— *Robertsoni*, ibid. p. 444, is *C. gibba*, Müller, p. 190.

Cytheropteron subcircinatum, ibid. p. 447, is *C. depressum*, nov., p. 218.

An Appendix (pp. 240-246) treats of the Ostracoda obtained in the French Expeditions of the 'Travailleur' and 'Talisman.'

Of the fifteen excellent quarto plates (drawn by G. S. Brady and lithographed by George West and Sons) illustrating this goodly Monograph four are devoted to the internal structure and organs of the minute bivalved Crustaceans herein dealt with; and in the last plate the characteristic limbs and soft parts of six of the genera (*Darwinula*, *Pontocypripis*, *Loxoconcha*, *Cytherura*, *Bythocythere*, and *Paradoxostoma*) are exhibited in place within the valves. In very many of the descriptions and figures throughout this Monograph the sexes and sexual characters are carefully indicated.

Besides the plates there are woodcut illustrations of several species at pages 88, 118, 241, 242, 244, 245, and 248.

Altogether this completely revised and augmented Monograph of the Podocopal Ostracoda of the north-western regions of the Northern Hemisphere adds greatly to the credit of the authors, well known for their industry, acumen, and extensive biological knowledge, of the lower Crustacea in particular. The care with which they have noted the helpful labours of their fellow-workers gives additional value to the results of their own researches.

A Supplementary Monograph of the Tertiary Entomostraca of England. By T. RUPERT JONES, F.R.S., &c., and C. DAVIES SHERBORN, F.G.S. *Palæontographical Society of London.* 4to. 55 pp. 3 plates. 1889.

IN 1857 a Monograph on the Tertiary Ostracoda of England was published by the Palæontographical Society, and some revision of the species was given in the 'Geological Magazine' of 1870 by Prof. Rupert Jones. Then the Post-tertiary Entomostraca of Scotland, England, and Ireland appeared in an elaborate Monograph (Palæont. Soc.) by Brady, Crosskey, and Robertson, in 1874. Further Tertiary species were published in the Geol. Mag. of 1874 by Jones and Sherborn; and all the known Tertiary species of England, with such of the Post-tertiary forms as had already been noticed in the Monograph of 1857, are now revised, redescribed, and refigured as far as may be necessary in the new Supplementary Monograph.

The Table at pp. 49-51 indicates 120 species and notable varieties of Ostracoda treated of in this Monograph, 4 ranging from the Cretaceous upwards to the Eocene; 5 in the Woolwich and Reading beds, one of them going up even to Recent times; 20 in the London Clay, a few of them ranging somewhat higher, but one not distinguishable from the recent *Krithe glacialis*: 17 from the Bracklesham Beds, a few of them repeated in the Barton and Headon Beds; 7 others in Barton Beds, 2 reoccurring in the Headon Beds and *Krithe bartonensis* even in the Post-tertiary and Recent; 7 belong to the Headon Beds, besides some already referred to. The Osborne, Bembridge, and Hamstead Beds have 7 species, mostly of freshwater or brackish habits, one of them (*Cypris gibba*) living on to late Pliocene and Recent times, and one (*Cypridea spinigera*) from Hamstead undistinguishable from a Wealden species. The White Crag of Suffolk gives 19 species, three going up to the Red Crag and three still higher, one of them (*Cythere convexa*) to existing seas. The Red Crag has three other species, two of which reoccur even among Recent forms. The Norwich Crag has 8 species, mostly peculiar, except the Recent *Cytheridea punctillata*. From the Weybourne Crag 15 species and varieties have been obtained (chiefly by Mr. Clement Reid, F.G.S.), of which about half range upwards to Post-tertiary and Recent times. Four or five Post-tertiary species, found also in the Recent state, come into the list as having been described in the original Monograph in 1857.

The elaborate Monograph by Brady and Norman on the British and North-western European Ostracoda, published contempo-

raneously, contains a revision of some of the recent genera, founded on the dissection of the soft parts of the animals. Hence the new genus *Scottia*, Brady, takes *Cypris Browniana*, Jones; *Eriocypris*, B. & N., takes *Candona (Cypris) reptans*, Baird; and *Ilyocypris*, B. & N., absorbs Ramdohr's *Cypris gibba*. *Cypris levis* of the Suppl. Tert. Monogr. is referred to *Cypris serena* (Koch) and *Candona compressa* to *C. pubescens* (Koch). These corrections can be readily made and with advantage.

Careful tables of the species in natural order, with their geological distribution, at pages 3-8 and 48-51, and the usual index of accepted and disused names, form part of this Suppl. Tert. Monogr. The three plates give very clear illustrations of 68 species and varieties which required figuring; and a uniform scale of amplification having been preserved throughout, the specimens have a more natural appearance than would otherwise have been the case. Five woodcuts also illustrate some species in the body of the work. We may note also that almost all the specimens described and figured are to be found in either the British Museum or the Museum of Practical Geology. Geologists will be glad of this work, and will thank the Palæontographical Society for publishing so useful a Monograph.

A Classified List of Mr. S. William Silver's Collection of New-Zealand Birds (at the Manor-House, Letcomb Regis), with short Descriptive Notes by Sir WALTER L. BULLER, K.C.M.G., D.Sc., F.R.S. 8vo. E. A. Petherick and Co., London, 1888.

MANY of our readers may remember seeing eight handsome cases of birds in the New-Zealand Court of the Colonial and Indian Exhibition in 1886, and the contents of these, as well as four others, are now described. Short explanatory notes render this work far more than a mere catalogue, and its value is enhanced by the introduction of a number of woodcuts from the last edition of the 'Birds of New Zealand.'

MISCELLANEOUS.

Notes on some new and little-known British Jurassic Fishes.*

By A. SMITH WOODWARD, F.G.S., F.Z.S.

THE remains of many undescribed fossil fishes from British Jurassic formations are preserved in various collections, and the author remarks upon a few of the more prominent types. Some are of genera already recognized on the continent, but not hitherto discovered in England.

1. *Eurycornus grandis*, sp. nov.—Founded on a well-preserved

* Abstract of paper read before Section C, British Association, Newcastle-upon-Tyne, 1889.


Ann. & Mag. N. Hist. Ser. 6. Vol. iv.

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head from the Kimmeridge Clay of Ely in the Woodwardian Museum. About twice as large as the typical *E. speciosus*, and differing in the granulation of the head-bones.

2. *Strobilodus suchoides*, Owen, sp.—As suggested by Von Zittel, the so-called *Thlattodus suchoides*, Owen, from the Kimmeridge Clay of West Norfolk, is certainly generically identical with the previously described *Strobilodus giganteus* from the Bavarian Lithographic Stone.

3. *Hypsocormus Leedsi*, sp. nov., and *Hypsocormus tenuirostris*, sp. nov.—The jaws of two new species of *Hypsocormus* have been discovered in the Oxford Clay of Peterborough by Mr. Alfred N. Leeds, of Eyebury. The first (*H. Leedsi*) equals the Bavarian species *H. macrodon* in size, and has a similarly obtuse snout; but it differs in the marked obliquity of the two great teeth in the upper jaw. The second species (*H. tenuirostris*) attains about half the size of the first, and is distinguished by the comparative elongation and acutely pointed form of the snout: the two great upper teeth seem to have been directed almost vertically downwards, as in *H. macrodon*. These fossils suggest an interesting comparison between the dentition of *Hypsocormus* and that of the Upper Cretaceous *Protosphyrapia*; two large tusk-like teeth at the base of the snout in each genus being opposed to a pair of similar teeth on each side of the mandible fixed in sockets in a short, stout, splenial bone.

4. *Leedsichthys problematicus*, gen. et sp. nov.—This, probably the largest Jurassic fish hitherto discovered, is indicated by an associated series of bones from the Oxford Clay of Peterborough in Mr. Leeds's collection. It can only be provisionally defined, and may be appropriately named *Leedsichthys problematicus*. None of the bones are externally ornamented, but all have a distinctly fibrous texture. A supposed frontal bone measures 2 feet in length by 1 foot 3 inches in maximum breadth; the hyomandibular is squamous, at least 1 foot 3 inches in length; and the bones of the branchial arches are irregularly -shaped in transverse section, bearing numerous gill-rakers. The last-named bones are elongated, laterally compressed, slightly expanded at the base, and rarely straight, but irregularly bent and contorted; the surface is coarse and rugose, and one long border is rounded, while the other is cleft by a longitudinal median furrow; the rounded border is comparatively smooth, but the furrowed edge is coarsely serrated, a series of short oblique ridges terminating in points on each side. The branchiostegal rays are very large, dense, and rounded in section, in not less than six pairs. The pectoral fin-rays sometimes attain a length of 5 feet, frequently dichotomously branching, but not jointed; each consists of fibrous bone, appearing as if composed of numerous long tapering splints incompletely fused together, and the two halves of the ray remain separate. The jaws and axial skeleton of the trunk are still unknown.

5. *Thrissops*.—Though not hitherto recorded, remains of the genus *Thrissops* are preserved in the British Museum from the Kimmeridge Clay and Portland Stone of Dorsetshire; the former equal

T. Heckli, Thiollière, from the French Lithographic Stone in size, the latter are much smaller.

6. *Brownieichthys ornatus*, gen. et sp. nov.—Remains of a small elongated fish, discovered by Mr. Montagu Browne in the Lower Lias of Barrow-on-Soar, pertain to a new generic and specific type, apparently related to the Belonorhynchidae. The notochord is persistent and the neural and hæmal arches are ossified, but there are no well-developed ribs. The scales are thin, cycloid, with prominent concentric lines of growth, deeply overlapping and externally ornamented with ganoine tubercles. Portions of a dorsal and ventral series of very large, narrow, pointed ridge-scales are also observable. The cranial bones are invested with ganoine and are coarsely tuberculated.

On the Occurrence of the Devonian Ganoid Onychodus in Spitzbergen.*

By A. SMITH WOODWARD, F.G.S., F.Z.S.

In the collection of Devonian fossils from Mimes Dal, Spitzbergen, in the State Museum, Stockholm, kindly shown to the author by Professor Lindström, is a small, arched, tooth-bearing bone, undistinguishable from the so-called "intermandibular arch" or "presymphysial bone" of the remarkable Ganoid fish *Onychodus*. The genus has hitherto been met with only in the Devonian of Ohio and New York (Newberry, Geol. Surv. Ohio, vol. i. pt. ii. p. 296) and the Lower Old Red Sandstone Passage-beds of Ledbury, England (*Onychodus anglicus*, A. S. Woodw., Geol. Mag. [3] vol. v. p. 500). The new specimen thus considerably extends the known range of *Onychodus* in space, and, so far as can be ascertained, pertains to a hitherto undetermined specific type. Four fractured teeth are preserved, scarcely more than half as large as those of the smallest described species, *O. anglicus*, and differing from the latter in the very large size of the internal cavity. The form may be provisionally named *Onychodus arcticus*.

On the Reproduction of some Otenostomatous Bryozoa.

By M. HENRI PROUHO.

The author's observations were made upon three species of Alcyonelleans collected at Bauyuls-sur-Mer, namely *Alcyonidium albidum*, Alder, *Alcyonidium duplex*, sp. n.†, and *Pherusa tubulosa*, Ell. and Sol.

In *A. albidum* the polypides of the sexual zoœcia have, between two tentacles of the anal side, a tubular organ communicating with the perivisceral cavity and opening outwards by a small ciliated vestibule. This organ occurs only in a few Bryozoa; it has been called the *intertentacular organ*; in *A. albidum* it is found only on

* Abstract of paper read before Section C, British Association, Newcastle-upon-Tyne, 1889.

† A species very nearly allied to *A. mytili*, Daly., but easily distinguished by the greater size of its cells, which attain a length of 1 millim.

the polypides of the sexual zoëcia. At the time of reproduction the ova detaching themselves successively from the ovary float in the perivisceral cavity; they then show irregular shrivelled forms and are furnished with a very delicate transparent shell. In this state they pass one at a time through the intertentacular organ of the expanded polypide, and when they thus get into the water they become regularly ovoid and the contents regularly spherical. During this process, which may last for some days, the spermatozoids press round the ovary and the ova detached from it. The author could not determine the precise moment of fecundation, but thinks that it takes place before the formation of the shell. Under any circumstances the intertentacular organ here fulfils the functions of an oviduct and the development is external.

The reproduction of *A. duplex* is more complex and very interesting. At the moment when the sexual elements are about to be developed the zoëcium is occupied by a polypide *destitute of any intertentacular organ*, and a cellular mass destined to form the spermatozoids appears against the wall of the stomachal cæcum. At the same time towards the aboral extremity of the same zoëcium a second polypide is formed, upon the funiculus of which young ovules originate. Thus one zoëcium has two polypides of different ages, of which the older one may be called the *male* and the other the *female polypide*. The male polypide soon begins to degenerate, leaving in the cell the brown body and a mass of spermatoblasts, while the female polypide, which continues growing, takes its place. The zoëcium then contains only a single polypide, the female, and *this is furnished with an intertentacular organ*. Later on the ova are seen to have passed into the sheath of this polypide probably by means of the intertentacular organ; they have a transparent shell and are attached, to the number of seven or eight, by a fine peduncle to the walls of the sheath, where their development takes place.

The liberation of the larvæ is very simple. When the polypide proceeds to expand the ovigerous part of the sheath becomes evaginated, forming a papilla, to the apex of which the ova are appended, and the larvæ which have completed their development burst through the shell and escape into the water. Thus in *A. duplex* two polypides of different sexes at first coexist in the same zoëcium; then the female polypide takes the place of the male and alone possesses the intertentacular organ through which the ova are evacuated; but while in *A. albidum* the ova are passed by this organ into the external medium, where they undergo a free development, in *A. duplex* it only conducts the ova into the invaginated sheath when their development takes place as in a sort of marsupium.

In *Pherusa tubulosa*, the polypides of which have no intertentacular organ, the larval form is a bivalve larva nearly identical in structure with that of *Flustrella*. The only known Bryozoan larvæ with two chitinous valves were those of *Membranipora* (*Cyphonautes*) and *Flustrella*; *Pherusa* furnishes a third example of this larval form.—*Comptes Rendus*, July 29, 1889, p. 197.

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LVI.—*Report of a Deep-sea Trawling Cruise off the S.W. Coast of Ireland, under the Direction of Rev. W. SPOTSWOOD GREEN, M.A., F.R.G.S.*

[Plates XVIII. & XIX.]

Summary of the Cruise. By Rev. W. S. GREEN.

HAVING for many years been deeply interested in the marine fauna of our southern and western coasts, it was with much pleasure that, at the suggestion of Dr. Günther, I this summer undertook a brief trawling cruise for the purpose of procuring specimens for the British Museum.

Experience gained in three previous cruises to the deep water under the auspices of the Royal Irish Academy, in two of which I was associated with Prof. A. C. Haddon, whose company now and last year I missed sadly, and many years of trawling on the coast, enabled me to calculate fairly on what we were likely to get; so I at once entered into negotiations with the Clyde Shipping Company, and chartered their steamer the 'Flying Fox' for a week's trip, her skipper, Captain Tobin, and his crew being the same I had worked with on former occasions.

Arriving at Queenstown on Friday the 28th of June, I set to work next day fitting the deep-sea gear into the 'Flying Fox.' For this purpose we brought her alongside the Royal Victoria Docks Passage West, where a crane was

available for lowering the heavy iron reels, &c., on board. Some of the gear in my charge belongs to the Science and Art Museum in Dublin, and the Director kindly permitted me to use it on condition that a complete set of duplicate specimens should be sent to Dublin. The gear which we used on the present occasion, and which I have been getting together and improving on for several years, consists chiefly of a deep-sea sounding-machine, made on Sir William Thomson's design, with improvements by Capt. Sigsbee of the U.S. Navy. For this we have two reels with 1400 fath. of steel sounding-wire on each. In deep water a belt connects the machine with the donkey-engine, so that we can haul up by steam. For dredging and trawling we have two reels of steel wire rope; on one is wound 1000 fath. of rope $\frac{7}{8}$ inch circumference, and on the other 500 fath. of $\frac{3}{4}$ inch rope. The donkey-engine had to be slightly altered to heave in this rope, which is wound on to the reels by hand. I have a good assortment of trawls and dredges, and though we took several in case of accidents, the only two we used were an ordinary 20-foot-beam trawl, having a fine-mesh inner lining to the net, and an Agassiz deep-sea trawl, 9-foot beam, and with double foot-ropes. This trawl has not only an inner lining of fine-mesh net, but in 1888 I gave it, with very good results, a second lining of mosquito netting.

A most important consideration in a dredging-expedition off the S.W. corner of Ireland, where the sea is nearly always rough, is to secure the co-operation of helpers possessed of sufficient zeal in the work to make them ignore the discomfort, and who may be proof against the *mal de mer*. This year I was fortunate in securing the help of two gentlemen, Mr. T. H. Poole, C.E., and Mr. W. de V. Kane, who were with me on a former cruise, and Mr. R. Ussher, who now came for the first time.

The work assigned to each was as follows:—Mr. Poole took charge of the soundings and the charting of our cruise, kept the log, and helped at trawling. Mr. Kane's speciality, besides helping at the log, was the preservation of spirit-specimens; and Mr. Ussher, though most especially an ornithologist, was asked to transfer his affections from birds' eggs to "sea eggs," and take charge of the numerous Echinoderms that needed drying and careful packing. Whatever success has crowned our efforts is due in the main to the efficient help I received from these gentlemen, and to that rendered with much enthusiasm by our good captain and crew.

We were most fortunate, too, in the weather. Never before

did we escape without a gale. In 1886, after having our decks swept by the sea, we ran for Valentia, but owing to torrents of rain driven before a fierce south-wester, obscuring all view, we failed to make the lights, and spent a bad night, steaming into the gale till daybreak, off Dingle Bay. In 1888 we were caught in the centre of a cyclone, which veered from S. to N.W., and raised such a sea that one of our paddle-boxes was demolished, and we had to run 75 miles for Beerhaven. This year we had fine weather; the ocean was almost perfectly level, except on one day, when the wind freshened from the eastward and raised a short lumpy sea.

My party joined me on board the 'Flying Fox' at Queens-town on the morning of Monday, July 1, but owing to some delays in completing fittings, it was just noon when we put to sea. On reaching the Fastnet we laid our course by compass W. by S., and, giving orders to have Mr. Poole and myself called about daybreak, we retired early to rest.

STATION I.

At 3.30 A.M., July 2nd, we came on deck, and on hauling the log found that we had run about 71 miles. We sounded at once, and found bottom at 315 fath. As soon as the lead was up, we shot the 20-foot-beam trawl, and veered to it about 600 fath. of rope. We dragged it slowly till 8.30, and then began to haul back. At 9.30 boarded trawl.

The haul was a fairly good one, and contained numerous specimens of Actiniæ, *Actinanga Richardi* being of most frequent occurrence. Of Echinoderms there was a large assortment, *Dorocidaris papillata*, *Pontaster tenuispinis*, *Holothuria tremula*, *Ophiothrix* sp.? being characteristic.

Hermit-crabs in various species of *Fusus* and *Buccinum*, and, besides animals belonging to many groups which will be duly dealt with in other portions of the report, we had a good take of fish.

While the trawl was being cleared we steamed on our course W. by S.

STATION II.

At 11.30 A.M. the engines were stopped, and a sounding gave a depth of 920 fath. Reeling up of the wire, though done by steam, took a long time, and then wishing to get outside the 1000-fath. line, we steamed on our course till 1 P.M., then shot the 9-foot Agassiz trawl, and veered to it 1450 fath. of rope. At 4.10 we commenced hauling up, and the trawl came on board at 7.10.

The trawl seemed very heavy, and as it approached the surface we could see it looming as a large white object in the clear blue depths. It was half full of *Globigerina*-ooze, so we had to let it wash about and drain for some time at the surface, and then, getting the burton purchase from the mast-head on to it, we drew it on board. Smothered up in the ooze were an immense number of pale purple *Holothurians*, half a dozen specimens of *Calveria*, and various other Echinoderms, including the broken-up arms of *Brisinga*. The ooze was full of the shells of *Hyalæa* and other Pteropods, and there were in it some large Dentaliums.

All day long the sea had been very calm, and Mr. Ussher, aided by various members of the crew, was indefatigable in keeping the surface-nets at work. The surface-waters teemed with Pteropods, *Cleodora lanceolata* being taken in abundance. Masses of *Salpæ* were constantly in sight, and we were fortunate in securing a fine *Carinaria* and one curious little fish (*Argyropelecus*).

By the time the animals were sorted from the ooze, with the help of the fire-hose, darkness had closed in, and a long and successful day's work was concluded. As I did not wish to get into deeper water, we gave orders for the ship being steamed 25 miles E. by S. during the night, and that I should be called at 3.30.

July 3.—At 4 A.M. came on deck; wind fresh from E.; more sea; sounded in 100 fath.; steamed five miles west.

STATION III.

Sounded in 110 fath.; shot beam trawl at 6 A.M.; boarded trawl 9.15 A.M.

The bag had fouled the beam, so the net was empty. In the tangles there were the following:—*Ophiothrix*, *Echinus* two species, *Spatangus Raschi*, and various Echinoderms.

STATION IV.

The sea had risen considerably with the fresh easterly wind. Steamed N. by W. till 11 A.M., then W. for an hour, and shot beam trawl in 250 fath.; boarded trawl at 3 P.M. This proved to be a good haul; amongst Echinoderms a variety of *Echinus* with red spines being specially interesting; and we had a large assortment of fish, *Scorpena*, *Macrurus*, &c. While clearing trawl we steamed west for six miles.

STATION V.

At 4 P.M. we sounded in 650 fath., but considering the

depth too great so late in the day, we retraced our steps and shot the Agassiz trawl in about 500 fath. When it was hauled at 9 P.M. the trawl was found to have fouled, and the rope was badly kinked and tangled.

This closed a very hard day's work, and a blank haul at the end was disheartening. In former years I had paid out our trawl warp over the stern. This year I tried the experiment of dragging the trawl from the bow. In smooth water the plan answered admirably, but in the rough water experienced this day I found that the steamer would not steer going astern, but having a tendency to round to the wind, made it most difficult to pay out the warp without kinks. Before the trawl was clear dark night had closed in.

July 4.—Kept as closely as possible to our position during the night. Longitude $11^{\circ} 36'$ W., Lat. at noon $51^{\circ} 24'$ N.

STATION VI.

Sounded at 5.15 A.M. in 350 fath.; shot Agassiz trawl. Once or twice I noticed an undue strain on the rope, and when the trawl came to the surface at 9, it was found to be all torn to pieces, the irons bent, pulled asunder, and polished like silver. We had evidently fouled rocks.

STATION VII.

Having steamed a few miles S.W., we shot the beam trawl at 10 A.M. in about 500 fath.

Boarded trawl at 1.30; it contained one large boulder weighing about 100 lbs., and several smaller ones, subangular and resembling those of the Boulder Clay. In animal life the haul was rather poor, but there were some interesting corals, worm-tubes, and Echinoderms. Most of the creatures were crushed by the boulders.

Since leaving Queenstown on Monday, most of us had had little or no sleep, so we now steamed off for land, sighting the Skelligs about sunset. We came across a dead and half-decomposed cetacean about 30 feet long floating on the surface of the sea. It was surrounded by a host of blue sharks, which were tearing it to pieces. We succeeded in shooting two, one of which we captured, and then proceeding on our way, let go anchor in Balinskelligs Bay at 10 P.M.

STATION VIII.

Friday, July 5.—Left Balinskelligs Bay at 5 A.M., and at noon shot trawl in 100 fath., 37 miles west of Bull Rock;

boarded trawl at 1.30 P.M. A great haul of Echinoderms and fish; 40 specimens of *Spatangus Raschi*, also a great number of *Echinus microstoma*, *Ophiothrix*, &c.

STATION IX.

Steamed 10 miles west, sounded in 185 fath. Shot trawl at 3.30 P.M.; towed it in a northerly direction; hauled it at 8.30 P.M.; sounded again and found 150 fath.

Holothuria tremula, *Dorocidaris*, and *Spatangus* in multitudes, a dead Madrepora, with every calyx inhabited by a small Ophiuran, giving the appearance of polyps, Cephalopods, Fish, including one dog-fish, eight Macrurids, about a score of flat-fish, &c., were the result of the haul.

When the trawl was up we steamed for the Fastnet.

STATION X.

Passed the Fastnet, and when in 55 fath. south of Jelly Head shot beam trawl at 8.15 A.M., and hauled it at 9.30. This proved a very rich haul in variety of species, amongst which were some splendid specimens of that most striking Echinoderm, *E. Flemingii*, and we obtained also several Actiniæ and Pinnæ. Steamed a few miles east.

STATION XI.

Shot beam trawl at 11 A.M. in same depth as last Station, and with very similar results.

STATION XII.

This, our last haul of the beam trawl, was in 40 fath. off Cork Harbour; the net contained many specimens of familiar forms; and then shaping our course for Queenstown, we landed our gear at 7 P.M.

During our cruise of six days, which included our voyage out and home, we thus made 12 hauls of the trawl. One was spoilt by an unavoidable accident, two by accidents which I ought to have avoided. The other nine gave what I consider to be fair results; and though we missed species which on former occasions we succeeded in obtaining, enough, I hope, has been done to prove the interesting nature of the marine fauna off our south-west coast.

FISHES. By Dr. A. GÜNTHER.

The results of Mr. Green's short cruise in the present year are fresh evidence of the incompleteness of our knowledge of the British Fauna whilst the deep water is allowed to remain unexplored. The importance of undertaking this investigation consists not merely in the addition of a number of unknown forms to our list, but equally and even more in the certainty that many of the mysteries which observations limited to the littoral fauna must for ever leave unexplained will be cleared up by a study of the pelagic and bathybial conditions. Thus the mode and season of propagation of many fishes, their vertical and horizontal distribution, their periodical or casual migrations and their causes, are at present blank chapters in their history, solely because part of their life is spent at a distance from the shallow water of the shore.

Of the eleven species of fishes collected during the present cruise, one (a Sole) has proved to be new to science, and five are new to the British Fauna; unknown facts with regard to the propagation of *Chimæra* have been ascertained; and of all exact data as to their bathymetrical range have been obtained. It is a singular fact that the five species new to the Fauna are species well known from more southern latitudes, from Madeira and the Mediterranean. Those who have perused my report on the Fishes collected by Mr. John Murray in deep water (50–100 fath.) on the west coast of Scotland, may recollect that the more characteristic forms, with few exceptions, were members of the northern or even arctic fauna. Whether this faunistic difference is due to the slight difference in latitude (six degrees), or to the circumstance that the Scotch fishes were collected at a considerably lesser depth, I am unable to decide at present.

The fishes collected are the following:—

Pristiurus melanostomus, Raf.

A young specimen from 150 fath. Collett had obtained the same species at Tromsö from a depth of 250 fath.

Chimæra monstrosa, L.

The egg-capsule of *Chimæra* was previously unknown; that figured by Joh. Müller (Abhandl. Berl. Ak. 1840, taf. 6. fig. 3) and by Duméril (Hist. Nat. Poiss. i. pl. 8. fig. 8) is that of *Callorhynchus*, and not of *Chimæra*. Mr. Green obtained one at 315 fath.

The whole capsule is $6\frac{1}{2}$ inches long, and consists of a

broader anterior portion containing the body of the embryo, and gradually tapering into a styliform posterior portion for the reception of the tail. The anterior portion is of an elongate ovate shape, a little broader in its dorso-ventral* diameter than in the transverse. Anteriorly the capsule is flattened and truncate, open in front as well as on the sides, but the two flaps fitting closely into each other, so that nothing but water is admitted. The styliform portion is provided with four narrow ridges, of which the strongest is that of the right side, extending nearly from one end of the capsule to the other, whilst the corresponding ridge of the left side disappears on the broad portion of the capsule. The dorsal and ventral ridges are much thinner, fragile, and show a rayed structure. The outer surface of the capsule is perfectly smooth.

The discovery of this egg-capsule has enabled me also to determine a similar object from Japan which has been in my possession for several years. In shape it agrees entirely with the Atlantic form, but it is considerably larger, measuring 9 inches, and has its surface finely ribbed longitudinally and



* This term is used in relation to the position of the embryo within the capsule, which, on opening the broad face of the egg in *Callorhynchus* as well as in *Chimæra*, is found to lie on its side.

a and *b*, transverse sections at the places indicated by a cross (X).

transversely. This is evidently the egg-capsule of the Japanese *Chimæra* which has been hitherto considered identical with *C. monstrosa*.

In the 'Challenger' report on Deep Sea Fishes (p. 13) I have already mentioned that *Chimæra* most probably propagates in deep water. This is now confirmed by the discovery of its egg in 300 fath. The capsule has no filaments for adhesion; they would be useless at a depth where the water is perfectly quiet. Probably the eggs simply lie on the ground or are implanted in the ooze by their styliform end.

Scorpæna dactyloptera, de la Roche.

Several specimens, from 250 fath.

New to the British fauna. Common in the Mediterranean and at Madeira, where Lowe found it in 250–400 fath.; and not uncommon on the coast of Norway, in depths of from 100–300 fath.

Hoplostethus mediterraneum, C. V.

One specimen, from 250 fath.

New to the British fauna. Hitherto found at considerable depths (no precise statements are available) in the Mediterranean, at Madeira, off Chesapeake Bay, and on the coast of Japan. The size of the scales varies conspicuously in specimens from the same locality.

Capros aper, L.

One specimen, from 180 fath.

The Boar Fish, which at irregular intervals appears on the coast in large numbers, seems to inhabit the deep water along the whole of the south and south-western coasts.

Phycis blennioides, Brünn.

One specimen, from 150 fath.

The Forked Beard was previously reported by Strom and Collett from a depth of from 70 to 200 fath. on the Norwegian coast.

Macrurus cælorhynchus, Risso.

Several specimens, from 250 fath.

New to the British fauna. Not uncommon in the Mediterranean, where it was discovered by Risso at a similar depth, and at Madeira. Collett thinks that he has observed also a specimen near Bergen.

Macrurus laevis, Lowe.

Several specimens, from 250 fath.

New to the British fauna. Not uncommon in the Mediterranean and at Madeira; a single example is known to have been obtained on the coast of Denmark (*Lütken*), one at Bohuslän (*Malm*), and another off the coast of Pernambuco ('*Challenger*').

Rhombus Boscii, Risso.

Several specimens, from 150 and 315 fath.

New to the British fauna. This species, originally discovered in the Mediterranean, was, probably owing to the small size or condition of the specimens, inaccurately described and figured by Risso, Bonaparte, and Canestrini. The scales were represented much too large, and the notes on the dentition were vague. Hence it was referred by myself to the genus *Arnoglossus* at a time when no specimens were available for examination (Fish. iv. p. 416), but there was sufficient evidence of its being a very distinct species from any of the Flat-fishes known to inhabit the British Seas. Nevertheless we find it in the 'Fishes of Great Britain' by F. Day (who seems to have followed Giglioli) relegated to the synonymy of *Rhombus megastoma*, an error which in 1883 was corrected by Vinciguerra*, and in 1887 by Kolombatović†, both of whom clearly pointed out the distinctive characters of these two species.

Rhombus Boscii may be recognized at the first glance by its enormous eyes, which are much larger than in *Rhombus megastoma*, as may be seen from the following measurements:—

	<i>R. megastoma.</i> lines.	<i>R. Boscii.</i> lines.
Total length. . . .	198	170
Length of head. . . .	50	46
Length of osseous orbit	11	15
Length of snout . . .	15	11

Rhombus megastoma never has the large black spots on the dorsal and anal fins which are so conspicuous a feature in *R. Boscii*, although they may also disappear in specimens of the latter species if they have been allowed to get stale before they are placed in spirits. The vomerine teeth are present

* Vinciguerra, Ann. Mus. Civ. xviii. 1883, p. 570.

† G. Kolombatović, Sui *Pleuronectes Boscii* e *megastoma*. Spalato, 1887. 8vo.

I am also indebted to the Marquis G. Doria for kindly communicating to me specimens of both species from the Gulf of Genoa, and to Professors Doderlein and Bellotti for specimens of *R. Boscii* from Palermo and Nice.

in both species, which therefore ought to be removed from the genus *Arnoglossus*.

In the British seas both species occur, but, so far as we know at present, *R. megastoma* does not go the same depth as *R. Boscii*, but extends further northwards.

I subjoin a full description of *Rhombus Boscii*.

D. 80-81. A. 63-65. L. lat. 85.

The height of the body is two fifths of the total length (without caudal), the length of the head nearly one third; scales rather small, with the posterior margin ciliated, truncated or rounded, covering nearly the whole head, the interorbital space and the maxillary included; interorbital space extremely narrow; the diameter of the eye is one third of the length of the head. Lateral line with a sub-semicircular curve above the pectoral fin. Lower jaw prominent; maxillary nearly one half of the length of the head. The teeth in the jaws form narrow bands; vomerine teeth in small number (two or three) implanted somewhat behind the front margin of the vomer. The lower eye a little in advance of the upper. The dorsal fin terminates at a distance from the caudal which is somewhat less than the depth of the free portion of the tail; its longest rays are at the commencement of the posterior third of the fin, where they are two fifths of the length of the head, and rather shorter than the pectoral. No spine before the anal. Body very light coloured, without spots; two large rounded deep black spots occupy the posterior portion of the dorsal and anal fins.

The largest specimen obtained is 14 inches long, the smallest about half that size.

Solea variegata, Flem.

One specimen, from 150 fath.

Solea Greenii, sp. n.

D. 81. A. 65. P. dextr. 5. P. sin. 1. L. lat. 144.

This species is very elongate, its greatest width being one third of the total length (without caudal); the length of the head is contained five and a half times in the total length. The shape of the head resembles very much that of the Common Sole. The eyes are of medium size, about as long as the snout and one fifth of the length of the head; the width of the interorbital space equals the vertical diameter of the eye. None of the nostrils dilated, that in front of the lower eye being prolonged into a short tube; the vertical fins are rather low and covered with

scales. The right pectoral very small, about as long as the eye; the left pectoral is reduced to a minute ray. The ventrals, also, are small, but the extremities of their middle rays extend backwards to the anal fin. The dorsal and anal terminate immediately in front of the caudal. Scales of both sides ctenoid, more so on the coloured than on the blind side. Coloration uniform grey.

This species is distinguished by characters which bring it near to *Solea vulgaris* as well as to *Solea variegata*. From the former it is separated by the rudimentary structure of its pectoral fins, from the latter by the number of its fin-rays, by its much smaller scales, and by its coloration. Unfortunately only one specimen was obtained, nearly 6 inches long, at a depth of 150 fathoms. It is in a perfect state of preservation.

MOLLUSCA. By EDGAR A. SMITH.

Of the twenty-four species enumerated in the following list, nearly all were obtained by the 'Porcupine' expedition off the west coast of Ireland or in other parts of the North Atlantic, and have been recorded by Jeffreys in his series of Reports in the Proc. Zool. Soc. 1878, 1879, 1881-85. It would therefore be of little use now to give references and distribution in full, which may be obtained by consulting the papers referred to. The collection only affords slight additional evidence with regard to geographical and bathymetrical considerations.

The fine *Dentalium* and *Sipho*, the *Lyonsiella*, and the new *Cuspidaria* are perhaps the most interesting of the additions to the Museum collection.

CEPHALOPODA.

Rossia Owenii, Ball.

From 150 to 200 fath.

Rossia sublævis, Verrill.

From 250 fath.

Eledone cirrosa, Lamarck.

From 150 fath.

PTEROPODA.

Peracle diversa, Monterosato.

Dead shells dredged in 1000 fath.

No full description of this species has yet appeared; indeed all the information respecting it which has been given is that it differs from *Peracle reticulata*, d'Orb., in having a shorter spire and a deeper and denticulate suture. To these distinguishing characters may be added that of the columella being surrounded by a *double* keel instead of a single one as in *P. reticulata*. The surface of fresh specimens has the same epidermal reticulation in both species.

I have not yet had an opportunity of examining the types of Pelseneer's *P. bispinosa*, but I have a strong suspicion that it is the same as *P. diversa*. Still, as no reference is made to the keel which circumscribes the columella (nor is it depicted in the figure), I must refrain from expressing a positive opinion.

Cavolinia (Diacria) trispinosa, Lesueur.

Dead shells in from 250 to 1000 fath.

GASTROPODA.

Buccinum undatum, var.

From 55 fath.

The single young specimen, about an inch long, is peculiarly fusiform, whitish, without colour-markings, and clothed with a delicate fibrous epidermis. Only the feeblest indication of oblique plication is discernible. Adult specimens of this variety were obtained by the 'Porcupine' expedition off the south of Ireland in 113 and 180 fath., and off the west coast in 90 and 159 fath.

Sipho (Siphonorbis) fusiformis, Broderip.

From 110 fath.

The single specimen obtained is very fine, and considerably exceeds the dimensions usually assigned to this shell. Its total length is 52 millimetres; aperture 23.

The 'Porcupine' expedition obtained examples off the west and south of Ireland in from 90 to 725 fath. The species occurs in deep water off the Norwegian coast, and was also dredged by the 'Travailleur' north of Spain in from 277 to 731 fath. (*Jeffreys, MSS.*).

Columbella (Anachis) haliæti, Jeffreys.

From 1000 fath.

Bulla semilævis, Seguenza.

From 1000 fath.

Cylichna (Sao) ovata, Jeffreys.

From 1000 fath.

This species was obtained in various parts of the North and West Atlantic in from 350 to 1000 fath. by the 'Porcupine' and 'Challenger' expeditions.

SCAPHOPODA.

Dentalium candidum, Jeffreys.

From 1000 fathoms.

One of the two specimens obtained is very fine, and considerably exceeds the dimensions quoted by Jeffreys. It is 85 millimetres in length ($=3\frac{3}{4}$ inches), and 8 in diameter at the aperture. The longitudinal striæ in this example can be traced from the apex along about half the length; and at a little more than an inch from the broader extremity a strongly marked reparation of an injury is visible, the result of an accident or the attack of an enemy.

This species was first obtained by the 'Valorous' expedition in from 410 to 1750 fath.; it was subsequently dredged at several stations off the west and south of Ireland by the 'Porcupine' expedition at depths ranging from 420 to 2435 fath.

Cadulus Olivi, Scacchi.

From 1000 fath.

Two specimens from the above depth agree exactly with others in the Museum obtained by the 'Porcupine' expedition, which Jeffreys* associated (and probably correctly) with this species. The latter were dredged off the west of Ireland in 1230 fath., and south of Ireland in 539 fath.

PELECYPODA.

Montacuta substriata, Montagu.

From 50-60 fath.

As usual around the British coasts, these specimens were dredged attached to the spines of *Spatangus purpureus*.

* Proc. Zool. Soc. 1882, p. 663. Remarks on distribution and synonymy are also given.

Cardium echinatum, Linné.

From 55 fath.

One young specimen, 10 millim. in length.

Cardium minimum, Philippi.

From 1000 fath.

One example only.

Lyonsiella gemma, Verrill.

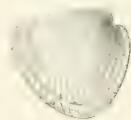
Lyonsiella gemma, Verrill, Proc. U.S. Nat. Mus. 1880, vol. iii. p. 396;
Dall, Bull. Mus. Comp. Zool. Harvard, vol. xii. p. 288; Smith,
'Challenger' Lamellibranchiata, p. 166.

From 1000 fath.

One perfect right valve was obtained.

Verrill's locality was off the east coast of the United States in 487 fath.

I cannot reconcile Verrill's description with the *Pecchiolia insculpta* of Jeffreys, with which it has been united by Dall (*l. c. supra*). The form appears to be quite different. In *L. insculpta* the anterior end is narrowed, the posterior obliquely arcuate and broad. On the contrary *L. gemma* is "broadly rounded anteriorly," and has the "posterior end short, narrowed, and tapered to an obtuse point"—terms exactly applicable to the single valve at hand.



On comparison with a 'Porcupine' example of *L. insculpta*, which very closely resembles the figure in the Proc. Zool. Soc. 1881, pl. lxx. fig. 4, the texture and surface ornamentation are seen to be identical, excepting that there are two or three extra radii.

When extensive series of these two forms are available, their outline may prove very variable and of little specific importance. This I think is very likely to be the case.

Verticordia subquadrata, Jeffr.

From 1000 fath.

Cuspidaria (Cardiomya) Greenii, sp. n.

Shell small, fragile, subpellucid, narrowly rostrate posteriorly; ventral outline regularly curved, but finely dentate by the terminations of the radiating ribs; dorsal margin on both sides of the beaks straight, subhorizontal, anterior portion very short; anterior outline of the valves oblique, slightly arcuate; radiating costellæ about 30, those



just in front of the central part stronger than those down the anterior side and the few upon the rostrum, which is truncate at the end and well marked off from the rest of the shell by a conspicuous contraction in the lower margin. Length 7, height $3\frac{2}{3}$ millim.

From 1000 fath.

Only a single specimen of this species was obtained. It is peculiar for the straightness of the hinge-line. In this respect, to some extent, it resembles the figure of *Cardiomya perrostrata*, Dall (Bull. Mus. Comp. Zool. Harvard, vol. xii. pl. ii. figs. 3 a, 3 b). That species, however, is distinguished by a somewhat longer rostrum, and the main portion of its valves is more globular.

Nuculana pusio (Philippi)?

From 1000 fath.

Several specimens from this locality I cannot distinguish from others obtained by the 'Porcupine' expedition, which were named *Leda pusio* of Philippi by Jeffreys. With this determination, however, I am not at all satisfied, for both the description and figure of Philippi indicate a shell of a considerably different form. I have not had an opportunity of seeing fossil examples, upon which the species was founded, and therefore hesitate to separate the recent specimens as a distinct species.

I feel compelled to adopt the generic term *Nuculana* notwithstanding the observations of Mr. Dall*.

Mörch† in his paper "On the genera of Mollusca established by H. F. Link," arrived at a similar conclusion.

Dall has translated "Die Schalen gleich, schliessen überall" (part of Link's diagnosis) thus: "shell smooth, closed all round," and states that this "will not apply to the group separated by Schumacher, afterwards, under the name of *Leda*." The correct rendering of the above sentence I believe should be *the valves equal (or alike) closed all round* ‡, terms which *do* apply to the only species quoted by the author, namely, *N. rostrata*, which is synonymous with *N. pernula* of Müller, under which name this species is now usually known.

As *Nuculana* has some years precedence over *Leda*, in Mr. Dall's words, it "must necessarily be adopted. The longer an untenable name is retained, the more inconvenience

* Bull. Mus. Comp. Zool. 1886, vol. xii. p. 245.

† Proc. Zool. Soc. Lond. 1862, p. 228.

‡ It is not probable that notice was taken of the very slight chink at the end of the rostrum.

results to science when it is, as it always will be, eventually overthrown."

Nuculana pustulosa, Jeffreys.

From 1000 fath.

Nucula reticulata, Jeffreys.

From 1000 fath.

Nucula corbuloides, Seguenza.

From 1000 fath.

This and the preceding species were both taken in deep water off the west of Ireland by the 'Porcupine' expedition.

Limopsis cristata, Jeffreys.

From 1000 fath.

Lima (Limatula) subovata, Jeffreys.

From 1000 fath. One valve only.

This species was dredged by the 'Valorous,' 'Porcupine,' and 'Challenger' expeditions at various stations in the Atlantic and the Mediterranean, and according to Jeffreys very fine examples were obtained by the Norwegian and Dutch Arctic Expeditions.

CRUSTACEA. By R. I. Pocock.

Although not extensive in numbers this collection is of considerable interest, inasmuch as it adds several forms to the Crustacean fauna of Great Britain.

Of course many of the specimens obtained are referable to species of common occurrence on our coasts, but I am not aware that such forms as *Anamathia Carpenteri*, *Lispognathus Thomsoni*, and *Parapagurus pilosimanus* have ere this gained the right to be included in a list of the fauna of the British area. Two species only are now for the first time characterized. One of these, *Ebalia nux*, has long been known from the Mediterranean under a manuscript name; the other *Eupagurus carneus*, appears to be wholly new.

DECAPODA.

Anamathia Carpenteri.

Anamathia Carpenteri, Norman, in Wyville Thomson's 'Depths of the Sea,' p. 175, fig. 35 (1873).

Anamathia Carpenteri. S. I. Smith, Report on Decapoda of Albatross dredgings, Washington, 1886, pp. 21, 22.

Several specimens from depths of 110 and 250 fath.

Lispognathus Thomsoni.

Dorhynchus Thomsoni, Norman, in Wyville Thomson's 'Depths of the Sea,' p. 174, fig. 34 (1873).

Lispognathus Thomsoni, A. M.-Edwards, Comptes Rendus, pp. 878-932 (1881); Miers, Brachyura of 'Challenger,' p. 28, pl. v. fig. 2.

Specimens were obtained at a depth of 250 fath.

Hyas coarctatus, Leach.

A specimen from 250 fath.

Eurynome aspera, Leach.

Two specimens from 315 fath.

Ebalia nux, sp. n.

Ebalia nux, Norman, MS.

Carapace as broad as it is long, entirely covered with rounded tubercles, convex from before backwards and from side to side, the regions well defined; the frontal region horizontal or slightly upturned, with somewhat sharply emarginate anterior edge; posterior gastric region marked with larger tubercles—two anterior and paired, and one or two posterior and median; intestinal region armed with a large tubercle above and with sharply emarginate hinder edge; lateral surface of carapace much more finely granular than the superior surface.

Chelipedes long in males, short in females, covered thickly with larger and smaller granules; merus almost cylindrical; propodus thicker at its distal than at its proximal end; dactylus gently curved and slightly inturned, widely separated at the base in the adult males, in contact in the females.

Legs granular above and below.

Abdomen in the male triangular, with the third and fourth segments fused together, with a median projection on the hinder margin of the terminal segment; in the female covering the whole sternal surface of the cephalothorax, with the



Ebalia nux, ♂, nat. size.

third, fourth, and fifth segments fused, the sixth very small and imbedded in an excavation at the base of the external maxillipedes.

♂. Length and width of carapace 11 millim.; length of chelipede 25 millim.

♀. Length and width of carapace 10 millim.; length of chelipede 14.

A number of specimens of this species were dredged by the 'Porcupine' in the Mediterranean. Some of these specimens were presented to the British Museum by the Rev. A. M. Norman and were labelled "*E. nux*, Norm." This name is included in the list of the species composing the Museum Normanianum, and also in the list of the species of *Ebalia* given by Mr. Miers in his Report on the Brachyura of the 'Challenger.' But no description of the species has yet been published. I have consequently taken this opportunity of characterizing it and have selected as types an adult male and female specimen belonging to the series dredged in the Mediterranean. In some of the small specimens of this series the larger tubercles on the gastric region of the cephalothorax are wholly absent.

A single damaged male specimen was obtained by Mr. Green at a depth of 315 fathoms. This specimen differs from all the Mediterranean forms that I have seen in having the legs almost wholly smooth.

Munida bamffica (Pennant).

Two specimens from 250 or 315 fath.

Although Prof. G. O. Sars has attempted to show that *M. Rondeletii* is specifically distinct from *M. rugosa*, nevertheless I agree with my friend Mr. A. O. Walker in thinking that the two names must be referred to one and the same species, which, in accordance with the laws of priority, must be termed *M. bamffica*, Pennant.

Eupagurus bernhardus (Linn.).

For synonyms and distribution of this and the following two species of *Eupagurus*, see Henderson, "A Synopsis of the British *Paguridae*," Proc. Phys. Soc. Edinb. 1886, p. 65.

One specimen from 55 fath.

Common in the North Atlantic.

Eupagurus pubescens (Kröyer).

Eupagurus pubescens (Kröyer), Henderson, loc. cit. p. 71.

One specimen from 200 fath.

Common in the North Atlantic.

Eupagurus excavatus (Herbst).*Eupagurus excavatus* (Herbst), Henderson, loc. cit. p. 70.

Two specimens from 110 fath.

Taken on the west coast of Ireland by the 'Porcupine' expedition, and ranging from Senegambia to the Shetlands.

Eupagurus carneus, sp. n.

Carapace with posterior and lateral portions membranous; anterior portion smooth, slightly convex from before backwards, more so from side to side, the median frontal projection well marked and sharp, the lateral less marked than the median and each tipped with a minute spine.

Ophthalmopods stout, with dilated corneæ and small tufts of hairs, projecting slightly beyond the second segment of the antennular and antennal peduncles; the scale small, narrow, and spatulate, being hollowed out above and bearing a small forwardly directed tooth below.

Antennæ. Basal segment bearing distally one spine on the upper inner margin, a second slightly longer on the inferior surface and externally, and a third very large one which, superiorly denticulate, extends as far as the distal end of the second segment; acicle slender and outwardly curved, projecting to about the middle of the distal segment of the peduncle; the whole of the peduncle more or less hairy.

Chelipedes very unequal in size, the right being much larger than the left. In the right the *merus* is trigonal, with convex internal and external surfaces; the external surface squamate, internal surface almost smooth; the external edge of the lower surface is finely denticulated, and prolonged in front into a spine; the internal edge of the lower surface bears proximally two larger blunt teeth; the anterior edge of the upper surface bears about five separated sharp teeth. The *carpus* is large, being longer than the greatest length of the *merus* by about one third of its own length; the upper surface slightly convex from before backwards and from side to side, proximally a little squamate, but the rest of the surface thickly covered with exceedingly minute close-set granules; the external and internal margins of this surface very well marked; the external margin slightly raised, denticulated in the middle, and gradually converging towards the meral articulation; the internal margin much more strongly marked, dentate throughout its extent, and abruptly converging towards the meral articulation; external surface more coarsely granular than the superior surface, and armed in front with a few small denticles; the inferior surface

internally squamate; internal surface finely granular, with sharply raised and very obscurely denticulated anterior margin. Upper surface of *manus* convex from before backwards and from side to side, much dilated externally, and



Eupagurus carneus, ♀, nat. size.

covered with exceedingly minute close-set granules; its inner and outer edge much compressed and denticulated throughout their extent; inferior surface of the hand also covered with minute granules, but these are less close-set than upon the superior surface. Upper surface of *dactylus* also finely granular, its external edge compressed, finely dentate, as is the corresponding edge of the hand, and not evenly convex but distinctly sinuate; inferior surface of *dactylus* smooth, shining, and sparsely punctate, as is the corresponding prolongation of the manus.

Left chelipede. *Merus* somewhat resembling that of the right, but more hairy, and without the teeth above in front. *Carpus* with two parallel rows of strong teeth above; its inner surface smooth in parts, and bearing two teeth in

front; its inferior surface squamate; its external surface granular, produced in front below into a bi- or tridentate lobe and above into a single sharp tooth; the upper surface armed between the two series of teeth with a single bifid tooth. *Manus*: upper surface bearing a large denticulated keel, which runs from the middle of the posterior margin to the extremity of the dactylar prolongation of the manus; externally and internally to this keel, except internally on the surface of the dactylar prolongation, where it is smooth, the upper surface is very finely and closely granular, and the external and internal margins are obscurely denticulate; the inferior surface is rounded, smooth, and sparsely but deeply punctured, and sparsely hairy. *Dactylus* smooth above and below, and furnished with small tufts of hairs.

Ambulatory limbs externally and internally smooth; in the first pair the merus is spiny beneath, and the carpus and propodus spiny above; in the second pair the carpus is spiny above and the propodus obscurely so; dactyli considerably longer than the propodi, and curved.

The penultimate abdominal tergite is marked by a median transverse constriction.

Colour (in spirit). The cephalothorax dirty white, with a patch of red on each side of the anterior portion; reddish tints about the bases of the ophthalmopods; the appendages pale pink, paler towards their distal extremities, and with darker patches here and there.

Measurements (in millimetres). Length of carapace $15\frac{1}{2}$; right chelipede—length of merus 9.10, of carpus 14, width of carpus 9; length of manus (to articulation of dactylus) 9, width of manus $10\frac{1}{2}$; length of dactylus 9.

Two female specimens, in shells of *Chrysodomus gracilis* and *Sipho despectus*, at depths of 110 and 315 fath.

Parapagurus pilosimanus.

Parapagurus pilosimanus, S. I. Smith, Trans. Conn. Acad. v. p. 51 (1879); id. Bull. Mus. Comp. Zool. x. p. 20, pl. ii. fig. 4 (1882).

Specimens, associated with *Epizoanthus*, from 315 to 1000 fath.

This species is abundant on the N.-American side of the Atlantic, and was obtained by the 'Albatross' at a depth exceeding 2000 fath. I am not aware that its occurrence within the limits of the so-called British area has been reported before.

Pandalus annulicornis, Leach.

Two specimens, at 55 and 250 or 315 fath.

AMPHIPODA.

? *Metopa Bruzelii* (Goës).

Metopa Bruzelii, Boeck, Skand. Arkt. Amph. p. 458, pl. xviii. fig. 2.

Three damaged specimens, which appear to be referable to this Arctic species, were taken in 55 fath. of water.

Callisoma crenata.

Callisoma crenata, Sp. Bate, Cat. Amph. Brit. Mus. p. 85, pl. xiv. fig. 5; id. Brit. Sessile-eyed Crust. i. p. 126; Boeck, loc. cit. p. 132, pl. vii. fig. 1.

One specimen, at a depth of 55 fath.

This specimen has been compared with the type, which is preserved in the collection of the British Museum.

Amphithopsis latipes.

Amphithoe latipes, Sars, Overs. Norsk.-Arct. Region Krebsdyr, p. 20.

Amphithopsis latipes, Boeck, loc. cit. p. 355, pl. xxii. fig. 4.

Several specimens, 55 fath.

I have compared these specimens with the type of *Calliope Ossiani* (Sp. Bate), and I find that they agree with it in all respects. But, according to Boeck, *Calliope Ossiani* is synonymous with *Amphithopsis latipes*.

Phronima sedentaria.

Cancer sedentarius, Forskål, Descript. Anim. p. 95.

Phronima sedentaria, Latr. Gen. Crust. et Ins. i. p. 56, pl. ii. fig. 2; Sp. Bate, Brit. Sessile-eyed Crust. ii. p. 23; Stebbing, Amphip. 'Challenger,' ii. p. 1357, pl. clxii. B.

A single specimen, associated with a *Beroë*, came up in the trawl 80 miles from land.

PANTOPODA.

Pycnogonum littorale (Ström).

For the literature of this species, and remarks on its distribution, see 'Report on the Pycnogonidea of the Challenger,' by Dr. Hoek, p. 99.

A single specimen, depth?

ECHINODERMATA.

By F. JEFFREY BELL, M.A., Sec.R.M.S.

[Plates XVIII. & XIX.]

The collection of Echinoderms made by Mr. Green is of very great interest and importance; it contains several excellent specimens of *Phormosoma placenta*, the type of which seems to be lost, and was, as Wyville Thomson reports, imperfect. The species of *Echinus* present, as may be expected, considerable difficulty, and it is clear that much to be said with regard to them must be considered as tentative; the range of variation exhibited by *Spatangus Raschi* is enormous, and the possibility of hybrids existing between it and *S. purpureus* will have to be borne in mind. *Asterias rubens* comes from 100 fathoms, a greater depth than any yet recorded; for the first time we are able to enumerate among the British deep-sea Echinoderms a species of the genus which Mr. W. Percy Sladen has lately described under the name of *Nymphaster*; *Astrogonium* is represented by a new species taken at 1000 fathoms, and there is an excellent series of *Astropectens*. There is a remarkable form from the same great depths which appears to be allied to *Hymenaster*; but I think it well to postpone an account of it till I am able to compare it with those described by Mr. Sladen, which will, I hope, shortly find their resting-place in the National Collection. I propose in like manner to defer an account of a remarkable Ophiurid till I have had under my eyes the *Ophiobyrsa hystericis* which was described some time since by Mr. Lyman, but which has not yet been deposited in the Museum; our specimen, which is unfortunately both unique and dry, agrees exactly with Wyville Thomson's description of "a very large Ophiurid with thick arms, upwards of 3 decimetres long, and a large soft disk resembling that of *Ophiomyxa*, to which genus it seems to be allied;"* but it does not correspond at all with another *Ophiobyrsa*, viz. *O. rudis*.

I must not conclude these introductory remarks without giving expression to the opinion that one of the most necessary pieces of work now to be done in marine zoology is the investigation of the deep-sea fauna of the south-west coast of Ireland.

A. PELMATOZOA.**I. CRINOIDEA.***Antedon bifida*, Penn.*Antedon rosacea*, auct.

In the present state of our knowledge I must refer to this

* 'Depths of the Sea,' p. 124.

species two specimens from 250 fathoms. Dr. H. Carpenter intends to investigate the limits of this species; it will, I think, be contrary to what usually happens when questions of this kind are closely studied if he should be led to any other conclusion than that we have here to do with what may justly be called a protean species. The depth recorded is greater than any yet given by 150 fathoms.

Antedon phalangium, J. Müller.

A single specimen from 250 fath. Dr. H. Carpenter gives 30-220 fath. as the bathymetrical range of the species. Mr. Green's dredging therefore slightly increases the range.

B. ECHINOZOA.

II. ASTEROIDEA.

Pontaster tenuispinis, Düb. & Kor.

Of this common species several specimens were sent from 315 fath.; "many" were also dredged at ? 250 fath. The finest specimens are unfortunately a good deal injured; but a good series was got, as some of the specimens are quite young.

Astropecten irregularis, Penn.

A number of specimens from various depths, 250, 500, and 1000 fath. The species is so variable that it would be unsafe to regard the arrangement of spines, proportion and number of marginal plates, and so on in these examples as in any way characteristic of deep-sea forms. I cannot, indeed, see any special points in them; but the depths are noteworthy, as Mr. Sladen has none greater than 374 fath.

Luidia ciliaris, Phil.

Two specimens, from 55 fath.

Astrogonium Greeni. (Pl. XIX. fig. 4.)

$$R=27, r=12.5.$$

The curve between the arms is well rounded; there are seven or eight superomarginal and seven to nine inferomarginal plates; those of the upper and lower series do not correspond regularly; the innermost are longer than wide, one or two about the middle of the row tend to be square, and the more external are wider than long; the terminal superomarginal

plate is elongated, and the more so when there are seven than when there are eight plates, while the terminal inferomarginal plate is triangular. The abactinal plates of the disk are uniformly granulated and are irregular in shape, with a not very well-marked tendency to be hexagonal in form. The ultimate, and sometimes also the penultimate, superomarginal of either side of each arm is not separated from its fellow by any of the abactinal plates.

The granules of the plates of the actinal are somewhat coarser than those of the abactinal surface; on each side of the middle line of the arm there are two rows of plates, one of which extends to the end of the arm and the other halfway. The adambulacral spines are short and square at their tip, so that they differ hardly at all from the granules of the adjacent plates; they are arranged in a single row, and there appear to be ordinarily five on each adambulacral plate. The groove is exceedingly narrow and the tube-feet are not to be seen in the single specimen collected. There are no signs of any pedicellariæ, and there are no spines. The madreporite is undistinguishable. The appearance of the specimen in alcohol is somewhat leathery, owing to the comparatively thick membrane with which it is invested.

Dredged at 1000 fath.

I have particularly compared this new species with the description of *Stephanaster Bourgeti**, Perrier, which Mr. Sladen has lately transferred to the genus *Astrogonium* and which was dredged off St. Vincent and the Cape-Verde Islands at 189-317 fath.; but the difference in the proportion of the greater and less rays, the larger number and different form of the marginal plates, and the absence of the remarkable pedicellariæ in our species are quite sufficient to show that there is no close relationship between these two forms.

Nymphaster protentus.

Nymphaster protentus, Sladen, Chall. Rep. Ast. p. 303.

Five specimens, one quadriradiate, from 315 fath.

I was at first inclined to regard these as examples of a new species; but a careful examination shows that they vary a good deal among themselves, and a more careful study of Mr. Sladen's description leads me to the conclusion that it is a *specimen* and not a *species* which he has described. As the 'Challenger' collection of Asteroids has not yet been deposited in its future home, the British Museum, I have had to content myself with the description and figures.

* Ann. Sci. Nat. xix. (1885), art. 8, p. 31.

This species, now for the first time recorded from the British seas, is here represented by specimens all larger than Mr. Sladen's type, for the smallest has the greater radius more than 71 millim., and the largest has a greater radius of as much as 100 millim.; in correspondence with this the number of marginal plates may be much nearer forty than thirty. Mr. Sladen states expressly that there are no spines on the marginal plates, but distinct, though small, spinous tubercles may be developed, particularly on the interomarginals; but their distribution is so irregular and their presence or absence seemingly so uncertain as to divest this character of any specific value at all. There is somewhat greater irregularity in the disposition of the adambulacral spines than is indicated in the original description. The groove marking the boundaries of the disk-pentagon varies a good deal in distinctness; this may be partly due to the specimens having been, unfortunately, dried; this may, further, explain why the abactinal disk-plates are not so regular in disposition, the primary embryonic plates so distinct, or the madreporite so prominent as they appear to be in the type specimen. None of these characters are, however, of value as indications of specific distinctness. As the 'Challenger' examples were dredged in 1525 fath. south-west of the Canary Isles, the locality at which Mr. Green found his specimens is one which is only probable enough.

Cribrella sanguinolenta, O. F. M.

Taken at 55 fath.

Asterias rubens, L.

Taken at 100 fath. Mr. Green justly remarks that this is a great depth for this species, and Mr. Sladen, in his recently-issued 'Challenger' Report, does not give a lower depth than 53 fath. A larger and more normal specimen was taken at 55 fath.

Brisinga coronata, G. O. Sars.

An injured specimen was brought up from 1000 fath. This depth is interesting, for though the species is known to come from still greater depths, all those reported for examples taken during the 'Porcupine' cruises are less *.

* See Sladen, Chall. Rep., Asteroid. p. 604.

III. OPHIUROIDEA.

Ophiothrix pentaphyllum, Penn.

Two large specimens from 200–315 fath., which would, I imagine, be referred to *O. Luetkeni*, Wyv. Thoms.*; I must own, however, that the variations exhibited among the better known littoral representatives of this species are so great that I cannot bring myself to look upon the specimens before me as anything more than large, well-marked individuals of this variable species.

IV. ECHINOIDEA.

Cidaris papillata, Leske.

Taken at various stations, from 150 to 315 fath.; as usual, in some localities the species was very abundantly represented. The specimens do not exhibit in any marked degree the variation to which Prof. Wyville Thomson has called attention, for they may all be said to have the spines rather long and slender than stout. In a young specimen the echinulation of the spines is more marked than in those which appear to be adult.

Phormosoma placenta.*Phormosoma placenta*, Wyv. Th.

The capture of this species was perhaps the greatest of Mr. Green's achievements; so far as English naturalists are concerned the disappearance of the Echinids described by Sir Wyville Thomson in the 'Philosophical Transactions' for 1874 has been a misfortune, as they have never had the opportunity of examining this form for themselves; the other specimens known to have been collected are those which were obtained by the 'Knight Errant' in the Færoe Channel †, and by the 'Blake' in American waters; the only naturalist who has, so far as can be gathered, had the opportunity of examining these specimens is Prof. Alex. Agassiz, who has chiefly occupied himself with describing the changes due to growth and discussing the affinities of these forms. Though such investigations are of interest and importance, we are still in need of that more elementary and less exciting information which consists in an adequate knowledge of the species itself

* 'Depths of the Sea,' p. 100.

† With it should be noted, dredging-apparatus provided at the expense of Sir W. Thomson; cf. Proc. Roy. Soc. Ed. xi. p. 644.

and of allied forms. The marked divergence in the statements which I now have to make with regard to *Phormosoma placenta* from those made by two brilliant and accomplished German naturalists with regard to an apparently allied species is sufficient to show this.

I should add that I have made some use of the material obtained by H.M.S. 'Challenger,' but the unique condition of some of the specimens, the disappearance of the viscera of others, and the absence of the remarkable *P. rigidum* have prevented me from making the investigation as complete as I wished.

In the interesting essay on the Echinothuriidæ*, which Dr. P. and Dr. F. Sarasin based on the beautiful form *Asthenosoma urens*, which they discovered off Ceylon, especial attention was directed to the organs of Stewart; these are of considerable size in the Ceylon species. Notwithstanding the fact that no description of these organs has been given by Thomson or Agassiz, the Doctors Sarasin ascribe to the Echinothuriidæ as one of their distinctive characters a "gewaltige Entfaltung der Stewart'schen Organe," and they say, further, "Sowohl die Cidariden als die Diadematiden besitzen die Stewart'schen Organe, welche bei den Echinothuriden reich entwickelt sind, in rudimentärer Ausbildung." I was somewhat interested to discover how it was that organs so remarkably well developed had not been seen by previous observers. The first example I opened served to settle the question on the same principle as that on which Tilburina could not see the Spanish fleet; the organs of Stewart were not there to be seen. In some anxiety to bring this state of things into conformity with the very absolute statement of the Drs. Sarasin I opened another specimen; here I found the arrangement shown in Pl. XVIII. fig. 2, which is drawn of the natural size, the whole test being 110 millim. in diameter. I come to the conclusion therefore that in *Phormosoma* the organs of Stewart may be present in a rudimentary or vestigial condition, or may be absent; I have been unable to find any trace of their presence in *Phormosoma bursarium* or *P. tenue*; but as these specimens have been several years in spirit, I will not lay much stress on the apparent absence of these organs. I need not do that to show that there is a considerable difference in the anatomical characters of the two genera, differences which most of us have tacitly assumed not to exist, which, possibly, we had no reason to expect to see, but as certainly no reason not to expect.

* Ergebnisse naturw. Forsch. auf Ceylon, I. 3. Ueber die Anat. der Echinothuriden u. die Phylog. der Echinodermen.

One of the most interesting discoveries of the Drs. Sarasin was that of the muscles which divide the test into a series of compartments and appear to be the agents in the vermicular contractions of the living test; this again they have made one of the characteristics of the Echinothuriidæ, and here, again, they have unfortunately argued from the particular to the general. These "Längsmuskeln" are altogether absent from *Phormosoma*. An interesting proof of this may be easily afforded: if a *Phormosoma* be opened and water poured into the test the whole test swells up; if a quadrant of an *Asthenosoma* be laid open and water poured in the whole test does not swell up, and such a specimen if returned to spirit will be found to float with one quadrant upwards, just as though it were provided with air-tight compartments; these, of course, are the "Kästchen" of the Sarasins. I am not, however, sure that, even confining ourselves to the genus *Asthenosoma*, as at present defined, we can always speak of the longitudinal muscles as being well developed; they certainly are remarkably well developed in *Asthenosoma Grubii*, but they are very poorly so in the smaller *A. pellucidum*. With the absence of the muscle is correlated that of the Kästchen, and with that of the Kästchen the peculiar loop of intestine in each alternate compartment. I do not like to lay too much stress on the apparent absence of the organs of Stewart from *Asthenosoma Grubii* and *A. pellucidum*; delicate membranes might well be injured or collapsed in specimens all of which were collected before 1876 (that is, of course, during the cruise of H.M.S. 'Challenger'), and I am not saying they are not to be found in all species of *Asthenosoma*; I have, however, some doubt as to whether or no they are so large or so constant as they seem to be in *A. urens*.

However that may be, the condition which obtains in *Phormosoma* shows that the large size of the organs of Stewart is not a character of the Echinothuriidæ. I need not press this point further by urging that this single fact will dispose of a good deal of the speculation which made Messrs. Sarasin's essay more than usually interesting.

Six specimens were dredged at 1000 fath, five of which are in the possession of the British Museum; the colour of the test preserved in alcohol varies from lightish yellow to a distinct purplish colour; in all cases, unfortunately, the spinulation is practically destroyed.

	Diam. of test. millim.	Diam. of mouth. millim.	Diam of apical area. millim.
A....	125	36	20
B....	110	34	18
C....	100	32	18
D....	95	24.5	15.5
E....	80	21	14.5

The specimens A and B were opened ; before this was done a small hole was made and spirit injected, so as to moderately distend the test ; the height of A was then 40 and of B 30 millim.

ECHINUS.

As will be readily supposed by those who know the difficulties always presented by a number of northern specimens of this genus, I have had to puzzle long over the large number of examples which Mr. Green collected. At this moment the matter seems to me clear enough, but I am by no means confident that if I had taken the set of specimens in a different order I should not have arrived at a different conclusion. I seem to have before me :—(1) *Echinus acutus*, (2) *Echinus microstoma*, and (3) *Echinus esculentus* ; I have had to detail at what will, I fear, be a wearisome length the doubts and difficulties I have experienced as to a fourth species which seems to me to be probably *E. elegans*.

Echinus acutus, Lamk.

First, as to the matter of the name I follow Prof. A. Agassiz (1872) in regarding *E. Flemingi* as synonymous with *E. acutus* ; Sir Wyville Thomson records *E. Flemingi*, Ball, but not *E. acutus*, as having been taken by the ‘ Porcupine.’ Thomson gives no reason for the adoption of Ball’s name, though it is clear from p. 722 of his memoir that he was acquainted with Mr. Agassiz’s ‘ Revision ; ’ in the matter of nomenclature, however, these two authors are often at variance, and Thomson holds *E. acutus* over (see p. 744).

E. acutus was obtained by Mr. Green at 55, 110, 500 fath.

E. acutus certainly varies considerably ; there is one well-marked variety in which the spines are a good deal longer than usual and bright crimson at the base when dry ; for example, in a “ typical example ” one of the longest spines measured 37 millim., and in the variety 46 millim., both being from the same haul of the dredge. This long-spined variety was found of different sizes, the proportionately longer spines being visible even in quite moderately sized specimens.

Echinus microstoma, Wyv. Thoms.
(Pl. XIX. fig. 1.)

There is certainly among these Echini a species distinct from *E. acutus* or *E. esculentus*; it has a bright red test and that test is depressed and thin. It is a little doubtful how much stress should be laid on colour and particularly red colour in Echinoderms; depressed tests may certainly be seen in specimens of species which are not always characterized by their possession; but the thinness of these tests is quite well marked. The specific name calls attention to the characters of the mouth; but smallness and largeness are relative terms, and I give, therefore, some measurements which Wyville Thomson omitted to add to his description. I have also thought it necessary to refigure the species, for the representations offered by Thomson are by no means good, and the differences between *E. microstoma* and *E. elegans* are hardly at all indicated. A reference to figs. 8 and 9, pl. lxviii. of Thomson's memoir and to fig. 3, Pl. XIX. of the present paper will show the difference in the form of the C-shaped spicules of these two species.

Diam. of test. millim.	Height of test. millim.	Diam. of mouth. millim.	Diam. of anus. millim.
50	25 • (50)	12 (24)	5 (10)
47	20 (42·5)	13 (27·6)	5 (10·6)
43	19·5 (45·3)	11·5 (26·7)	5 (11·6)
40	21 (52·5)	10·5 (26·2)	4·5 (11·2)

Echinus esculentus, L.

Two specimens, one from 50–66 fath., the other from 110 fath.

Both examples are somewhat compressed instead of being globose, and tend towards the “marked variety with a tall, narrow test” spoken of by Sir Wyville Thomson (*t. c.* p. 744). The lowest recorded depth for this species that I can find is 80 fath.; Prof. Agassiz gives no specific information on this point in his ‘Challenger’ Report.

* As no measurements have yet been given of this species, I give the absolute values; the percentage values, which are much more valuable for the purposes of comparison, are added in brackets. There is no better method for showing the range of variation. For the purposes of comparison I give the following percentage measurements of a rather young *E. acutus*, the diameter of which is 51 millim.:—height 58·8, mouth 35·3, anus 18.

Echinus elegans, D. & K.
(Pl. XIX. figs. 2 and 3.)

I refer to this species four specimens from 250 fath.; but I have had great difficulty in making up my mind about them, for the Museum is very poorly provided with examples of what Sars called an "overordentlig sjeldne Art," though a good many would seem to have been collected by the 'Porcupine.' The four examples now before me are all small, and there would be no reason to suppose that they are sexually mature were it not that Wyville Thomson* has put on record the existence of a small ("pony") race of *Echinus norvegicus*; I am quite unable to settle the question, as the specimens were all dried before being sent to me†.

I cannot see on these specimens the "beautiful vermilion bands, extending from the apex towards the ambitus on both sides of the bare median vertical line," which Prof. A. Agassiz states to be the feature by which *E. elegans* may be "recognized from its congeners"‡; but I do not see the same bands in a beautiful and perfectly preserved specimen (62 millim. in diameter) which the Trustees have lately acquired from the Bergen Museum, and which was taken in the Hardangerfjord at a depth of 150 fath.; and they agree well enough with the diagnosis of Düben and Koren. They cannot be expected to agree very closely with the figure given by those distinguished naturalists, on account of the marked difference in size.

It often happens that a minute histological character goes a long way in settling doubtful questions of resemblance, and the fact that the spicules in the suckers of these small specimens are exactly similar to the straight-backed C-shaped spicules of the tube-feet of an undoubted *C. elegans* has done much in deciding me as to what name to apply to these specimens. I greatly regret that, though I have made several efforts, I have not yet succeeded in obtaining examples of what other workers in Echinology have called *E. elegans* §.

* 'Depths of the Sea,' p. 117.

† It often happens that one has to lament the fact that while spirit has been saved the specimens have been for some purposes lost.

‡ Rev. Ech. p. 491.

§ With a single exception of some specimens from Norway, sent me by a curator of a museum who had not a very large series, and who had so named some examples of *E. acutus*. Since the above was sent to press the Rev. Dr. Norman has, with his usual generosity, sent me a number of specimens of *Echinus* for examination. An inspection of them leads me to think that I have rightly ascribed the four specimens now under discussion to *E. elegans*.—Nov. 7, 1889.

The 'Challenger' is reported to have collected the species at "St. 46" and off Tristan d'Acunha; but, as the following measurements show, the specimens so determined by Prof. A. Agassiz are much more depressed and have a much longer periproct and a larger anus than the specimen from the Bergen Museum.

	Diam. of test.	Height of test.	Diam. of mouth.	Diam. of periproct.	Diam. of anus.
Bergen specimen ..	62	49	21	13	6
Tristan d'Acunha ..	70	35	20	20	10
St. 46	65	30	20	18	8

If other specimens diverge as widely from a fairly typical example as do those determined by Prof. Agassiz, we are a long way yet from getting either a consensus of opinion or accuracy in comparison.

I will, with the aid of Mr. Highley's pencil, do my best to let my fellow-students understand what I mean by young specimens of *E. elegans*, and I add the following measurements, as they will be of use:—

	Diam. of test.	Height of test.	Diam. of mouth.	Diam. of periproct.	Diam. of anus.
i. . .	19	8·5	7·75	5·5	3
ii. . .	19	9	7·5	6	2·5
iii. . .	15	8	5·5	..	2
iv. . .	12·5	5·5	6	..	2

The spines have the appearance of being broken at their tips; the longest I have found are on tests iii. and iv., on each of which there is a spine 12·5 millim. long. With regard to the broken look of the spines, it is to be noted that the figure illustrative of Düben and Koren's paper illustrates the same point, and that it is also to be observed in the well-preserved specimen from the Hardangertjord already mentioned.

Spatangus purpureus, O. F. M.

Two specimens, of moderate size, from 50 to 60 fath.

Spatangus Raschi, Lovén.

A fine series from 100 to 180 fath., showing how very considerably this species varies, so much so, indeed, that one is almost inclined to suspect that it forms hybrids with *S. purpureus*. In the latter the primary spines are, as is well known, much longer, stronger, and more prominent than the

secondary or smaller spines; in *S. Raschi*, on the other hand, this difference is, typically, hardly noticeable, and in correspondence with this the tuberculation is much more uniform. In one of the specimens of *S. Raschi* now lying before me the spines are as long and as prominent as in a specimen of *S. purpureus* of nearly the same size; in another, somewhat larger, the spines are much longer than we generally find them in *S. Raschi*; but they are much more uniform in size than in either the first-named specimen or than in *S. purpureus*, and, so far, the latter could not be confounded with the more common species. Nor could the first-named, but for a different reason; it is much higher than a *S. purpureus* of the same length, but the second specimen, though some 10 millim. longer, is about 2 millim. less high, and, of course, looks much less high than its smaller companion.

With the difference in the size of the spines there is, of course, correlated a difference in the size of the tubercles which bear them; an inspection of Prof. Lovén's figure* shows that the difference is not very marked in his type specimen. I removed the spines from a specimen which, in its spinulation, most closely resembles *S. purpureus*, and I find on cleaning the test that some of the tubercles are more than ordinarily larger than the rest; the general facies of this test is, however, distinctly that of *S. Raschi*.

So, again, it may be noted that while some tests are less deep than others, others are more rounded; again, variations may be seen in the depth of the peristome. On the whole the most constant character of the deeper-water species appears to be the form of the labrum; this is always more pointed and convex than in *S. purpureus*.

We may, then, observe with regard to a number of the so-called specific characters of *S. Raschi* that they vary within very wide limits. Of the specimens collected not one would be assigned to any other species, the general facies of *S. Raschi* being maintained throughout; but on analysis the several "specific characters" are found for the most part to vary considerably.

These observations seem to me to have some bearing on the question of the utility of specific characters, for they show that we must exercise the greatest caution in the selection of the points of structure which we use as such marks. It would be preposterous to imagine any zoologist more capable than Prof. Lovén of discriminating between two species of Echinoids, and yet among the characters by which his species

* Öfv. Vet.-Akad. Förhandl. 1869, pl. xiii.

is distinguished from the commoner form he enumerates the spines, *S. purpureus* having "radiolis primariis eminentioribus colore albicante insignibus;" but the differences between the two species in this particular are much reduced when a series is examined. On the other hand, whether specific characters are useful or not, spines are certainly valuable to the individual which possesses them. As the accompanying measurements show, the form of *S. Raschi* may vary a good deal, and these variations must affect such characters as are indicated by such expressions as "ambitu fere orbiculato, dorso multo minus convexo, margine magis rotundato." This brings us to another still unsettled question:—How far are characters that vary within considerable limits to be used as specific characters? and to such a question we can well imagine different systematists giving very different answers.

Questions like these may well be raised, if the answers that are given are tentative and not dogmatic. The only moral I can definitely see is one which has been, but must again and again be, insisted on. The definitions of species are often drawn up from a few specimens, or perhaps only one; with increased knowledge of the representatives of such species our judgment as to its characters is bound to be affected by the variations which will undoubtedly present themselves—very much so when the describer has a small knowledge of the group—to some extent even when the description is by the hand of a master in his science.

Among the specimens is one which is considerably depressed and deformed; but the abnormal characters which it presents do not seem to throw any light on the characters of the species.

Measurements of Spatangus Raschi.

Percentage value of

Long. diam.	Transv. diam.	Height.
107	86	60·74
91	85·7	70·3
90	97·7	75·5

Brissopsis lyrifera, Forbes.

Two spineless specimens, of ordinary size, were taken in 5 fath.

V. HOLOTHURIOIDEA.

Holothuria tremula, Gunner.

Dredged at 100 and 315 fath.; it was dredged from greater depths than these by the Norwegian North-Sea Expedition.

Holothuria aspera. (Pl. XVIII. fig. 3.)

Although there is but a single specimen of what I think is certainly a new species of *Holothuria*, the spicules appear to be so characteristic that there is no harm in giving a name to a form of which we shall, I hope, soon obtain a supply large enough to enable me to give a complete account of its special points.

This single specimen is a good deal contracted and the tentacles are all withdrawn. The skin has to the touch a peculiar roughness, which is no doubt due to the very dense deposit of spicules in it. Above, the skin is wrinkled, below it is smooth; on each side there is a single row of not closely packed pedicels; no other processes are to be detected. The colour of the skin is a dirty grey. The length of the body is 77 millim. and the greatest breadth 46.

The spicules are particularly difficult to isolate; their general form is well shown in fig. 3, Pl. XVIII.

The processes or arms may touch or overlies one another. As there is only one specimen I have not dissected it.

It was dredged at 1000 fath.

EXPLANATION OF THE PLATES.

PLATE XVIII.

- Fig. 1.* *Phormosoma placenta* laid open, so as to show the lantern and the parts adjacent thereto. It will be noticed that the organs of Stewart are altogether wanting. Natural size.
- Fig. 2.* The same, opened as before. s in three radii points to small projecting cæca, two of which are quite small and the third hardly more than a papilla. Natural size.
- Fig. 3.* Calcareous spicules from the skin of *Holothuria aspera*. $\times 220$.

PLATE XIX.

- Fig. 1.* *Echinus microstoma*. The specimen from which this figure was taken agrees in all essential characters with one which is referred to the same species by the Rev. Dr. Norman and which was collected by the 'Porcupine.' Natural size.
- Fig. 2.* *Echinus elegans*, small specimen. $\times 2$.
- Fig. 3.* C-shaped spicule of *Echinus elegans*. $\times 220$.
- Fig. 4.* *Astrogonium Greeni*, seen from above. $\times \frac{3}{2}$.
-

POLYZOA, HYDROZOA, SPONGES, and RADIOLARIA. By R. KIRKPATRICK.

a. POLYZOA.

- Membranipora pilosa*, L. Encrusting *Natica*, 315 fath.
Membranipora Flemingii, Busk. Encrusting stems of *Eudendrium rameum*, 55 fath.
Porella compressa, Sowerby. 55 fath.
Cellepora ramulosa, L. 55 fath.
Cellepora armata, Hincks. Encrusting *Eudendrium*, 55 fath.
Idmonea serpens, L. 55 fath.
Lichenopora hispida, Fleming. 55 fath.
Aleyonidium mytili, Dalyell. On *Tubularia*-stems, 55 fath.
Arachnidium simplex, Hincks. On *Chrysodomus*, 315 fath.
 This species is new to the British fauna. The type specimen is from Barents Sea, 62 fath. (v. Hincks, Ann. & Mag. Nat. Hist. (5) vi. 1880, p. 284, pl. xv. figs. 10, 11).
Triticella flava, Dalyell. Growing on *Natica*, 315 fath.
Barentsia gracilis, Sars. On *Eudendrium*, 55 fath.

b. HYDROZOA.

- Podocoryne areolata*, Alder. Growing on *Aporrhais pes-carbonis*, 150 fath.
Eudendrium rameum, Pallas. 55 fath.
Tubularia indivisa, Linn. 55 fath.
Campanularia Hincksi, Alder. 55 fath.
Lafœa dumosa, Fleming. 58 fath.
Sertularella tenella, Alder. 55 fath.

c. SPONGIIDA.

Only one sponge was obtained :—

- Aphrocallistes Bocagei*, Wright. 500 fath.

The specimen is about $3\frac{1}{2}$ inches in height, and is well preserved. Specimens were previously obtained by the 'Porcupine' expedition at Station 36, from a depth of 725 fath. As will be seen from the following list, the range of the species is very wide, having been found off Florida, Bermudas, St. Thomas W.I., S.W. Ireland, S.E. Spain, Portugal, Cape Verde Is., Ascension Island in the Atlantic, at depths varying from 420 to 1075 fath.; the species also occurs in the North Pacific, specimens having been purchased at Inoschima by Dr. Döderlein.

d. RADIOLARIA.

Orosceua Huxleyi, Haeckel ('Challenger' Report on the Radiolaria, p. 1599, pl. xii. figs. 1, 1a). Found in ooze, dredged in 1000 fath., S.W. Ireland.

Two complete spheres and a fragment of this form were sent; but none of the long branched spines, which radiate from the surface of the sphere, had been preserved. The diameter of the shells is from 1.75 to 2 millim.

The type specimen, which is in the 'Challenger' collection, was obtained from a depth of 2740 fath., west of the Canary Islands; but there has been no opportunity of comparing the specimens from S.W. Ireland with the type, as the 'Challenger' Radiolaria have not yet been sent to the Natural History Museum.

FORAMINIFERA *. By JOSEPH WRIGHT.

Biloculina sphaera, d'Orb. Very rare.

— *bulloides*, d'Orb. Frequent.

— *ringens* (Lamk.). Very large. Frequent.

— *elongata*, d'Orb. Very rare.

— *depressa*, d'Orb. Very large. Frequent.

— —, var. *murrhyna*, Schw. Frequent.

— —, var. *serrata*, Brady. Rare.

Spiroloculina tenuiseptata, Brady. Rare.

Miliolina seminulum (Linné). Frequent.

— *oblonga* (Mont.). Very small. Very rare.

— *Auberiana* (d'Orb.). Frequent.

— *subrotunda* (Mont.). Very rare.

— *agglutinans* (d'Orb.). Very rare.

Planispirina contraria (d'Orb.). Very rare.

Sigmoilina celata (Costa). Common.

Cornuspira carinata, Costa. Large. Very rare.

Orbitolites tenuissima, Carp. Rare.

Astrorhiza arenaria, Norman. Broken specimens. Very rare.

Pelosina variabilis, Brady. Frequent.

— *rotundata*, Brady. Very rare.

Storthosphæra albida, Schulze. Very rare.

Pilulina Jeffreysii, Carp. Rare.

Psammosphæra fusca, Schulze. Most of the specimens built round sponge-spicules. Common.

* Dredged in 1000 fath.

- Hyperammina arborescens*, Norman. Rare.
 — *elongata*, Brady. Frequent.
 — *ramosa*, Brady. Rare.
 — *vagans*, Brady. Frequent.
Marsipella elongata, Norman. Rare.
Rhabdammina abyssorum, M. Sars. Frequent.
Rheophax adunca, Brady. Rare.
 — *dentaliniformis*, Brady. Rare.
 — *distans*, Brady. Very large. Common.
Haplophragmium agglutinans (d'Orb.). Rare.
 — *canariense* (d'Orb.). Frequent.
 — *globigeriniforme*, P. & J. Rare.
 — *latidorsatum* (Born.). Common.
Placopsilina vesicularis, Brady. Very rare.
 — *cenomana* (d'Orb.). Very rare.
Thurammina papillata, Brady. Frequent.
Hormosina globulifera, Brady. Rare.
Ammodiscus charoides, J. & P. Frequent.
Trochammina pauciloculata, Brady. Common.
 — *Robertsoni*, Brady. Frequent.
 — *nitida*, Brady? Rare.
Cyclammina cancellata, Brady. Common.
Webbina clavata, J. & P. Frequent.
Textularia agglutinans, d'Orb. Rare.
 — *aspera*, Brady. Rare.
Verneuilina pygmæa, Eggar. Frequent.
Gaudryina rugosa, d'Orb. Frequent.
 — *pupoides*, d'Orb. Very common.
 — *filiformis*, Berthelin. Frequent.
Bulimina elegans, var. *exilis*, Brady. Rare.
 — *inflata*, Seg. Very common.
 — *ovata*, d'Orb. Very rare.
 — *pyrula*, d'Orb. Very rare.
 — *subteres*, Brady. Very rare.
 — *fusiformis*, Will. Very rare.
Virgulina subsquamosa, Eggar. Rare.
 — *Schreibersiana*, Czjek. Rare.
Bolivina punctata, d'Orb. Frequent.
 — *textilarioides*, Rss. Rare.
 — *dilatata*, Rss. Rare.
 — *difformis*, Will. Rare.
Cassidulina lævigata, d'Orb. Common.
 — *Bradyi*, Norman. Very rare.
Milletia Earlandi, J. Wright, MS. Very rare.
Lagena globosa, Mont. Rare.
 — *apiculata* (Rss.). Rare.
 — *gracillima* (Seg.). Rare.
 — *hispida*, Rss. Very rare.
 — *distoma*, P. & J. Frequent.
 — *sulcata* (W. & J.). Very rare.

- Lagena striatopunctata*, P. & J. ? Very rare.
 — *hexagona* (Will.). Rare.
 — *laevigata*, Rss. Very rare.
 — *staphyllearia* (Schw.). Rare.
 — *marginata* (W. & B.). Frequent.
 — *lagenoides* (Will.). Very rare.
Nodosaria (*Glandulina*) *laevigata*, d'Orb. Rare.
 — (*G.*) *rotundata* (Rss.). Rare.
 — *communis*, d'Orb. Rare.
 — *soluta*, Rss. Frequent.
 — *scalaris*, Batsch. Very small. Rare.
 — *raphanus* (Linné). Rare.
 — *obliqua* (Linné). Rare.
Vaginulina legumen (Linné). Rare.
 — *spinigera*, Brady. Rare.
Rhabdognium tricarinatum (d'Orb.). Very rare.
Cristellaria tenuis, Born. One small specimen.
 — *obtusata*, var. *subalata*, Brady. Frequent.
 — *variabilis*, Rss. Very rare.
 — *crepidula*, F. & M. Not typical. Very rare.
 — *cultrata*, Montf. Very rare.
Polymorphina, sp. Very rare.
Uvigerina pygmaea, d'Orb. Frequent.
 — *aculeata*, d'Orb. Frequent.
 — *angulosa*, Will. Rare.
Globigerina bulloides, d'Orb. Very common.
 — *inflata*, d'Orb. Very common.
 — *rubra*, d'Orb. Rare.
 — *æquilateralis*, Brady. Common.
Orbulina universa, d'Orb. Very common.
Pullenia quinqueloba, Rss. Common.
 — *sphaeroides*, d'Orb. Rare.
Sphaeroidina bulloides, d'Orb. Rare.
Discorbina Bertheloti (d'Orb.). Rare.
 — *nitida* (Will.). Rare.
Truncatulina lobatula, W. & J. Rare.
 — *Wuellerstorfi* (Schw.). Common.
 — *Ungeriana* (d'Orb.). Very common.
Pulvinulina canariensis (d'Orb.). Very common.
 — *patagonica* (d'Orb.). Very common.
 — *Micheliniana* (d'Orb.). Very common.
 — *Karsteni* (Rss.). Very small. Rare.
 — *elegans*, d'Orb. Very rare.
Rotalia orbicularis, d'Orb. Frequent.
 — *Soldanii*, d'Orb. Frequent.
Nonionina umbilicatula (Mont.). Rare.
 — *turgida*, Will. Frequent.

LVII.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander Alfred Carpenter, R.N., D.S.O., commanding.*—No. 13. *On the Bathybial Fishes of the Bay of Bengal and neighbouring waters, obtained during the seasons 1885–1889.* By ALFRED ALCOCK, M.B., Surgeon-Naturalist to the Survey.

[Concluded from p. 399.]

Family **Scopelidæ**.

BATHYPTEROIS, Gthr.

Bathypterois Guentheri, sp. nov.

B. 12. D. 13. A. 11. P. 2/6 5. V. 8. C. 20.
L. lat. circ. 55. L. tr. $\frac{7}{8}$.

Body elongate and compressed, its height nearly one sixth of the total, without caudal. Head contained nearly three and a half times in the same measure; depressed, flat-crowned, as broad as deep. Snout broad, depressed, rounded, duck-bill shaped, with a median intermaxillary notch, into which a strong recurved projection of the very prominent mandible fits; its length one third that of the head; its surface with numerous large pores. A wide mucous channel with a line of large pores along the under surface of the broad mandibles. Eyes minute, situated near the vertical middle of the maxilla, close to its edge, a snout-length apart; the orbital margins rounded and inflated. Interorbital space flat from side to side. Nostrils small, superior, far in advance of the eye. Cleft of mouth extremely wide, slightly oblique; the maxilla, which has a dilated, abruptly-truncated, hinder end, is nearly two thirds the head-length. Villiform teeth in broad bands on the outer edges of the strong jaw-bones, and in a minute patch on each side of the expanded vomer. Gill-cleft reaching to the fore end of the isthmus; gill-laminæ broadish; gill-rakers numerous, close-set, long, bristle-like, except on the fourth arch. Body and head, except the jaws and front part of the vertex of the snout, covered with large, thin, smooth scales, those on the sides of the head rather deciduous, those on its crown enlarged. The caudal and paired fins with one or more extremely stout, rigid, prolonged rays; the inter-radial membrane of all the fins except the caudal covered with a thick, black, velvety, deciduous integument. The dorsal begins a little in advance of the vertical middle line,

and is just entirely in advance of the anal, the two fins being of nearly equal extent and height. A thin, narrow, adipose dorsal in the posterior half of the tail. Caudal large and deeply forked; its lowermost ray rigid, prolonged, curved, with a spatulate tip, the total length of the ray from base to tip being nearly two thirds of the total (caudal excluded). The pectoral consists of three distinct portions:—(1) an upper, of two detached, produced, rigid rays, the first of which, though broken, reaches to the tip of the upper lobe of the caudal and is simple throughout, while the second is about half the length of the first; (2) a middle portion of six comparatively short branched rays, diminishing from above downwards, connected together by a stout interradi al membrane; and (3) a lower portion of five free, simple, elongated rays, which reach halfway along the tail. The ventrals arise just in front of the dorsal; the two outermost rays of each fin are inseparably united throughout their extent to form a long, curved, rigid, spatulate appendage, between one fifth and one sixth longer than the elongated lower caudal ray, which reaches to the vertical from the tip of the upper caudal lobe.

Colours in spirit:—Head nearly black; body dark brown, with two broad, transverse, white bands, one just in front of the dorsal fin, the other near the middle of the tail; caudal white; the other fins black, except their prolonged rays, which are translucent white, with black tips. A large, opaque-white, digitate body shows through the bones of the crown of the head and snout, and there is a similar linear body along the mucous canal of the mandible.

One specimen, a female with gravid ovaries, 10 inches long (prolonged caudal ray excluded).

Hab. Andaman Sea, $7\frac{1}{2}$ miles east of North Cinque Island, 490 fathoms.

I beg to name this species after Dr. Albert Günther, F.R.S., to whose monumental works all students of ichthyology must ever remain grateful debtors.

Family Stomiati dæ.

STOMIAS, Cuv.

Stomias nebulosus, sp. nov.

D. 17. A. 21. P. 6. V. 5.

Near *Stomias affinis*.

Head-length one ninth of the total. Body compressed, its height one twelfth of the total. Snout shorter than the large

eye. Cleft of mouth oblique, enormous; the limbs of the mandibles widely distensible. Teeth fixed, upwards of twenty-five small, unequal, and curved in each premaxilla, and about the same number, in the form of minute, close-set, down-curved, even serrations, in each maxilla; a fang on each side of the vomer; one or two moderate-sized teeth in the palatines. The teeth of the lower jaw are very large, curved and acute, and stand out laterally, eight or nine on each side, almost at right angles outside the mouth. Barbel about as long as the head and ending in three longish filaments. The bony part of the opercle is reduced to a small preoperculum. The surface of the body is covered with a tenacious slime. There are no scales, but the body is mapped with regular rows of hexagonal depressions, each with a minute central white point. Median line of the abdomen, from throat to anal fin, occupied by a salient white line, which is resolved by the lens into a linear cloud of thick-set white specks. On each side of this are two rows of enlarged luminous organs, the inner extending from the isthmus to the base of the caudal and numbering 64 (to base of pectoral 6, to base of ventral 40, to origin of anal 49, to base of caudal 64), the outer from the base of the pectoral to the origin of the anal and numbering 35. The dorsal fin begins in the last fifth of the body, a little in rear of the commencement of the anal, which is also the deeper. Caudal not forked. The pectorals arise on very narrow bases near the ventral profile; their length is equal to the height of the body. The ventrals are also narrow and are exceedingly prolonged, reaching beyond the origin of the anal.

Colours in spirit:—Uniform black; fins and barbel white, with black tips.

Two specimens, rather mutilated, the longer $3\frac{1}{2}$ inches.

Hab. Gulf of Manaar, lat. $6^{\circ} 29'$ N., long. $79^{\circ} 34'$ E., 597 fathoms.

MALACOSTEUS, Ayres.

Malacosteus indicus, Gthr.

Malacosteus indicus, Günther, Ann. & Mag. Nat. Hist. 1878, vol. ii. p. 181; Zool. Chall. Exp. vol. xxii. p. 214, pl. liv. fig. B.

Hab. Andaman Sea, off Cinque Island, 650 fathoms.

Family Alepocephalidæ.

BATHYTROCTES, Gthr.

Bathytroctes microlepis, Gthr.

Bathytroctes microlepis, Günther, Ann. & Mag. Nat. Hist. 1878, vol. ii. p. 249; Zool. Chall. Exp. vol. xxii. pp. 226, 227, pl. lvii. fig. A.

A specimen, very badly mutilated and not unequivocally identifiable, from the Andaman Sea, 8 miles south-east of Cinque Island, in 500 fathoms.

Family **Halosauridæ**.

HALOSAURUS, Johnson.

Halosaurus anguilliformis, sp. nov.

B. 12. D. 12. P. 12. V. 9. L. tr. $\frac{12}{2}$.

All the tissues fragile. Head long, its length exceeding the distance between the gill-opening and the base of the ventral fins. Body subcylindrical, its height being but two thirds the length of the snout, which is half that of the head measured to the end of the occiput. Snout tapering, produced just half its length beyond the mouth. Suboperculum very large; the whole opercle covered with a thin, tough, whitish membrane, which roofs over two very wide, parallel, muciferous channels, which extend, one from the preorbital to behind the eye, the other from the symphysis of the lower jaw to the hinder edge of the suboperculum. Diameter of the eye two fifths the length of the postocular portion of the head and exceeding the width of the flat interorbital space. The nostrils are small perforations immediately before the front angle of the eye. Mouth inferior; the maxilla barely reaches the vertical from the front margin of the orbit. Teeth in broad villiform bands in the jaws and hyoid, in a crescentic band on the palatines, and in narrow tapering bands on the pterygoids. Gill-openings wide; gill-membranes entirely separate; four gills, with narrow laminae; fourteen gill-rakers on the first arch, of which the middle ones are long and bacillate. Body covered with large cycloid scales; head, excepting the cheeks and upper part of opercles, scaleless. The scales of the lateral line are a little enlarged, being rather over a quarter of an inch in diameter and perforated in the centre. The lateral line shows as an opaque white cord curving abruptly downwards from the base of the pectoral fin to the lower profile of the body, along which it runs. Dorsal and anal fins with scaly bases. Pectorals arising well above the middle line of the body, long and narrow, reaching nearly to the base of the ventrals.

Colours in spirit:—Pinkish brown, opercles and cheeks silvery, gill-membranes black; fins light grey, posterior part of anal black. Some bright opaque-white masses show through the bones of the vertex of the head; a large sagitti-

form one, followed by a small circular one, in the middle line; a large circular one behind two converging cuneiform ones in each temporal region.

Length 14 inches.

Two specimens, females with gravid ovaries, both in fragments.

Hab. Gulf of Manaar, lat. $6^{\circ} 32' N.$, long. $79^{\circ} 37' E.$, in 675 fathoms.

HALOSAURICHTHYS, gen. nov.

Differing from *Halosaurus* in possessing a long rudimentary second dorsal fin and in having the ventrals united into a broad flat plate.

Halosaurichthys carinicauda, sp. nov.

B. 13. D. 11. P. 15. V. 10. L. tr. $\frac{14}{5}$.

Head short, its length being $7\frac{1}{3}$ in the total and tapering from the broad branchial region to the pointed snout. Body long, low, and somewhat compressed, its greatest height being equal to the length of the postocular portion of the head. Tail long and tapering. Snout overhanging the mouth, its length three times that of the eye or of its preoral portion. Preoperculum small; suboperculum much larger than the operculum. Two parallel, wide, mucous channels, closed over by a thin, tough, white membrane, extend, one from the preorbital to the front limit of the operculum, the other from the mandibular symphysis to the hinder edge of the suboperculum. Eyes lateral, small, their major diameter $3\frac{2}{3}$ in the postocular portion of the head and greater than the width of the interorbital space. Nostrils large, the anterior separated from the posterior by a broad, black, outstanding loop of skin. Mouth narrow; the maxilla not reaching to the vertical from the front margin of the orbit. Villiform teeth in broad bands in the jaws and hyoid, forming a broad crescent in the prominent loose palatines and a short narrow band in the pterygoids. Gill-membranes entirely separate; four gills; first branchial arch with some rather long bacillate gill-rakers. Head covered everywhere, including the glossohyal region, with small or minute adherent scales. Body with large, thin, rather deciduous, cycloid scales, not larger along the lateral line than elsewhere. Small scales on the lower half of the dorsal fin and along the extreme base of the anal. The lateral line shows as an indistinct opaque white thread. Dorsal fin short, arising just behind the origin of the ventrals.

The posterior half of the interval between this fin and the tip of the tail is crested by a low median fold of skin (not much more than half a millimetre high after contraction in spirit), enclosing distant, thin, sharp, irregular indurations. Between this second rudimentary dorsal and the first dorsal is a median erectile scale a little longer than the eye. The anal fin arises a little in advance of the vertical middle of the body and is continued to the tip of the tail. The pectorals, which arise on narrow bases above the horizontal middle of the body, reach barely halfway to the origin of the ventrals. These, which arise exactly halfway between the gill-openings and the vent, are united together into a broad plate.

Colours in spirit:—Pinkish brown; fins grey; opercles and gill-membranes black.

Stomach short, caecal; intestine straight, wide; both invested throughout with black peritoneum; a few minute, rudimentary, pyloric caeca. The liver embraces the œsophagus; its left lobe large, its right extremely small. The generative glands form an elongated series of almost independent lobules on each side. The air-bladder is an elongated thick-walled nacreous sack, occupying the greater part of the length of the abdominal cavity and ending abruptly in front in a fine cord, which is firmly attached to the dorsal surface of the œsophagus.

Total length $15\frac{1}{2}$ inches.

One specimen.

Hab. Andaman Sea, $7\frac{1}{2}$ miles east of North Cinque Island, in 490 fathoms.

The dorsally-keeled tail with its indurations, the united ventrals, and the loose palatine bones, all coexisting in one fish suggest an alliance in the direction of *Notacanthus*.

Family *Murænidae*.

Group *ANGUILLINA*.

CONGROMURÆNA, Kaup.

Congromuræna longicauda, sp. nov.

Head tapering in both dimensions from the gill-cleft to the fleshy, blunt-pointed, projecting snout. Trunk an eye-length longer than the head, one third higher immediately behind the gill-opening than at the anal level, with a hog-back dorsal and an inflated abdominal curve. Tail nearly twice the length of the united head and trunk, compressed and gently tapering. Eye large, circular, more than half the

length of the snout. Nostrils very large, the anterior a wide short tube at the end of the snout, the posterior situated in front of the upper half of the eye. Head with wide mucous channels, which communicate with the exterior by large open pores; one such channel with five pores along each upper lip, one with ten pores extending from the mandibular symphysis to the operculum on each side, and one along each side of the top of the head ending in two very wide pores on each side of the snout. Two small pores at the base of the snout just outside the mouth. Cleft of mouth horizontal and reaching just beyond the middle of the eye; the upper jaw far overhung by the snout and overhanging the lower. Tongue long, pointed, fleshy, free. Teeth minute, in rather broad bands in the jaws, and in a broad patch outside the mouth in the expanded premaxillæ; a few small teeth in the vomer, quite anteriorly. Gill-openings narrow, widely separated; a broad fold of skin extends to the base of the pectoral from their anterior margins. No scales. A row of close-set pores extends throughout the whole length of the lateral line. Pectorals narrow, a little longer than the snout. Vertical fins confluent; the dorsal begins above the gill-opening.

Colours in spirit:—Transparent grey, with minute black specks.

Total length 16 inches.

Hab. Andaman Sea, south-east by south of Ross Island, in 265 fathoms.

COLOCONGER, gen. nov.

Allied to *Conger*.

Snout and tail very short. Muscular and osseous systems well developed. Four gills, which communicate with the pharynx by wide slits. Gill-openings separate. Heart situated immediately behind the gills. Eyes large. Posterior nostril superior. Cleft of mouth wide, extending beyond the middle of the eye. Tongue free. Teeth in a single continuous ridge in each jaw, none on the vomer. No scales. Vertical fins well developed, confluent; the dorsal begins above the root of the pectoral. Pectorals well developed.

Coloconger raniceps, sp. nov.

Head broad, massive, frog-like; its length measured to the gill-opening a little more than twice its breadth and one fifth of the total. Trunk deep, its length, which exactly equals that of the short, compressed, abruptly-pointed tail, is three

times its height; abdomen large and full. Snout blunt, hardly advanced, its surface studded with pin-hole pores; its breadth nearly twice its length, which is but three fourths of that of the eye. Eyes large, nearly circular, prominent, their major diameter a little less than one fourth the length of the head measured to the gill-opening. Nostrils large, the anterior subtubular, the posterior above the angle of the eye. Mouth cavernous. Jaws slender, equal. Tongue short, broad, fleshy, free in its anterior third. In each jaw a row of small uniform teeth in continuous contact, except at their extreme tips, which show as minute recurved asperities on a sharp-edged ridge. No vomerine teeth. A large, oval, horny, granular plate in the fauces behind the superior pharyngeal bones. A mucous channel with numerous pores along the lower jaw beneath. Gill-laminæ narrow; gill-openings of moderate size, a broad fold extends from their outer edge to the base of the pectoral fin. No scales. Head with numerous black tubular papillæ. Lateral line a salient tube, with upwards of a hundred similar papillæ. Vertical fins confluent; the dorsal, which begins above the base of the pectoral, is considerably higher than the anal. Pectorals two fifths of the length of the head.

Colours in spirit:—Uniform yellow-brown; abdomen speckled with black, due to the peritoneal pigment showing through.

Visceral peritoneum black. Stomach with a cæcum half as long as the body-cavity. Intestine sinuous. Only the left lobe of the liver developed. Air-bladder large, globular.

Length $6\frac{1}{2}$ to $10\frac{1}{2}$ inches.

Hab. Andaman Sea, off Ross Island, in from 265 to 271 fathoms.

Group? Allied to *MURÆNESOCINA*.

SAUROMURÆNESOX, gen. nov.

Form of the body widely departing from the typical, the trunk being high and well marked off from the head and tail, which is a long tapering appendage. Tissues well developed. Gills four, opening into the pharynx by wide slits; gill-openings separate. Heart situated immediately behind the gills. Nostrils lateral. Eye large. Tongue free. Vertical fins ill developed, confluent; the dorsal begins in front of the level of the gill-opening. Pectoral fins well developed. No scales. Snout long, pointed. Cleft of mouth extending far behind the eye; the upper jaw overlapping the lower. One

complete row of teeth in each jaw and a second incomplete row in the maxilla; premaxillary teeth and those at the mandibular symphysis fang-like; a single row of large fangs in the vomer.

Sauromurænesox vorax, sp. nov.

General form of the body much like that of a chameleon. The length of the head measured to the gill-opening is about $4\frac{2}{3}$ in the total; its branchiostegal region is extremely deep and wide, its anterior half is contracted and tapers to the long, narrow, sharp-pointed snout. The trunk, the length of which is two thirds that of the tail, is high and compressed, with a nearly straight abdominal and a very strongly convex dorsal profile; it is conspicuously constricted off from both head and tail, its height at the middle being more than twice its height at the anal level and about one ninth of the total length. The tail is slightly compressed, tapers to a fine point, and has the appearance of a mere appendage of the trunk; its length is one half the total, excluding the snout and eye. The length of the snout is twice the width of the interorbital space and more than twice the diameter of the large circular eye; it tapers to a fine point, which is slightly hooked. Nostrils large, the anterior subtubular, at some distance from the tip of the snout; the posterior in front of the middle of the eye. Cleft of mouth wide, extending an eye-length behind the posterior border of the orbit; the upper jaw overlapping the lower. Tongue free, bicylindrical, truncated. In maxillæ and mandibles a single row of close-set, equal, acute teeth of moderate size; also in the former an inner incomplete series of similar teeth, and in the latter at their symphysis three pairs of canine teeth, the middle of which are very large, and fit when the mouth is closed into a notch between the maxillaries and premaxillaries; four large equal canines in a row in the vomer; premaxillæ with three smaller canines, which project when the mouth is closed. Gill-openings wide, extending obliquely from the upper border of the base of the pectoral fins to near the middle line of the abdomen; a broad flap of skin connects their anterior margin with the base of the pectoral fin; gill-laminæ broad. Integument thin, without scales. Lateral line follows the dorsal curve and ends in the posterior half of the tail; it is perforated throughout with pores. Vertical fins, especially the anal, feebly developed, confluent; the dorsal begins considerably in advance of the gill-opening, the anal behind a very large abdominal pore. Pectorals longer than the snout.

Colours in life :—" Head and dorsum pale chocolate ; venter pale silvery slate " (*Dr. G. M. Giles*). In spirit vertical fins transparent white ; pectorals dark brown, edged with light grey.

One specimen, a female 14 inches long, with gravid ovaries.

Hab. Bay of Bengal, lat. $20^{\circ} 17' 30''$ N., long. $88^{\circ} 51'$ E., in 193 fathoms.

Group ? Allied to *SACCOPHARYNGINA*.

DYSOMMA, gen. nov.

Soft tissues well developed ; osseous tissues weak. Body high anteriorly and the head much inflated. Tail tapering to a point. Vent situated immediately behind the gill-opening. Snout short, slightly overhanging the mouth, its surface with many pores. Eyes minute, concealed beneath the skin. Nostrils large, lateral. Cleft of mouth wide. Minute sharp teeth in a single row in each jaw ; a row of larger teeth in the vomer. Tongue not free. Four gills, communicating with the pharynx by wide slits. Osseous elements of the gill-cover rudimentary or absent. Gill-openings separate. Head situated between the gills. No scales. Vertical fins fairly developed, the dorsal beginning just behind the occiput. Pectorals well developed.

Dysomma bucephalus, sp. nov.

Head posteriorly deep and much inflated, its length measured to the gill-opening nearly one fourth of the total. Vent situated with the abdominal pore on a large, round, fleshy clitellum immediately behind the gill-opening. Height of the body at the anal level $10\frac{1}{2}$ in the total, and gradually diminishing to a point at the tip of the tail.

Snout short, about one sixth the length of the head measured to the gill-opening, broad, depressed, rounded, it and the cheeks studded with minute pores. Eyes minute, their diameter about one fifth the length of the snout, concealed beneath semitransparent, partly pigmented skin. Nostrils large, the anterior tubular, situated near the tip of the snout, the posterior valvular, almost on the eye. Mouth wide ; jaws weak ; lips inflated, each with several rows of small pores. Teeth minute, sharp, in a single row in both jaws, in a single short row, rather larger, in the vomer. Tongue not free. The gill-covers are formed of a tough skin, in which neither bony opercles nor branchiostegal rays are

apparent; the branchial arches are weak and flexible, the gill-laminae broad and cut square; gill-openings of moderate size. No scales. Lateral line in the form of a row of pores following the dorsal curve. Vertical fins fairly developed; the dorsal begins immediately behind the occiput and the anal immediately behind the fleshy anal clittellum. Pectorals longer than the snout, rounded.

Colours in life:—"Head and dorsum pale chocolate; venter silvery slate" (*Dr. G. M. Giles*). In spirit vertical fins white, lower half of the end of the tail black.

Body-cavity extending far behind the vent, more than halfway along the tail, lined with silvery peritoneum, speckled with black pigment. Visceral peritoneum colourless. Stomach caecal, nearly half the length of the body-cavity; the pyloric and oesophageal openings almost on the same level. Intestine forming a long loop, the convexity of which reaches to the extreme hinder end of the body-cavity. Air-bladder thick-walled, nacreous, trilobed, with a large central and two small lateral lobes, the narrow, thread-like, oesophageal duct springing from the end of one of these. Only the left lobe of the liver developed.

One specimen, a female with gravid ovaries, $8\frac{3}{4}$ inches long.

Hab. Bay of Bengal, lat. $20^{\circ} 17' 30''$ N., long. $88^{\circ} 51'$ E., in 193 fathoms.

Group *NEMICHTHYINA*.

GAVALICEPS, gen. nov., Wood-Mason, MS.

Differing from *Nemichthys* in having the eyes small and in wanting pectoral fins.

Gavialiceps taniola, sp. nov., Wood-Mason, MS.

Body narrow, compressed, ending in a long lash-like tail. Head depressed. Snout in the form of a stout spatulate beak, formed by the jaws and the prolongation beyond them of the vomer; the upper segment of the beak overlapping the lower. Two rows of small sharp teeth in each jaw, continued up to the end of the beak, and a long row, extending the whole length of the beak, of larger distant teeth in the vomer. Eyes in diameter about one sixth the snout-length, situated in advance of the angle of the mouth. Gill-openings separate, extending nearly to the middle line of the abdomen. Vent situated about a head-length and three quarters behind

the gill-opening. No scales. Vertical fins confluent; the dorsal begins about a snout-length behind the occiput. No pectorals.

Colours in life:—"Silvery; iris black" (*Wood-Mason*).

Maximum length $10\frac{1}{2}$ inches.

Four specimens.

Hab. Bay of Bengal, lat. $19^{\circ} 35'$ N., long. $92^{\circ} 24'$ E., in 272 fathoms; Andaman Sea, 7 miles south-east by south of Ross Island, in 265 fathoms.

Gavialiceps microps, sp. nov.

Body cylindrical; tail long and pointed, but not tapering. Vent situated about a snout-length behind the gill-opening. Snout in the form of a long, rigid, needle-pointed beak, with a stout pyramidal base, formed by the jaws and vomer; the upper segment slightly projecting. Upper jaw serrated; a row of slightly recurved teeth in the lower jaw; on the vomer, which forms the anterior third of the upper segment of the beak, a single prolonged row of long teeth posteriorly and a cluster of minute asperities anteriorly. Eyes minute, situated before the angle of the mouth. Two minute nostrils in a triangular depression in front of the eye. No scales. Vertical fins confluent; the dorsal beginning about two snout-lengths behind the gill-opening. No pectorals.

Colours in spirit:—Grey-brown, belly yellowish; branchiostegal region and base of beak superiorly black.

One specimen, $10\frac{1}{2}$ inches long, very much injured.

Hab. Bay of Bengal, west of the Ten Degree Channel (between the Andamans and Nicobars), in 1045 fathoms.

In conclusion, I have to record my deep obligations to Professor Wood-Mason, of the Indian Museum, who himself collected the larger number of these fishes. In field-work Professor Wood-Mason has, with the most unceasing kindness, aided me with his unrivalled Indian experience; while in the museum and library his advice has been more to me than I can express.

I must also acknowledge my indebtedness to Dr. Günther's work on the 'Challenger' deep-sea fishes, without which I could have made no progress.

LVIII.—*Note on the Nomenclature of the Short-eared New-Zealand Bat.* By OLDFIELD THOMAS.

It has always been a subject of regret that, owing to Gray's error in ascribing * to Forster's "*Vespertilio tuberculatus*" a specimen of the Long-eared Bat of New Zealand, which he then described and made the type of the genus *Mystacina*, the specific names of the two New-Zealand bats should have been identical, an identity particularly inconvenient to writers on the fauna of that country. It is therefore with some pleasure that I am now able to point out that the names of the two species should after all not both be "*tuberculatus*."

The *Mystacina* unquestionably should bear that name; but in the case of the other species, referred in modern times to the genus *Chalinolobus*, the name *tuberculatus* has not the priority of publication, although dating in manuscript from the last century. It is now universally recognized that manuscript names do not confer priority, and before Forster's description of 1772-74 was published by Lichtenstein in 1844† a second name had been given to the bat by Dr. Gray, who described a specimen from South Australia as *Scotophilus morio*‡, and under the latter short and convenient specific name the *Chalinolobus* should certainly stand.

Instead, therefore, of *Chalinolobus tuberculatus* and *Mystacina tuberculata* we shall have *Chalinolobus morio* and *Mystacina tuberculata* as the two bats of New Zealand, both of them being represented by their type specimens in the National Collection.

In this connexion it may be pointed out that *Chalinolobus signifer*, Dobs.§, from Queensland, is in all probability the same as *Ch. morio*, its distinguishing character—the transverse cutaneous lobule on the muzzle—being a mark of old age, especially developed in the male sex, and not of specific distinctness. A male specimen from one of the outlying islands round Stewart Island, New Zealand, recently presented to the Museum by Mr. Charles Traill, has this lobule quite as well marked as in the type of *Ch. signifer*, and all the other fully adult specimens of *Ch. morio* in the Museum show some trace of the same lobule, while in immature individuals no sign of it is present.

* Voy. 'Sulphur,' Mamm. p. 23 (1843).

† Forst. Descr. Anim., ed. Licht. p. 62 (1844).

‡ Gray's Austr., App. ii. p. 405 (1841).

§ Ann. & Mag. Nat. Hist. [4] xvii. p. 289 (1876).

LIX.—*Notes made during the Summer of 1887 on the Effect of offering various Insects, Larvæ, and Pupæ to Birds.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

A FEW weeks ago I received an envelope by post containing all the letters and notes which I sent to Mr. Poulton in 1887. No word of explanation accompanied this missive; and although such an action appeared hardly in accordance with my, perhaps strained, ideas of strict courtesy, I could not but presume that the envelope must have been forwarded by Mr. Poulton.

That the short communication which I published in the 'Annals' for August should be assumed to be intended for a personal attack upon Mr. Poulton never entered my head; indeed, I supposed that he, in common with all who delight in the study of natural history, would have welcomed any facts, even though apparently adverse to a pet theory, which tended to throw light upon a subject which he had long and eagerly studied.

Few things ever astonished me more than the hostile attitude which Mr. Poulton assumed with regard to that innocent paper, or the cruel misconstructions which he put upon the most harmless remarks made therein; that my comment touching the repeated reproduction of a few comparatively unimportant observations of my own should have been dislocated into a claim to the origination of Wallace's theory is too absurd to be considered seriously. In spite of my much-valued friend Mr. Weir's careful experiments, as also those of Messrs. Fritz Müller, Weismann, and Poulton, I still insist that, so long as a few desultory observations are incessantly forced into a front place, it is an evidence of how little has hitherto been done, upon which to establish the truth of a theory; many more observers are wanted, and all their observations must be *impartially* treated if we are to arrive at exact scientific truth.

I was not aware that Mr. Poulton had made a selection of "the most interesting results" of my recent experiments for publication in the Report of the British Association, or I should not have said "so far nothing seems to have come of it;" nevertheless, as it is impossible for any one man to judge how far even apparently uninteresting results may eventually tell for or against a theory—as, too, Mr. Poulton has evidently forgotten some of those facts when he comments upon *Zeuzera aesculi* and the size of the spiders offered to

birds*,—I think I cannot do better than publish the whole of my observations in detail.

I may mention here that in my late paper, whilst speaking of the behaviour of my birds when confronted with *Zeuzera æsculi*, I had quite forgotten how eagerly in years past my Bulbul had devoured the species. How Mr. Poulton overlooked the fact that my tiny Waxbills did not hesitate to attack a full-grown (female of) *Epeira diademata* on the 4th September I cannot say; it is only one out of numerous instances which I could adduce to show that even the smallest birds do not consider size where they see a luxury before them. Wagtails are nervous over large spiders, but Blue Tits, Robins, Nightingales, and numerous other insectivorous birds prefer them to small ones; even the most awful-looking *Tegenaria domestica* is eagerly seized by a Blue Tit, and the poplar hawk-moth has no chance in an aviary with that plucky little acrobat.

The notes which I now propose to publish *in extenso* commence in the form of letters written to Mr. Poulton, and are, by that gentleman's wish, continued in the form of a diary. In the original MS. I recorded everything, whether interesting to Mr. Poulton or not, because it saved me from keeping a double diary; as, however, the account of my purchases or losses by death are not to the purpose (since the causes of death proved to be in no way connected with diet), I do not think it necessary to repeat them here.

I may mention that, previous to the preparation of my notes, Mr. Poulton was kind enough to express his willingness that I should put them in print myself, and although I did not then wish to do so, his late irritation at my publication of a few facts has somewhat altered my intention. It is true that my birds at the present time are in a more natural condition than they were in 1887, since at that time they were in rather a confined space, whereas now they have abundance of room for flight and opportunities for catching much insect-food; but in 1887 my birds were by no means ever allowed to be hungry, and not a few of them, and more especially the finches, when opened after death, have shown too clearly that excess of good living has been the sole cause of their demise.

I shall now proceed to quote from the letters containing my earlier notes, and then pass on to my regular diary. My first letter refers to one or two footnotes to Mr. Poulton's paper in the 'Proceedings of the Zoological Society' (in which he

* One might imagine from Mr. Poulton's remark that the larva of *Stauropus fagi* left the egg full-grown.

appears to doubt the probability of lizards eating the males of *Orgyia antiqua* or the moths of *Abraxas grossulariata*), as follows:—"I frequently hung up the newly emerged *Orgyia* females in my lizard-house, and as the doors were not made by a cabinet-maker, but by myself, there was plenty of room for the males to squeeze through; the lizards used to sit by the door, after seeing two or three males enter there, and regularly snap them up and swallow them as they entered the cage or vivarium; I have seen this dozens of times, and am not mistaken, nor, for that matter, am I in the case of *A. grossulariata*; indeed, I accounted to myself for the fact that the imago was eaten where the larva was rejected, on the supposition that the acidity of the larva was derived from the gooseberry and that it had passed away during the pupal stage."

"Now, as to my birds: I have at present 95, of 32 species*, and I have had the young of several other species during the year, only they have died.

"*Cerura vinula*, larva.—Fought for, shaken to death, banged on the floor of the cage (as a Thrush bangs a snail), the viscera devoured as shaken out, the blood pecked even from the walls, and the elongated skin finally swallowed whole [by three young Nightingales]. The tails did not deter the Nightingales from attacking this larva for a second; indeed, they seized upon them as handles to pull by, much to my astonishment, for they are somewhat spiny.

"*Mamestra brassica*, larva.—Eaten by all birds; but Wry-necks will not pick up any but the green variety; the others they will swallow when their beaks are opened and the larvæ administered as pills.

"*Orgyia antiqua*, larva.—Eaten without hesitation (but always after rubbing on the ground) by my Missel-Thrush.

"*Ilia wavaria* [larva].—Eaten by Nightingales, Skylarks, Thrushes, Canaries.

"*Biston hirtaria*, larva.—Eaten by *Leiothrix* (the Pekin Nightingale).

"*Ganoris brassica* and *rape* [imago].—Eaten by Nightingales, Thrushes, Starlings, Blackbirds, Sedge-Warbler, Weaver-birds, *Leiothrix*; examined by Canaries, which, however, were startled by their sudden movements; eagerly looked after by various species of *Estrela* (small Waxbills), but I would not trust so large a Lepidopteron with such timid little creatures.

* I subsequently purchased others, bringing the number at one time up to 108; but many died before the end of the year, chiefly of typhoid fever.

"*Triphaena pronuba*, *Hepialus humuli*, *Cossus ligniperda*, *Zeuzera asculi*, and *Apamea didyma* (all imagines).—Eaten with the greatest relish by a Persian Bulbul [*Pycnonotus leucotis*].

"As regards flies (*Musca domestica*), I never saw anything like the eagerness which the Nightingales, Sedge- and Willow-Warbler showed for them, eating them in all stages (I had about half a pint of their maggots sifted out of a heap of refuse from the cages); the maggots were also greedily picked up by my Wrynecks.

"Finches will eat any green caterpillar and all varieties of *Mamestra brassica*; the Indigo Finch of North America and the Chaffinch prefer them infinitely to mealworms.

"As regards other insects, the common broad centipede (*Lithobius forficatus*) is greedily eaten by *Leiothrix* and the Brambling; the latter bird will eat almost anything, even including Woodlice, which most birds reject after pinching them*, and I verily believe it would eat the nauseous kinds; it would be a good bird to try with.

"Earwigs are eaten by all birds [which are] quick enough to pick them up; several species of plant-bugs (evil-smelling) and a *Coccinella bipunctata* were eaten by my *Leiothrix*.

"*Pterostichus malidus*.—Greedy broken up and devoured by my Nightingales.

"I found the larvæ of *Hyponomeuta padella* and an allied species from the hedges almost invariably rejected by most birds; the Nightingales would sometimes eat them when hungry†; on the other hand, my Rose-Finch (*Carpodacus*) devoured them with avidity."

My second letter contained a few additional notes:—

"I gave the larva of *Spilosoma menthastri* to my Missel-Thrush yesterday, and he seized it immediately, rubbed it about on the earth to get rid of the hair, and swallowed it. I do not think that most birds would eat hairy caterpillars; a friend informed me yesterday (Mr. H. Powell) that his fowls invariably refuse them. I should be almost afraid to try the Nightingales, as they are such voracious little fellows that they might swallow them heedlessly and kill themselves; and this brings me to your question as to their age. They were hatched about the first week of June, taken from the nest when nine days old, and I got them the following day; they have therefore been full-grown since about the third week in July; indeed, the day after the feast on *Cerura* I

* Quite recently I noticed my Blue Tits eating them with avidity.

† Being very voracious, this was sometimes possible to them.

had to separate them, in consequence of their fighting almost incessantly in the vicious manner of adult birds.

"With regard to *Orgyia* ♀: my lizards never ate it, and I could not understand why, as they must sometimes have seen it hanging on a bramble-leaf in the vivarium or feebly kicking on its back after laying its unfertilized eggs.

"My sole remaining Wryneck is at present strong and lively, and readily picks up caterpillars, especially green ones; mealworms and earwigs it licks, but they are too smooth and hard-shelled to suit its taste. I find, however, that it will eat the common house-fly in all stages, including the pupa, which it picks up with its bill, not with its tongue.

"As to instinctive likes or dislikes: my little Sedge-Warbler is fond of *Pieris brassicae*, chases him over the cage until he has pinned him down, and then knocks him about until little more than the body remains, and this he swallows; in his natural state I do not believe the Sedge-Warbler would even look at anything so big, there being plenty of small flies and spiders amongst the reeds and sedges. I much doubt whether a Missel-Thrush would chase a white butterfly if at liberty; but in a large cage he does so in the most reckless manner, sometimes quite damaging his appearance by cutting his face against the wires in his eagerness to seize his prey.

"Generally speaking, when I say that an insect is eaten by any species, it has not been tried with any other; in the case of *Pterostichus madidus*, however, the Missel-Thrush has eaten it; he and the Nightingales have both eaten the common cockroach with evident relish.

"About a month since a man brought me about a dozen full-grown larvæ of the large cockchafer (*Melolontha*), which were greedily eaten by the Missel-Thrush, Song-Thrush, Blackbird, Skylark, and Bulbul; the dirty stains all over the walls of their cages remain to this day.

"Yesterday my Missel-Thrush and one of my Starlings took the grey-tailed humble-bee, and after a few rubs swallowed them whole; the Starling certainly swallowed his alive and kicking."

My third letter merely gives the results recorded on the first day of my diary, which commenced on the

16th August.

Offered larva of *Acronycta alni* to Missel-Thrush; crushed and contents eaten; skin left.

Vanessa urticae (larva).—Offered to Weaver-birds and Brambling; rejected without trial. To Nightingale; killed

and swallowed, ejected and again swallowed. To Song-Thrush ; thoroughly crushed and then swallowed.

Pupa of *V. urticae* to Missel-Thrush, Bulbul, and Starling ; crushed and eaten with evident relish. To Skylark, *Leiothrix*, and Nightingales ; contents swallowed, the shell left.

Imago of *V. urticae* to Missel-Thrush, Song-Thrush, *Leiothrix*, Starlings, Blackbird, Bulbul, and Nightingale ; eaten by all with pleasure excepting the Blackbird, which hesitated before finishing it. On the other hand, it was rejected without trial by the Sedge-Warbler, Wryneck, Cape Canary, and Rose-Finch.

17th August.

Offered larva of *V. urticae* to Missel-Thrush, which rubbed it about and then swallowed it. To *Leiothrix*, which swallowed the contents but rejected the skin. Three Nightingales and a Starling eagerly devoured the larvæ entire ; a Chaffinch ate part, but did not seem to relish it.

Pupa of *V. urticae* to Chaffinch, which pecked but rejected it. Two Siskins, two Cordon-bleus and sixteen other Waxbills (*Estrella*, spp.), four *Munia rufo-nigra*, two other *Munias*, and the Rose-Finch entirely ignored them. On the other hand, two Nightingales and a Skylark seized and ate them at once.

Imago of *V. urticae* to Missel-Thrush, Nightingale, Indigo Finch, and Chaffinch, all of which ate it without hesitation. It was, however, rejected by the Sedge-Warbler, and my eighteen Waxbills were all afraid of it.

18th August.

Offered pupa of *V. urticae* to Missel-Thrush, four Song-Thrushes, Blackbird, Bulbul, and Nightingale ; eaten by all without hesitation ; it was ignored by the Wryneck.

Imago of *V. urticae* to Nightingales, which ate them at once.

Offered earwig to Sedge-Warbler ; not eaten.

19th August.

Offered larva of *Mamestra brassicae* to Sedge-Warbler, which at once seized and devoured it. A spider (*Attus*, sp.) was also eaten without hesitation. A second larva of *M. brassicae* was offered to the Wryneck, but, being of the brown variety, he licked but did not eat it ; the Sedge-Warbler took it directly.

20th August.

Brown variety of larva of *M. brassicæ* again rejected by Wryneck.

21st August.

Grey-tailed humble-bee eaten by Missel-Thrush; larvæ of *Mamestra brassicæ* by Wryneck!, Sedge-Warbler, Nightingales, and Indigo Finch; larva of *Ganoris rapæ* by Sedge-Warbler; butterflies of *G. rapæ* and *brassicæ* by Nightingales, Sedge-Warbler, Bulbul, *Leiothrix*, Starling, Blackbird, and Thrushes; refused by Cape Canary, Common Canary, Chaffinch*, and Weaver-birds; an evil-smelling brown plant-bug eaten by *Leiothrix*, and various spiders (*Theridion* and *Epeira*) by Sedge-Warbler.

23rd August.

Larvæ of buff ermine moth given to Missel-Thrush; played with (as a cat plays with a mouse), then rubbed about to get rid of the hair, and eaten. Larva of *G. brassicæ* offered to Wryneck; licked, but I believe not eaten. Harvest-spider eaten by Nightingale.

24th August.

Epeira diademata eaten by Nightingale, but not swallowed whole as a mealworm would be; red-tailed humble-bee offered to Missel-Thrush, but ignored.

25th August.

Caterpillar of buff ermine given to Blackbird; rubbed about in the sand and then eaten. *Oniscus asellus* and earwigs eaten without hesitation by Nightingales; numerous caterpillars of *Apamea didyma* eaten with avidity by Sedge-Warbler, Wryneck, and Rose Finch; caterpillars of *Ganoris rapæ* eaten with evident pleasure by Wryneck.

28th August.

Gave caterpillar of buff ermine to Song-Thrush; killed at once and subsequently eaten, though not immediately. A second caterpillar offered to Weaver-birds, which ignored it; they also rejected a larva of *Ganoris brassicæ*, which, however, was at once eaten by the Missel-Thrush; a caterpillar of *G. rapæ* was killed and partly eaten by the Indigo Finch and finished by the Chaffinch; others were again eaten by

* This is curious, because the same Chaffinch now eats these butterflies with the greatest pleasure.

the Wryneck and Sedge-Warbler; *Epeira diademata* by Nightingales, Indigo Finch, and Chaffinch, and a small one by Cordon-bleu (Red-eared African Waxbill). The Waxbills never refuse spiders.

29th August.

Caterpillars of *Ganoris brassicæ* given to Nightingales; killed but not eaten. The Song-Thrush and Starling, however, ate them without hesitation. Caterpillars of *G. rapæ* again eaten by Wryneck.

30th August.

Caterpillars of *G. brassicæ* eaten by Missel-Thrush, Song-Thrush, and Starling, rejected by Indigo Finch; again killed but not eaten by Nightingales; caterpillars of *G. rapæ* eaten by all my soft-billed birds, by the Indigo Finch, and Chaffinch. A caterpillar of *G. brassicæ* was rejected by a pair of Orange Weavers, but they were both at the time in a dying condition.

31st August.

Caterpillars of *G. brassicæ* killed and the contents (but not the skin) eaten by Bulbul; swallowed entire by Missel-Thrush; eaten, apparently without relish, by Song-Thrushes; killed but not eaten by Blackbird; caterpillars of *G. rapæ* eaten as before by all soft-billed birds, Indigo Finch, and Chaffinch; small spider (*Tegenaria*, sp.) eaten by Sedge-Warbler; caterpillars of *Mamestra brassicæ* were eaten by many of the birds, but I have never known this species altogether refused by any insectivorous bird in good health; the Wryneck alone objects to the brown variety, but he will get over this in time I believe.

4th September.

Largest-sized *Tegenaria domestica* given to Nightingales, Missel-Thrush, and Bulbul, and eaten with the greatest relish; large specimen of *Epeira diademata* eaten by Waxbills; earwigs eaten by Nightingales.

6th September.

Gave caterpillar of *Cossus ligniperda* to Missel-Thrush, which tasted but did not relish it; took it away and offered it to Blackbird, which ate it at once and made the whole place smell horribly. Gave caterpillars of *Ganoris brassicæ* to Missel-Thrush and Starling; the former swallowed them whole, the latter tasted and then rejected them.

7th September.

Again gave caterpillars of *G. brassicæ* to Missel-Thrush, Nightingales, and Starlings; the Starlings treated them as before, but the others ate them at once. Specimens of *Epeira diademata* eaten by Cordon-bleu and Nightingale; earwig by Nightingale.

9th September.

Caterpillar of *G. rapæ* offered to *Leiothrix*, but ignored; eaten at once by Nightingale and Wryneck. A wasp flew into young Thrush's cage, was at once seized and killed; the Thrush apparently was stung, as it dropped the wasp and abruptly retired to the back of the cage; subsequently he returned and ate the wasp.

10th September.

Caterpillars of *Mamestra brassicæ* eaten by Wryneck! and Nightingales; caterpillar of *Pygæra bucephala* by Missel-Thrush.

11th September.

Caterpillar of *Orgyia antiqua* eaten by Missel-Thrush; of *G. rapæ* by Wryneck, Nightingales, and Robin; of *Mamestra brassicæ* by Wryneck and *Leiothrix*; *Epeira diademata* by Cordon-bleu.

At this point I went away from home, and nothing worth recording occurred until the 18th, when I again gave a caterpillar of *Orgyia antiqua* to the Missel-Thrush, which rubbed it about and ate it; *Eristalis tenax* was eaten by Nightingales*. *Quedius tristis* was also swallowed immediately when offered to *Leiothrix*; a caterpillar of the buff ermine was unaccountably refused by the Missel-Thrush, but eaten by the Blackbird.

19th September.

Eristalis again eaten by Nightingales and earwigs by *Leiothrix*; caterpillars of *Ganoris brassicæ* eaten by Missel-Thrush and Starlings; tasted but rejected with disgust by Nightingales; licked but refused by Wryneck.

21st September.

Eristalis offered to Brambling and Rose-Finch; refused by both, the latter being evidently alarmed by its appearance;

* This year (1889) I have given many to Wagtails, Great Tits, the American Nonpareil, and various Weavers, all of which ate them, the Weavers alone showing the least suspicion of them.

seized and eaten with evident pleasure by Indigo Finch. (N.B.—All these birds are moulting and therefore out of condition.) Earwigs eaten by Robin and *Leiothrix*, refused by Rose-Finch.

At this point, having purchased many birds to replace losses amongst my Finches, I numbered 108 birds.

22nd September.

Eristalis eaten with pleasure by Indigo Finch and *Leiothrix*, Nightingales, Robin, Bulbul, and Missel-Thrush; ignored by Orange-Weavers, Wryneck, Rose-Finch, and Song-Thrush; examined but refused by Waxbills; killed at once and reluctantly eaten by Starling. Full-grown *Epeira diademata* seized and greedily eaten by Robin, ignored by Orange-Weavers.

25th September.

Gave an imago of *Phlogophora meticulosa* to *Leiothrix*; the cock bird flew down and examined it attentively for some time, evidently half deceived by its leaf-like appearance; eventually he pecked it, and, becoming convinced of its edibility, tore it to pieces and devoured it with great satisfaction. Earwigs were eaten by *Leiothrix*, Nightingales, Bulbul, Robin, and Starling; a number of small spiders and young larvæ of *Apamea didyma* eaten by Waxbills.

26th September.

Epeira and *Agelena* eaten with pleasure by Robin, Nightingales, *Leiothrix*, and Waxbills.

27th September.

Eristalis eaten by *Leiothrix*.

28th September.

Eristalis again eaten by *Leiothrix*, Robin, and Nightingales; rejected after examination by Waxbills.

29th September.

Caterpillar of buff ermine offered to Missel-Thrush but ignored; seized at once by Blackbird, passed backwards and forwards between his beak until nearly all the hairs were rubbed off, then swallowed.

30th September.

Caterpillars of *Mamestra* and *Apamea* eaten by Waxbills.

1st October.

Caterpillar of *Mamestra persicaria* offered to Wryneck ; licked, but rejected ; immediately eaten by Nightingale.

2nd October.

Quedius eaten by *Leiothrix*.

3rd October.

Caterpillar of *Mamestra persicaria* rejected (as too large to swallow) by Wryneck ; eaten at once by Nightingale.

5th October.

Caterpillar of *Spilosoma menthastri* eaten by Blackbird.

After this date nothing occurred worth recording, as I found it difficult to obtain insects of any kind with the exception of mealworms and a few house-flies.

It is noteworthy, from an examination of the above records, that no insect in any stage excepting the red-tailed humble-bee (which, by the way, I only offered to the Missel-Thrush) was rejected by all my birds ; those insects which were refused by certain species were eagerly devoured by others, so that it was impossible to conclude that any of them enjoyed perfect immunity from destruction. In the second place, so far from my birds learning by experience to reject with scorn that which they had proved to be unpalatable, I found that in some instances they seemed to acquire a taste for larvæ previously refused. Birds are very intelligent, but their memories are ridiculously short.

LX.—*A new Species of Rhax*. By R. I. POCKOCK,
of the British Museum (Natural History).

Rhax semiflava, sp. n.

Clothed with more or less golden hairs.

Colour.—The cephalic plate and chelicerae chocolate-brown ; thoracic membrane white ; sides of the abdomen paler brown ; first five abdominal tergites dark brown on the upper surface ; the succeeding four tergites pale testaceous above ; the anal somite wholly blackish ; under surface of the body wholly testaceous. Legs mostly testaceous ; the maxillary palpi with chocolate-brown tarsus and metatarsus ; the first pair of legs with brown terminal segment ; dactyli of chelicerae and ocular tubercle black.

Chelicerae.—Movable digit bearing a minute tooth in front of the large principal tooth, and with a single small

tooth behind and on the inner side of the large tooth; the immovable dactylus with two teeth in front of the largest tooth; behind the largest tooth on the outer side is a series of six teeth and on the inner side a series of four teeth; the hinder margin of the space between these teeth furnished with two or three denticles.

Under surface of the penultimate segment of the palpus armed with many spines, interspersed with coarser and finer hairs.

Tibiae of second and third pair of legs armed distally with a single spine; proximal tarsal segment of second and third pairs armed with six or seven spines above and the second pair with a single distal spine behind.

Fourth pair of legs not spined.

Measurements in millimetres of male specimen.—Length of chelicera $13\frac{1}{2}$, of cephalic plate 6, of abdomen 20; total length $42\frac{1}{2}$; length of maxillary palpi 20; width of cephalic plate $9\frac{1}{2}$, of abdomen $10\frac{1}{2}$.

A single specimen from Kohat, in the Punjab. Collected and presented to the British Museum by Lieut. A. Graeme Batten.

This species may be recognized by having the anterior half of the upper surface of the abdomen black and the posterior half white or rather testaceous.

LXI.—*A new Species of Glomeris from Borneo.* By R. I. Pocock, of the British Museum (Natural History).

Glomeris concolor, sp. n.

Colour wholly pale testaceous above and beneath. Tergites exceedingly finely and closely punctured. The nuchal plate marked with two parallel striae; the first tergite laterally with about nine fine striae and on the vertex with about six; the rest of the tergites with two striae.

Eye on each side composed of nine ocelli, eight in a gently curved longitudinal series and one on the outer side of the upper end of the series.

A single female specimen in the Museum Collection, preserved in alcohol, and brought from Borneo by the Rev. G. Brown.

This species resembles *Glomeris carnifex* * in possessing a large number of striae on the first dorsal plate. It differs from all the species of the genus in being coloured throughout of a uniform testaceous tint.

* Pocock, Journ. Linn. Soc. xxi. p. 290.

BIBLIOGRAPHICAL NOTICE.

An Illustrated Manual of British Birds. By HOWARD SAUNDERS, F.L.S., F.Z.S., &c. Parts xiii.-xx.

THE issue of the concluding part of this book imposes upon us the pleasing duty of congratulating the Author of what may certainly be considered one of the most useful of recent publications. The accuracy which marked the earlier portion has been fully sustained in the remainder, and no pains have been spared to render the volume as complete as possible; while, without adding to the estimated expense, maps have been furnished of the United Kingdom, Europe, and the North Polar district, showing the elevation of the land and the depth of the surrounding seas in the first two cases. The labour involved in the constant condensation necessitated by the plan of the work must have been enormous, especially in such articles as those on the Red Grouse, Curlew, Great Bustard, and Great Auk; yet we notice that space is found for many useful details—for example, the critical differences between the Arctic, Common, and Roseate Terns, the Slavonian and Eared Grebes, the Arctic and Long-tailed Skuas, the eggs of the Guillemot and Razorbill.

The new woodcut of the Great Auk is taken from Bullock's Orkney specimen, while the Killdeer and Sociable Plovers, the Mediterranean Black-headed Gull, the Solitary Sandpiper, the Lesser Golden Plover, and the White-billed Northern Diver are recognized as British birds, and the first three are figured. The Spotted Sandpiper, on the other hand, is now rejected. Besides this, the names Wedge-tailed Gull, Bonaparte's Gull, and Little Tern have been substituted for Cuneate-tailed Gull, Bonapartian Gull, and Lesser Tern, which were employed by Yarrell and which Mr. Saunders evidently felt constrained to employ in the 4th edition of the work which bears that author's name; the changes rendered possible by the absence of that feeling being decided improvements. A new derivation is suggested for the word 'Avocet;' the discovery of the Pectoral Sandpiper's eggs has been made since the 4th edition of 'Yarrell' appeared; and a probable occurrence of the Great Auk in the St. Kilda group has been lately brought to light.

In the Appendix, among further notes on several species, are to be found important records of the breeding of the Sand-Grouse and Snow-Bunting in Scotland, with the capture in Britain of *Emberiza cioides*. The Introduction contains a list of the families and genera, with characters of the latter; while in the full and thorough Index we are glad to see that different type is used to distinguish the above as well as the species, and that in cases of local or little-known names the usual English equivalents have been added in brackets, to avoid the necessity of a double reference.

MISCELLANEOUS.

Note on the Occurrence of a Species of Bothriceps in the Karoo System of South Africa. By R. LYDEKKER.

SPECIMENS of skulls of a small Labyrinthodont from the Karoo System of the Orange Free State preserved in the British Museum

(nos. R. 506-508) agree so closely in general characters with the genus *Bothriceps*, Huxley, presumably from the Hawkesbury Beds of Australia, that they may be regarded as indicating a new species of that genus, for which I propose the name *Bothriceps Huxleyi*.

The skull of this species is distinguished from that of the typical *B. australis* by its smaller size and narrower contour, the extreme length being about $2\frac{3}{4}$ inches in the specimen which I take as the type (no. R. 507). The sculpture is of the pitted nature characteristic of the typical species of *Bothriceps*, which at once serves to distinguish this form from *Petrophryne*, Owen, which (as Prof. von Zittel has pointed out) appears to be inseparable from *Micropholis*, Huxley.

The occurrence of *Bothriceps* in the Australian Hawkesbury Beds and the Karoo System of the Cape district is paralleled by that of the Ganoid genus *Cliotholpis*, which Mr. Smith Woodward has recently recorded from the latter deposits.

On the Phosphorescent Infestation of the Talitri and other Crustaceans.

By M. A. GIARD.

Several naturalists have noted the phenomenon of phosphorescence in Amphipoda of different groups and often badly determined (*Gammarus*, *Talitrus*, *Orchestia*, &c.). Tilesius, Viviani, Suriray, and Snellen van Vollenhoven have cited cases of this kind, and the Rev. T. Stebbing, in the admirable bibliography of his Report upon the 'Challenger' Amphipoda, has summarized these older observations. In most cases the observed phosphorescence did not belong to the animal itself. In *Talitrus*, especially, M. de Quatrefages has indicated the cause of this apparent phosphorescence; it is due to *Noctiluca* which attach themselves to the carapace of the Amphipod as they lie upon the damp sand after the retreat of the tide*. Therefore my surprise was great when, on the 3rd September last, I found on the beach at Wimereux a phosphorescent *Talitrus* of such intense and continuous lustre that the *Noctiluca* evidently had no part in the phenomenon. It was at 10 o'clock at night, and notwithstanding the brightness of the moon, then nearly at the full, the luminous *Talitrus* could be perceived at a distance of several metres. The light was greenish; it proceeded from the interior of the body of the Crustacean, which was completely illuminated to the extremities of the antennae and legs, and presented no dark points except the two eyes, which formed two black spots upon this brilliant ground. The animal walked slowly upon the sand, instead of leaping briskly like its congeners. All search made on the same night and following evenings to find other *Talitri* in the same state were absolutely unsuccessful.

This excessive rarity of the phosphorescent *Talitri* upon a beach on which those animals exist in thousands led me to suppose that we had to do here with a parasitic action rather than a physiological peculiarity. Therefore the next day I examined under the microscope a leg cut off from the luminous animal. This limb proved to be stuffed with Bacteria swarming among the muscles, and particularly visible in the terminal joints, which were thinner and more transparent. Under the influence of this microbe the

* "Sur la phosphorescence de quelques Invertébrés marins," in *Ann. Sci. Nat.* sér. 3, vol. xiv. p. 236, 1850 (see also 'Silliman's Journal,' vols. xv. and xvi., and 'Annals,' ser. 2, vol. xii. pp. 15 and 180, 1853).

muscles presented a profound alteration, which explained the enfeebling of the animal's movements.

To study the Bacteria more completely I collected a drop of blood from the *Talitrus* and added to it a drop of gentian-violet. Thus treated the Bacterian was brightly coloured. It presents the form of a *Diplobacterium* measuring about $2\ \mu$; each of the geminate joints is less than $1\ \mu$. There are also chaplets of three or four joints, rarely more, and here and there a few isolated bacilli, a little longer ($3\text{--}5\ \mu$).

The phosphorescent disease being manifestly of an infectious nature, I tried inoculations upon *Talitri* and *Orchestia* (*O. littorea*, Mont.). For this purpose I cut off two more legs of the luminous *Talitrus*. Each of these was torn up separately in blood of *Talitrus* and of *Orchestia*; then with a sterilized needle I pricked the *Talitri* and the *Orchestia* on the sides of the body, taking care not to wound the liver or touch the dorsal vessel, in order to avoid a too abundant hæmorrhage. I then applied a drop of virus to the wounded places, and the inoculated animals were enclosed in glasses furnished with a thin layer of sand, and covered over and placed in the cellar of the laboratory at the temperature of $59^{\circ}\text{--}64^{\circ}\text{F}$.

The result exceeded my expectations. Of the *Talitri* inoculated on the 6th September six began to shine on the 8th and appeared on the evening of the 9th as brilliant as the first luminous *Talitrus*. Out of a dozen *Orchestia* inoculated the same day three became phosphorescent on the 9th and were resplendent on the 10th. I have since continued the inoculations, operating about every two days: and I possess at present *Talitri* of the sixth luminous generation and *Orchestia* of the fourth generation. The action of the microbe does not seem to diminish at all, and in the evening the cellar of the laboratory presents a fairy aspect, which is the admiration of the bathers staying at Wimereux.

The Bacteria is not modified by passing into the *Orchestia*: *Talitri* inoculated with virus taken from *Orchestia* of the third generation behaved as if they had been infected by the blood of other *Talitri*.

The disease follows a very regular course. At first one sees only a luminous point at the place of the puncture. After the lapse of from forty-eight to sixty hours the whole animal is phosphorescent, but with a white light which has little external diffusion. At this time the *Talitrus* still shows great activity. After the third or fourth day the phosphorescence becomes brilliant and of a fine greenish tint and the animal throws out a bright light around it. It may be perceived at a distance of 10 metres, and two *Talitri* suffice to enable one to see the time by a watch as in full daylight. At this phase of the malady the *Talitrus* progresses more slowly; it can still issue from its burrow, which it illuminates, and return there if disturbed. The period of this state may last from three to six days; then comes a period of immobility, during which the phosphorescence retains all its brilliancy. Lastly, in three or four more days the animal dies; the body remains phosphorescent for some hours and then acquires a very characteristic brown tint. Frequently the point of inoculation is surrounded by a small blackish circle. Lowering of the temperature seems to prolong the life of the animal: *Talitri* inoculated on the 9th September and kept at a temperature of $50^{\circ}\text{--}57^{\circ}\text{F}$. were still living on the 22nd September.

In the *Orchestia* the inoculations do not succeed so easily because the operation is more delicate; but the animal longer retains its muscular power: an *Orchestia* inoculated on the 12th still jumped on the 19th, although it was in full phosphorescence. The *Talitri* and *Orchestia* in which the inoculation does not succeed remain in perfect health long after their congeners are dead; the puncture, when well made, therefore is not serious in itself.

I have inoculated examples of *Hyale Nilssoni*, Rathke, with perfect success: in these little Amphipoda phosphorescence is produced in forty-eight hours. Specimens of *Ligia oceanica*, Linn., though more resistant, also gave a favourable result. Of six *Ligia* unsuccessfully inoculated on the 10th and reinoculated on the 16th only one was infected; but after the 20th it presented an admirable spectacle.

I have also succeeded in inoculating crabs (*Carcinus mænas*, Linn., and *Platyonychus latipes*, Penn.). In these animals, however, the morbid phenomena are much more complex, and I will notice them in a subsequent communication. At the same time I will describe my experiments in the culture of the Bacteria in artificial media.—*Comptes Rendus*, September 23, 1889, p. 503.

On the Parasitic Castration of the Typhlocybæ by a Hymenopterous Larva (Aphelopus melaleucus, Dalm.) and by a Dipterous Larva (Atelenevra spuria, Meig.). By M. A. GIARD.

The Hymenopterous and Dipterous larvæ parasitic upon *Typhlocyba* noticed by the author in a former communication* belong, the former to *Aphelopus melaleucus*, Dalm., the latter to *Atelenevra spuria*, Meig. (*A. velutina*, Macq., *Chalarus spurius*, Schin.).

These insects, like their hosts the *Typhlocybæ*, have two generations in the year: one, proceeding from pupæ formed during the second fortnight in June, comes out at the beginning of July; the other infests the second generation of *Typhlocyba*, enters the pupa state towards the end of September or in October, and probably passes the winter in that state, producing the perfect insect in the following spring.

Combining these observations with those of Perris (on the parasitism of *Dryinus pedestris*, Dalm., upon *Athysanus maritimus*, Perris) and of J. Mik (on the parasitism of *Gonatopus pilosus*, Thoms., upon *Deltocephalus xanthoneurus*, Fieb.) it seems probable that the Procotrupians of the family Dryinidæ are generally parasitic upon Homoptera of the family Jassidæ.

On the other hand, as regards the Diptera, the present observation, especially in conjunction with Boheman's statements, particularly as to the infestation of *Cicadula viridescens*, Fall. (*Thamnotettix sulphurella*, Zett.), by the larva of *Pipunculus fuscipes*, Fall., makes it probable that the Diptera of the family Pipunculidæ are also generally parasitic upon Jassidæ.

The *Typhlocybæ* with yellow or whitish elytra form a small group of species often living side by side upon the same trees, and resembling each other so closely that it is almost impossible to distinguish them. Mr. James Edwards, of Norwich, has recently called attention to the very distinct differential characters presented by the male genital armature in these different species. In accordance

* *Comptes Rendus*, July 8, 1889, p. 79; see *Annals*, *suprà*, p. 254.

with his researches the *Typhlocyba* of the horse-chestnut indicated in the former note as *T. rosæ*, Linn., really belong to two distinct species, viz., *T. hippocastani*, J. Edw., and *T. Douglasi*, J. Edw., which are equally common on the trees of the Luxembourg. These two species may be attacked by the two parasites here mentioned: but the *Aphelopus* especially infests *T. hippocastani*, while the *Atelenevra* almost always occurs in *T. Douglasi*.

The females of *T. hippocastani* and *T. Douglasi* are very difficult to distinguish; nevertheless in the latter the ovipositor is more robust and presents only a single curvature, while in *T. hippocastani* it is thinner and doubly curved in the form of a scimitar. In individuals of both species parasitized by *Aphelopus* the ovipositor is generally much reduced and incapable of penetration, but *Atelenevra* seems to have much less influence on the development of this organ.

As regards the male genital armature, in *T. Douglasi* the penis is simple and the lateral pieces have the form of legs; parasitic castration, whether by *Aphelopus* or *Atelenevra*, causes very slight modifications in it. In *T. hippocastani* the lateral pieces are simple and slender arcs, but the penis presents a very complex structure and terminates in a fork with eight branches of very elegant form. In the males parasitized by *Atelenevra*, and especially in those infested by *Aphelopus*, the penis undergoes considerable reductions: it has sometimes six, sometimes four, and sometimes only three branches. The specific character is thus greatly modified, and some of the forms might easily be confounded with *T. rosæ*, Linn., or *T. Lethierryi*, J. Edw.

Modifications of equal extent occur in certain singular organs, the existence of which in the males of *Typhlocyba* does not appear to have been noticed, and of which the function is quite unknown. These are two invaginations of the ectoderm which start from the ventral surface of the first abdominal segment and extend like the fingers of a glove to the extremity of the fourth segment or a little further. The author regards them as homologous with the stridulant organs of the male Cicadas. In the males of *T. Douglasi* and *T. hippocastani* infested by *Aphelopus* or *Atelenevra* the ventral invaginations are much reduced, reaching only, in general, to the second abdominal segment, and often forming only two little pockets on the first segment.

Aphelopus melaleucens appears to be pretty common; it has been met with at Wimereux and in the wood at Meudon upon *T. hippocastani* and *T. ulmi*, which often live together upon the elm, with *T. opaca*, J. Edw. In these localities the sac which contains the larva instead of being yellow as in the Luxembourg garden, is usually of a blackish colour. This colour is evidently protective of the more numerous individuals living upon *T. ulmi*, the abdomen of which is black, and is probably due to heredity in the others. Perhaps, moreover, *Aphelopus* presents varieties in the different species of *Typhlocyba* which it infests: Walker has described fifteen forms of this Hymenopteron, and the individual figured by him differs in certain characters from those examined by the author, who says that he has been unable to find the least trace of the cells of the fore wings, and that the palpus possesses only five joints instead of six.—*Comptes Rendus*, Nov. 4, 1889, p. 708.

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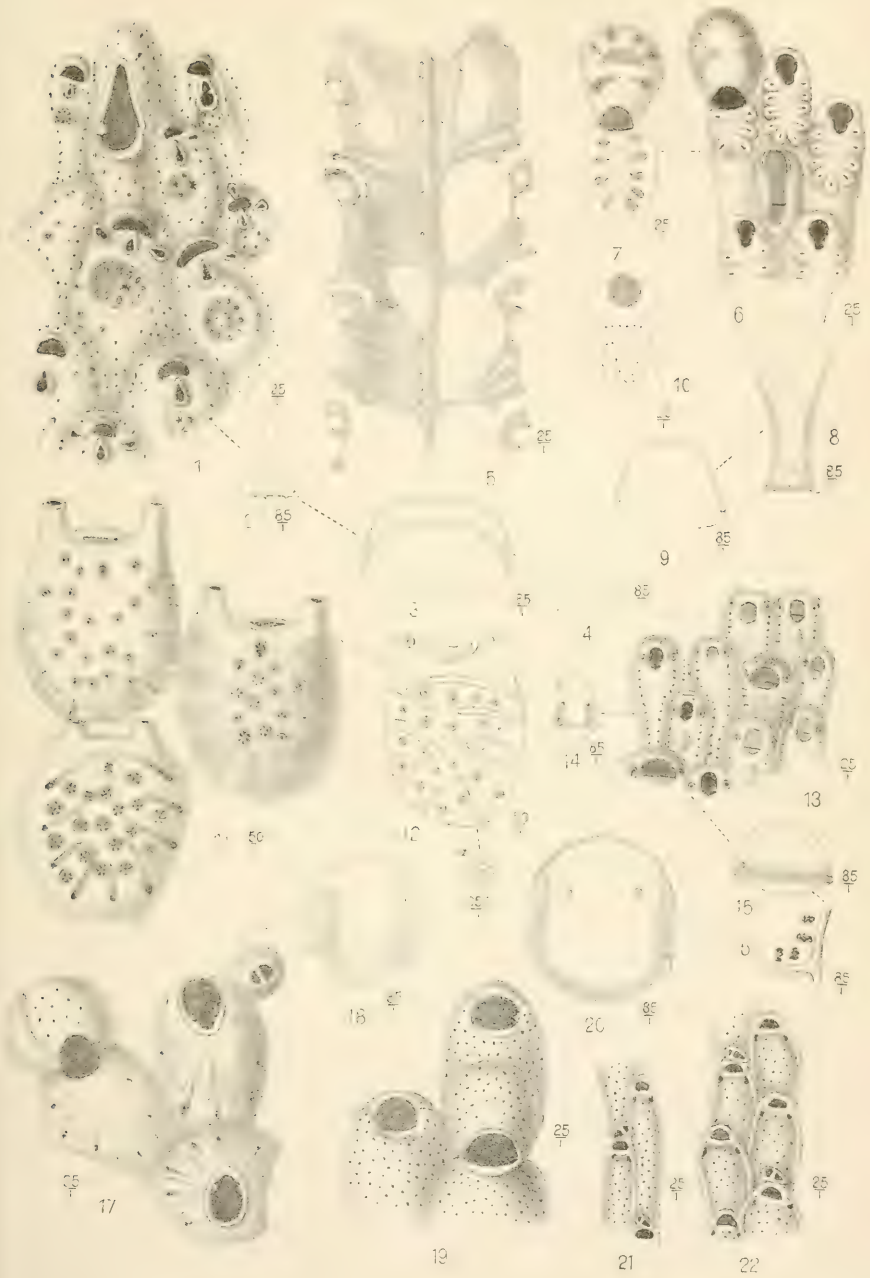
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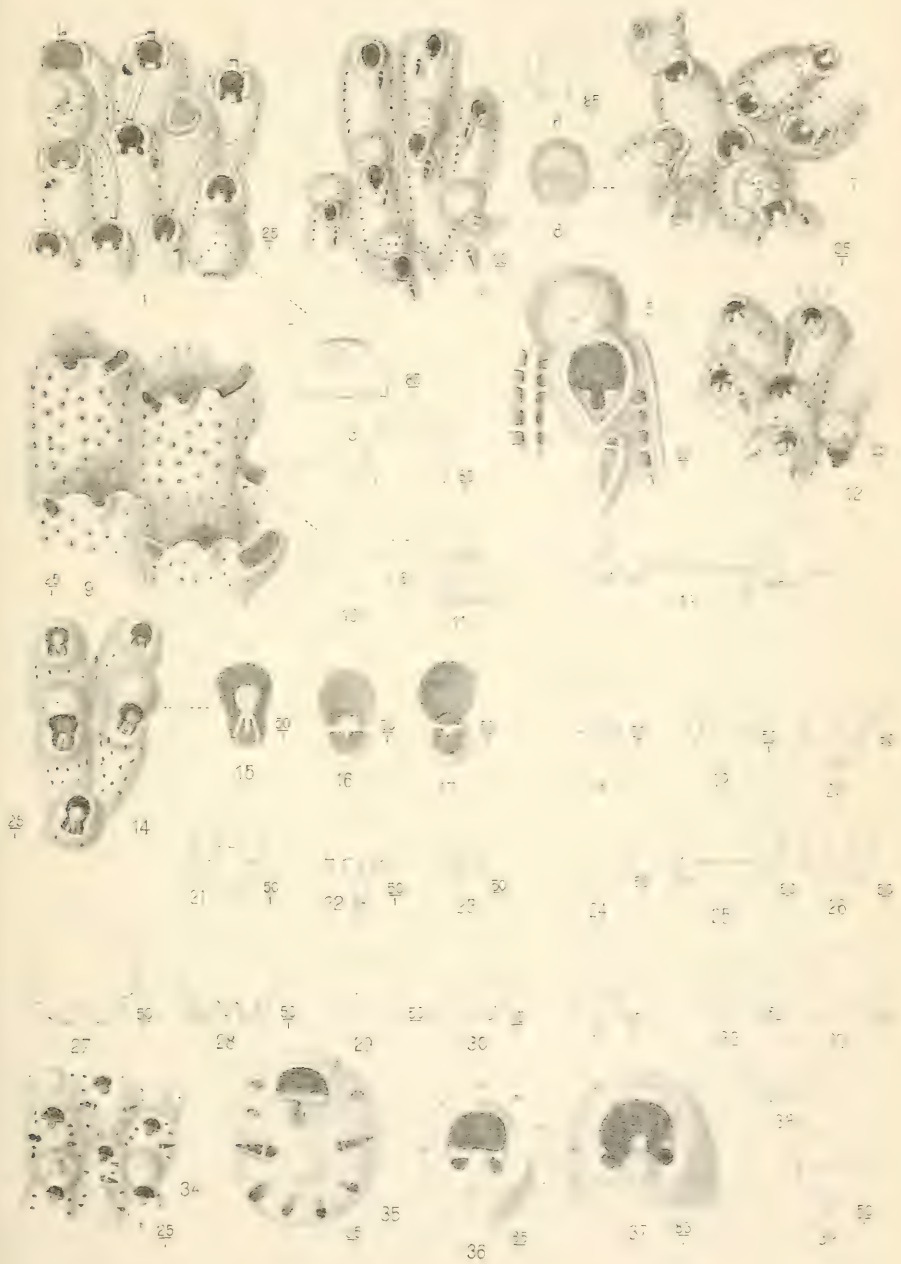
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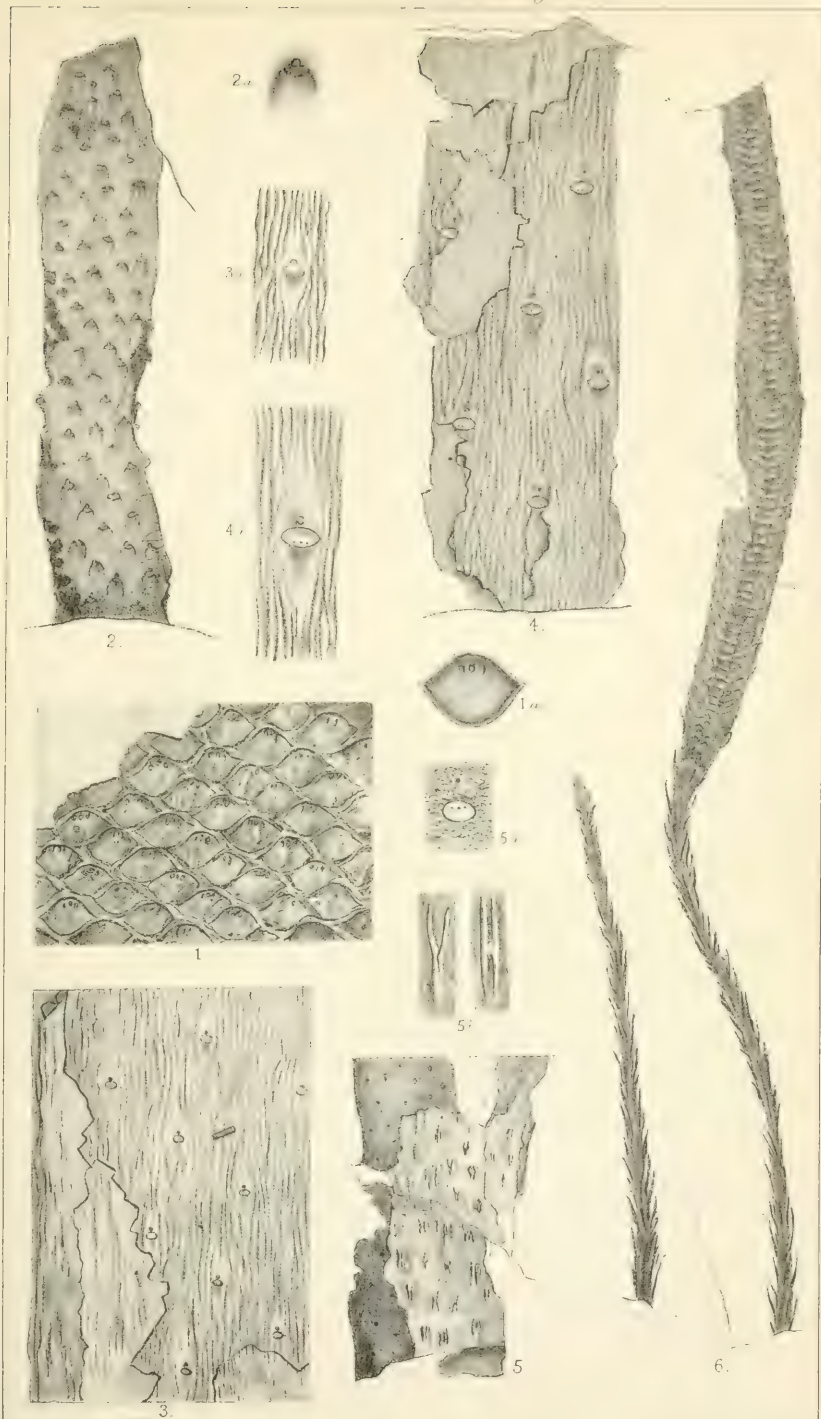
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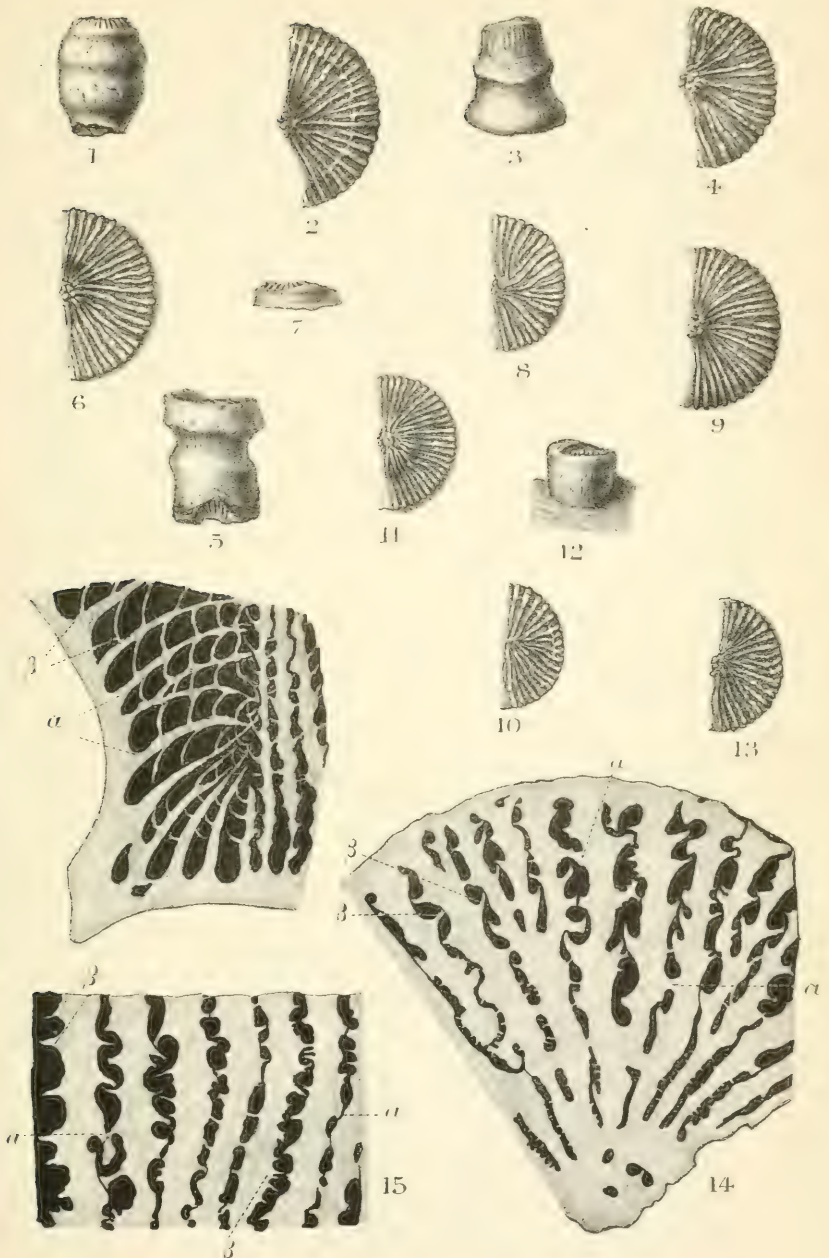


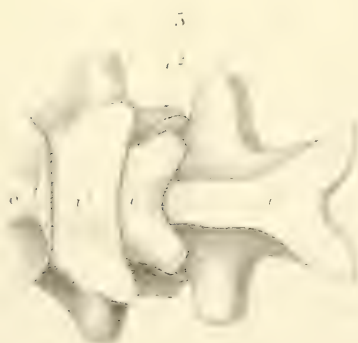
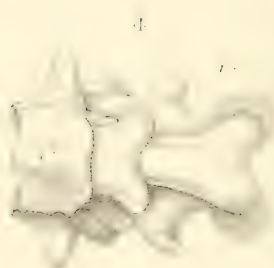
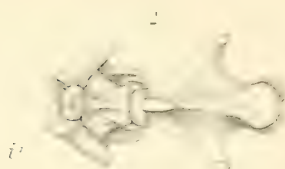
R. Kidston, del.

M'Farlane & Erskine Lith. Edin.

1. SIGILLARIA DISCOPHORA, König, sp. 2-4. BOTHRODENDRON WIIKIANUM, Kidston, n. sp.

5-6. BOTHRODENDRON MINUTIFOLIUM, Kidston, n. sp.





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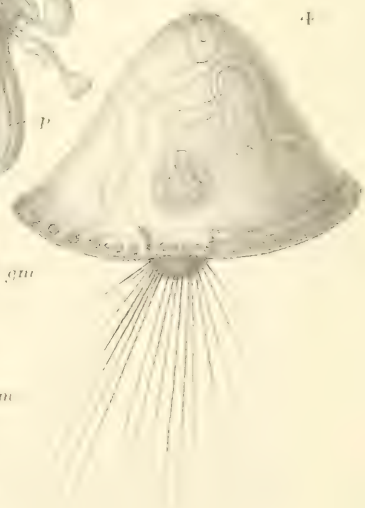
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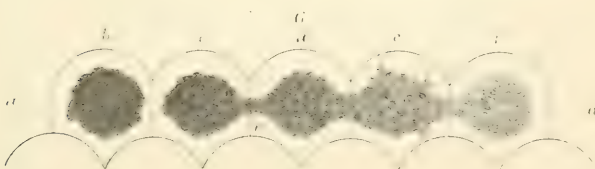
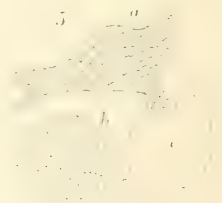
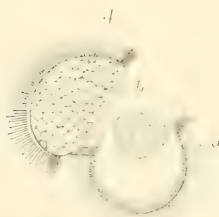
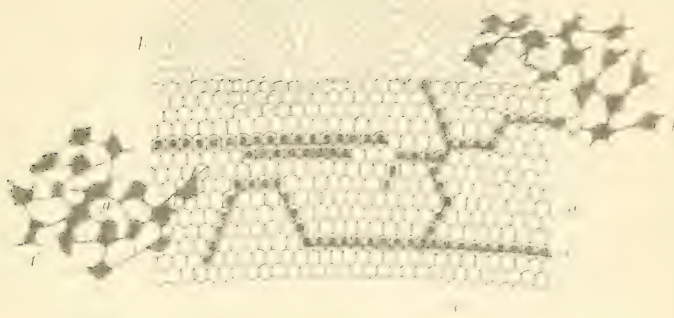


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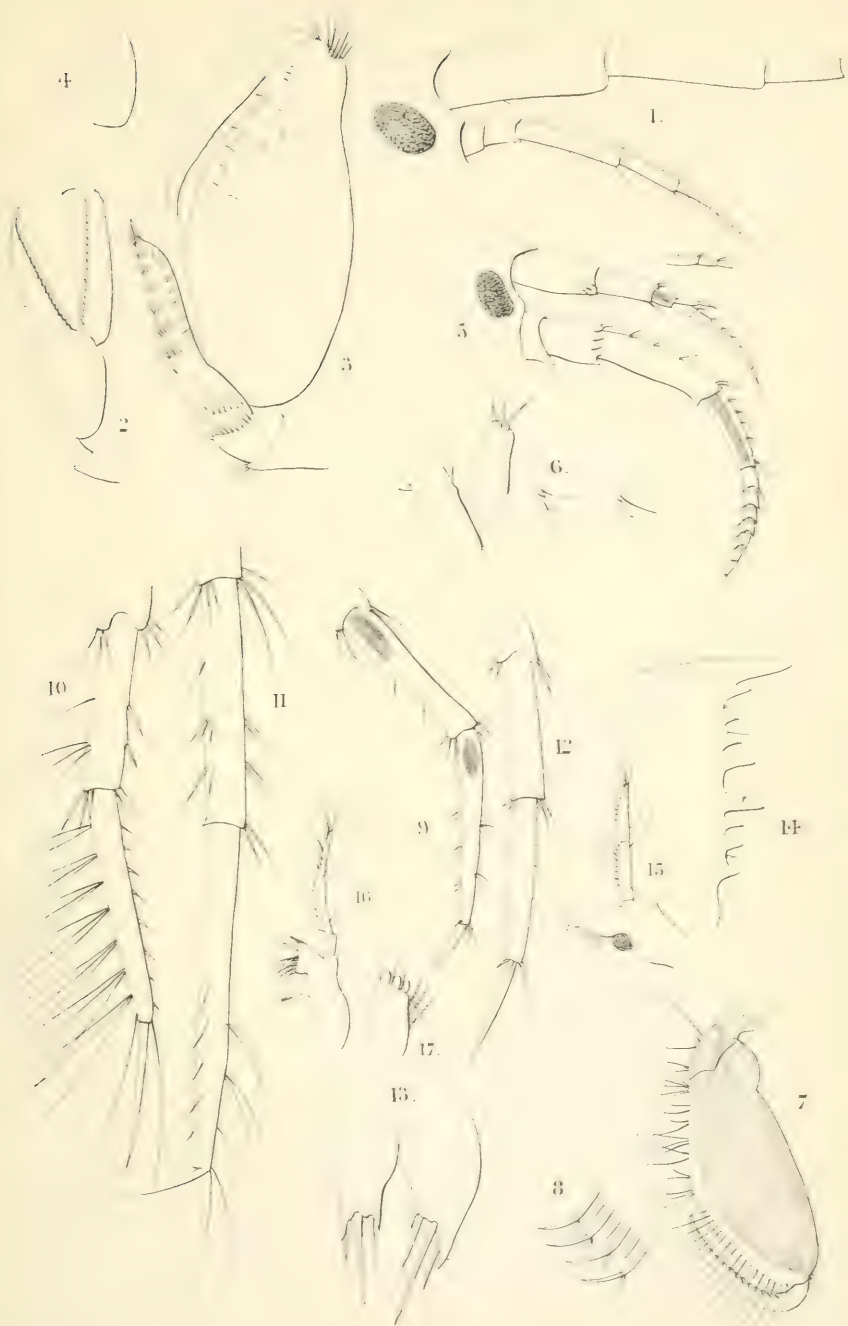
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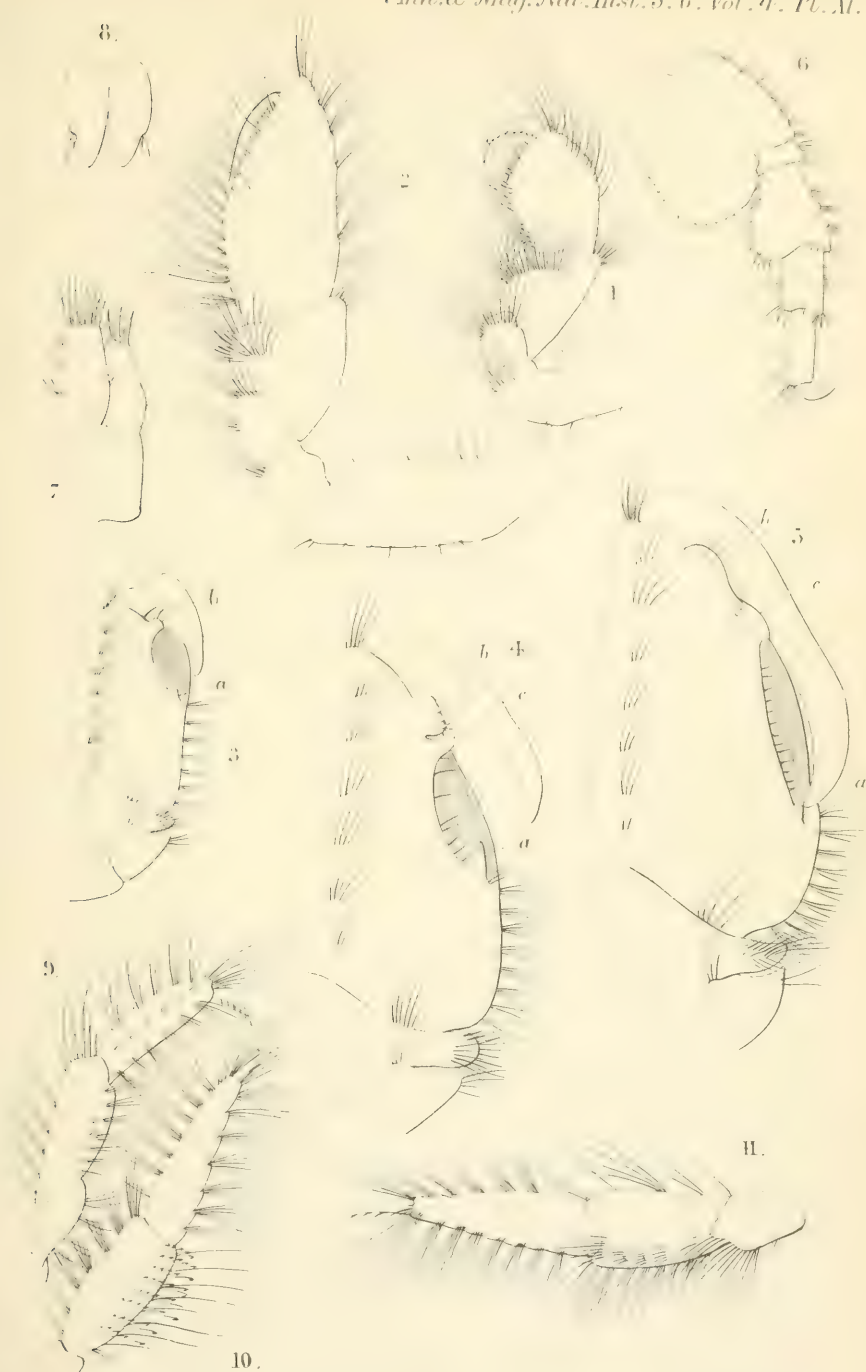
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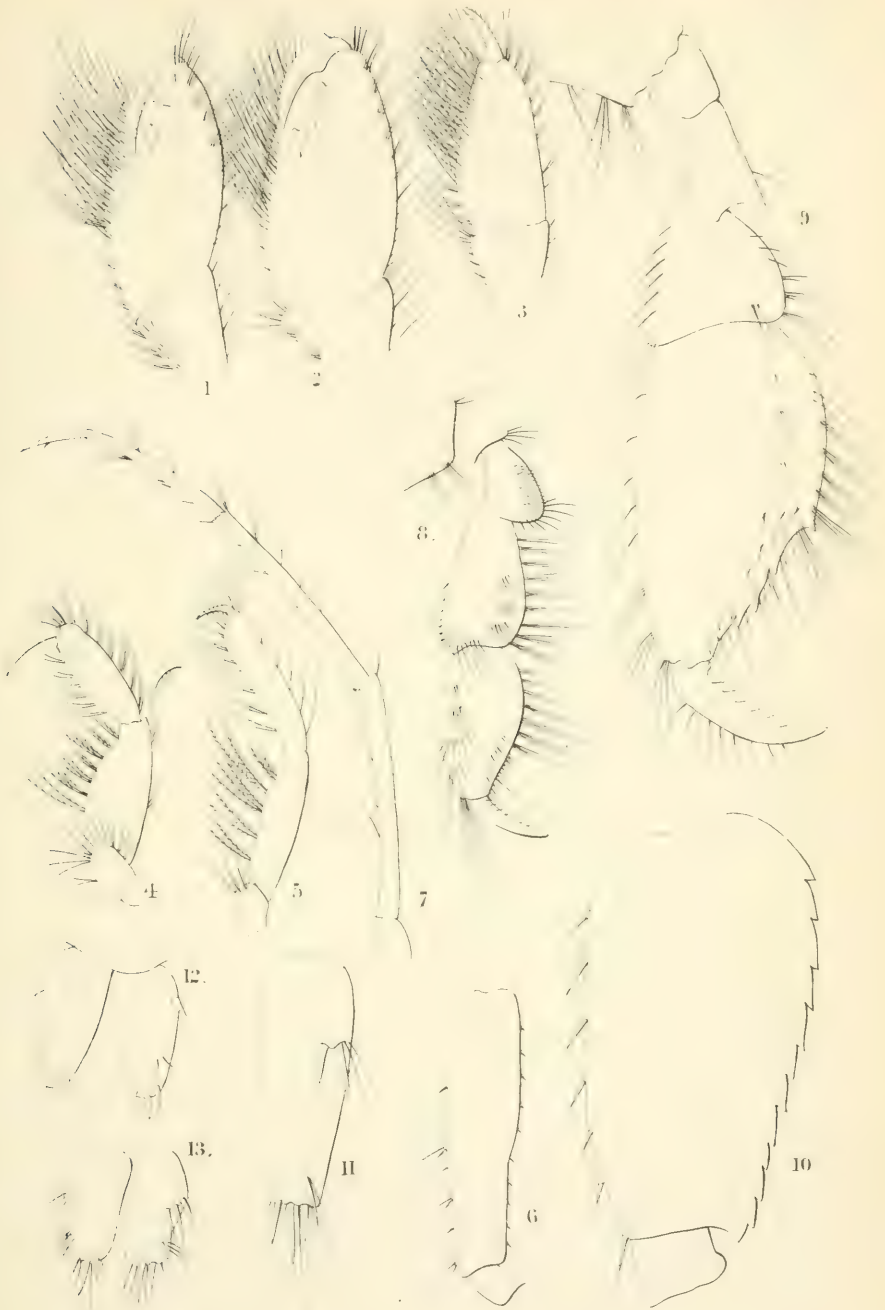


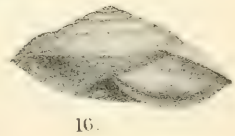
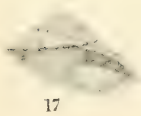
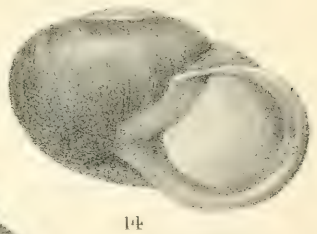
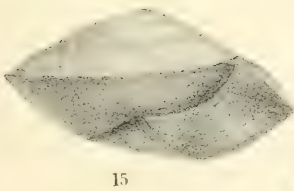
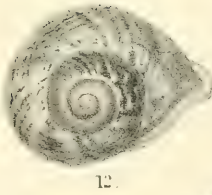
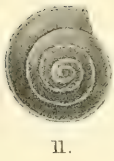


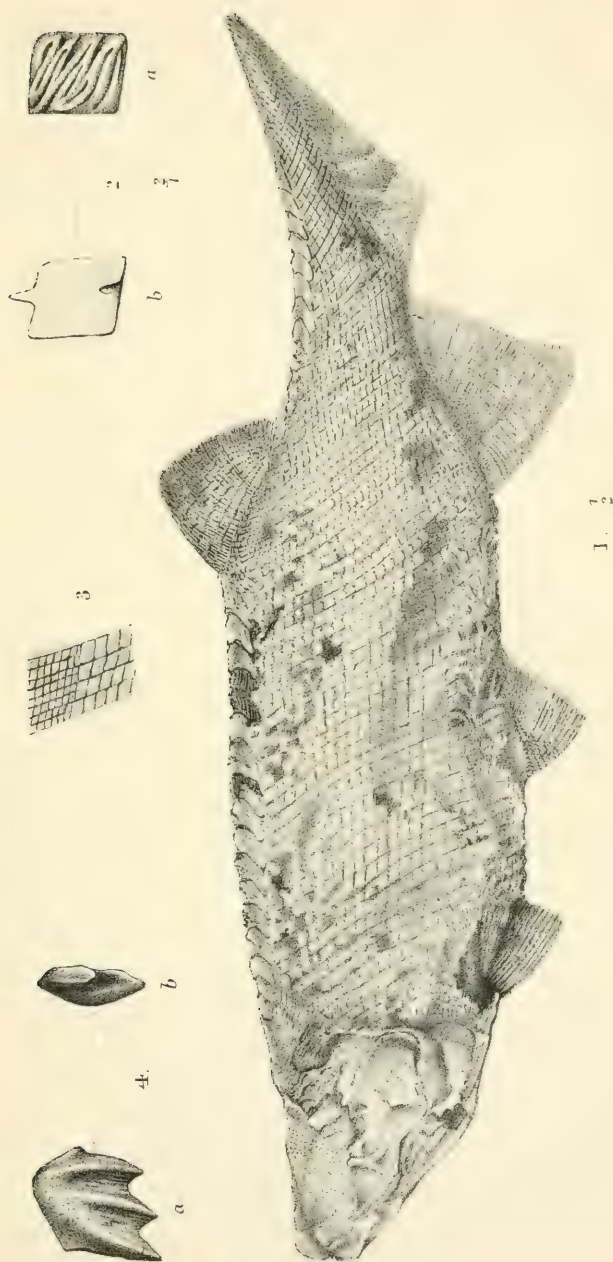




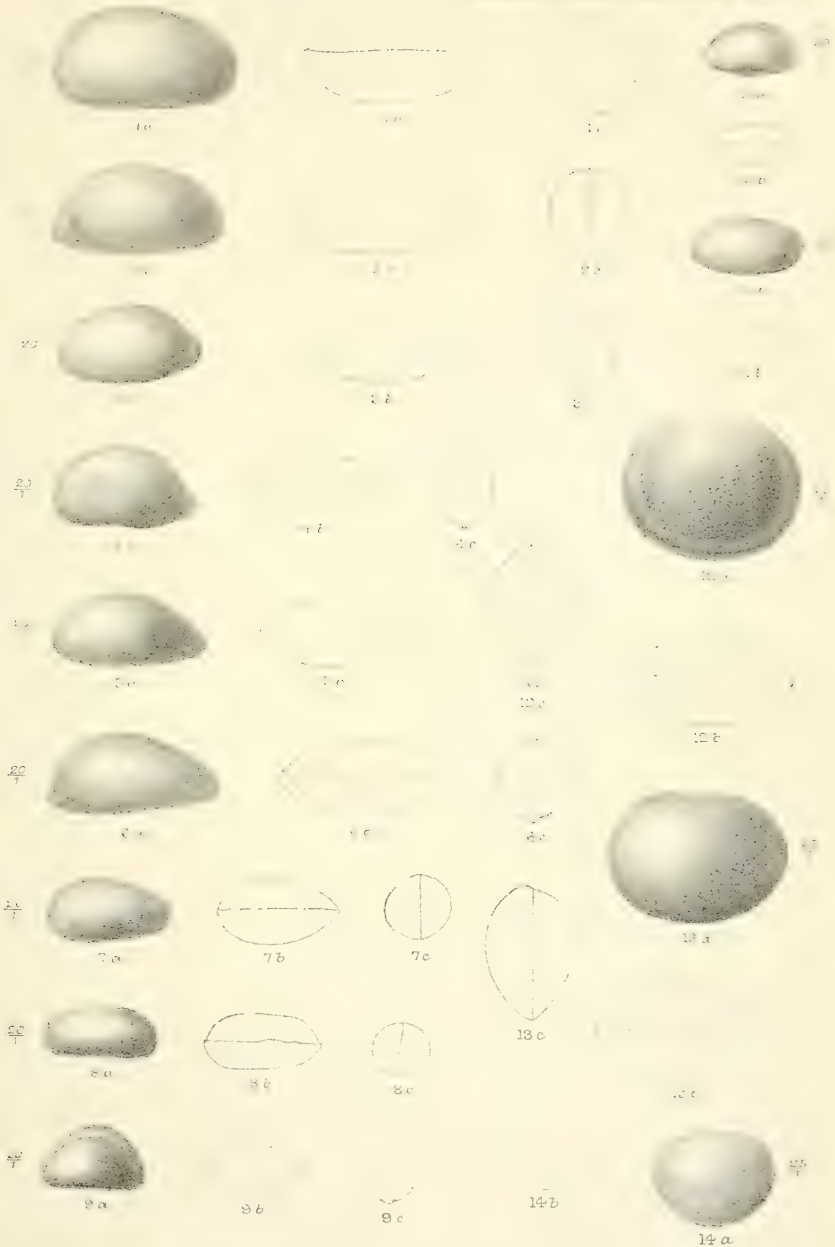








1 3. *Illosteonotus scutatus*. 4. *Ceratodus capensis*.



Hedelin del.
E C Knight lith.

West. Newman imp.

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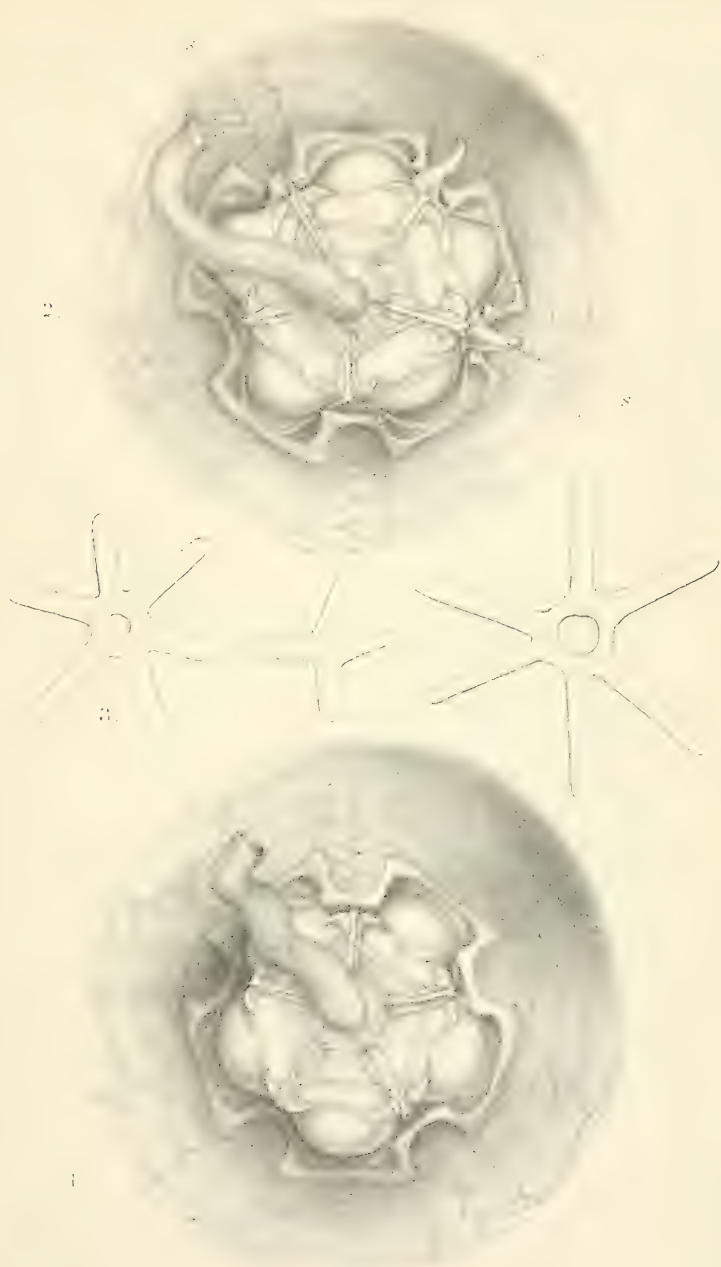
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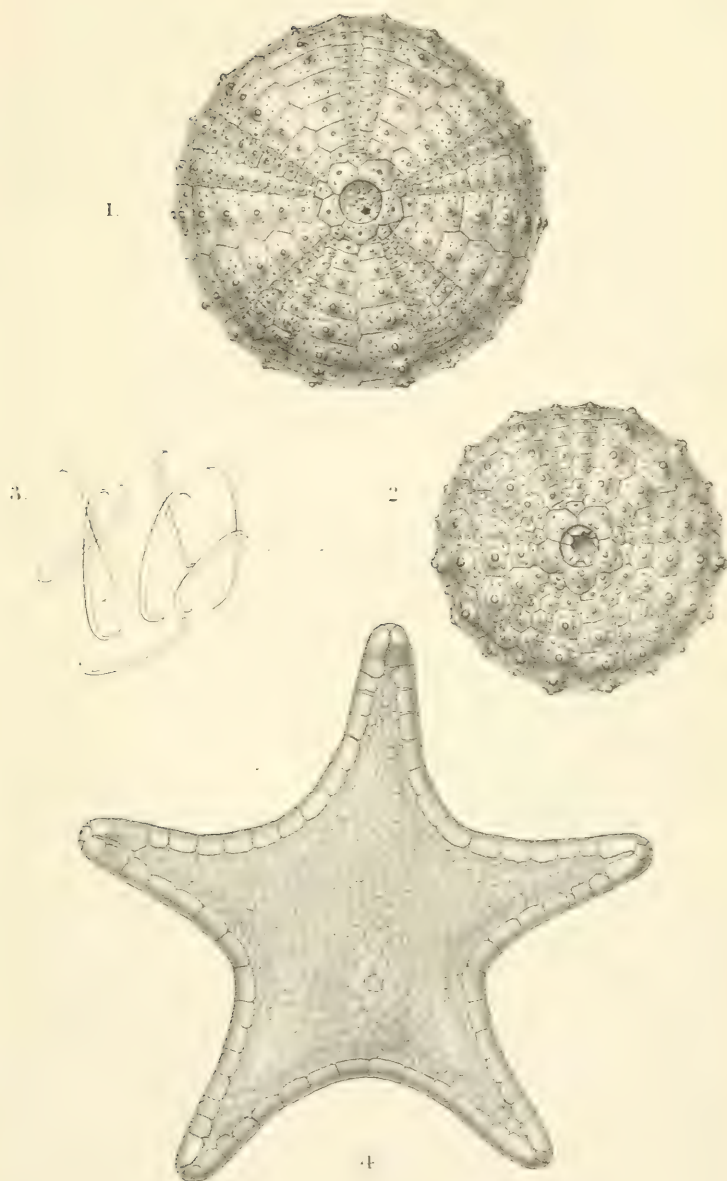
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