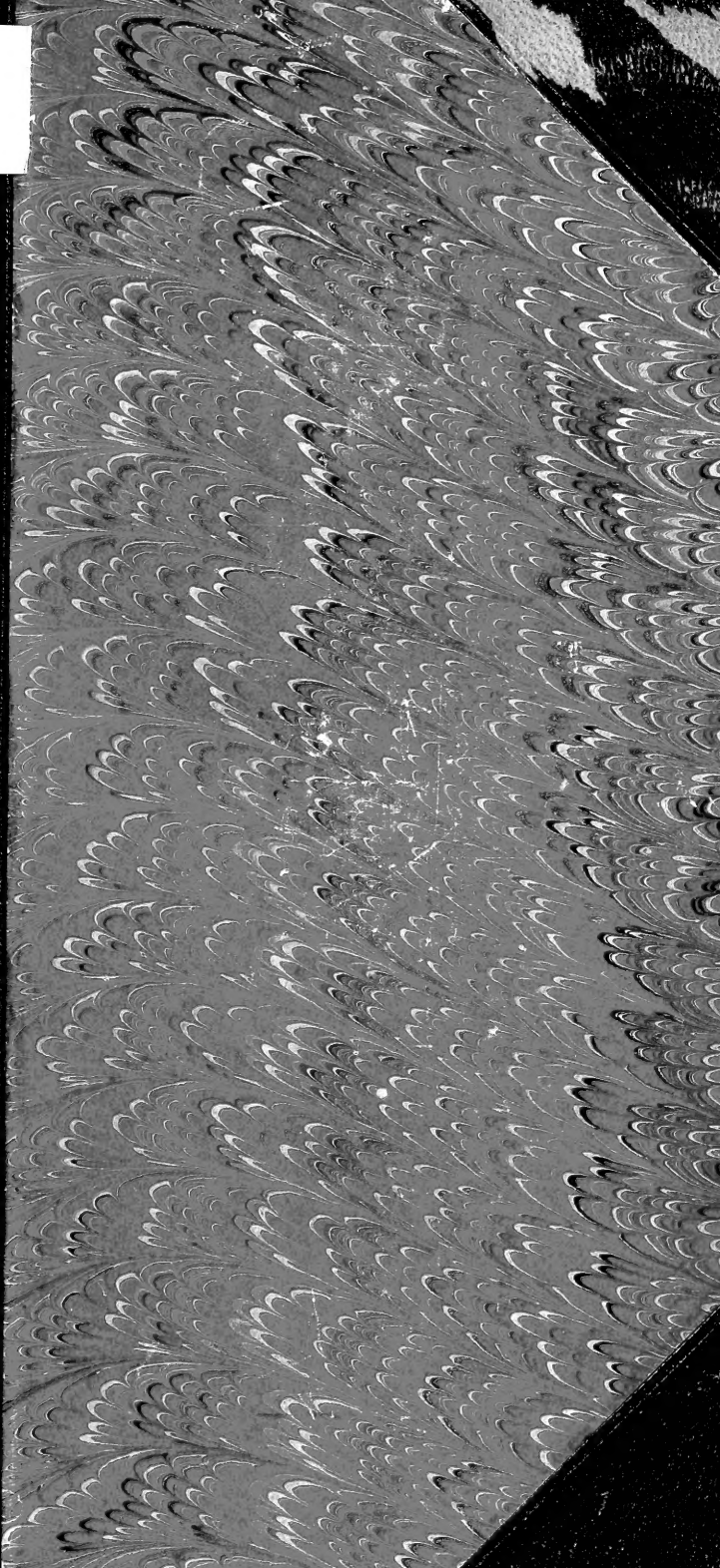
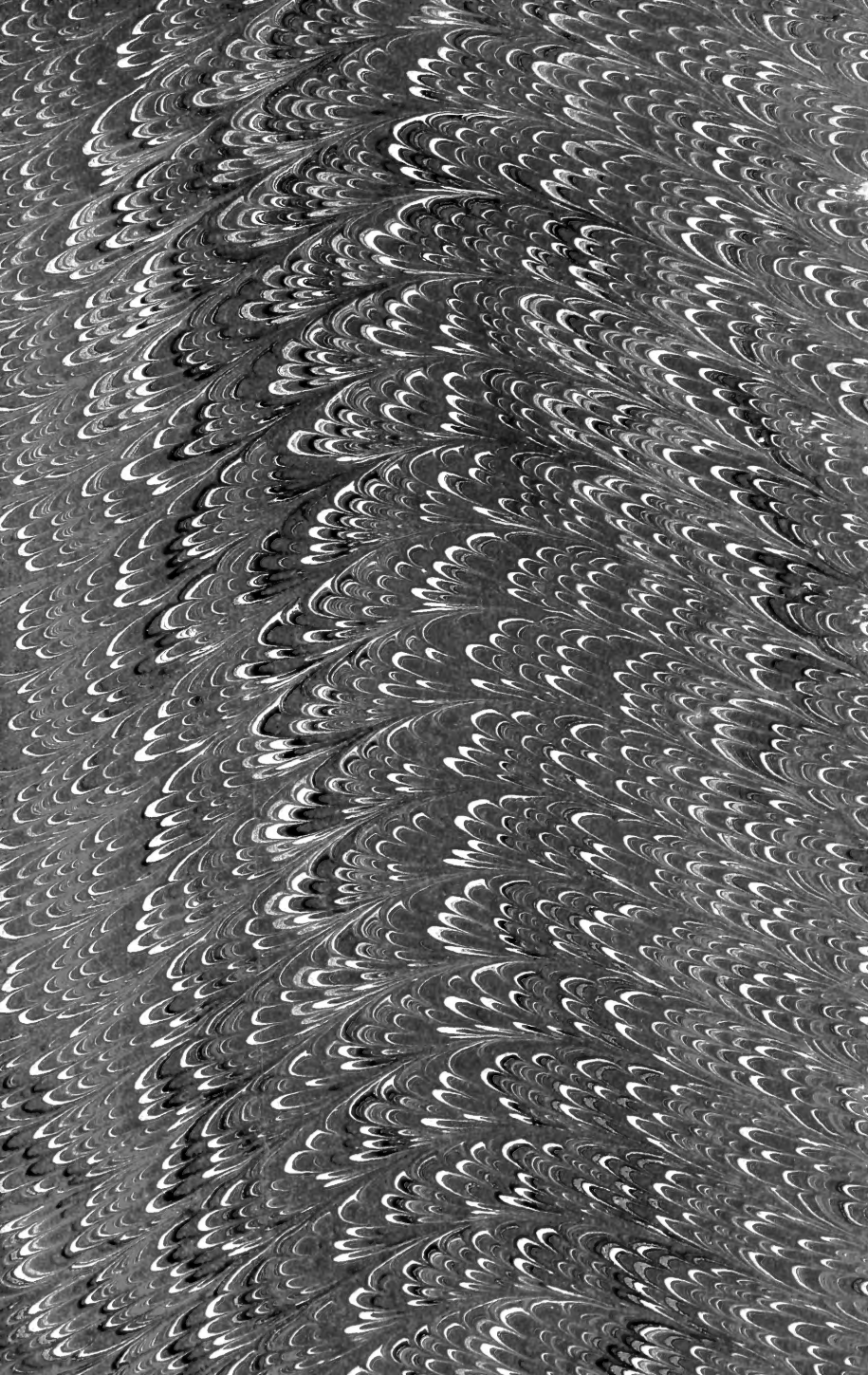
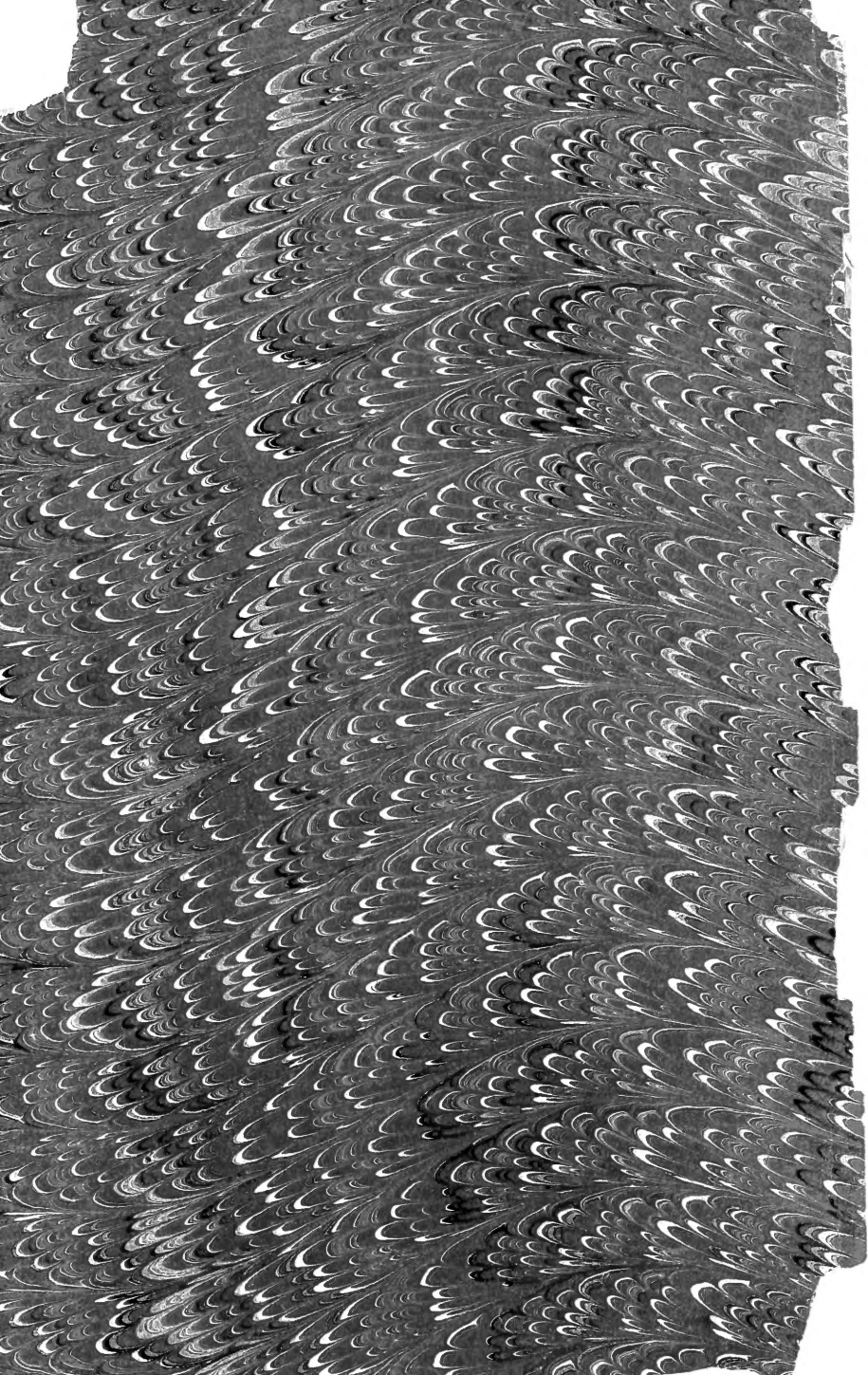


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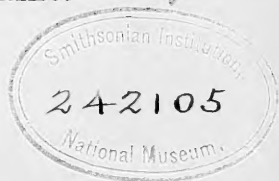
THE ANNALS
AND
MAGAZINE OF NATURAL HISTORY,

INCLUDING
ZOOLOGY, BOTANY, AND GEOLOGY.

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

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

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VOL. VII.—SIXTH SERIES.  
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1891.

“Omnes res creatæ sunt divinæ sapientiæ et potentia 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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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 Eol. 1.

No. 37. JANUARY 1891.

I. — *Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.*—No. 21. *Note on the Results of the last Season's Deep-sea Dredging.* By J. WOOD-MASON, Superintendent of the Indian Museum, and Professor of Comparative Anatomy in the Medical College of Bengal, and A. ALCOCK, M.B., Surgeon I. M. S., Surgeon-Naturalist to the Survey.

DURING eight seasons' surveying-operations along the Indian coasts the 'Investigator,' in her passages from surveying-ground to surveying-ground, has availed herself of numerous opportunities of collecting information about the life of the depths of the Indian seas. In the present paper we propose to give a general sketch of the results of the last season's labours in this direction, as summed up in twelve hauls of the trawl, in depths ranging from 90 to 1439 fathoms, in the Bay of Bengal and in that part of the Arabian Sea intervening between the Laccadive Islands and the Malabar coast, which we have called the Laccadive Sea.

We could not, in the time available, include the deep-sea collections of previous seasons; but we hope that in course of time these too may be noticed—at least in the same general way.

Except in the classes of Fishes and Crustaceans we have made no attempt at systematic detail, our object being to

enlist the interest of European naturalists in an almost unworked field of Indian zoology, and not single-handed to engage in an impossible research.

The apparatus generally used was a reversible trawl with steel-wire rope.

List of the 'Investigator' Deep-sea Dredging-Stations during the Season 1889-90.

Station No.	Position.	Depth in Fathoms.	Nature of Bottom.	Temperature Fahr.	
				At surface.	At bottom.
56	Off west coast of Andamans, between N. & S. Sentinel Islands.	240-220	Coral sand, with Foraminifera.	84 ^o	?
62	Bay of Bengal, lat. 16° 45' N., long. 88° 32' 50" E.	1439	Brown mud.	79.7	35.3
76	Bay of Bengal, off Ganjam coast, 25 miles S.E. $\frac{1}{2}$ E. Barwa Beacon.	93	Brown mud.	79	64
81	Bay of Bengal, off Ganjam coast, 24 miles S.E. Gopálpur.	93-89	Brown mud.	?	?
96	Bay of Bengal, lat. 18° 30' N., long. 84° 46' E.	98-102	Sand.	80	64
97	Bay of Bengal, lat. 18° 26' N., long. 85° 24' E.	1310	Olive mud.	80	36.2
100	Bay of Bengal, lat. 16° 55' 41" N., long. 83° 21' 18" E.	840	Brown mud.	79	41
101	Bay of Bengal, lat. 16° 11' 15" N., long. 82° 30' 30" E.	922	Brown mud.	87	39
102	Bay of Bengal, lat. 15° 38' N., long. 82° 30' E.	920-690	Brown mud.	85	39.75 (at 920 fath.)
103	Bay of Bengal, lat. 15° 14' N., long. 81° 09' E.	1260	Blue mud.	86	36
104	Laccadive Sea, off Elicapeni Shoal, lat. 11° 12' 47" N., long. 74° 25' 30" E.	1000	Olive mud, with coral detritus and 2.15 per cent. Foraminifera.	83	38.6
105	Laccadive Sea, off Goa coast, lat. 15° 02' N., long. 72° 34' E.	740	Grey ooze, coral mud, and 12.5 per cent. Foraminifera.	83	44

Grade A. *PLASTID OZOA*.Class *RETICULARIA*.

The Foraminifera of the Bay of Bengal have been largely determined by Dr. John Murray from small quantities of deep deposit sent home by Commander A. Carpenter, R.N., D. S. O., lately in charge of the Marine Survey of India. The results of one of Dr. Murray's analyses of mud brought up by the 'Investigator' from the Bay of Bengal (lat. 17° 34' N., long. 87° 59' E., 1300 fathoms) will be found in the 'Magazine of the Scottish Geographical Society,' vol. v. p. 420 (August 1889), to which it is sufficient for our purpose to refer.

Off the west coast of the Andamans, in 240 to 220 fathoms, a few specimens of *Masonella planulata*, H. B. Brady, were found adhering to the tangles. *Masonella*, it may be recalled, is a new Astorhizid genus instituted by Dr. Brady (Ann. & Mag. Nat. Hist. (6) iii. (1889), p. 293) for the reception of two species of Andaman 'Investigator' Foraminifera with large discoid, arenaceous, reticulated tests, in the radiating tubules of which the living sarcode is contained. In sorting the collection specimens were discovered (*Promasonella*, Wood-Mason) which establish a connecting-link between *Astorhiza* and *Masonella*; and of this genus there are two species, *Promasonella Carpenteri*, Wood-Mason, and *P. alterniramis*, Wood-Mason.

Grade B. *ENTEROZOA*.Subgrade A. *CŒLEENTERATA*.Phylum *NEMATOPHORA*.Class *SCYPHOMEDUSÆ*.Order *DISCOMEDUSÆ*.Family *Ephyridæ* (*COLLASPIDÆ*).*ATOLLA*, Hæckel.

Two slightly differing specimens of a species of this 'Challenger' deep-sea form were taken—and they were the only deep-sea Medusæ taken—during the season. Both were trawled in the Bay of Bengal, off the Madras coast, one in 840, the other in 920 to 690 fathoms.

Both have the central disk of the exumbrella, inside the

exumbral coronal furrow, with an entire (*i. e.* not indented) margin—in this respect differing from *Atolla Wyvillii*, Hæckel, and from *Atolla Bairdii*, Fewkes.

In both the edges of the marginal lobes and the entire surface of the gastro-vascular cavity are covered with a delicate, deciduous, violet-black membrane. In one specimen the thick external coronal muscle forms a very broad, in the other a comparatively narrow, band.

The bathybial habitat of *Atolla* has been argued by Professor Hæckel on the ground of the retrogression of some of the organs of sense. It might be added that the violet-black of the pigmented parts is such as in our experience is only to be found in undoubted bathybial forms, as in certain deep-sea Zoantharia and Fishes.

Class ANTHOZOA.

Subclass ALCYONIOMORPHA.

Order PENNATULIDA.

In 240 to 220 fathoms, off the west coast of the Andamans, some fine specimens of an *Umbellula* were taken; and in 1000 fathoms, in the Laccadive Sea, several specimens of a Funiculid were obtained with the polyparium coloured a uniform delicate pink.

Subclass ACTINIOMORPHA.

Order ACTINIARIA.

Family Actinidæ.

Specimens of three gigantic species of bathybial Actiniaria were met with during the season—one species in 1310 fathoms in the Bay of Bengal (Station 97), the others in the Laccadive Sea in 1000 and 740 fathoms (Stations 104 and 105).

An *Epizoanthus* symbiotic with *Hyalonema* must also be mentioned.

Lastly, at 740 fathoms in the Laccadive Sea there was obtained a colonial Zoantharian closely resembling Professor S. I. Smith's figure (Proc. U. S. Nat. Mus. iii., 1883) of *Epizoanthus paguriphilus*, Verrill, which, like Professor Verrill's species, forms a "carcinœcium" for a hermit-crab of the genus *Parapagurus*. In our specimen, however, no adventitious particles have been incorporated either in the cœenchyma or in the tests of the polyps; but the whole

expanded colony forms a smooth mass of a cartilaginous consistence. No trace is to be detected of any spiral shell which might have formed a basis of investment for the polyps.

Order MADREPORARIA.

Only four species of deep-sea corals were taken during the season, but all on different occasions. Two of them appear to be new to science, and are here described. We take this opportunity of describing also a remarkable specimen of a (deep-sea) *Rhizotrochus* from the neighbourhood of Gaspar Straits, lately presented to the Indian Museum by Captain Worsley.

MADREPORARIA APOROSA.

Family Turbinolidæ.

[RHIZOTROCHUS, Edw. & H.

1. *Rhizotrochus Worsleyi*, sp. n., Alcock.

Corallum translucent, extremely thin and fragile, low, moderately compressed, cornute, terminating abruptly in a small, curved, laterally-situated pedicle, the longitudinal axis of which meets the same axis of the calicle at an angle of about 125° . From the thecal wall, which is almost smooth with but faint and incomplete costal striations, branch out ten coarse, rudely cylindrical, hollow rootlets of unequal length, which communicate directly with the calicular cavity; they are arranged in two irregularly concentric series. The calicle is deep, but largely filled up by the prominent primary and secondary septa; its orifice is irregularly elliptical, and its margin is everted, in places impendent, and crenulate and irregularly plicated. There are six systems of septa and five complete cycles; the septa are not exsert, except where they coincide with the indentations of the marginal plications; and in all the systems, except in the half-system coincident with and in the half-system opposite to the laterally-situate pedicle, they have a strong lateral twist towards the pedicle; their surfaces are finely and distantly granular. The primary and secondary septa of the same system are coequal, but the different systems are unequal with one another; they descend almost vertically, but with the lateral twist referred to, to be loosely fused in the bottom of the calicle by their edges, which there become sinuous, and thus to form a rudimentary parietal columella; their surfaces are transversely striated. The

septa of the third cycle are in general barely one fifth the breadth of the septa of the first two cycles; they descend to the bottom of the calicle. The septa of the fourth cycle, which reach just over halfway down the calice wall, are still narrower, and those of the fifth cycle, which end quite in the upper part of the calice, are mere ridges.

Height of corallum from base to calicular margin $\cdot 75$ inch; longitudinal diameter of calicular orifice $\cdot 95$ inch; transverse diameter of calicular orifice $\cdot 70$ inch; depth of calicular fossa $\cdot 55$ inch; length of longest rootlet $\cdot 55$ inch.

From the Eastern Telegraph Co.'s cable, in the neighbourhood of Gaspar Straits. One specimen.

Rhizotrochus Worsleyi differs from the other known species of the genus most conspicuously in its irregularity, which is shown in the shape of the corallum and in the size and arrangement of the principal cycles of septa. Further, the rudimentary parietal columella appears to be characteristic.]

CARYOPHYLLIA, Stokes.

2. *Caryophyllia communis*, Moseley.

Caryophyllia communis, Moseley, 'Challenger' Reports, vol. ii. pt. vii. pp. 135-138, pl. i. figs. 4 and 5; Pourtalès, Bull. Mus. Comp. Zool. vol. vi. p. 100, pl. i. figs. 12 and 13.

This species, which the 'Challenger' and the 'Blake' have found to have an extended range over the Atlantic Oceans, was taken by the 'Investigator' in 1000 fathoms off the Elicapeni Bank in the Laccadive Sea. Over two hundred large specimens, more than half of them living, came up in a single haul of the trawl.

Many of the dead coralla were incrustated with siliceous sponge.

3. *Caryophyllia ephyala*, sp. n., Alcock.

Attached by a broadish base to some loose spicules from the anchor-rope of a *Hyalonema*.

The corallum, which is thin and entirely invested with a vitreous epitheca, is goblet-shaped, the short cylindrical peduncle being constricted immediately above the base of attachment and then rather suddenly expanding into a slightly-curved turbinate calice with a broadly elliptical mouth. Costæ extending from calicular margin to base, faint, subequal, slightly wrinkled.

Septa in four complete cycles, exsert, especially those of the coequal first and second cycles, beautifully crimped. A

crown of very large twisted pali opposite the tertiary septa, and these, to make room for the pali, are cramped and pressed back, presenting very sinuous, thickened, bilaterally doubled-up margins.

Columella conspicuous, consisting of several large twisted lamellæ.

Extreme height of corallum $\cdot 40$ inch ; diameters of elliptical calicular orifice $\cdot 30$ by $\cdot 20$ inch.

A single specimen from off the west coast of the Andamans, 240 to 220 fathoms (Station 56).

The specimen is small and may possibly be immature, but its characters are so well marked that we propose a distinctive name for it.

STEPHANOTROCHUS, Moseley.

4. *Stephanotrochus nitens*, sp. n., Alcock.

Corallum bowl-shaped, dense and stony throughout, ivory-white. The epithecate base is gently convex, culminating in a central obtuse point ; the side-wall rises with an outward slope of about 35 degrees from the vertical. The primary and secondary costæ, which radiate from the central basal point, are salient throughout, coarse and crenulate on the base, sursumversely spinate or serrate on the side-wall of the theca ; the tertiary and quaternary costæ show as faint finely granular radial striations, most conspicuous at the junction of base and side-wall, and obsolescent about halfway up the latter. The calicle has a circular margin and a very capacious fossa. There are six systems of septa, with four complete cycles and an incomplete fifth. All the septa are exsert, those of the first two cycles projecting about $\cdot 17$ of an inch and those of all the higher cycles about $\cdot 05$ of an inch above the calicular margin ; and all are of an unpolished smoothness, with thin trenchant edges. Within the calicle the coequal primary and secondary septa are conspicuously pre-eminent. They repeat the simple curve of the thecal wall, and near the middle of the fundus of the calicular fossa their ends become depressed, thickened, and tortuous, and enter into loose interrupted fusion, in which the tertiaries of the systems in which a fifth cycle is developed also join, to form an inconspicuous radicate columella, from which arise small, erect, subconical, finely granular pinnacles to the number of about ten, excluding the paliform papillæ to be next described. Just external to this the edge of each primary septum rises into a low, dentate, paliform process, while the edges of the

secondary septa show linear series of two or three small uncinatè paliform papillæ. The tertiary septa have their edges widely notched just below the middle of their curve, the lower angle of the notch projecting as a small uncinatè paliform lobe; below this they approach and are occasionally fused with the secondaries. The septa of the fourth cycle are thin lamellæ which end about halfway down the calicular wall, except in the systems in which a fifth cycle is developed, where they resemble but do not equal the tertiaries.

Height of corallum from base to limit of epitheca $\cdot 35$ inch, from base to edge of calice $\cdot 75$ inch, from base to summit of primary and secondary septa $\cdot 90$ to $\cdot 92$ inch; diameter of calicular orifice $1\cdot 4$ inch; depth of calicular fossa $\cdot 60$ inch.

The soft tissues of the polyp are very thick and fleshy; the oral disk and tentacles are a very dark purple.

The characteristic feature in the corallum of this species is the comparatively slight exsertion of those quaternary or quinary septa which lie next the primaries; usually they are equally exsert with the tertiaries, and in only two systems do they distinctly surpass these last in height.

Of the paliform processes those only of the third cycle are truly paliform; these, though not very prominent, project enough to form a support for the retracted oral disk.

The form of the corallum is intermediate between the cup-shaped and platter-shaped extremes figured by Professor Moseley from the 'Challenger' collection.

From the Laccadive Sea, at 740 fathoms (Station 105).

One fine perfect specimen.

MADREPORARIA FUNGIDA.

Family Fungiidæ.

BATHYACTIS, Moseley.

5. *Bathyactis symmetrica* (Pourtalès).

Fungia symmetrica, Portalès, Ill. Cat. Mus. Comp. Zool. (1871), no. iv. p. 46, pl. vii. figs. 5 and 6.

Fungia symmetrica, Duncan, Trans. Zool. Soc. viii. p. 334, pl. xlix. figs. 16-19.

Bathyactis symmetrica, Moseley, 'Challenger' Reports, vol. ii. pt. vii. pp. 186-190, pl. x. figs. 1-13.

Three specimens of this very widely ranging deep-sea Fungiid were obtained in the Bay of Bengal, 920 to 690 fathoms (Station 102).

The diameter of the corallum of the largest specimen is $\cdot 80$ inch.

Phylum **PORIFERA.**Class **SILICOSPONGIÆ.**

Numerous specimens of sponges, belonging to seven genera and eight species, were obtained during the season in deep sea. Seven species are Hexactinellid, and one is a siliceous sponge with thickly felted monaxial spicules.

On muddy bottoms between 100 and 1500 fathoms in the northern part of the Bay of Bengal not one sponge was found. But off the west coast of the Andamans, from a clean bottom of coral-sand in 240 to 220 fathoms, the tangles came up incrustated with *Farrea* (two species) and with a few specimens of *Euplectella* (one species), *Hyalonema* (one species), and two other species of Hexactinellid sponges.

Again, in 1000 fathoms in the Laccadive Sea numerous sponges were taken in the trawl, including *Euplectella*, *Hyalonema*, and over twenty specimens of a firm, compact, globular species, of which the skeleton is formed by a thick felt of monaxial siliceous spicules. These last either were adherent to dead coralla of *Caryophyllia communis* or had grown round the anchor-stalks of dead *Hyalonema*.

The anchor-stalks of all our living specimens of *Hyalonema* were thickly incrustated with colonies of an *Epizoanthus*.

Subgrade B. **CÆLOMATA.**Phylum **VERTEBRATA.**Class **PISCES.**

The bathybial fishes collected during the season number thirty-five species, of which all but ten are new to science. As the whole of these species have been already described or noticed in this Magazine ('Annals,' Sept. & Oct. 1890), it will be sufficient now to give merely a list of them.

We divide them into (1) true bathybial forms, and (2) forms which are locally bathybial in the surface-heated seas of India.

(1) The true bathybial fishes are twenty-five species; among them are the following apparently new types:—

(i.) *Bathyseriola* ('Annals,' Sept. 1890, p. 202).—A Carangid with the general aspect of *Cubiceps*.

(ii.) *Ponerodon* (l. c. p. 203).—A Trachinid which might be taken for the Gadoid *Chiasmodus*, but that, besides having large pseudobranchiæ and an armed preopercle and wanting an air-bladder, it has the first ray of the ventral, the first and second (small) rays of the anal, and all the rays of the first dorsal fin in the form of well-characterized non-articulated

spines. Our specimen, which is over 6 inches long and in good preservation, was examined in the fresh state, and if it should prove to be identical with *Chiasmodus*, we consider that *Chiasmodus* must be removed from the Malacopterygians, while *Ponerodon* must become a synonym.

(iii.) *Paroneirodes* (l. c. p. 206).—A Pediculate with the spinous dorsal fin reduced to two (luminiferous) cephalic tentacles, and hardly differing from the Arctic *Oneirodes*.

(iv.) *Tauredophidium* (l. c. p. 212).—A Brotuline Ophidiid allied to the 'Challenger' Indo-Pacific genus *Acanthonus*, but having the eyes reduced to hidden rudiments.

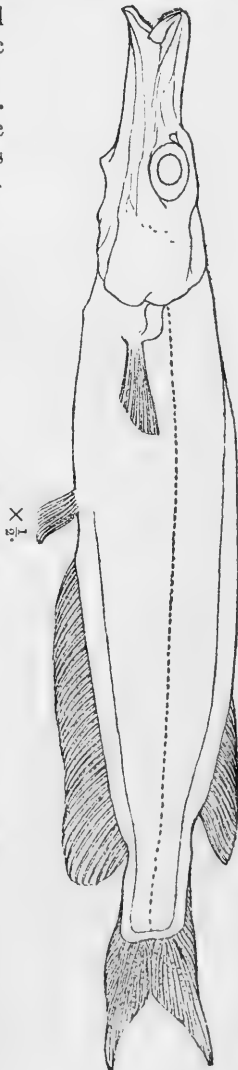
(v.) *Dermatorus* (*ibid.* Oct. 1890, p. 298).—A Brotuline Ophidiid with close affinities to the wide-ranging deep-sea form *Porogadus*.

(vi.) *Scopelengys* (l. c. p. 302).—A Scopelid apparently related to both *Scopelus* and *Nanobrachium*.

(vii.) *Thaumastomias* (*ibid.* Sept. 1890, p. 220).—A Stomiid differing from the remarkable genus *Malacosteus* only in some details of dentition, in the forward position of the ventral fins, and in the complete absence of pectoral fins. The curious hyomental muscular band, which allows the lower jaw to be turned completely backwards over the hyper-extended head, is as well developed as it is in *Malacosteus*.

(viii.) *Narcetes* (*ibid.* Oct. 1890, p. 305).—An Alepocephalid very nearly allied to *Bathytroctes*, from which it differs most conspicuously in the pluriserial arrangement of the teeth in the jaws.

(x.) *Aulastomatomorpha* (l. c. p. 307).—A most remarkable Alepocephalid, differing from all other genera of its own family in having the pseudo-branchiæ quite rudimentary and the bones of the head prolonged into a



long snout. The head of this unique fish is covered throughout with a thick spongy glandular skin of a dazzling white reflexion and probably luminous in function. In correlation with this the eyes are very large. Fig. 1 represents *Aulastomatomorpha phospherops*, one half the natural size.

(x.) *Promyllantor* (*l. c.* p. 310).—A Murænid of the Conger alliance, characterized by the almost inferior position of the mouth, and by the broad bands of villiform teeth in the jaws and palatè.

The complete list is as follows:—

		Fathoms.
1. <i>Melamphaës mizolepis</i> , Gthr.	Bay of Bengal.	1310
2. <i>Bathyseriola cyanea</i> , g. et sp. n. (A.)	„	90-102
3. <i>Ponerodon vastator</i> , g. et sp. n. (A.)	„	920-690
4. <i>Paroneirodes glomerosus</i> , g. et sp. n. (A.)	„	1260
5. <i>Neobythites pterotus</i> , sp. n. (A.) . .	{ „	1310
	{ Laccadive Sea.	1000
6. <i>Bathyonus glutinosus</i> , sp. n. (A.) . .	Bay of Bengal.	1310
7. <i>Monomitopus nigripinnis</i> , g. et sp. n. (A.). (Ophidiidæ.)	Laccadive Sea.	740
8. <i>Paradicrolene Vaillantii</i>	„	„
9. <i>Dermatorus trichiurus</i> , g. et sp. n. (A.)	„	„
10. <i>Tauredophidium Hextii</i> , g. et sp. n. (A.)	Bay of Bengal.	1310
11. <i>Macrurus Hoskynii</i> , sp. n. (A.) . .	„	„
12. — <i>Wood-Masoni</i> , sp. n. (A.) . .	Laccadive Sea.	1000
13. — <i>Hextii</i> , sp. n. (A.)	„	„
14. <i>Bathygadus longifilis</i> , Goode and Bean	„	„
15. <i>Scopelus pyrsobolus</i> , sp. n. (A.) . .	Bay of Bengal.	920-690
16. <i>Scopelengys tristis</i> , g. et sp. n. (A.)	Laccadive Sea.	1000
17. <i>Chauliodus Sloanii</i>	Bay of Bengal.	922 & 1260
18. <i>Thaumastomias atrox</i> , g. et sp. n. (A.)	„	1310
19. <i>Bathytroctes squamosus</i> , sp. n. (A.)	Laccadive Sea.	740
20. <i>Narctes erimelas</i> , g. et sp. n. (A.)	„	„
21. <i>Platytroctes apus</i> , Gthr.	„	„
22. <i>Aulastomatomorpha phospherops</i> , g. et sp. n. (A.)	„	1000
23. <i>Halosaurus affinis</i> , Gthr.	„	„
24. — <i>Hoskynii</i> , sp. n. (A.)	„	„
25. <i>Promyllantor purpureus</i> , g. et sp. n. (A.)	„	„

(2) The local bathybial or hemibathybial forms taken were:—

		Fathoms.
26. <i>Parascombrops pellucidus</i> , Alcock . .	Bay of Bengal.	98-102
27. <i>Centropristis investigatoris</i> , sp. n. (A.)	"	"
28. <i>Uranoscopus crassiceps</i> , sp. n. (A.)	"	"
29. <i>Trigla hemisticta</i> , Schlegel	"	"
30. <i>Gobius cometes</i> , sp. n. (A.)	"	"
31. <i>Callionymus carebares</i> , sp. n. (A.)	"	"
32. <i>Scianectes macrophthalmus</i> , Alcock	"	"
33. <i>Cynoglossus Carpenteri</i> , Alcock . .	"	"
34. <i>Scopelus pterotus</i> , sp. n. (A.)	"	"
35. —, sp.	"	"

Phylum **ECHINODERMA.**

Class **ASTEROIDEA.**

Asteroidea were trawled on three occasions, and thirty-eight individuals of nine species and as many genera were collected. Of these thirty-two specimens, of five species and genera, were obtained on a clean and comparatively hard bottom of coarse coral-sand off the west coast of the Andaman Islands, in 240 to 220 fathoms, while the six remaining specimens, of four species and genera, came from 740 to 1000 fathoms in the Laccadive Sea, where the bottom consists principally of coral-mud. Of nine fairly successful hauls in water of 100 to 1500 fathoms in the northern part of the Bay of Bengal, where the bottom consists of soft mud (terrigenous deposit), not one produced a starfish.

There is little doubt that the investigation by a specialist of this collection, which is but a small part of the accumulations of several years' trawling in Indian waters, would bring to light some new forms.

We have here attempted nothing more than to roughly indicate the affinities of the forms most recently acquired.

Order **PHANEROZONIA.**

Family **Archasteridæ.**

1. **PONTASTER**, Sladen.

Three fairly perfect specimens of a species very near to *P. venustus*, Sladen, were taken in the Laccadive Sea, off the Elicapeni shoal, in 1000 fathoms. In our specimens the supero-marginal plates are more numerous and the inner series of spinelets on the infero-marginal plates is comparatively

stronger ; but in all other respects they correspond with the description of the ' Challenger ' species. Colours in the fresh state light pink.

2. PLUTONASTER, Sladen.

We refer with some hesitation to this genus a single specimen of a proctuchous form from 740 fathoms, off the coast of Goa. It has supero-marginal plates, with a prominent, centrally-placed dorsal spine ; but the Madreporiform body is exposed and the adambulacral plates are covered with small spinelets, as in the subgenus *Tethyaster*. Colour in the fresh state light pink. The stomach of this specimen contained an intact *Natica* and an empty *Dentalium* tube.

Family Porcellanasteridæ.

3. PORCELLANASTER, Wyville Thomson.

One small specimen of a form resembling in all important particulars *P. ceruleus*, Sladen, was obtained from 740 fathoms on the same occasion as the last preceding. Some of the actinal intermediate plates carry a delicate centrally-placed spicule. Colour in the fresh state bluish white. The stomach was distended with mud.

4. Family Astropectinidæ.

A small mutilated Astropectinid, of whose exact position we cannot be assured, was taken in 240 to 220 fathoms, off the west coast of the Andaman Islands.

Family Pentagonasteridæ.

5. NYMPHASTER, Sladen.

From 240 to 220 fathoms, in the same situation as the last, a single specimen closely related to *N. protentus*, Sladen. Colour yellowish white.

6. MEDIASTER, Stimpson.

With considerable hesitation we refer to this genus a single specimen from 740 fathoms, off the coast of Goa. It has all the essential characters of the genus, except that it does not bear pedicellariæ. Colour light pink.

Order CRYPTOZONIA.

Family Zoroasteridæ.

7. ZOROASTER, Wyville Thomson.

Twenty-three specimens of a species nearly resembling *Z. Ackleyi*, Perrier, from off the West-Indian Islands. Off the west coast of the Andamans, 240 to 220 fathoms. Colours brick-red.

Family Echinasteridæ.

8. PLECTASTER, Sladen.

We venture to include in this genus a remarkable cryptozone, reticulate form, characterized by the exceedingly wide-meshed reticulation of the abactinal plates (which leave large interspaces each of which is perforated by innumerable papulæ), by the groups of stout spinelets imbedded in membrane borne by the abactinal plates, and by the parallel, biserial, palisade-like armature of the adambulacral plates. In only one specimen, however, are the actinal intermediate plates—and in that one only a few of the plates—spiniate. Five specimens, from 240 to 220 fathoms, off the west coast of the Andamans. Colours dark reddish brown.

Family Pedicellasteridæ.

9. PEDICELLASTER, Sars.

Two large specimens of a species characterized by very numerous and very large forcipiform pedicellariæ, from 240 to 220 fathoms, in the same situation as the last.

Class OPHIUROIDEA.

Eight or nine species of Ophiuroidea were obtained during the season. Of these six or seven species, numbering several scores of individuals, were caught in the tangles on a clean bottom of coarse coral-sand off the west coast of the Andamans (240 to 220 fathoms). A single specimen was taken in the Laccadive Sea in 740 fathoms, bottom coral-mud; and off the Madras coast, from a muddy bottom in 1310 fathoms, six small specimens of a form which is probably *Ophiomastus* were obtained.

In a group presenting so many technical difficulties we

have not in the time available made any attempts at determination.

Class ECHINOIDEA.

From the station off the west coast of the Andamans which yielded such a rich result in Sponges, Umbellulids, Asteroids, and Ophiuroids were also obtained numerous specimens of Cidarids of the genera or subgenera *Dorocidaris* and *Porocidaris*.

The first of these had previously been noted by the 'Investigator' as exceedingly abundant off the reefy Andaman coasts in 100 to 250 fathoms. Off the Madras coast, in 1310 fathoms (Station 97), two specimens of a large irregular Echinoid with hard, thin, and very brittle test were met with. And finally, in the Laccadive Sea, at 740 and 1000 fathoms, several fine specimens of *Phormosoma* of three different species were taken.

Class HOLOTHUROIDEA.

In the mud of the north-western part of the Bay of Bengal (Stations 76, 81, 97, 101, 102) Holothurians were fairly abundant. Those near the 100-fathom limit, as far as superficial examination goes, are indistinguishable from the shallow-water forms to be found in this vicinity. Those from 690 to 1310 fathoms were characteristic forms with the body-wall of the mucoid or gelatinous consistence of the tissues of a Medusa, defying preservation, and of a uniform coloration ranging from pinkish purple to dark violet.

In the Laccadive Sea, at 740 and 1000 fathoms, similar large Holothurians were numerous; and at the latter depth two specimens of the deep-sea genus *Deima*, with rigid calcareous exo-skeleton, were taken.

Phylum MOLLUSCA.

Branch A. GLOSSOPHORA.

Class GASTROPODA.

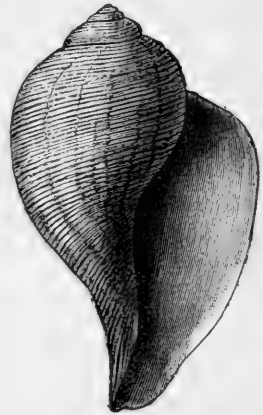
Family Sycotypidæ.

1. *Sycotypus*, sp. (Fig. 2.)

A large species; the shell characterized by a comparatively exsert spire, by a relatively short and broad siphonal

canal, by the umbilicus open to the very apex, and by a supra-sutural band of white glaze left throughout the spire by a portion of the callus remaining uncovered during growth. The longitudinal ribs of the shell are obtundate, alternately broad and narrow, with finely wrinkled edges, the crenulations being produced at regular intervals to form by their approximation very narrow, decussating, transverse lines. Colour of shell warm cinnamon, with transverse streaks of darker brown corresponding to lines of growth. Colour of the animal delicate pink, the edges of the mantle shading into a lemon-yellow. Three large specimens from a sandy bottom in 98 to 102 fathoms off the Ganjam coast.

Fig. 2.



× ½.

Family Pleurotomidæ.

2. A single small Pleurotomid was taken from the mud at Station 97, 1310 fathoms.

Family Strombidæ.

3. *Rostellaria delicatula*, Nevill. (Fig. 3.)

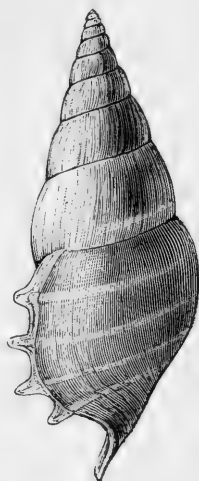
Rostellaria delicatula, Nevill, Journ. As. Soc. Beng. vol. 1. (1881), pt. ii. p. 262.

This species has now become recognized as a quite characteristic inhabitant of the infra-littoral of the Bay of Bengal at and near the 100-fathom contour, as far as this has yet been explored by the 'Investigator,' from Arrakan to the Godávari. The living animal is a bright pink, and it has imparted to the spirit in which it was preserved a beautiful magenta colour, which has stained permanently the packing-material, the legs and the branchiæ of some Penæi, and the soft tissues of a Chætopod and of some other mollusks, contained in the tin in which it was first placed. The eyes are very large. The animal is possessed of great vitality, and, though coming from a considerable depth, lives happily for days in a bucket of sea-water, and appears to be unaffected by

prolonged deprivation of water in the moist atmosphere of ship-board.

The type appears to have been described from an abnormally thin and varicose shell, which also, judging from the slight development of the digitate processes of the outer margin of the aperture, was probably young. The thinness of the type specimen is perhaps to be explained by its having come from a greater depth, our present series showing that the thickness of the shell varies inversely as the depth.

Fig. 3.



Family Phoridæ.

4. *Xenophora pallidula* (Reeve).

A tolerably perfect dead shell was taken off the west coast of the Andamans in 240 to 220 fathoms (Station 56). It may be mentioned that Prof. Wood-Mason dredged a dead and weathered specimen of this shell in the Andaman Sea at 228 fathoms, at the same time with the type of the Homarid genus *Nephropsis*; and that in 1887 Commander Carpenter dredged a fine series of living specimens in 290 to 240 fathoms very near the position of Station 56.

Family Capulidæ.

5. *Amalthea*, sp.

Some small specimens, symbiotic with *Rostellaria delicatula*, were taken in 98-102 fathoms (Station 96).

Family Calyptræidæ.

6. *Crepidula*, sp.

At Station 105 in the Laccadive Sea, at 740 fathoms, a single specimen was obtained of a curious form which we doubtfully refer to this genus.

The shell is broadly and not quite regularly oval, depressed, thin, translucent, and covered with a delicate olive-green

epidermis; the apex is posterior, produced, pointed, with a slight spiral inclination to the left; the posterior fifth of the aperture is closed by a horizontal shelly lamina. The animal has the tentacles subulate and the eyes apparently absent; but the rostrum is produced, in continuation of the buccal cavity, into a long proboscis, which is grooved dorsally and expanded at the apex.

Class SCAPHOPODA.

7. An empty shell of a *Dentalium* was found in the stomach of a starfish of the genus *Plutonaster* at Station 105, 740 fathoms. In its proportions and polished whiteness it much resembles the shell of *Dentalium perlongum*.

Class CEPHALOPODA.

8. Only two cuttle-fishes were obtained, both of the order Decapoda. One was taken at Station 101, 922 fathoms, and from the transparency of its tissues, as well as from the fact of its being alive when brought on board, we infer that it is a pelagic form. The other was removed from the stomach of a fish (*Uranoscopus crassiceps*) taken in 98 to 102 fathoms (Station 96).

Branch B. LIPOCEPHALA.

Class LAMELLIBRANCHIATA.

Family Pectinidæ.

9. *Amussium*, sp.

At 740 fathoms in the Laccadive Sea, on a bottom of coral-mud, numerous specimens of an *Amussium* were found. It is a species with a large, compressed, subequivalve, slightly inequilateral, thin, white, semitransparent shell, with small subequal ears. The interior of the shell is highly polished and each valve is strengthened by eleven conspicuous radiating costulae, the middle and longest of which reaches from the dorsal margin only three quarters of the distance to the ventral margin of the shell. The costulae of the right valve are of nearly the same width throughout; but those of the left increase in breadth from dorsum to venter, and are club- or fan-shaped. The animal is white and has no vestiges of pallial eyes, as has been previously observed in other species of the genus.

Attached to the exterior of several shells were some curious dull green objects resembling fronds of *Fucus*. These consisted of a thallus-like expansion firmly adherent to the shell, ending in a free vesicle, the contents of which resemble yolk of egg; they are perhaps eggs of some fish.

Family *Mytilidæ*.

10. *Modiola*, sp.

An almost characteristic inhabitant of the mud of the Bay of Bengal, as at present explored, in and near 100 fathoms, is a species of *Modiola* with a very thin, transparent, polished shell of an olive or dull yellow colour. The byssus is a large bunch of fine silky threads saturated with fine mud usually. Met with in beds in thick mud in 89 to 93 fathoms, and on sand in 98 to 102 fathoms.

[To be continued.]

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

[Continued from vol. vi. p. 261.]

SINCE the first part of these notes was written Professor Chr. Aurivillius, of Stockholm, has called my attention to two species belonging to the group, which were described by Dalman in Schönherr's 'Synonymia,' and which have apparently been omitted from the Catalogue of Gemminger and Harold. The first species—*Lamia serricornis*—is considered by Prof. Aurivillius to be identical with *Prospihilus pilosicollis*, Thoms.; and with this conclusion I quite agree. The synonymy of the species will accordingly read:—

Prospihilus serricornis, Dalm.

= *Lamia serricornis*, Dalm. Schönh. Synon. i. 3, Appendix, p. 160.

= *Prospihilus pilosicollis*, Thoms.

Prof. Aurivillius was good enough to send me for examination some specimens of the second species mentioned above—*Lamia umbrina*, Dalm. These were found to agree quite well

with typical specimens of *Ploceoderus nitidus*, a species which I regard as synonymous with *Ploceoderus ferrugineus*, Linn. (see Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 51). The species with its synonyms and varieties may therefore be written as follows:—

Ploceoderus ferrugineus, Linn.

= *Cerambyx ferrugineus*, Linn., Oliv., et Fabr.

= *Cerambyx gigas*, Fabr.

= *Lamia umbrina*, Dalm. in Schönh. Synonym. i. 3, Appendix, p. 161.

= *Hammaticherus nitidus*, White.

Var. *P. versutus*, Pasc. (*Cerambyx*).

Var. *P. niger* (Chevr. MS.), Gahan, l. c. p. 51.

I have to thank Prof. Aurivillius for also pointing out that *Cælodon rusticum*, Fähr., is a species of *Taurotagus*, very closely allied to *T. Klugii*, Lac.

To Dr. Fr. Meinert, of Copenhagen, I am indebted for information concerning the type specimens of *Cerambyx holosericeus*, Fabr. Two specimens from Tranquebar are ticketed as types; in one the *intergenal* groove is straight, in the other it is distinctly bowed backwards. I do not believe that these two conditions occur in the same species; and I take therefore as representing *holosericeus*, Fabr., that specimen in which the *intergenal* groove is straight. The amended synonymy of the species may thus be written:—

Æolesthes holosericeus, Fabr.

= *Cerambyx holosericeus*, Fabr. (nec Oliv.).

= *Pachydissus velutinus*, Thoms.

= *Pachydissus similis*, Gahan.

= *Neocerambyx holosericeus*, Cotes, Ind. Mus. Notes, vol. i. no. 2, pl. v. fig. 3.

To the synonymy of *Ploceoderus fulvicornis*, Guér. (= *ruficornis*, Newm.), may, I think, be added *P. pruinus*, Pasc. (*Cerambyx*).

In Lacordaire's subdivision of the genus *Ploceoderus* (Genera 8, p. 255) there is a misleading error with regard to the type species, *P. cyanipennis*, Thoms. This species is placed in the first division of Section A, whereas it should come in the second division of the same section. *P. nitidipennis*, Chevr., was in all probability the species mistaken by Lacordaire for *cyanipennis*, Thoms.

Neocerambyx grandis, sp. n.

Magnus, sericeo-aurato dense pubescens; capite supra inter oculos leviter angustimque sulcato, sulco inter antennis descendente;

prothorace lateraliter in medio obtuse angulato, dorso omnino fortiter irregulariterque rugoso; elytris pube sericeo-aurata non-nihil mutabile obtectis, apicibus rotundatis, inermibus; processu prosterni postice verticali, acetabulis anticis extus angulatis; antennis (σ) corpore multo longioribus, articulis tertio quartoque valde incrassatis, tertio quam primo paullo longiore et crassiore, primo et quarto subæqualibus, quinto minus fortiter incrassato, tertio subæquali.

Long. 56, lat. 17 mm.

Hab. N. India, Allahabad (*J. C. Bowring, Esq.*).

The single specimen (in the Museum collection) of this distinct and magnificent species is in a rather damaged condition. There are but ten complete joints to the antennæ, and these together surpass the body by about a third part. The fine silky golden-yellow pubescence gives rather feeble *moiré* reflexions on the elytra. Owing to the shortness and great thickness of the third and fourth joints of the antennæ I was at first inclined to place the species in *Pachydissus*; but the size and remaining characters seem to fit it better for *Neocerambyx*. As in the true *Pachydissus*, we see that even amongst evidently nearly related species of the same genus the third joint may vary considerably in length and thickness. It must be admitted that *Neocerambyx*—taking *N. paris*, Wied., as the type—cannot by any hard-and-fast characters be differentiated from *Pachydissus*. The eyes offer no distinguishing character, and the anterior cotyloid cavities may in some species of *Pachydissus*, and even in some specimens of the same species, e. g. *P. picipennis*, be angulate externally, while in others they are completely closed. It was unfortunate that Lacordaire should have taken the characters of the eyes and of the anterior coxal cavities as the basis of his subdivision of this group.

Imbrius? mandibularis, sp. n.

Fuscus, griseo-cinereo-pubescentis; mandibulis longis, valde curvatis; oculis supra approximatis, subtus late distantibus; capite pone oculos gradatim angustato; prothorace latitudine paullo longiore, utrinque leviter rotundato, supra transversim irregulariterque plicato; elytris minute confertimque punctulatis, cinereo-pubescentibus, singulis lineis tribus vel quatuor glabris, obsolete elevatis, apicibus conjunctim et subacuminate rotundatis; antennis (σ) corpore duplo longioribus, articulis a tertio ad decimum (quarto multo brevioribus excepto) subæqualibus, articulo undecimo longissimo; antennis (ρ) corpore paullo longioribus.

Long. (σ) 24, lat. $5\frac{3}{4}$; long. mandib. $3\frac{1}{2}$ mm.

Hab. Penang.

By the long, strongly curved, and acutely pointed mandibles this species may be distinguished from any other in the whole group. Whether this character and one or two others of minor importance are in themselves sufficient to raise the species to the rank of a genus I am at present unable to decide. Though the mandibles are much longer than in the typical species of *Imbrius*, they seem to be of much the same form. The head is more elongate and more gradually narrowed behind the eyes than in *Imbrius lineatus*; but this difference is not so evident in the female, in which also the mandibles are much less developed. The prosternal process is feebly tubercled behind. The first joint of the posterior tarsus is almost equal in length to the two following joints combined.

The genus *Imbrius* ought, I think, to be retained, though it would be hard to give characters of importance separating it from *Dymasius*. The most essential difference lies in the truncate and spinose apices of the elytra in the latter. The antennæ of the male in both genera are much longer than those of the female. In *I. ephebus*, Pasc. (σ), the antennæ are half as long again as the body; and in *I. lineatus*, Pasc. (σ), they are almost twice as long as the body.

DYMASIUS, Thoms.

Lacordaire's characterization of this genus is inaccurate. Though he has described the male as well as the female, he probably had only specimens of the latter sex before him.

In the male the antennæ are about twice as long as the body, with the eleventh joint much longer than the tenth, with the third and fifth joints subequal, each longer than the fourth. (Lacordaire says "3 égal à 4-5 réunis;" but this is not true even of the female, in which the third joint is distinctly longer than the fifth, but is certainly not equal to the fourth and fifth united.) The first joint of the posterior tarsus is not quite as long as the two succeeding joints combined.

In referring to the elytra Lacordaire says these organs present no trace of punctuation. In the five or six specimens that I have seen the longitudinal subglabrous lines of the elytra exhibit a fine punctuation made up of close unequal-sized punctures.

Cerambyx macilentus, Pasc. (*Pachydissus* in Cat. Gem. et Har.), must be referred to this genus. The male type of this species differs from males of *D. strigosus*, Thoms., only in that the third and fifth joints of the antennæ are relatively shorter and the external apical spines of the elytra are directed

more obliquely outwards. These differences may perhaps be little more than individual.

ELYDNUS, Pasc.

This genus is even more nearly allied to *Dymasius* than is *Imbrius*. It will be best perhaps to consider it as a distinct section of *Dymasius*, characterized by the unspined apices of the elytra and the prothorax almost equally contracted at the base and apex. I can find nothing in the characters of the antennæ and sternal processes by which it can be distinguished generically from *Dymasius*. In addition to the species placed in it by Mr. Pascoe, the section will include *D. strigosus*, Pasc. I propose to alter the name of this species to

Dymasius (Elydnus) Pascoei, n. n.

= *Dymasius strigosus*, Pasc. (nec Thoms.).

Dialeges undulatus, sp. n.

D. pauperi subsimilis, sed differt inter alia capite pone oculos minus elongato; oculis valde emarginatis, haud divisis; articulo antennarum quinto quam tertio longiore, articulo undecimo (σ) longissimo; elytris apice conjunctim rotundatis, inermibus.

Long. (σ ♀) 16-21, lat. $3\frac{1}{4}$ -5 mm.

Hab. Siam, Burmah, and Ceylon.

Head but slightly elongated behind the eyes; the latter deeply enough emarginate in front. Prothorax somewhat longer than broad, constricted at the base and apex, slightly rounded at the sides; transversely and not very strongly wrinkled above; covered, with the exception of a line along the middle of the disk, with a silky greyish pubescence. Elytra clothed with a dense silky pubescence, giving *moiré* reflexions; where rubbed the reddish-brown derm is seen to be closely and very finely punctulate; apices conjointly rounded and unarmed. Head transversely wrinkled below between the eyes. Antennæ in the male more than twice as long as the body, with the third and succeeding joints villose underneath, with the third joint shorter than the fifth, the fifth, sixth, and seventh subequal, the fifth to tenth gradually decreasing and, taken together, scarcely longer than the eleventh: antennæ in the female a little longer than the body, with the eleventh joint scarcely longer than the tenth.

This species has at first sight a rather strong resemblance to *D. pauper*, Pasc., and allied species, but is to be distinguished by characters that may almost be considered generic in their importance.

Lachnopterus socius, sp. n.

Ater; prothorace supra nitido, fere omnino transversim plicato, sulcis duobus longitudinalibus antice conjunctis impresso; elytris rufescentibus, confertissime punctulatis, pube breve fulvo-aurantiaca sparsim obtectis; antennis (σ) subgracilibus, corpore paullo longioribus.

Long. 16, lat. 5 mm.

Hab. Philippine Islands. In the collection of Mr. Alexander Fry.

Deep black. Prothorax broadest just behind the middle, somewhat glossy and almost wholly transversely wrinkled above; the disk without smooth tubercles and with two longitudinal impressions which anteriorly become more oblique and unite at some distance before the apex. Elytra reddish, with a short tawny-orange pubescence not thick enough to conceal the very close and fine punctuation beneath it. Antennæ in the male rather slender, a little longer than the body.

In *L. auripennis*, Newm., the only hitherto described species of the genus, the prothorax is broadest at or a little before the middle, is covered above by a dull black tomentum, and, on the disk, bears three usually smooth tubercles. The elytra are more thickly pubescent than in *socius*, and the antennæ are in both sexes shorter than the body.

PACHYDISSUS, Newm.

Some of the species previously included in this genus I have placed in *Æolesthes*, some I have removed to *Plocederus*. Those that remain form a heterogeneous collection, which may for the sake of convenience be arranged in sections. These sections are so distinct as to be almost equivalent to genera, and names will therefore be proposed for them. The antennæ of the male are in no case longer than twice the length of the body, and are usually much shorter than this; the joints are never spined at their outer apex; the third and fourth joints are usually, though sometimes very feebly, thickened at the apex. The pubescence is usually somewhat silky, sometimes with feeble *moiré* reflexions on the elytra. The head is nearly always grooved between the upper lobes of the eyes, though the groove is in many cases very shallow. The eyes vary in the extent to which they are produced in front. The head generally carries underneath one or more transverse grooves, in addition to a postocular sulcate constriction.

In the following synopsis the references to the antennæ are

to those of the male. The antennæ in the female are in nearly every case shorter than the body.

§ A. Antennæ variable. Femora without carinæ. Prosternum subtruncate behind. Elytra usually spinose at the apex. (*Pachydissus verus*.)

Antennæ shorter than the body, with the third to fifth joints strongly thickened, subequal. Apices of the elytra transversely truncate, each briefly bispinose. Head with a single transverse groove underneath.

1. *P. brevicornis*, sp. n.

Antennæ slightly surpassing the elytra, with the third and fourth joints strongly thickened, the third but little longer than the fourth. Apices of elytra obliquely truncate, each bispinose. Head underneath with two distinct transverse grooves separated by a prominent ridge

2. *P. sericus*, Newm.

Antennæ (♂)? Prothorax wholly irregularly wrinkled above. Apices of elytra transversely truncate, each moderately bispinose. Head with a single transverse groove underneath. Prosternal process slightly bifid behind

3. *P. rugosicollis*, sp. n.

Antennæ (♂) almost half as long again as the body, with the third and fourth joints slightly nodose at the apex, the third half as long again as the fourth. Apices of elytra obliquely truncate, each bispinose. Head with two distinct transverse grooves underneath.

4. *P. intermedius*, sp. n.

Antennæ half as long again as the body, with the third and fourth joints very slightly thickened at the apex, the third twice as long as the fourth. Apices of elytra transversely truncate, each bispinose. Head with a single transverse groove underneath

5. *P. nubilus*, Pasc.

Antennæ a little longer than the body, with the third and fourth joints strongly thickened, subequal. Apices of the elytra rounded or subtruncate, each briefly mucronate at the suture. Head with a single transverse groove underneath

6. *P. picipennis*, Germ.

Antennæ nearly twice as long as the body, with the third and fourth joints and some of the following slightly nodose at the apex, the third much longer than the fourth. Prothorax narrowed anteriorly and posteriorly, somewhat angulately dilated in the middle. Apices of the elytra truncate, each briefly spined at the suture.

7. *P. parvicollis*, sp. n.

Antennæ nearly twice as long as the body, with the third and fourth joints scarcely thickened at the apex, the third much longer than the fourth. Prothorax very slightly rounded at the sides. Elytra with slight *moiré* reflexions. Apices somewhat obliquely truncate, each briefly spinose at the suture. Intermediate cotyloid cavities narrowly open externally 8. *P. natalensis*, White.

Pachydissus elongatus, Harold, may perhaps come into this section. According to Harold it is very near *P. natalensis*, and differs chiefly by its slightly curved posterior tibiæ. The third joint of the antennæ is scarcely longer than the first, while in *P. natalensis* the third joint is nearly twice as long as the first.

§ B. Antennæ (♂) longer than the body, with the third and fourth joints more or less thickened, the third scarcely longer than the fourth. Elytra rounded or subtruncate, and unarmed at the apex. Femora without carinæ. Prosternum simple, not very strongly arched. Head without a distinct transverse groove underneath. (*Margites*, Pasc., MS.)

Antennæ with the third and fourth joints strongly thickened, obconical. Prothorax slightly uneven at the sides. Elytra with a grey pubescence 9. *P. egenus*, Pasc.

Antennæ (♂)? Prothorax somewhat uneven at the sides. Elytra with a fulvous pubescence 10. *P. fulvidus*, Pasc.

Antennæ a little longer than the body, with the first to fifth joints subequal, the third and fourth thickened, subcylindrical. Prothorax evenly and not very strongly rounded at the sides. Elytra with a greyish tawny or fawn pubescence 11. *P. humilis*, sp. n.

§ C. Eyes large, not very widely separated below. Antennæ in the male longer than the body, with the third and fourth joints slightly thickened at the apex, the third distinctly longer than the fourth. Apices of the elytra truncate or subtruncate, dentate or unarmed. Femora feebly carinate on each side below. Prosternal process not strongly raised, subtruncate or tuberculate near its posterior extremity. Metasternum usually provided with a small antero-lateral process, which partly cuts off the epimeron from the intermediate cotyloid cavity. (*Derosus*.)

Antennæ about half as long again as the

body, with the third joint much longer than the fourth. Prothorax with a broad, smooth, excised space on each side. Elytra truncate at the apex, dentate at the suture. Antero-lateral process of metasternum very feeble 12. *P. mauritanicus*, Buq.

Antennæ a little longer than the body, with the third joint not much longer than the fourth. Eyes in the male almost contiguous above. Prothorax with a narrower excised smooth space on each side. Apices of elytra subtruncate or almost rounded, and unarmed. Antero-lateral process of metasternum distinct 13. *P. demissus*, Pasc.

Antennæ (♂)? Prothorax with a narrow canaliculate excised space on each side, the disk with two oblique impressions, anteriorly widely diverging. Apices of elytra subtruncate, and unarmed. Pubescence with faint *moiré* reflexions. Antero-lateral process of metasternum distinct 14. *P. arciferus*, sp. n.

Antennæ nearly half as long again as the body, with the third and fourth joints scarcely thickened at the apex, the third almost twice as long as the fourth. Prothorax obtusely bituberculate on each side, without excised smooth space. Apices of the elytra truncate, dentate externally, briefly spined at the suture. Prosternal process somewhat strongly and obtusely tubercled behind. Antero-lateral process of metasternum distinct 15. *P. femorellus*, Chev.

Pachydissus incultus, Gerst., probably belongs to this section.

§ D. Of relatively shorter and stouter form than the species of the preceding sections. Antennæ in the male nearly twice as long as the body, with a short delicate fringe of hairs underneath; with the scape cicatrized, the cicatrice limited by an incomplete carina. Elytra truncate at the apex. Femora feebly carinate on each side below. Prosternal process subtruncate behind. (*Diorthus*.)

Pubescence less dense. Antennæ with the third joint much longer than the fourth 16. *P. simplex*, White.

Pubescence denser. Antennæ with the third joint but little longer than the fourth. . . 17. *P. vagus*, sp. n.

Pachydissus brevicornis, sp. n.

Grisco dense pubescens; antennis corpore brevioribus, articulis a

tertio ad quintum (σ) fortiter incrassatis; elytris apice truncatis, breviter quadrispinosis.

Long. 26, lat. 8 mm.

Hab. West Australia. Male in British Museum, male and female in Mr. Fry's collection.

Clothed with a dense ashy-grey pubescence, giving on the elytra slight silky reflexions. Antennæ in both sexes shorter than the body, in the male a little longer than in the female, and with the third to fifth joints very much thickened; the third joint, conical in form, about equal in length to the scape, the fourth scarcely shorter than the third or fifth. Prothorax slightly angulate at the middle of each side, with the rugosity of its upper surface almost concealed by the pubescence; the disk with an apparently smooth space just in front of the basal transverse groove. Elytra transversely truncate and briefly quadrispinose at the apex. Head underneath with a single transverse groove in addition to the postocular constriction.

Pachydissus sericus, Newm.

Antennæ in the male barely surpassing the elytra, with the third and fourth joints much thickened and the third but little longer than the fourth. Elytra obliquely truncate and quadrispinose at the apex, prolonged more at the outer than at the inner angles, and with the outer spines a little longer and stronger than the inner ones. Prothorax feebly tubercled on each side, somewhat regularly transversely wrinkled above, with two longitudinal impressions uniting anteriorly and limiting a subcentral smooth space. Head underneath with two distinct transverse grooves, separated by a median ridge, in addition to the sulcate constriction immediately behind the eyes.

Pachydissus rugosicollis, sp. n.

Piceo-fuscus, griseo subtiliter pubescens; prothorace lateraliter in medio obtuse angulato, supra intricato-rugoso sine impressionibus longitudinalibus; elytris fuscis, pube grisea subsericea subtiliter obtectis; apicibus recte truncatis, quadrispinosis; processu prosterni postice leviter bifido. ♀.

Long. 33, lat. $9\frac{1}{2}$ mm.

Hab. Australia.

Prothorax intricately wrinkled above, without longitudinal impressions. Apices of the elytra transversely truncate, with all the angles distinctly spined. Head underneath with a

single transverse groove in addition to the postocular constriction.

The species somewhat resembles *P. sericus*, but may be easily distinguished by the characters given.

Pachydissus intermedius, sp. n.

P. serico verisimilis, sed differt prothorace lateraliter in medio obtusius tuberculato, et antennis corpore sesqui-longioribus, articulis tertio quartoque apice minus fortiter nodosis, articulis tertio quintoque plus elongatis. ♂.

Long. 27, lat. $7\frac{1}{2}$ mm.

Hab. South Australia (*Bakewell*).

Without the distinct difference in the antennæ this species might well be placed with *sericus*. The antennæ are, however, much longer (surpassing the elytra by about the last three joints); the third joint is about half as long again as the fourth, and both these joints are only slightly nodose at the apex. The prothorax is more obtusely tubercled at the sides.

Pachydissus parvicollis, sp. n.

Badius, pube aureo-flava sericea leviter obtectus; prothorace antice posticeque gradatim angustato, medio utrinque obtuse angulato, supra irregulariter et minus fortiter plicato; elytris elongatis, leviter sericeo-pubescentibus; apicibus truncatis, sutura spinosis; antennis (♂) corpore duplo fere longioribus, articulo tertio quam primo multo longiore, (♀) corpore brevioribus.

Long. (♂) 32, lat. $8\frac{1}{2}$ mm.

Hab. N. India.

Prothorax somewhat obtusely dilated or angulated at the middle of each side, and from thence gradually narrowed to the base and apex, irregularly and not very strongly wrinkled above. Elytra rather long, gradually and slightly narrowed posteriorly for about four fifths of their length, and then more quickly narrowed towards the apex, where they are truncate, with a short spine at the suture on each side; with a not very dense yellowish-tawny silky pubescence, which veils a reddish-brown derm, the pubescence giving faint wavy reflexions in certain lights. Antennæ in the male not quite twice as long as the body, with the third and fifth joints subequal, each much longer than the first or fourth, and with the third and fourth and some of the succeeding joints slightly nodose at the apex. Antennæ in the female a little shorter than the body.

Pachydissus (Margites) humilis (Chevr., MS.), sp. n.

Fuscus; prothorace supra et lateraliter punctato-rugoso, pube grisea plagiatis disposita; lateribus leviter et subæqualiter rotundatis; elytris piceo-rufis, ruguloso-punctatis, pube cervina vel griseo-fulva dense obtectis; apicibus subtruncato-rotundatis, inermibus; pedibus antennisque piceo-rufis, illis ruguloso-punctatis, leviter pubescentibus, his (♂) corpore paullo longioribus, articulis a primo ad quintum subæqualibus, ceteris gradatim crescentibus, articulis tertio et quarto crassatis, subcylindricis.

Long. 14-15, lat. 3½ mm.

Hab. Senegal.

This species may be easily distinguished from *P. egenus* or *P. fulvidus* by the more evenly rounded sides of the prothorax, the greatest width of the latter being just behind the middle, and by the relatively narrower elytra. The antennæ in the male are shorter than in *P. egenus*, with the third and fourth joints much less strongly thickened.

In one (female) specimen the pubescence of the elytra is fawn-coloured and somewhat glossy; in the other two (in Mr. Fry's collection) it is dull and grey or fulvous; but in these I believe that it is faded.

Pachydissus (Derolus) demissus, Pasc.

? *Cerambyx volvulus*, Fabr. Syst. Eleuth. ii. p. 271.

Hamaticherus volvulus, Dej. Cat.

Piceus, griseo tenuiter pubescens; oculis magnis, supra (♂) fere contiguus; prothorace lateribus in medio rotundatis singulisque spatio angusto exciso, glabro; dorso transversim plicato, in medio raro levi; elytris tenuiter sat denseque punctulatis, subtiliter pubescentibus; apicibus subtruncatis, inermibus; processu anterolaterali metasterni distincto; antennis (♂) corpore paullo longioribus, subserratis, articulis tertio et quarto apice leviter nodosis, quarto quam tertio paullo brevioribus.

Long. 15-17, lat. 4-4½ mm.

Hab. India (Tranquebar, Nilghiris, Silhet), Philippines, and China.

This species was included by Mr. Pascoe in his proposed genus *Margites*, but it seems better placed in Section C of the preceding arrangement. The species is quoted by Dejean in his Catalogue as the *Cerambyx volvulus* of Fabr., and it certainly agrees very well with Fabricius's description.

Pachydissus (Derolus) arciferus (Chevr., MS.), sp. n.

Niger, griseo-pubescent; capite supra inter oculos sat distincte

angustimque sulcato: prothorace supra transversim leviterque plicato, disco impressionibus duabus obliquis postice transversim connexis, antice late divergentibus; elytris pube grisea sericea, nonnihil mutabile, obtectis, dimidio basali sparsim punctulato, apicibus subtruncatis, muticis; processu prosterni postice subverticali; parte laterali metasterni antice in processu parvo producta; antennis (♀) corpore brevioribus.

♀. Long. 17-19, lat. $4\frac{1}{2}$ -5 mm.

Hab. Senegal, Port Natal.

Head with a distinct but narrow groove between the eyes above, with the eyes rather large, not very widely separated below, with the underside not distinctly grooved. Prothorax somewhat irregularly, transversely, and not strongly wrinkled above; the disk with two oblique slightly arcuate impressions, joined by means of the bisinuate basal transverse groove behind, and anteriorly widely diverging, with the space between less distinctly wrinkled than the parts external to them. Elytra with a silky grey pubescence giving rather feeble *moiré* reflexions. The antero-lateral process of the metasternum is distinct enough, without completely cutting off the epimeron from the intermediate cotyloid cavity.

This species, of which I have only seen female specimens, seems somewhat nearly allied to a South-African species which I believe to be very near, if not the, *Tapinolachnus Gyllenhali* of Fåhræus.

Pachydissus (Diorthus) simplex, White.

Cerambyx holosericeus, Oliv. (nec Fabr.).

Hammaticherus simplex, White.

Cerambyx vernicosus, Pasc.

Pachydissus inclemens, Thoms.

Hammaticherus heterocerus, Dup. Dej. Cat.

Hammaticherus sericeus, Dej. Cat.

Head feebly grooved above between the eyes. Antennæ in the male more than half as long again as the body, with the third and most of the following joints fringed with short and delicate grey hairs underneath; with the third joint much longer than the fourth, both these joints nodose at the apex; with the cicatrice of the scape limited by an incomplete carina. Prothorax rounded at the sides, irregularly and not very strongly rugose above; the disk with some not very distinct longitudinal and oblique grooves, together forming a somewhat crown-shaped impression. Elytra with a unicolorous, greyish, slightly glossy pubescence, somewhat thinner on each side before the middle, and there revealing a reddish-brown or dark brown derm; apices truncate, shortly spined at the suture. Femora feebly carinate on each side.

The types of all the species quoted above (with the exception of *P. inclemens*, Thoms., which I have had an opportunity of examining) are contained in the British Museum collection, and, after careful comparison, I have come to the conclusion that they represent but a single species. The types of *simplex* (White) and *sericeus* (Dej.) differ from the others in having the elytral derm reddish brown rather than dark brown. The distribution of the species, so far as it at present is known, is somewhat strange, and has caused me to hesitate before arriving at the conclusion stated above. The specimens named *simplex* and *heterocerus* are from West Africa, the types of *holosericeus* (Oliv.), *vernicosus*, and *inclemens* are from India, and *sericeus* is from Java. There are also in the Museum collection dark-coloured specimens from Siam.

To avoid the confusion which might arise by adopting Olivier's name I have taken as the name of the species the one which comes next in order of priority.

Pachydissus (Diorthus) vagus, sp. n.

P. simplici affinis et similis, sed differt pube grisea densiore, articulo antennarum tertio quam quarto paullo longiore.

Long. 25, lat. $7\frac{1}{2}$ mm.

Hab. "Senegal?"

Clothed with a dense ashy-grey pubescence, somewhat thinner on each side of the elytra before the middle. Antennæ (in the single male before me) about half as long again as the body, with the third joint not much longer than the fourth, with the scape cicatrized as in *P. simplex*. Femora feebly carinate on each side. The sculpturing of the prothorax is apparently almost exactly the same as in *P. simplex*, but, owing to the denser covering of pubescence, is not so easily seen.

This species has a strong resemblance and an evident affinity to *P. simplex* (White), and its habitat might have thrown some light upon the distribution of the latter. Unfortunately, however, of the two specimens one (the male type) is ticketed "Senegal?," the other (a female, in Mr. Fry's collection) is ticketed "Nov. Holland." The latter locality can scarcely be correct.

Xoanodera laticornis, sp. n.

Nigro-fusca; prothorace supra irregulariter corrugato, dorso utrinque fulvescente bivittato; elytris maculis lineisque fulvescentibus,

postice crebre punctatis, lateraliter ab humeris usque ad medium reticulato-corrugatis, disco versus basin irregulariter rugoso, apicibus oblique truncatis, singulisque breviter bispinosis; antennis articulis a quarto unilateraliter compressis et valde dilatatis; femoribus haud carinatis.

Long. 25, lat. $8\frac{1}{2}$ mm.

Hab. Sarawak.

Blackish brown. Head with a sparse fulvous-white pubescence in front, and with two indistinct fulvous-white vittæ on each side above. Prothorax coarsely and irregularly rugose above, with two fulvous-white vittæ towards each side. Elytra each with a sutural line, a series of spots external to it, a short line from the base along the middle of the disk, and lines and spots on the posterior half fulvous-white; with the sides from the shoulders to a little beyond the middle coarsely and reticulately corrugate, with the disk also somewhat irregularly rugose, with the posterior half and the sutural region just in front of the middle closely punctured where not covered by pubescence. The apices obliquely truncate and each furnished with two short spines directed somewhat obliquely outwards. Body underneath with a sparse tawny pubescence. Legs very thinly pubescent; femora without carinæ. Prosternal process strongly arched in the middle, gradually declivous posteriorly. Antennæ greyish pubescent, equal in length to the body, with the joints from the fourth compressed and dilated on the inner side, with the sixth, seventh, and eighth joints most strongly dilated, the antennæ thus being broadest about the middle.

A single specimen in the British Museum collection.

In the greater width of the antennæ and the absence of carinæ from the legs this species differs from all the others included in the genus.

Xoanodera? vitticollis, sp. n.

Nigro-fuscus; capite fulvo-albo-pubescente, oculis magnis, supra approximatis; prothorace latitudine vix longiore, supra irregulariter rugoso, vittis quinque longitudinalibus, albo-pubescentibus; —una media, duabus versus singulum latus; elytris fortiter confertissimeque punctatis, maculis albo-pubescentibus prope suturam et apicem nonnihil spissis et ad marginem lineam formantibus, apicibus rotundatis; antennis corpore paullo longioribus, articulis a quinto ad decimum intus compressis et ad apicem angulato-productis. ♂.

Long. 20, lat. 6 mm.

Hab. Borneo.

Dark brown, nearly black. Head with a fulvous-white pubescence. Prothorax about as long as it is broad in the middle, feebly rounded at the sides, irregularly rugose above, with five pubescent whitish lines, one median and two towards each side. Elytra very strongly and very closely punctured, with whitish pubescent spots somewhat irregularly and thickly spread on the sutural region, arranged in a row at the lateral margin, and forming a few short lines towards the apex. Body underneath with a slight greyish pubescence. Prosternal process strongly arched, posteriorly declivous. Mesosternal process almost horizontal, feebly declivous anteriorly. Antennæ surpassing the elytra by about the last joint, with the third and fifth joints subequal, each barely longer than the scape, the fourth shorter, the sixth to tenth gradually increasing, the eleventh about half as long again as the tenth, with the joints from the fifth to the tenth compressed on the inner side and each angulately produced at the apex.

I have placed this species in *Xoanodera*, rather to indicate its affinities than because I believe it to strictly belong to that genus. With but a single specimen before me I should not feel justified in creating a new genus in such a group as the present.

Rhytidodera robusta, sp. n.

Pubes grisea fulvaque sat dense obtecta; prothorace supra valde irregulariterque rugoso, disco tuberculis duobus aculeatis; elytris pube subplagiatim disposita, apicibus subrotundatis, sutura spinosis; antennis (♀) dimidium corporis vix excedentibus. Long. (♀) 34, lat. 9 mm.

Hab. Bombay.

Prothorax strongly and irregularly rugose above, with two of the short ridges, just in front of the middle of the disk, so much raised as to appear like two wedge-shaped tubercles, very slightly constricted at the apex, with an obtuse tubercle on each side close to the anterior border. Elytra with a pubescence partly fulvous, partly grey, somewhat denser in places, with the apices rounded or subtruncate and each with a moderately strong spine at the suture.

This species most nearly resembles *R. integra*, Kolbe, but is much larger, and is distinguished by the structure of the prothorax and the more prominent spine at the sutural apex of the elytra.

[To be continued.]

III.—*British Fossil Crinoids*.—IV. *Thenarocrinus gracilis*,
sp. nov., *Wenlock Limestone*, and *Note on T. callipygus*.
 By F. A. BATHER, M.A., F.G.S.

[Plate I.]

A. *Note on Thenarocrinus callipygus*.

SOME seven weeks after the publication of Paper III., "On *Thenarocrinus callipygus*"*, my friend Mr. W. Madeley of Dudley sent me an excellent specimen of that species which he had found in the cabinets of Mr. C. B. Ketley of Smethwick. The collection of the late Mr. Charles Ketley is for the most part in the museum of Mason's Science College at Birmingham, and it may be remembered that three of the finest specimens of *T. callipygus* are there to be found. Some of the collection is, however, still in the possession of Mr. C. B. Ketley, and it is remarkable that it should contain this other even more instructive specimen of so rare a species. My best thanks are due to its owner for the ready loan of this interesting fossil.

The specimen appears to come from the same horizon and locality as all the others, viz. the Upper Wenlock Limestone of Dudley.

The specimen is a complete crown broken away from the stem at the second or third joint. Its interest lies in the fact that it is seen from the posterior, and that the anal plates and lower portion of the ventral sac are very clearly displayed in their natural positions. In no other specimen known to me is the anal area shown so clearly or completely; hence in the preceding paper it could only be represented by a reconstructed and composite diagram (Diag. 1, p. 227). The figure of the present specimen (Pl. I. fig. 3) proves the essential truth of this diagram.

It was stated on p. 228 that slight variations existed, hence we are not surprised to find the present individual departing in one or two minor particulars from the more usual type. Thus, the first plate of both the distichous series is axillary, and not the second as was stated on p. 228 to be generally the case. In the tetrastichous series the first plate on the inner right hand is seen to bear two small plates, but these again support only one. Such variations have no systematic value, but it would be unwise, while we are yet in the dark as

* 'Annals,' 1890, vi. p. 222.

to the true meaning of the ventral sac, to assert that they are of no morphological importance.

The large size of the posterior infra-basal, caused by its rising up to meet the radianal, is noteworthy, especially in connexion with the possible Carabocrinid affinities of this genus.

In this species the angle which the side of the cup makes with the long axis is not $9\frac{2}{3}^{\circ}$, as erroneously stated on p. 225, but is $15^{\circ} 15'$.

I take this opportunity of publishing better representations of the British Museum specimens 57478 *a* (Pl. I. fig. 2) and 57478 *b* (Pl. I. fig. 1); these correspond to figures 3 and 5 of plate x. ('Annals,' 1890, vol. vi.).

B. *Thenarocrinus gracilis*, *sp. nov.*

This species is founded on a specimen in the general collection of the Museum of the Yorkshire Literary and Philosophical Society at York. Although I saw this specimen when examining the Crinoids of that museum in September 1889, yet, as the genus *Thenarocrinus* was not then formulated, the relationship of this species to *T. callipygus* escaped my notice. Unfortunately the existence of this specimen only recurred to me after Paper III. had gone to press. It is with little doubt a *Thenarocrinus*, and, being entrusted to me through the kindness of my friend Mr. H. M. Platnauer, Secretary to the Yorkshire Literary and Philosophical Society, I hasten to describe it. It would have been better to have procured yet other specimens, but none are known to me, and it seems advantageous to publish a description while on the subject of *Thenarocrinus*, instead of laying it aside to be again forgotten.

The specimen (Pl. I. fig. 4) is a crown with 6 millim. of stem attached; it lies in the matrix, but is fortunately seen from the posterior. Formerly in the possession of Mr. Edward Wood, of Richmond, Yorkshire, it was in 1880 bought along with the rest of that gentleman's specimens by John Reed, Esq., M.R.C.S., of York, and by him presented with the whole of his collection to the Literary and Philosophical Society.

The specimen retains Mr. Wood's original label, which runs as follows:—" *Cyathocrinus* (*showing Proboscis*), *Silurian*, *Dudley*." It obviously comes from the Upper Wenlock Limestone.

DIAGNOSIS.

Cup conical, rather elongate; plates mostly higher than

wide. Arms about six times length of cup, slender, dichotomize about five times; arm-ossicles, when seen from back, about as high as wide; lateral compression very slight. Anal plates situated low in the cup. Stem (so far as known) smooth.

The graceful and slender appearance suggests *gracilis* as a natural *nomen triviale*.

DESCRIPTION OF SPECIMEN.

Dorsal cup forms a cone the sides of which are almost in a line with the gradually tapering proximal part of the stem below and with the arms above; thus its elongate character is exaggerated. The measurements are:—Breadth at base 3·2 millim.; breadth at summit 6·5 millim.; height of cup 5·5 millim. The specimen, however, is obviously flattened in the plane of bedding; the stem, for instance, is so crushed that its section, instead of forming a circle, is an ellipse with axes in the proportion of nearly 3:2; the cup, as one would expect, is crushed more than the stem, and the proportions may be taken as quite 3:2. The true measurements would thus be:—Breadth at base 2·7 millim.; at summit 5·4 millim. Consequently the angle which the side of the cup makes with the long axis is about 13° 47'.

IB. presumably 5, of which 4 should be pentagonal. Only the two posterior are seen: r. post. IB. pentagonal, with height about equal to breadth; l. post. IB. abnormally wide, of somewhat uncertain relations, but probably with truncate top supporting post. B.

B. presumably 5 and hexagonal. Only post. B. is completely seen; portions of r. and l. post. BB. are visible. They would appear to have been about as high as wide. The post. B., however, is higher than wide, and its distal angle is truncated by a small plate which seems to belong to the tegmen: this is probably an individual abnormality.

R. presumably 5, though only 2 are seen: higher in proportion than in type species, with articular facet apparently more excavated. The l. post. R. is cut short on the side next the anal area by the tegminal plate that was mentioned as resting on the post. B.: this feature also is probably an individual abnormality.

Arms have, by reason of their slenderness, a longer appearance than those of *T. callipygus*; but, owing to the greater height of the cup, their length relatively to it is less, namely six instead of seven times its height. The extent of their dichotomy cannot be exactly ascertained, but their free

brachials are probably only the third postpalmar, instead of the sixth as in *T. callipygus*, a fact that further enhances the graceful slimness of the arms. The arm-ossicles are smooth with a very slight constriction in the middle, and a very slight swelling, hardly to be called a ridge, anteriorly. The height of the ossicles is about equal to their breadth all the way up the arms. Lateral compression is more obvious in the proximal than in the distal region of the arms, and may in this case be due to simple mechanical pressure by the rock. More distally the arms have almost a flat shallow appearance. The ventral surface of the arms is nowhere exposed.

Costals, in r. post. arm apparently 9. The edges of the proximal costals in each ray are bent upwards parallel to the curved edges of the radial facet. There is no bevelling of the outer edge as in the type species.

The remainder of the arms is too fragmentary to allow the number of distichals, palmars, &c. to be more than guessed at: the average number in each series was probably about 10.

Anal structures :—Radial, since it rests on both r. and l. post. IB., is hexagonal, not pentagonal; in correlation with this it is higher than wide: in other respects as in type species.

Brachianal not shield-shaped, but an irregular hexagon, very slightly higher than wide. Normally it was probably situated as in *T. callipygus*, but in the present specimen it is separated from l. post. R. by the tegminal plate before alluded to.

The connexion of the ventral sac with the anal plates is as follows (see Pl. I. fig. 5). The Brachianal does not support a second brachianal, but is itself axillary. The first plate of the left-hand distichous series is axillary, and the same appears to be the case with the corresponding plate on the right. Then follow series of folded plates so like those of *T. callipygus* that further description is unnecessary; the anticlinal folds, however, are a little broader proportionally than in that species.

In the present specimen the ventral sac attained a length of at least 24 millim.

The Tegmen, beyond a few small plates on either side the origin of the ventral sac, is not seen in this specimen.

The Stem (Pl. I. fig. 5) is smooth in the proximal portion, and this smoothness does not appear to be due to rubbing. There are 23 ossicles preserved, of alternating height but regularly decreasing diameter. The smaller ones are about half the height of the larger, so that approximate measurements are :—height $\cdot 34$ and $\cdot 17$ millim.; diameter $2\cdot 7$

to 1.66 millim. There is a very slight trace of a radial suture in what would normally be the l. post. radius, but, owing to the abnormalities of the infrabasal circlet, this suture appears to lie in the posterior interradius. The axial canal appears to have been large, but its exact size cannot be determined.

GENERAL REMARKS.

To our knowledge of the morphology of *Thenarocrinus* the present species adds but little; the following points may, however, be noticed. First, it entails a slight modification of the diagnosis (*l. c.* p. 224), which must now read "R' in Basal circlet, resting on one or more post. IB." Secondly, from the evidence of this specimen, combined with that of specimens of *T. callipygus*, it is certain that at least four out of the eight ridges of the ventral sac arise by dichotomy from the brachial. Lastly, we must mark the absence of a second brachial, for in nearly all genera of *Fistulata* that plate is present: in the few cases where it cannot be distinguished, in other words where the first brachial is itself axillary, the two plates may possibly have fused; certain facts render this explanation probable, but there is nothing in the present specimen that makes either for or against it.

The small size of this specimen, as compared with the specimens of *T. callipygus*, may suggest that it died young. But the fully developed plication of the plates in the ventral sac is more powerful evidence of its maturity.

Certain features in the present specimen, since they appear to be abnormalities rather than specific characters, find no place in the diagnosis. They are, however, of some interest from a morphological point of view, especially as it is not easy to see how they arose. The sinking of a tegminal plate, on the left of the posterior interradius, so low that it rests on the posterior basal, is no doubt in accordance with the general development of this genus, and tends to counteract the greater narrowness of the cup in the present species; at the same time it would be rash to regard so unusual a structure as more than an individual variation.

The relations of the left posterior infrabasal to the posterior basal, though probably obtaining throughout the species, are very remarkable, and more material is required for their complete elucidation. It is even possible that, if all future specimens were found to possess the many curious characters of the present one, the establishment of a new genus would be warrantable. But under any circumstances the species would remain close to *T. callipygus*. Systematically considered

T. gracilis is indeed less differentiated in most points than *T. callipygus*; the essential features of the genus are present, but in the structure of the arms and general shape of the cup the form before us is closely connected with the ordinary Dendrocrinite type.

EXPLANATION OF PLATE I.

A. *Thenarocrinus callipygus*, Bather.

- Fig. 1.* 57478 *b*, B. M. Previously figured Ann. & Mag. Nat. Hist. ser. 6, vol. vi. pl. x. fig. 5. This shows the tegminal plates, which were not rendered by the lithographer, and the broad ventral sac. (Nat. size.)
- Fig. 2.* 57478 *a*, B. M. Previously figured *loc. cit.* fig. 3. Shows fine branching of arms, a few tegminal plates, and, on the left, the base of the ventral sac; in the stem is seen the trace of a radial suture. (Nat. size.)
- Fig. 3.* Mr. C. B. Ketley's specimen. Shows anal area and base of ventral sac. Distally the arms are somewhat broken, disordered, and rubbed. The lower part of the cup is damaged by fracture. (Nat. size.)

B. *Thenarocrinus gracilis*, sp. nov.

- Fig. 4.* Specimen in York Museum. (Nat. size.)
- Fig. 5.* The lower part of the same outlined to show arrangement of plates and stem-ossicles. ($\times 4$)

IV.—*List of Lepidoptera in a Collection made by Emin Pasha in Central Africa.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

THE present collection consists of eighty species, chiefly of Rhopalocera; only two of the species appear to be actually new to science, although several others have only been described comparatively recently.

By far the greater number of the recognized species are identical with forms found in South Africa, and in all cases where closely allied representative forms occur in the south and west, the southern form is the one represented in the present collection; the eastern element is very slightly indicated.

RHOPALOCERA.

Nymphalidæ.

1. *Tirumala petiverana*.

Danaïdæ, var. *petiverana*, Doubleday, Gen. Diurn. Lep. pl. xii. fig. 1 (1847).

Three male examples : Njangabo, 29th April, 4200 feet ; Kiriamo, 16th May, 2900 feet.

2. *Amauris dominicanus*.

Amauris dominicanus, Trimen, Trans. Ent. Soc. 1879, p. 323.

6 ♂, 7 ♀, Njangabo, Kandra, and Ngúru, in April, October, and November.

3. *Limnas chrysippus*.

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

♀, Kiriamo, 16th May ; ♂, Kissakka, 16th June ; Unyamwézi, 14th October ; Kandra.

Var. *alcippoides*.

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

♀, Njangabo, 4th May, 4200 feet.

Var. *dorippus*.

Euplœa dorippus, Klug, Symb. Phys. pl. xlvi. figs. 1-4 (1845).

♀, Ngúru, in November.

Var. *Klugii*.

Limnas Klugii, Butler, Proc. Zool. Soc. 1885, p. 758. n. 2.

4 ♂, 2 ♀, Mpwapwa, 12th, 18th, and 20th November ; 2 ♂, 4 ♀, Kandra and Ngúru, October and November.

From the examples above recorded it would seem that the races of the *L. chrysippus*-group are not specifically separable in Central Africa.

4. *Melanitis solandra*.

Papilio solandra, Fabricius, Syst. Ent. p. 500. n. 244 (1775).

Kassari, 13th July ; Viaruha, 23rd July ; Kandra and Ngúru, October and November 1889.

5. *Gnophodes parmeno*.

Gnophodes parmeno, Doubleday, Gen. Diurn. Lep. pl. lxi. fig. 2 (1851).

♀, Ngúru, November.

6. *Mycalesis eusirus*.

Mycalesis eusirus, Hopffer, Ber. Verh. Ak. Berl. 1855, p. 641.

Kandra and Ngúru, October and November.

7. *Ypthima itonia*.

Ypthima (sic) *itonia*, Hewitson, Trans. Ent. Soc. ser. iii. vol. ii. p. 287, n. 11, pl. xviii. fig. 13 (1865).

Buguéra, 5400 feet, 17th March, 1889.

8. *Ypthima albida*.

Ypthima albida, Butler, Proc. Zool. Soc. 1888, p. 59. n. 14.

Buguéra, 5400 feet, 17th March, 1889.

9. *Charaxes Hansalii*.

Charaxes Hansalii, Felder, Reise der Nov., Lep. iii. pl. lix. figs. 3, 4.

Kandera and Ngúru, October and November.

10. *Charaxes Bohemani*.

Charaxes Bohemani, Felder, Wien. ent. Mon. iii. pl. vi. fig. 3 (1859).

Kandera, October.

11. *Charaxes jocaste*.

Charaxes jocaste, Butler, Proc. Zool. Soc. 1865, p. 628.

Kandera, October.

12. *Charaxes Kirkii*.

♀. *Charaxes Kirkii*, Butler, Ent. Month. Mag. xviii. p. 105 (1881).

♂. Butler, Proc. Zool. Soc. 1888, p. 60.

Kandera, October.

13. *Pulla varanes*.

Papilio varanes, Cramer, Pap. Exot. ii. pl. clx. D, E (1779).

Waramba village, 2 hours from Semliki River; Njangabo, 4200 feet, 29th April; Kandera and Ngúru, October and November.

14. *Hypolimnas misippus*.

Papilio misippus, Linnæus, Mus. Lud. Ulr. p. 264 (1764).

2 ♂, Ngúru, November.

15. *Euralia marginalis*.

Euralia anthedon, var. *marginalis*, Butler, Ann. & Mag. Nat. Hist. ser. 4, vol. xvi. p. 395 (1875).

♂, Kandera, in October.

16. *Euryphene neophron*.

Romaleosoma neophron, Hopffer, Ber. Verh. Ak. Berl. 1855, p. 640.

♂, Kandera.

17. *Euryphene achlys*.

Harma achlys, Hopffer, Ber. Verh. Ak. Berl. 1855, p. 641.

♀, Kandera.

18. *Hamanumida dædalus*.

Papilio dædalus, Fabricius, Syst. Ent. p. 482. n. 174 (1775).

Viaruha, 23rd July; Ussambiro, 8th September; Unyamwézi, 13th to 22nd October; Ussagara, 18th November, 1889.

19. *Euxanthe Crossleyi*.

Godartia Crossleyi, Ward, Ent. Month. Mag. viii. p. 36 (1871).

Kandera.

20. *Junonia clelia*.

Papilio clelia, Cramer, Pap. Exot. i. pl. xxi. E, F (1775).

Kandera and Ngúru, October and November.

21. *Junonia boöpis*.

Junonia boöpis, Trimen, Trans. Ent. Soc. 1879, p. 331.

Ussagara, 18th November, 1889.

22. *Junonia natalica*.

Precis natalica, Felder, Wien. ent. Mon. iv. p. 106. n. 65 (1860).

Kandera.

23. *Junonia orthosia*.

Vanessa orthosia, Klug, Symb. Phys. pl. xlvi. figs. 8, 9 (1845).

Njangaba, 29th April, 1889, 4200 feet.

A shattered example of *Pyramis cardui* was obtained at Kandera.

24. *Salamis cacta*.

Papilio cacta, Fabricius, Ent. Syst. iii. i. p. 116. n. 356 (1793).

Kandera.

25. *Protogoniomorpha definita*.

Salanis definita, Butler, Ann. & Mag. Nat. Hist. ser. 5, vol. iv. p. 230 (1879).

Waramba village, 2 hours from Semliki River; Kandra and Ngúru.

26. *Protogoniomorpha anacardiæ*.

Papilio anacardiæ, Linnæus, Mus. Lud. Ulr. p. 236 (1764).

Njangabo, 4200 feet, 24th April; Bukóko, 3rd June; Waramba village, 2 hours from Semliki River.

27. *Crenis madagascariensis*?

Crenis madagascariensis, Boisduval, Faun. Mad. p. 48 (1833).

Buguéra, on the slope of the hills, 5400 feet, 17th March, 1889.

It is possible that the single example obtained may represent a distinct species, but on such slight evidence it would be unwise to separate it.

28. *Atella columbina*.

Papilio columbina, Cramer, Pap. Exot. iii. pl. cccxxxviii. A, B (1782).

♀, Buguéra, 4800 feet, 22nd March, 1889.

29. *Hypanis polinice*.

Papilio polinice, Cramer, Pap. Exot. iv. pl. cclxxv. G, H.

♂ ♀, Ussagara, 12th and 20th November; ♂ ♀, Ngúru. Six specimens were obtained.

30. *Hypanis goetzius*.

Papilio goetzius, Herbst, Natursyst. Schmett. ix. pl. cclviii. figs. 1-4 (1798).

♂, Ussagara, 20th November; ♂ ♀, Ngúru. Seven specimens were obtained.

31. *Neptis agatha*.

Papilio agatha, Cramer, Pap. Exot. iv. pl. cccxxvii. A, B (1782).

2 ♂, Buguéra, 17th March, 4800 feet; Njangabo, ♂, 4th, ♀, 29th May, 4200 feet; ♀, Kandra, October.

The last-mentioned female is unusually large and has the white band of the primaries divided by a black third median branch; in all other particulars it corresponds with ordinary examples.

32. *Telchinia Buxtoni*.

Acræa Buxtoni, Butler, Ann. & Mag. Nat. Hist. ser. 4, vol. xvi. p. 395 (1875).

♂ ♀, Kandera.

33. *Telchinia oncæa*.

Acræa oncæa, Hopffer, Ber. Verh. Akad. Berl. 1855, p. 640.

Itikua brook, Unyamwézi, 21st October; Msaka brook, 22nd October; Masvéa, Ugógo, 8th November, 1889.

34. *Telchinia cæcilia*.

Papilio cæcilia, Fabricius, Sp. Ins. ii. p. 34. n. 142 (1781).

Kandera and Ngúru, October and November.

One of the females is a melanistic aberration.

35. *Telchinia natalica*.

Acræa natalica, Boisduval, Voy. Deleg. ii. p. 590 (1847).

Kandera and Ngúru, October and November.

Lycænidæ.

36. *Teriomima? hildegarda*.

Teriomima? hildegarda, Kirby, Ann. & Mag. Nat. Hist. ser. 5, vol. xix. p. 367 (1887).

♂, Kandera.

I fail to see how this differs from *D'Urbania aslauga*, Trimen; in any case it is the male of the insect figured by Kirby.

37. *Polyommatus bæticus*.

Papilio bæticus, Linnæus, Syst. Nat. i. 2, p. 789. n. 226 (1767).

♂, Ngúru.

38. *Catochrysops osiris*.

Lycæna osiris, Hopffer, Ber. Verh. Ak. Berl. 1855, p. 642.

♀, Ngúru.

39. *Azanus amarah*.

Polyommatus amarah, Guérin, Lef. Voy. Abyss. vi. p. 384, pl. xi. figs. 5, 6 (1847).

Kandera.

40. *Tarucus pulcher*.

Lycæna pulchra, Murray, Trans. Ent. Soc. 1874, p. 524, pl. x. figs. 7, 8.

Njangabo, 29th April; Htikua brook, Unyamwézi, 21st October; Msaka, 22nd October; Kandera, October.

41. *Zizera knysna*.

Lycæna knysna, Trimen, Trans. Ent. Soc. ser. iii. vol. i. p. 282 (1862).

Ngúru, in November.

42. *Myrina ficedula*.

Myrina ficedula, Trimen, South Afr. Butt. ii. p. 141 (1887).

Kandera, October.

Papilionidæ.43. *Terias zoë*.

Terias zoë, Hopffer, Ber. Verh. Ak. Berl. 1855, p. 640.

2 ♂, Ngúru, November; 2 ♀, Mpwapwa, Ussagara, 12th November.

44. *Terias senegalensis*.

Terias senegalensis, Boisduval, Faun. Madag. p. 672. n. 31 (1836).

Kiriambo, 16th May, 2900 feet.

45. *Terias chalconiæta*.

Terias chalconiæta, Butler, Ann. & Mag. Nat. Hist. ser. 5, vol. iii. p. 190. n. 10 (1879).

Buguéra, 4800 feet, 22nd March; Njangabo, 4200 feet, 16th April and 4th May, 1889.

46. *Terias regularis*.

Terias regularis, Butler, Ann. & Mag. Nat. Hist. ser. 4, vol. xviii. p. 486 (1876).

Buguéra, 4800 feet, 22nd March, 1889.

47. *Teracolus maimuna*.

Idmais maimouna, Kirby, Proc. Roy. Dubl. Soc. ii. p. 337 (1880); Aid, iii. pl. cxliii. (1884).

Kandera.

48. *Teracolus aurigineus*.

Teracolus aurigineus, Butler, Ann. & Mag. Nat. Hist. ser. 5, vol. xii.
p. 103 (1883).

♀, Kandera.

49. *Teracolus bacchus*.

Teracolus bacchus, Butler, Proc. Zool. Soc. 1888, p. 73. n. 94.

♂, Kandera.

50. *Teracolus imperator*.

Teracolus imperator, Butler, Proc. Zool. Soc. 1876, p. 132. n. 20.

♂, Kandera.

51. *Teracolus anax*.

Callosune anax, H. G. Smith, Ann. & Mag. Nat. Hist. ser. 6, vol. iii.
p. 125 (1889).

6 ♂ and 1 ♀, Kandera and Ngúru, October and November.

52. *Teracolus hyperides*.

Teracolus hyperides, Butler Proc. Zool. Soc. 1876, p. 149. n. 76.

♂, Kandera.

53. *Teracolus laura*.

Teracolus laura, E. Sharpe, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 441
(1890).

♂, Kandera.

54. *Teracolus Trimenii*.

Teracolus Trimenii, Butler, Proc. Zool. Soc. 1876, p. 150. n. 79.

♀, Kandera.

55. *Teracolus omphale*.

Pieris omphale, Godart, Enc. Méth. ix. p. 122. n. 12 (1819).

♂, Kandera.

56. *Teracolus Eminii*, sp. n.

♂. Nearest to *T. eione*; rather larger; the costal and external borders of the primaries more broadly blackish, the veins towards outer margin more distinctly black; the apical patch of a paler orange; the bifid blackish spot on the lower radial interspace larger: secondaries with the blackish costal

border less distinct, diffused; the external border broader, only showing two white spots towards costa on the subcostal interspaces, all the other spots being obliterated. Under surface much whiter, without the yellow tint on the secondaries.

Expanse of wings 43 millim.

♂, Kandera.

57. *Catopsilia florella*.

♀. *Papilio florella*, Fabricius, Syst. Ent. p. 479. n. 159 (1775).

♂, Kasari (Nkole), 13th July; ♀, Hapiringa, Unyamwézi, 14th October; ♂, Mpwapwa, Ussagara, 12th November; Mikesse, Ussagara, 29th November; ♂ ♀, Kandera and Ngúru, October and November 1889.

58. *Catopsilia pyrene*.

Colias pyrene, Swainson, Zool. Ill. 1st ser. pl. li. (1820-21).

♂, Gombe ja Ikungu, Unyamwézi, 17th October; Usaka, 22nd October; Kapaláta, Ugógo, 25th October; ♂ ♀, Mpwapwa, Ussagara, 12th November; ♀, Muini, Ussagara, 18th November; ♂, Udéva, 20th November; Mikesse, 29th November, 1889; ♂ ♀, Kandera and Ngúru, October and November.

59. *Glutophrissa contracta*.

Glutophrissa contracta, Butler, Proc. Zool. Soc. 1888, p. 75. n. 102.

2 ♂, Kandera in October.

60. *Belenois thysa*.

Pieris thysa, Hopffer, Ber. Verh. Ak. Berl. 1855, p. 639.

♀, Kiriamo, 15th May; ♂ ♀, Waramba village, 2 hours from Semliki River.

61. *Belenois severina*.

Papilio severina, Cramer, Pap. Exot. iv. pl. cccxxxviii. G, H (1782).

♂, Njangabo, 26th April, 4200 feet; ♂ ♀, Kandera and Ngúru, October and November.

62. *Belenois infida*.

Belenois infida, Butler, Proc. Zool. Soc. 1888, p. 78. n. 111.

♂, Kiriamo, 16th May, 1889; Mikesse, Ussagara, 29th November.

Six males were obtained, five of them at Kiriamo; the variation noted in the females extends to a less extent to the males.

63. *Belenois lordaca*.

Pieris lordaca, Walker, Entom. v. p. 48.

♂ ♀, Kandera and Ngúru, October and November.

64. *Belenois gidica*.

Pieris gidica, Godart, Enc. Méth. ix. p. 131. n. 37 (1819).

Mikesse, Ussagara, 29th November.

65. *Nepheronia Buquetii*.

Callidryas Buquetii, Boisduval, Sp. Gén. i. p. 607. n. 1 (1836).

♂ ♀, Kandera and Ngúru.

66. *Papilio corinneus*.

Papilio corinneus, Bertoloni, Mem. Bolog. 1849, p. 9, pl. i. figs. 1-3.

Kandera and Ngúru.

67. *Papilio similis*.

Papilio similis, Cramer, Pap. Exot. i. pl. ix. B, C (1775).

Kandera.

68. *Papilio porthaon*.

Papilio porthaon, Hewitson, Ex. Butt. iii. Pap. pl. vii. figs. 21, 22 (1865).

Mikesse, Ussagara, 29th October, 1889.

69. *Papilio nyassæ*.

Papilio nyassæ, Butler, Ann. & Mag. Nat. Hist. ser. 4, vol. xix. p. 459 (1877).

♂ ♀, Mikesse, Ussagara, 29th October; Kandera, in October 1889.

70. *Papilio demoleus*.

Papilio demoleus, Linnæus, Mus. Lud. Ulr. p. 214 (1764).

Waramba village; Njangabo, 4200 feet, 29th April and 4th May; Kissakha, 16th June; Kasari, 13th July; Gombe ja Ikungu, 19th October; Msaka, 22nd October; Masvéa, Ugógo, 8th November; Muini, Ussagara, 18th November; Kandera and Ngúru, October and November.

Hesperiidæ.71. *Hesperia forestan*.

Papilio forestan, Cramer, Pap. Exot. iv. pl. cccxci. E, F (1782).

Kandera in October.

72. *Ceratruchia?*, sp.

A single much-worn and damaged example of a species apparently belonging to this genus.

Kandera.

HETEROCEA.**Agaristidæ.**73. *Eusemia indecisa*, sp. n.

Allied to *E. africana*; differing above in the subapical oblique band being broader, ovate, and not notched internally; the external border of secondaries less sharply angulated; the first black band at basal third of primaries on under surface divided into two quadrate spots; the central yellow band immediately beyond it consequently broader; the apical fringe of secondaries ochreous instead of snow-white.

Expanse of wings 67 millim.

Kandera in October.

Two male examples were obtained.

Lithosiidæ.*HYP SIN.Æ.*74. *Egybolia Vaillantina*.

Phalæna Vaillantina, Stoll, Suppl. Cram. Pap. Exot. v. p. 142, pl. xxxi. fig. 3.

One example from Kandera.

Polydesmidæ.75. *Polydesma*, sp.

A worn and broken specimen from Masvéa, Ugógo, 8th November, 1889.

Ommatophoridæ.

76. *Cyligramma fluctuosa*.

Phalæna-Noctua fluctuosa, Drury, Ins. Exot. ii. p. 24, pl. xiv. fig. 1.

Two worn specimens from Kandra.

77. *Hypopyra capensis*.

Hypopyra capensis, Herrich-Schäffer, Lep. Exot. figs. 121, 122.

Two worn specimens from Kandra.

Pyralidæ.

78. *Zebronia podalirialis*.

Spilomela podalirialis, Guénéé, Delt. et Pyral. p. 231. n. 274.

♂ ♀, Njangabo, 4200 feet, 24th April, 1889.

79. *Cadarena sinuata*.

Phalæna sinuata, Fabricius, Ent. Syst. iii. p. 203. n. 295.

Second camp in Usamba, 24th May, 1889.

Macariidæ.

80. *Macaria incessaria*?

Tephрина incessaria, Walker, Lep. Het. xxiii. p. 962. n. 31 (1861).

One imperfect example from Mpwapwa, Ussagara, 12th November.

It is impossible to be certain of the identification of this moth, as the markings are partly obliterated; but if not identical with *M. incessaria*, it must be very closely related to it.

V.—Notes on the Synonymy of some Species of Scolopendridæ, with Descriptions of new Genera and Species of the Group. By R. I. POCKOCK, of the British Museum (Natural History).

[Plate IV.]

On Scolopendra Gervaisiana and Scopoliana, Koch.

Upon looking into the synonymy of the North-African species of *Scolopendra* I find that much confusion has existed as to the identity of the two mentioned under the above heading. In 1841, in vol. iii. of Wagner's 'Reisen in Algier,'

Dr. Koch described these two species. A perusal of the descriptions and a glance at plate xi. of the Atlas at once reveals two things—firstly that the species are quite distinct, and secondly that the engraver in lettering the plate applied the name *Gervaisiana* to the figure of the species described as *Scopoliana*, and *vice versâ*. In 1845, in vol. xix. of the Trans. Linn. Soc., Newport described a third species from Algeria, to which he gave the name *algerina*. In 1849, in the Expl. Sci. de l'Alg., Lucas redescribed and figured the two species characterized by Koch, and pointed out the engraver's error connected with the plate. So far all was well; but unfortunately, for some unknown reason, this author came to the conclusion that Newport's *algerina* was synonymous with Koch's *Gervaisiana*—an error which becomes apparent as soon as the descriptions are compared. As a matter of fact *algerina* is synonymous with *Scopoliana*. This was mistake number two. But by far the greatest error was committed by Koch himself, who in 1863, in vol. i. of his work 'Die Myriopoden,' absolutely transposed the names of the species that he had previously made known, and described and figured *Sc. Gervaisiana* as *Scopoliana* and *Scopoliana* as *Gervaisiana*. This was probably on account of the mistake originally committed by the engraver of the plates in Wagner's 'Reisen in Algier.' However that may be, in 1881, when Dr. Kohlrausch monographed the Scolopendridæ in the Arch. für Nat., instead of clearing away the obstacles he, apparently misled by Lucas's mistake, added three more difficulties to those that already beset the question—*i. e.* he concluded, in a characteristically sweeping manner, firstly that the three species under discussion, namely *Scopoliana*, *Gervaisiana*, and *algerina*, were identical, and secondly that they were synonymous with *Sc. morsitans* (Linn.); and finally, having thus happily disposed of and forgotten Koch's *Gervaisiana*, he redescribed it under his genus *Cupipes* as a new species named *græcus*.

The full synonymy then of the two species will be as follows:—

Scolopendra Scopoliana, Koch.

Scolopendra Scopoliana, Koch, in Wagner's Reisen in Algier, iii. p. 222, pl. xi. (1841).

Scolopendra algerina, Newport, Trans. Linn. Soc. xix. p. 387 (1845).

Scolopendra Scopoliana, Lucas, Expl. Sci. Alg. i. p. 341, pl. ii. fig. 5 (1849).

Scolopendra Gervaisiana, Koch, Die Myr. i. p. 53, pl. xxiii. fig. 46 (1863). Not *Gervaisiana* in Wagner's Reisen &c. iii. p. 223.

Scolopendra morsitans (Linn.), Kohlrausch, Arch. f. Nat. 1881, p. 104.

Cupipes Gervaisianus (Koch).

Scolopendra Gervaisiana, Koch, in Wagner's Reisen in Algier, iii. p. 223, pl. xi. (1841).

Scolopendra Gervaisiana, Lucas, Expl. Sci. Alg. i. p. 343, pl. ii. fig. 6 (1849), excluding synonymy.

Scolopendra Scopoliiana, Koch, Die Myr. i. p. 39, pl. xviii. fig. 34 (1863).

Not *Sc. Scopoliiana*, Koch, in Wagner's Reisen in Algier, iii. p. 222, pl. xi.

Cupipes græcus, Kohlrausch, Arch. f. Nat. 1881, p. 81.

Cupipes græcus, Meinert, Vid. Medd. Foren. 1884-86, p. 123.

On the Genus *Rhombcephalus*.

Rhombcephalus, Newport, Trans. Linn. Soc. xix. p. 425 (1845).

Since this genus was characterized by Newport it has not been recognized by any author who has worked systematically at the group. This circumstance is easily explained by the fact that the genus was based upon a character which results mainly from the drying of immature examples of *Scolopendra*.

In the British Museum there are three types of this genus; these are *Rh. viridifrons* from France, which proves to be the young of *Scolopendra cingulata*; *Rh. parvus*, Newport, from Malta, is also a young example of *Scolopendra cingulata*; *Rh. smaragdinus*, Butler, from Rodriguez, is the young of *Scolopendra subspinipes*, Leach. Thus, since the type of the genus *Rh. viridifrons* is a specimen of *Sc. cingulata*, *Rhombcephalus* must be a synonym of *Scolopendra*.

The other typical examples, which I have not seen, will probably prove upon examination to be the young of the species of *Scolopendra* or *Cormocephalus* common in the locality from which the types were obtained.

On *Euryolithobius Slateri*, Butler.

Euryolithobius Slateri, Butler, Phil. Trans. Roy. Soc. clxviii. p. 499 (1879).

This genus and species were based upon the exuviated cuticle of a specimen of *Scolopendra morsitans*. The names must consequently be added to the long list of synonyms already appertaining to this widespread form.

On *Cupipes Guildingii* (Newport).

Cormocephalus Guildingii, Newport, Trans. Linn. Soc. xix. p. 425.

Ostigma cormocephalinum, Pocock, Ann. & Mag. Nat. Hist. (6) ii. p. 473, pl. xvi. fig. a.

In May of 1889 I was enabled, through the kindness of

Prof. Westwood, to examine the type of *Cormocephalus Guildingii*, which is preserved in the Hope Museum at Oxford. I at once recognized that the species is referable to the genus *Cupipes*, and moreover that, misled by the absence of the anal legs, I had redescribed a specimen of it as a new species, *Otostigma cormocephalinum*.

On Otostigma spinicauda (Newport).

Branchiostoma spinicauda, Newport, Trans. Linn. Soc. xix. p. 412, pl. xl. fig. 7 (1845).

Otostigma deserti, Meinert, Vid. Medd. Nat. Forening, 1884-86, p. 121.

An examination of Newport's type of this species shows that it is not referable to the genus *Branchiostoma*, or *Rhysida* as it should be called, inasmuch as there are no spiracles in the seventh somite. It is in fact a veritable *Otostigma*, having the ear-shaped stigmata, spurred tarsi, produced pleuræ, and simple, not sulcate, head-plate which are so characteristic of the genus.

Ot. deserti of Meinert, from Biskra, is, I feel confident, the same species, the only difference that I can detect being the presence of two spines on the under surface of the femur of the anal leg in *Ot. deserti*, whereas in specimens of *Ot. spinicauda* from Tripoli there are either three or four spines in this position. Analogy, however, justifies the conclusion that this character cannot be regarded as of specific importance.

On Monops nigra (Newport).

Cryptops nigra, Newport, Trans. Linn. Soc. xix. p. 408.

Monops nigra, Gervais, Ins. Apt. iv. p. 294.

Newport described this species from a figure on pl. xc. of the unpublished drawings by Major-General Hardwicke of the Spiders (and Myriopods) of India. Consequently Gervais's assertion that the typical specimen is preserved in the British Museum is erroneous. There is no type, unless the figure be regarded as such.

It is difficult to conceive why Newport should have regarded that figure as representing a *Cryptops*. There is little or nothing of a *Cryptops* about it. It is quite true that in the rough drawing that is given of the under surface of the head no prosternal plates are represented; but the form of the maxillary feet is so totally unlike anything known in the Chilopoda—the appendage being figured as a single stout internally serrate tooth—that no reliance is to be placed upon this drawing. Again, with regard to the eyes: Newport quite

correctly described the *figure* as being furnished with a single eye on each side, and on the strength of this statement Gervais established the genus *Monops* for the reception of the species. But there is not a particle of evidence that the specimen from which the figure was taken was provided with *only* one eye. The drawing which justified Newport in making mention of the eyes at all is the one above referred to of the underside of the head. But, when viewed from this aspect, *all* the four eyes of a Scolopendrid *cannot* be seen. Only two are visible, and these, when examined carelessly with the naked eye or even with a lens of low power, appear as a single black patch; and that General Hardwicke, when painting this figure, did make only the most superficial examination of his specimen, is shown by the manner in which he drew parts so conspicuous as the maxillary feet.

Furthermore, that the specimen did not belong to the *Cryptops* group is clearly manifested by an enlarged drawing that is given of one of the legs. This shows that the tarso-metatarsus was composed of two distinct segments, of which the distal is much shorter than the proximal. In *Cryptops* and its allies the tarso-metatarsus is undivided, except in the case of the posterior two pairs of legs. But when they are divided the segments are subequal in length and not manifestly unequal, as in this *Monops niger*.

In conclusion, I may add that, after carefully examining the figure, I have no doubt that it was taken from some specimen either of *Otostigma* or *Rhysida*; but since this is a point which will probably never be definitely settled, and considering, too, the circumstances under which the genus was established, I have thought it superfluous to introduce *Monops* into the accompanying key of genera.

Descriptions of new Species.

Heterostoma longicauda, sp. n. (Pl. IV. figs. 1-1 b.)

Heterostoma longicauda, Newport, MS.

Body robust; widest at the fourteenth tergite, from the fourteenth narrowed posteriorly to the twenty-first and anteriorly to the fourth, the first very wide.

Colour deep reddish brown, the posterior margin of the tergites with a greenish or ochraceous tinge; legs and antennæ ochraceous; shining.

Head-plate cordate, smooth, very finely punctured.

Antennæ moderately long, composed of twenty segments, whereof the basal four are bare, the rest pubescent.

Maxillary sternite smooth, sparsely and finely punctured; prosternal plates large, quadrate, each furnished with three conical teeth, of which the internal may be bifid.

Tergites feebly punctured, from the third bisulcate, from the seventh marginate, lightly wrinkled.

Sternites scarcely bisulcate, the sulci being very faint, anteriorly and posteriorly abbreviated, and deserving rather to be called impressions than sulci; marked posteriorly with a median and two fainter lateral circular impressions.

Anal somite.—*Tergite* much wider than long, not sulcate, in one specimen with a low median anterior ridge, in the others quite normal; *pleuræ* very long, reaching to the middle or nearly to the end of the femur, more or less rounded, densely porous, with a widely bifid extremity, a single lateral spine, no superior spines; *sternite* with posteriorly converging margins and deeply excised posterior margin; *legs* of normal form; femur usually armed with seven strong spines—2, 2 on the upper inner edge, 1 on the under inner edge, and 2 on the under outer edge, the process very long, sharp, and simple; claw armed basally with two very minute spurs.

Legs with the first tarsal segment (sometimes including the twentieth pair) armed with a spur.

Measurements in millimetres of largest specimen:—Total length 134; width of fourteenth tergite 16, of fourth 11, of first 15, of twenty-first 10·5, of head 11; length of anal leg 34, of femur 12, of pleura 15.

Three specimens from India (*Mr. Barnes*) and two from Ceylon (*R. Templeton*).

This species is related to *H. platycephalum* of Newport, but may be recognized by the very long sharp process and the small number of spines on the anal femur, by the wide space separating the apical spines of the pleuræ, by the absence of a superior spine on these organs, &c.

In one specimen the number of spines on the anal femur falls as low as five, two being wanting on the upper inner edge.

Heterostoma viridipes, sp. n. (Pl. IV. fig. 2.)

Body robust posteriorly, slender anteriorly.

Colour olivaceo- or ochraceo-castaneous, antennæ and distal segments of the legs with olivaceous tint.

Head-plate small, a little wider than long, punctured.

Antennæ of moderate length, attenuate, composed of twenty segments, whereof the basal four are naked, the rest pubescent.

Maxillary sternite punctured, with a short anterior sulcus; prosternal plates normally developed, each bearing three distinct teeth.

Tergites.—The first narrower, equal in width to the seventh; from the third very faintly bisulcate, from the fifth or sixth marginate.

Sternites marked with a posterior median impression, which is more pronounced at the anterior end of the body, and with two sulci, which are more distinct at the posterior end of the body.

Anal somite.—*Tergite* normal, wider than long; *pleuræ* moderately elongate, projecting beyond the middle of the femur, tolerably stout, armed with two small contiguous apical spines, two small lateral spines, and one small superior spine; *sternite* medianly impressed, narrowed behind, with emarginate posterior border; *legs* of average length, stout, the femur armed with eleven spines (including the short spiniform process)—three on the upper inner edge, two on the inner surface, two and one on the under inner edge, and three on the under outer edge; patella and tibia much rounded and swollen beneath and on the inner surface, the swollen part being of an olivaceous hue, contrasting strongly with the castaneous tint of the rest of the appendage; claws armed with minute basal spurs.

Legs (including the twentieth pair) with proximal tarsal segment spurred.

Measurements in millimetres of largest specimen:—Total length 113; width of head 8·5, of first tergite 10·3, of fourth (narrowest) 9, of fourteenth (widest) 13, of last 9; length of anal pleura 11, of entire leg 25·5, of femur 8·7, of patella 7·3, width 3·3; length of tibia 5, width 2·3.

Two specimens from Ternate (*H.M.S. 'Challenger'*).

This species is very closely allied to *H. platycephalum* of Newport (= *Brownii*, Butler), but differs from all the specimens of this last-named that I have examined in being decidedly less flat- and wide-headed, in having a spur on the tarsus of the preanal legs, in having shorter and stouter anal pleuræ, and distinctly stouter anal legs. Of these characters, however, the only one upon which I place much reliance is the form of the anal legs. In *H. platycephalum* the patella and tibia of these appendages are evenly cylindrical, and not internally and inferiorly swollen, so that their greatest width amounts to about one third of their length; whereas in *H. viridipes* the width is almost equal to half the length. This difference may prove to be a sexual character.

Heterostoma rubripes (Brandt), var. *grossipes*, var. nov.
(Pl. IV. figs. 3, 3 a.)

Heterostoma grossipes, Newport, MS.

Body slender anteriorly, stout posteriorly.

Colour castaneous, legs paler.

Head-plate cordate, a little wider than long, punctured.

Antennæ (broken) with the four basal segments bare.

Maxillary sternite punctured, anteriorly depressed; prosternal plates long, each furnished with three strong teeth, whereof the internal is subdivided.

Tergites smooth, from the third bisulcate, from the fifth marginate.

Sternites smooth, the anterior ones medianly impressed posteriorly, ? bisulcated (the plates being much wrinkled by drying).

Anal somite.—Tergite wide, of normal form; pleuræ of moderate length, closely porous, with two close-set apical spines, about five minute superior spines, and two lateral spines; sternite narrowed behind, with emarginate hinder border; legs very stout, the width of the segments being equal to half their length; femur armed with eight or nine spines (including the short spiniform process), five or four on the upper inner edge and inner surface, two on the under inner edge, and two on the under outer edge; claw with basal spurs.

Legs with claws and first tarsal segment spurred.

Length 80 millim.; width of head 7 millim., length 6·3; width of anal tergite 8·5; length of anal leg 19; length of femur 7, width 3·6; length of patella 5·5, width 3.

A single specimen from Sunday Island.

I consider this form to be merely a variety of *H. rubripes*, Brandt. It differs from the typical *H. rubripes* in having thicker anal legs with fewer spines on the femur.

ETHMOPHORUS, gen. nov.

(ἔθμος, a sieve, and φέρω, so called from the form of the stigmata.)

It is needless to characterize this new genus at length, since it only differs from *Heterostoma* in the form of its maxillary feet.

In *Heterostoma* the prosternal plates are enormously large and strongly dentate and the femoral segment of the appendage has no internal tooth.

In *Ethmophorus*, on the other hand, the prosternal plates

are small and weakly dentate and the femoral segment of the appendage is furnished with a distinct internal tooth.

In fact, this new genus appears in a way to connect the genus *Heterostoma* with *Rhysida* and *Trematoptychus*.

Ethmophorus monticola, sp. n. (Pl. IV. figs. 4, 4 a.)

Body flat, stout, widest at the twelfth somite, much narrowed anteriorly, slightly so posteriorly, the first tergite only moderately wider than the second.

Colour of tergites piceous, with a tinge of violet; head, first tergite, maxillary feet, and anal pleuræ obscurely castaneous; antennæ ochraceous; sternites and legs olivaceous, the latter with the distal segments ochraceous.

Head-plate small, about as wide as it is long, feebly punctured.

Antennæ (fractured), with the four basal segments naked.

Maxillary sternite and feet feebly punctured, the prosternal plates very small, like those of, e. g., a *Scolopendra*, each furnished with four obscurely defined obtuse teeth; femoral segment of the jaws furnished with a well-developed subdentate basal tooth, as in, e. g., *Scolopendra*.

Tergites lightly wrinkled mesially and laterally, from the third bisulcate, from the seventh marginate.

Sternites not bisulcate, marked with three faint impressions, two lateral, representing the sulci, and one posterior and median.

Anal somite.—Tergite wider than long, wider behind than in front; pleuræ long, slender, rounded, finely porous, reaching almost to the end of the femur, terminated by two spines, whereof the inferior is much the larger, either with or without a small superior spine and with one or two minute lateral spines; sternite with a median impression and very strongly emarginate hinder border; legs of moderate length, normally slender, with cylindrical segments, the femur armed with a simple, short, spiniform process, and with three spines beneath, one minute and internal, and two in the middle and at the posterior end, one large, the other very minute and behind it; patella and tibia normal (tarsal segments absent).

Legs.—Claws armed with two spurs; tarsi of the preanal legs unarmed, tarsi of the rest with a single spur.

Measurements in millimetres:—Total length 123; width of twelfth tergite 12, of first 10, of twenty-first 8.3, of head 8.5; length of pleura from the apex to point of attachment with tergite 8.5; length of anal femur 9.5.

A single specimen obtained by Mr. J. Whitehead on Mount Kina Balu in North Borneo.

In its long anal pleuræ this new species resembles those species of *Heterostoma* of which *platycephalum* may be regarded as the type. The spine-armature of the anal leg, as it has been described, may be abnormal, for one leg is entirely missing and the other is damaged.

Rhysida longicornis, sp. n. (Pl. IV. fig. 5.)

Body slender and nearly parallel-sided.

Colour (in alcohol) wholly ochraceous, shining.

Head-plate sparsely punctured, not sulcate.

Antennæ very long, reaching when stretched laterally to the end of the eighth tergite, composed of twenty-one long cylindrical segments, whereof the basal three are bare and the rest pubescent; in the distal half the segments are at least twice as long as wide.

Maxillary sternite entire, feebly punctured; prosternal plates, in contact, wider than long, the anterior edge convex and bearing four blunt conical teeth; basal tooth prominent and subdentate.

Tergites smooth, from the fifth bisulcate, from the tenth or eleventh marginate.

Sternites smooth, sparsely punctured, not completely bisulcate, there being only two very short sulci quite on the anterior portion.

Anal somite.—*Tergite* not sulcate, with raised lateral margins; *pleuræ* densely porous, furnished with a long stout process which is armed with one strong lateral spine, one or two small superior spines, and three strong apical or subapical spines; *sternite* narrowed posteriorly, with emarginate border; *legs* long and slender, femur armed with from ten to thirteen strong spines, that is six or four in an irregular series on the upper inner edge, four or three on the under inner edge, and three on the under outer edge; there is no spinous process and no spine in the position of the process; tarsal segment unspined; claws with basal spurs.

Legs.—From the seventeenth to the twentieth pairs each with a single tarsal spur, the sixteenth to the first with two tarsal spurs, the third with a tibial spur (second pair absent), the first with a tibial and a patellar spur; claws of all bicalcarate.

Stigmata of normal form.

Length about 43 millim., of antennæ 12 millim.

A single specimen from Socotra, collected by Prof. I. B. Balfour.

Allied to the widespread *Rh. longipes* of Newport, but differing in its much longer antennæ and in the irregular arrangement of the spines on its anal femora (there being no apical spine).

Rhysida calcarata, sp. n. (Pl. IV. figs. 6, 6 a.)

Body slender, almost parallel-sided.

Colour olivaceo-ochraceous, legs testaceous; shining with submetallic lustre.

Head-plate sparsely punctured.

Antennæ long, composed of seventeen to twenty-one segments, whereof the basal three are bare, the rest pubescent, the segments much shorter than in *Rh. longicornis*.

Maxillary sternite entire, sparsely punctured; prosternal plates wider than long, almost in contact, each bearing four teeth; basal tooth well developed and subdentate.

Tergites smooth, from the fourth bisulcate, from the eleventh or twelfth with raised margins.

Sternites smooth, bisulcate, the sulci extending considerably past the middle of the plate, but becoming indistinct posteriorly.

Anal somite.—Tergite not sulcate and not impressed behind; pleuræ densely porous, with well-developed somewhat slender process, which is armed with one lateral and four apical or subapical spines; sternite narrowed posteriorly, with almost straight or lightly concave hinder border; legs somewhat short; femur armed with about fifteen spines—six or seven in two rows on the upper inner edge, two to four on the under inner edge, and from three to five on the under outer edge; the posterior process is well developed, in one specimen (? ♀) it is short, very wide, and armed with eight or ten spines, in two others (? ♂) it is long, slender, cylindrical, blunted, and armed with five or six spines; tarsus not spined; claw with two basal spurs.

Legs.—Twentieth pair either with or without a tarsal spur, nineteenth to seventeenth with one tarsal spur each, sixteenth to first with two tarsal spurs; first pair with a spine upon the femur, patella, and tibia; claws of all the legs spined.

Three specimens from Cambodia; one of these, measuring 57 millim., is larger than the others, has the antennæ composed of seventeen segments, the anal legs more slender and the femoral process short and wide; in the others measuring about 36 millim., the antennæ are composed of twenty-one segments, the anal legs are stouter, and the femoral process much longer. I suspect that the last two are the males and

the first a female of one and the same species. It is a well-marked form resembling *Rh. longipes* in some respects, such as in possessing marginate tergites and spined anal legs. It differs, however, from this species in having bisulcate sternites and a well-developed spinous process on the anal femur.

Scolopendra (?) *civivis*, sp. n. (Pl. IV. fig. 7.)

Colour (dry specimen) ochraceous, posteriorly more castaneous, anteriorly olivaceous.

Body robust, narrowed anteriorly, but with very wide maxillary feet and sternite.

Head-plate small, flat, ovate, slightly longer than wide, distinctly punctured, with a posterior median fine stria or ridge.

Antennæ (imperfect, with fourteen segments) attenuate, segments cylindrical, the basal five or six bare.

Maxillary sternite very wide, punctured, with a slight median longitudinal depression and an anterior depressed area; prosternal plates moderately long, not wide, in contact, each bearing four teeth, of which the three internal are more or less fused; basal tooth on a level with the prosternal plates, well-developed and subdentate; claw very stout, powerful and curved.

First tergite meeting but not covering the head-plate, marked in front with a conspicuous but fine transverse sulcus; rest of the tergites smooth and (except the last) strongly bisulcate, from the eleventh strongly marginate.

Sternites smooth and strongly bisulcate.

Anal somite not so wide as the twentieth somite; *tergite* strongly margined laterally, with a fine median longitudinal sulcus, posteriorly depressed in the middle; *pleuræ* very finely porous, with one posterior superior spine, the process short but distinct, and armed with four strong spines; *sternite* much narrowed behind, mesially depressed, with straight hinder border; *legs* punctured, short, thick, and more or less in contact, with a notch in the middle of the superior posterior margin of the first three segments; the femur armed on its inner and under surface with from fifteen to eighteen spines; the process stout at the base, pointed at the apex, which is tipped with either four or two spines; claw short, basally spurred.

Legs with claws basally spined and the proximal tarsal segment bearing one inferior spur.

Length about 90 millim.; width of head-plate 6, of maxillary sternite 8.6, of anal tergite 8.2.

Locality doubtful. The specimen was taken from a bottle labelled 'India and S. America.'

It is not easy to point out the affinities of this species, because I am unable to determine its exact generic position. In the sum of its characters, however, it seems to come nearest to *Scolopendra*, although the head-plate does not overlap the anterior portion of the first tergite. One of its most marked features is the great stoutness of the anal legs.

Cormocephalus Willsii, sp. n.

Body robust and parallel-sided.

Colour olivaceous or ochraceous, head and anal tergite ferruginous; shining.

Head-plate convex, wider than long, coarsely punctured, with two posterior diverging sulci.

Antennæ of moderate length, composed of seventeen segments, whereof the basal eight are bare, the rest pubescent.

Maxillary sternite coarsely punctured, slightly depressed and striated in the middle line, marked in front with transverse, more or less branching striæ and a short median longitudinal stria; prosternal plates well developed, parallel, almost in contact, each armed with four or five conspicuous teeth; maxillary feet also coarsely punctured, with a well-developed basal subdentate tooth.

Tergites.—First coarsely punctured, not sulcate; the second with two very faint abbreviated sulci; the third with the sulci still incomplete; the fourth to the twentieth completely bisulcate; the seventh to the twentieth marginate and lightly wrinkled laterally, all of them punctured.

Sternites smooth, punctured, bisulcate.

Anal somite.—*Tergite* not marked by a median sulcus; *pleuræ* coarsely porous, the process well-developed and terminated by two spines, one spine in the middle of the hinder border; *sternite* much narrowed posteriorly, with straight hinder border; *legs* somewhat short, moderately slender; femur armed with about eleven strong spines (not including the process, which is well developed and bifid), three or four on the inner surface, two on the under inner edge, and four or five in two longitudinal series on the under outer edge; claws not basally spurred.

Legs with first tarsal segment unarmed; claws furnished basally with two spurs.

Length up to 65 millim.

Locality Madagascar. Two specimens collected by the Rev. R. Baron and one by the Rev. J. Wills.

This species differs from all the South-African forms described by Porath in not having the anal tergite marked by a longitudinal sulcus. This I believe is the first record of the genus from Madagascar.

Cormocephalus cupipes, sp. n. (Pl. IV. fig. 8.)

Body slender, widest at its posterior end.

Colour (dry specimens) olivaceo-ochraceous above; under surface and maxillary sternite much paler; antennæ and distal segments of the legs olivaceous.

Head-plate elongate, ovate, slightly longer than wide, sparsely but somewhat coarsely punctured, marked in its posterior half by two anteriorly diverging sulci.

Antennæ long and slender, composed of seventeen segments, whereof the basal six are naked and the rest pubescent.

Maxillary sternite sparsely but coarsely punctured; prosternal plates elongate, in contact, each bearing four well-defined sharp teeth; basal tooth long, sharp, and subdentate.

Tergites, except the first and last, conspicuously bisulcate, from the fifth or sixth marginate.

Sternites strongly bisulcate and furnished in addition in the anterior portion of the middle with a median longitudinal impression.

Anal somite.—*Tergite* with a conspicuous median sulcus, wider than long, its posterior border evenly convex and not produced in the middle; *pleuræ* very narrow, coarsely punctured, the process very short, conical, and bearing two apical spines; there are no lateral or superior spines; *sternite* long and narrow, nearly twice as long as the basal width, with a conspicuous median longitudinal impression; *legs* very short and very stout, not very much longer than those of the twentieth somite, stout at the base and evenly attenuated towards the apex, very coarsely punctured, the three basal segments more or less flattened above, with feebly developed posterior marginal notches, the two femora together nearly as wide as the tergite, in contact throughout in the middle line, each armed with three spines in an irregular series on the upper inner edge, two on the inner surface, two on the under inner edge, and four in two series on the under outer edge; the process short, conical, and tipped with two spines; the median part of the under surface without spines and markedly excavated in front; patella rounded laterally and beneath; tibia with its upper surface bearing two longitudinal depressions separated by a median ridge; in one specimen there is a depression on the inner surface of this same

segment; tarsal segments short and cylindrical; claw small, short, not inferiorly serrate, without spurs.

Legs with tarsi unspined; claws with two basal spurs.

Length 43 millim.

Two specimens from Natal, collected by Gueinzus.

In the thickness of its anal legs this species resembles *Cupipes*. I refer it, however, to *Cormocephalus* for the following reasons:—There are no sulci on the first tergite, the anal pleuræ are provided with a short process, the spine-armature of the anal femora is like that of a typical *Cormocephalus*, and the claw of the anal leg is not serrate beneath and small, being shorter than the first tarsal segment of this appendage.

Of the South-African species already described it perhaps comes nearest to *C. rugulosus*, Porath. But this form, as its name implies, is rugulose. Moreover, judging from Dr. Porath's description, which makes no mention of any peculiarity in the structure of the anal legs, these appendages are normally formed in his species.

Cormocephalus inermipes, sp. n. (Pl. IV. figs. 9, 9 a.)

Body moderately robust, parallel-sided.

Colour (dry specimen) olivaceous, with metallic lustre.

Head-plate cordate, slightly wider than long, somewhat coarsely punctured, with two posterior anteriorly diverging sulci.

Antennæ short, slender, attenuate, composed of seventeen segments, whereof the basal six are naked, the rest pubescent.

Maxillary sternite wide, entire, and coarsely punctured; prosternal plates widely separated, each furnished with four teeth, one external, separate, and posterior, three internal, fused and projecting—the distance between the plates is almost equal to the width of one of them; basal tooth prominent and subdentate.

Tergites punctured, smooth, from the second strongly bisulcate, from the fifth or sixth marginate.

Sternites smooth, strongly bisulcate.

Anal somite.—*Tergite* much wider than long, marked in its posterior half with a faint longitudinal sulcus; *pleuræ* closely porous, the process long, slender, and tipped with two strong spines; no lateral or superior spines present; *sternite* much narrowed posteriorly, with straight hinder border; *legs* moderately long and very stout, almost in contact; femur not twice as long as it is wide, armed with nine or ten spines (not including the process)—one on the upper

inner edge, two or three on the inner surface, two on the under inner edge, and four in two rows on the under outer edge; the process very short and tipped with two or three spines; patella about as wide as it is long; tibia a little longer than wide; the claw long, as long as the last tarsal segment, not spurred.

Legs with tarsi not spurred; claws of all the legs *unspined*. Length 45 millim.

A single specimen from Ceylon (*R. Templeton*).

This species is evidently allied to *C. sarasinorum*, Haase, of which the Museum possesses two specimens from Ceylon. It differs, however, as it does from all the other species of the genus, in that the claws of all the legs are unspined. Moreover the prosternal plates are very widely separated; but I do not care to lay too much stress upon this character, seeing that it may be the result of accident and not normal.

Cormocephalus dentipes, sp. n. (Pl. IV. fig. 10.)

Colour (of dried and faded specimen) testaceous; head and pleuræ ochraceous; when fresh the specimen was probably ochraceous, with castaneous head and pleuræ.

Head subcircular, with conspicuous posterior sulci; basal lamina visible.

Antennæ short, attenuate, composed of seventeen cylindrical segments, whereof the basal four or five are bare, the rest pubescent.

Maxillary sternite and feet more or less rugulose, the sternite irregularly grooved longitudinally and of a deeper colour centrally and posteriorly than anteriorly and laterally; prosternal plates well-developed, wide and long, each bearing four distinct teeth, whereof the external one is sharper and separated and the three internal blunter and more or less fused.

Tergites smooth, with the exception of the last, but including the first, strongly bisulcate; from the thirteenth distinctly marginate.

Sternites conspicuously bisulcated.

Anal somite.—*Tergite* wider behind than in front, the margins rounded anteriorly and converging, without a median sulcus; *pleuræ* closely and somewhat coarsely porous, the process smooth and short, terminated by two strong spines and bearing one lateral superior spine; *sternite* much narrowed posteriorly, with straight hinder border and rounded posterior angles; *legs* of moderate thickness and length, not including the posterior internal process, which is short and tipped with two strong spines, armed with about seventeen

conspicuous spines—three on the anterior half of the upper inner edge, five in a posteriorly ascending series on the under inner edge, three defining the internal boundary of a smooth very lightly depressed area which occupies the middle of the under surface of the segment, three bounding this area externally, and three or four on the under outer edge; posteriorly beneath the segment is obsoletely tubercular; patella flat above, distinctly tubercular internally and beneath, tibia similarly but more thickly and more strongly tubercular, distinctly sulcate above; proximal tarsal segment lowly tubercular throughout; distal tarsal segment obsoletely tubercular anteriorly; claws with spines at the base.

Legs with spined claws but unarmed tarsi.

Length about 42 millim.

A single specimen from Bengal.

This species is so remarkable for the peculiar tubercular armature of its anal legs that no further feature need be mentioned as characteristic of it.

Cormocephalus lævipes, sp. n.

Body tolerably robust, slender anteriorly.

Colour chocolate-brown; anal legs ferruginous, rest of the legs and antennæ with greenish tint; shining.

Head-plate punctured, with two posterior sulci.

Antennæ broken, slender, the basal five segments bare.

Maxillary sternite coarsely punctured, anteriorly sulcate; prosternal plates well developed, converging, about as long as wide, each bearing four blunt teeth, whereof the external one is separated; basal tooth well developed, subdentate.

Tergites.—The first punctured with anteriorly and posteriorly abbreviated vestiges of two sulci; from the second bisulcate, from the sixth marginate, lightly wrinkled mesially and laterally.

Sternites strongly bisulcate.

Anal somite.—*Tergite* wider than long, with a complete median sulcus and raised margins; *pleuræ* densely prours, the process short, stout, blunt, and tipped with two minute close-set spines, no lateral or superior spines; *sternite* narrowed posteriorly, with converging sides, rounded lateral angles, and straight posterior margin; *legs* short, somewhat stout, coarsely and closely punctured, the segments rounded, smooth; the femur furnished with two minute spinules on the upper inner edge, two or one on the inner surface, two on the under inner edge, and two in the position of the process, which is absent; claw furnished with two spines.

Legs with tarsi not spurred; all the claws armed basally with two spurs.

Length about 80 millim.

A single specimen from Lord Howe's Island (*H.M.S. 'Herald'*).

In possessing spurred claws to its anal legs and a median sulcus on its anal tergite this species resembles *C. aurantiipes* and *C. subminiatus* (= *miniatus*) of Newport; but it may be at once recognized by the punctures and small spinules on its anal legs, by the short, stout, pleural process, &c.

[To be continued.]

VI.—*Description of Two new Species of Parrots of the Genus Cyanorhamphus in the British Museum.* By T. SALVADORI, C.M.Z.S.

Cyanorhamphus cyanurus.

Similar to *C. novæ zealandiæ*, but larger and with the tail blue; the two central tail-feathers are tinged with green on both webs, the remainder only on the outer webs, towards the base; under wing-coverts and also the longest under tail-coverts tinged with blue; tail underneath dusky olive, darker than in *C. novæ zealandiæ*; bill black, with the base of the maxilla silvery grey; feet dusky. Total length 12·7 inches, wing 6·6, tail 6·5, bill 0·8, tarsus 0·82.

Hab. Raoul Island, Kermadec group (*Voy. H.M.S. 'Herald'*).

Cyanorhamphus subflavescens.

Intermediate between *C. Cooki* and *C. Saisseti*; about the size of *C. Cooki**, and very much like it in colour, but of a more yellowish tinge, especially on the underparts, and with the red on the head much reduced and nearly confined to the forehead; the red spot on the ear-coverts not very conspicuous, those on the sides of the rump much extended; the lower part of the cheek-feathers yellowish as in *C. Saisseti*, from which the present species differs in being stronger and larger, notwithstanding its shorter tail; the upper parts have a slightly more yellowish tinge, while the underparts have the yellow tinge greener; the primaries are less blue and more green, especially towards the apical half of the outer webs; tail below golden-olive with no greyish tinge, the tips of the tail-feathers not contrasting with the rest; bill bluish black, with the base of the maxilla silvery grey; feet dusky brown. Total length 12·7 to 11·3 inches, wing 5·8 to 5·7, tail 6 to 5·5, bill 0·86 to 0·73, tarsus 0·88 to 0·83.

Hab. Lord Howe Island (*Voy. H.M.S. 'Herald'*).

* Having compared the types, I have been able to identify *C. Cooki* with *C. Rayneri* from Norfolk Island.

VII.—*Descriptive Notes on some obscure British Spiders, with Description of a new Species.* By the Rev. FREDERICK O. PICKARD-CAMBRIDGE.

[Plate II.]

OF the spiders described in the following pages one is new to science and another new to the British list. These species, belonging to two different genera, were both found in the Lake districts of Cumberland upon Mount Helvellyn, during a hasty ascent made by no means with a view to hard work amongst the spiders. There can be little doubt that the Lake districts, both vale and hill regions, will, when worked, produce a number of good things. The warm moist glens or chines, so noticeable a feature in the country round Carlisle and the hilly north-west of England, seem to be particularly suitable to the encouragement of spider-life; and, although other more important occupations have hitherto prevented any extended or diligent search in these localities, yet I feel convinced, judging from casual captures caught up at odd times and in odd places, that there is a considerable wealth of species to be "turned up" by a zealous arachnologist.

So far I am unable to make any comprehensive note upon the spider fauna of Cumberland with a view to a knowledge of the distribution of species; but the few data which have come to hand would indicate that many species rare in the extreme south are abundant in the north, noticeably *Amaurobius fenestralis*, Stroem, *Lycosa agricola*, Th., *Cryphaea silvicola*, Blackw., *Calotes atropos*, Walck., *Tmeticus scopiger*, Grube; but beyond this fact and the conjecture that we have up here a number of species which are peculiar to Alpine regions, it is impossible, with the very small amount of material yet gathered together, to draw any general conclusions as to climatic influences which may be of any service to the question of geographical distribution. One would be inclined to expect that many of the species apparently peculiar to the north would be found in the southern counties in localities whose physical characteristics are somewhat similar, e. g. in the hilly districts of the three extreme south-western counties and in Wales.

The opportunity has been taken in the following paper of including in a synoptic table diagnoses of those genera adopted by M. Simon in his classification of those species of the family Therididæ which fall under one of his subgroups Linyphini. It is not yet possible to say that the subdivision

of this difficult family is by any means quite satisfactory ; but the generic characters given may be of assistance to fellow students who may wish for a few good landmarks to guide them in the task of threading the intricacies of a distressingly involved group of spiders.

Fam. Therididæ.

Group LINYPHINI.

This large group comprises all those numerous spiders described under the generic name *Linyphia*, Bl. & Cambr., as well as many under the names *Neriene*, Bl. & Cambr., *Micryphantes*, Menge, and other generic titles.

The spiders have as a rule long slender legs, clothed with more or less long stout spines. They construct a horizontal sheet-like web, in many cases having a maze of crossing and recrossing labyrinthine threads above it, upon bushes, amongst grass, in the foliage of trees, amongst rocks, in the corners of outhouses, &c., while many of the smaller members of the group merely weave a slight horizontal web beneath stones and over hoof-marks or slight depressions in the ground. One species, *Drapetisca socialis* (*Linyphia*, Bl. & Cambr.), is always found with its legs outstretched and its body lying flat on fir-tree trunks or smooth rocks.

Below will be found the most tangible characters by which the members of this group, as characterized by M. Simon in 'Les Arachnides de France,' may be recognized, and added to these will be found a brief summary of the characters which appear to be most easily observable, and therefore, it is hoped, the most practically useful, of those genera into which M. Simon has divided his group Linyphini.

LINYPHINI.

Labium having a fold in the integument at the apex (having the margin reflexed or turned back upon itself). Tibiæ of the fourth pair of legs (usually of all the other legs as well) furnished with two erect spines or bristles on the upperside, one near the base, the other towards the apex.

The following genera are all represented by one or more species to be found in Great Britain, and most of them seem to form good distinctive groups. *Taranucnus*, Sim., represented in our fauna by *Linyphia setosa*, Cambr., however, seems scarcely separable from *Leptyphantes*, while *Porhomma*,

Sim., *Hilaira*, Sim., and *Tmeticus*, Menge, Sim., run very close together.

The whole family Therididæ is still, as it were, a super-saturated solution of species, into which M. Simon, Mr. Emerton, and other arachnologists have flung their crystals, and around these are gradually gathering, like to his like, the better disposed species who will condescend to recognize a brother amid the motley heterogeneous assemblage. As to the others, we must be content for the present to leave them still in solution until a further boiling down shall concentrate the residue and render it possible to gather together its wayward atoms into something like decent scientific order.

Genera.

- A. Anterior row of eyes very strongly curved, its convexity directed forwards.
 - i. Legs not furnished with spines. Clypeus very low, slightly wider than the central anterior eyes. Central anteriors larger than the laterals *Tapinopa*, Westr.
 - ii. Legs very spinose. Clypeus very high, equalling the width of the ocular area. Central anteriors smaller than the laterals *Frontina*, Sim.
- B. Anterior row of eyes straight or almost so.
 - i. Basal joint of falces with two stout spines on the inner frontal margin of each *Drapetisca*, Menge.
 - ii. Basal joint of falces without spines in front.
 - 1*. Anterior metatarsi as long as tibiæ.
 - A. Eyes of posterior row widely separated, their intervals always greater than their diameter.
 - a. Anterior tarsi very long, at least two thirds the length of the metatarsi *Bolyphantes*, Menge, Sim.
 - b. Anterior tarsi only half the length of the metatarsi (except *lineata*) *Linyphia*, Latr.
 - B. Eyes of posterior row nearer together, their intervals smaller than their diameters.
 - i. Eyes of anterior row equal in size. Metatarsi armed with several spines *Labulla*, Sim.
 - ii. Eyes of anterior row unequal; centrals much smaller than laterals.

- A. Posterior row of eyes strongly curved, its convexity directed forwards. Femora of all four pair of legs armed with at least one spine on the upperside *Taranucus*, Sim.
- B. Posterior row of eyes straight or almost. Femora of first pair of legs only armed with spines. (*Leptyphantes*.)
- i. Femora of first pair alone armed with a spine. Metatarsi of at least the first two pairs bearing a single erect spine on the upperside near the base of the joint (*nebulosus*, *leprosus*, *alacris*, and *minutus* have several lateral spines as well). Falces in both sexes similarly though very slightly attenuated and divergent at the apex *Leptyphantes*, Menge, Sim.
- ii. Femora of at least the first two pairs armed with spines. Metatarsi without any spines at all. Falces of males alone slightly attenuated and divergent. *Bathyphantes*, Menge Sim.
- 2*. Anterior metatarsi shorter than the tibiae.
- A. Eyes small and widely separated.
- i. Sternum produced behind into a long, slender, pointed prominence, extending beyond the coxal joints of the fourth pair of legs, not suddenly curving downwards *Opistoxyx*, Sim.
- ii. Sternum *terminating* behind and suddenly curving down between the coxal joints of the fourth pair of legs.
- a. Legs long and slender; tibial spines long and stiff. Sternum terminating in a stout, short, conical point. *Porhomma*, Sim.
- b. Legs short and very stout; tibial spines short and fine. Sternum terminating in a truncate point. *Hilaira*, Sim.
- B. Eyes larger and much nearer together.
- i. Legs short and stout. Eyes of posterior row rarely less than one diameter apart, *usually more*. Prominences on which are situated the lateral eyes scarcely noticeable *Tmeticus*, Menge, Sim.
- ii. Legs long and more slender. Eyes of posterior row seldom more than one diameter apart, *usually less*. Lateral eyes situated upon very distinct oblique prominences.

- a. Eyes of posterior row almost equal in size, centrals slightly larger.
1. Falces of males much attenuated towards the apex and very much divergent *Microneta*, Menge, Sim.
 2. Falces of males not attenuated or divergent; similar in both sexes *Sintula*, Sim.
- b. Eyes of posterior row unequal; centrals very much larger *Syedra*, Sim.

Genus LEPTYPHANTES, Menge, Simon.

This genus, originally instituted by Herr Menge, has been adopted by M. Simon for the reception of a certain number of spiders which, in company with many other species more or less closely allied, have hitherto been described temporarily for convenience' sake by our English arachnologists under the generic title *Linyphia*.

The species which the learned French arachnologist has thus gathered together seem to form a fairly distinct little group. The close grouping of the eyes, those of the posterior row not being more than one diameter apart, the sternum never longer than broad, and the absence of any spines upon the femora of the second, third, and fourth pairs of legs render them distinct from a certain number of forms otherwise closely allied and very much alike in general appearance, while the presence of at least one erect spine upon the metatarsi will distinguish them readily from another group of very closely allied spiders which M. Simon separates under the generic name *Bathyphantes*.

The different species which are thus conveniently assembled under a distinctive name may be again broadly divided *inter se* by the following character:—*minutus*, Bl., *nebulosus*, Sund., *alacris*, Bl., *leprosus*, Ohl., exhibit several (four or five) spines upon the metatarsi of the first two pairs of legs at least, while the rest, e. g. *cristatus*, Menge, *pallidus*, Cambr., *zebrinus*, Men., *tenebricola*, Wid., &c., have *only one spine* upon the upperside of the metatarsi near the base.

For further characters we must turn to the general colour of the spider, as a rule similar in both sexes, and to the abdominal pattern; but it is often, indeed almost always, necessary to examine very carefully under a strong simple lens or the 1-inch objective of a compound instrument the palpus and organs of the male and the epigynal process of the female, in order to distinguish each sex individually of the various species.

The palpus, in addition to great divergence in the form of the base of the digital joint, presents also great differences in the shape and development of two processes attached to the palpal organs on the outer side. These are in the following descriptions termed respectively the "falciform process" and the "lateral stylum." These processes are usually very distinct in the majority of the Linyphini, but especially so in species of the genera *Leptyphantes*, *Bathyphantes*, *Tmeticus*, and *Microneta*.

The epigynal process of the female is usually an infallible specific character; but in some cases the females of two different species present, if any difference, one that is almost inappreciable, and therefore for practical purposes useless.

A view of the process in profile with a strong simple lens will usually suffice; but often under a good light and a 1-inch objective the form of the apex of the process viewed from above furnishes a very distinctive character.

It is not of course absolutely necessary that the identification of all the species of this or any other obscure genus should depend entirely upon the variation in form of these minute portions of structure; but when all other characters have failed to give a satisfactory and reliable test of specific difference, then this must be the last resort of the determined-to-see-some-difference scientist, and, failing satisfaction here or failing to define a difference which, though somehow or other apparent, can yet neither be described with pen nor delineated with pencil, then the obstinate irreconcilables must surely be regarded as in a transition-stage, and must be left until such time that under the influence of a wholesome self-respect, aided by other kindly external influences, they get rather more advanced, when perhaps some gimlet-eyed seer may be enabled to detect some difference which he can not only feel himself but can also see and describe in such a way that his disciples may be able to feel and perceive as well.

In the italicized portions of the following descriptions will be found as a rule characters which are peculiar to the particular species under consideration. Those defined in the non-italicized letterpress are almost all equally shared by one or more species (sometimes by all) of the genus.

It is necessary, however, to give these also if a thorough and accurate description of a single species be needed.

Leptyphantes zebrinus, Menge.
(Pl. II. fig. I. 1, 2, 3, 4.)

Linyphia terricola, Blk.

Linyphia zebrina, Cambr. Spid. of Dorset, p. 182.

Leptyphantes zebrinus, Sim. Les Arach. de France, p. 319.

Length of male $1\frac{1}{2}$ line.

Cephalothorax, legs, and palpi clear orange-yellow.

Abdomen bearing a dorsal longitudinal series of black V-shaped bars (the anterior ones broad, the posterior ones fine and more distinct), standing out conspicuously upon a dull white ground, the latter speckled with cretaceous spots.

A white, wavy, longitudinal line runs along the lateral area.

Often the whole dorsal area is dull white, the bars being barely indicated. Occasionally the prevailing tint is black, when the white V-shaped intervals become more conspicuous.

Sternum dark brown, convex, its surface covered with scattered granulations, each bearing an erect black hair.

Caput rather prominent, owing to the concavity of the clypeus (*vide* Pl. II. fig. I. 4).

Eyes conspicuously situated upon black spots. Those of the posterior row equal and equidistant (though they do not at first sight appear so). Anterior centrals much smaller than the laterals, separated by less than half the diameter of one of them.

Clypeus viewed in profile very concave, higher than the width of the ocular area, bearing a single upcurved bristle immediately beneath the central anterior eyes.

Falces attenuated at the apex and very slightly divergent in the male sex. The outer surface is transversely furrowed with a row of deep striations in both sexes.

The inner margin has three small teeth.

Legs slender; femora of the first pair bearing a single stout spine on the upperside, the others bearing no spines. Genual joints each with one spine. Tibiæ of all four pairs with two erect spines on the upperside, those of the first two pairs having in addition two lateral spines near the apex. Metatarsi of all four pairs bearing one fine bristle near the base on the upperside.

Palpus of Male.—Humeral joint having on the inner side near the base a small spine-bearing tubercle, probably working upon the transverse striæ on the outside of the falces.

Cubital joint as broad as long, convex above, bearing a single curving bristle near its apex. *Radial joint* broader in front, bearing a group of fine hairs, having amongst them a single, long, curving bristle. *Digital joint* with the palpal organs large, orange-red, and rather elongate, exhibiting on the outer side near the base a falciform process curving up from beneath; its apex is bifid, the anterior branch long, strongly kneed, and aculeate at the apex (Pl. II. fig. I. 1, A, B).

The lateral stylum curves up from beneath, alongside of the falciform process, taking a somewhat S-shaped form, termina-

ting in two black sharp points, the lower one being the longest, its apex extending beyond the organs (Pl. II. fig. I. 1, A).

The epigyne of the female is short and conical, bearing at its apex in front a small tongue-like upcurving process. It is more prominent viewed in profile than that of *tenebricola*, but when viewed from above it so much resembles the same structure in the next species that the difference cannot be described, except that at all points that of *zebrinus* is rather more exaggerated (fig. I. 2).

This species, which is very likely to be confounded with the next, although it will be seen on a close examination to be very different from it, is of a bright orange-red colour, the clypeus is higher than the ocular area, the anterior central eyes are smaller and nearer together, the palpal organs form a larger, more elongate mass, the lateral stylum is much more conspicuous and longer, while the falciform process is larger and terminates in a sharp spiniform point.

The spiders are much more brightly coloured than *tenebricola*. The females can be distinguished by the high clypeus and the very small central anterior eyes, which are within half a diameter from each other. The epigyne is more prominent when viewed in profile.

Very abundant in the autumn amongst grass and other herbage in woods, running actively in the warm sunshine.

They are recorded from Dorset, Cumberland, Essex, Hertfordshire, Cambridgeshire, &c.

Leptyphantès tenebricola, Wider.
(Pl. II. fig. II. 1, 2; 2 A, 3, 4.)

Linyphia tenebricola, Cambr. Spid. of Dorset. p. 185.

Leptyphantès tenebricola, Sim. Les Arach. de France, p. 317.

Linyphia tenuis, Bl.

Length of male $1\frac{1}{4}$ line.

Cephalothorax dull brown, tinged with olive-green, the marginal line and striæ tinged with darker brown.

Legs pale straw-yellow, sometimes with an orange-red tinge.

Abdomen very variable; markings consist of a central dorsal series of transverse, dark black, V-shaped bars, their free ends being dilated into a small blotch. The anterior shoulders of the abdomen exhibit a short white slash of cretaceous spots, often in the male sex being the only pale markings on the abdomen, the rest black. Often the pale dull-white ground-colour is predominant, and the apices of the V-shaped bars becoming obsolete, the dorsal pattern resolves itself into two longitudinal series of dark spots, these often obsolete except just

above the spinners, the space immediately above the latter organs being black. The lateral area exhibits a more or less well-defined, longitudinal, sinuous white line, often entirely obsolete in the middle. The ventral surface is uniformly black or lighter brown.

Sternum dark brown-black, very convex, covered with scattered granulations, each of these bearing an erect black hair.

Caput prominent in front; *clypeus* scarcely as wide as the ocular area, very concave, bearing in front immediately below the eyes a single, strong, upcurved bristle (fig. II. 4).

Eyes situated upon dark spots; those of posterior row equal in size and equidistant.

Central anteriors smaller than the laterals and separated by almost a full diameter from each other (fig. II. 3).

Falces three times as long as the clypeus, slightly attenuated and slightly divergent at the apex in the male sex, parallel in the female sex.

The outer surface of the basal joint is in both sexes transversely furrowed with a row of striae. The upper margin of the fang-groove is furnished with three sharp teeth, the two at the angle being longest.

Legs long, not stout, the femora of the first pair bearing one long spine on the upperside, the others bearing none. Genual joints bearing each one spine. Tibiæ of all four pairs bearing two erect spines on the upperside, those of the first two pairs bearing in addition two lateral spines on either side near the apex.

Palpus of Male.—Humeral joint bearing on inner side at the base a small spine-bearing tubercle. *Cubital joint* rather longer than broad, convex above, bearing a short sinuous bristle near the apex above. *Radial joint* longer than the cubital, wide in front, bearing a long curved bristle near apex above.

Digital joint with the palpal organs forming a small, compact, rounded mass, having on the outer side near the base a falciform process, small, rather abruptly curved upwards, bifid at its termination, one branch being produced into a slender, sinuous, blunt process, not aculeate.

The lateral stylum curves upwards and forwards, terminating in two black points, the lower one being longest, but its apex scarcely reaches the anterior margin of the palpal organs. This process is much smaller and less prominent than in "zebrinus," as indeed is the whole digital joint (fig. II. 1, A, B).

The epigyne of the female is less prominent when viewed in

profile than that of "zebrinus," appearing as a somewhat conical protuberance, bearing at its apex a rounded tongue-like projection (fig. II. 2, 2 A).

Very similar to the last species, but can readily be distinguished if the following points be noted:—

The whole spider in both sexes is of a dull yellow-brown colour where the last species is orange-red, the legs pale yellow. The clypeus is scarcely as high as the ocular area. The anterior central eyes are not much smaller than the laterals and are nearly one diameter apart. The palpus of the male forms a much smaller, black, compact, rounded mass; the falciform process is smaller and its apex is not aculeate; the lateral stylum is not nearly so prominent, nor does its apex extend beyond the palpal organs. Otherwise the spiders look very much alike.

It is a very common species amongst grass and herbage. I have taken it most abundantly in stables, where it spins its slight horizontal web in the angles of the walls.

Leptyphantes pinicola, Simon.

(Pl. II. fig. III. 1, 2, 3, 4.)

Length of male 1 line, female $1\frac{1}{4}$ line.

Cephalothorax sepia-brown, darker along the lines of segmentation and round the margin.

Abdomen dull black, iridescent in a strong light, having an olive tinge, without any visible pattern or pale markings.

Legs reddish straw-yellow, the metatarsal and tarsal joints tinged with brown.

Sternum black.

Caput, viewed in profile, a little prominent, owing to the concavity of the clypeus.

Eyes large, central anteriors much smaller. Those of the posterior row in a slightly curving line, its convexity directed forwards, close together, scarcely one diameter apart. Lateral anteriors larger than central anteriors, the latter almost contiguous and scarcely one diameter from the laterals.

Legs slender, not long. Femora of first pair with one or two spines above, the others unarmed. Anterior metatarsi as long as tibiae. Tibial joints of all four pairs of legs bearing five or six long spines, each at least three times as long as the width of the joint. Genual joint with one long spine at the apex. Metatarsi of all four pairs with one erect spine on the basal third of the upperside of the joint.

Clypeus as high as the width of the ocular area, very much concave, bearing in front a single upcurved bristle. (Almost identical in form with that of *L. tenebricola*, Wider.)

Falces three times as long as the height of the clypeus, slightly convex and slightly divergent at the apex in the male, parallel in the female; bearing on the upper margin of the fang-groove two short, sharp, conspicuous teeth and a third smaller one.

Labium with its margin reflexed (as in all the Linyphini).

Sternum not very convex, black, granulose, and set with stiff black hairs.

Palpus of Male (fig. III. 2, 3, 4).—*Cubital joint* of the male palpus a little longer than broad, convex above, bearing at its apex a single fine bristle.

Radial joint as broad at the apex as it is long (in a lateral view), bearing a few short hairs and a single bristle at its apex.

Digital joint forming with the semi-inclosed palpal organs a small globular mass.

Palpal organs exhibiting on the outer side near the base the usual chitinous falciform process (not abnormally developed in this species), also a long, slender, flattened, spine-like process, originating from below the base of the falciform process, curving upwards, and directed in a straight line forwards, terminating far beyond the apex of the main palpal organs in a sharp strongly curved point, exhibiting on the lower side, rather more than halfway from the base to the apex, a small, sharp, barb-like spine.

The curved apex of this process seems to be aculeate, but under a strong lens it appears ensiform.

This curious and very distinctive process is merely a highly-developed form of the same process (which has been termed in this paper the lateral stylum) exhibited on the palpal organs of several allied species of British spiders, notably *L. zebrina* and *L. tenebricola*. In these two species the two black points of the process, however, scarcely pass beyond the main palpal organs.

The epigyne consists of a long, dark, ovipositor-like prominence, projecting downwards at an angle from the ventral surface, bent suddenly (like the spout of a water-pot) near its termination, and squarely truncate at the apex, its outer side being clothed with stiff dark hairs (fig. III. 1).

This exceedingly distinct and satisfactory little spider has no really close ally amongst known British species, *tenebricola* alone approaching it in general form and structure. From that species it may be distinguished at once by the absence of all markings on the abdomen and of course by the form of the palpal organs and of the epigyne.

On the continent are found, however, several very closely

allied species which exhibit the same process on the male palpal organs highly developed, though of a different form.

Four males and one female of this curious little species (which is new to the British list) were taken by myself on Sept. 18, 1890, beneath stones upon the steep sides of the ridge known as the Swirrel edge, close to the summit of Helvellyn. They were apparently plentiful, and forty or fifty could no doubt easily have been secured had I glanced at my captures and perceived their value.

Doubtless careful search will bring to light in these districts some more of the continental species peculiar to the mountain regions.

Genus TMETICUS, Menge, Simon.

This genus comprises a number of spiders very distinct in general appearance from those of the last genus, or indeed from those of the greater part of the Linyphini.

They may be recognized by their rather short stout form, by the round, somewhat hirsute abdomen, by their stout legs and the bluffly rounded caput with eyes large and closely grouped.

They approach in general appearance the spiders comprised under M. Simon's group Enoplognathini, but the margin of the labium of these latter is not reflexed as it is in the Linyphini.

The following species are found in Great Britain:—*T. bicolor*, Bl. (sub *Linyphia*, Blk., and *Nerienne*, Cambr.), *T. concinnus*, Thor., *T. sylvaticus*, Bl. (sub *Nerienne*), *T. rufus*, Wid., *T. affinis*, Bl. (sub *Nerienne*), *T. Huthwaitii*, Cambr. (sub *Nerienne*), *T. scopiger*, Grube (*Linyphia rufa*, Cambr.), *T. Warburtonii*, Cambr., *T. arcanus*, Cambr. (sub *Nerienne*, Cambr.), *T. prudens*, Cambr. (sub *Nerienne*, Cambr.), *T. abnormis*, Bl. (sub *Linyphia*, Bl.), *T. niger*, F. Cambr.

Of these *T. bicolor*, Bl., is by far the commonest, while the others are all more or less rare, found beneath stones or low down amongst herbage in damp situations. The species described below appears to be quite new and forms a fine addition to our spider-fauna.

Tmeticus niger, sp. n. (Pl. II. fig. IV. 1, 2, 3, 4, 5, 6.)

Length of male $1\frac{1}{2}$ line, of female 2 lines.

Cephalothorax pale sepia-brown, depth of tint varying in different specimens, the thoracic and cephalic lines of segmentation being picked out with darker brown.

Abdomen dull black, clothed with short dark hairs, usually

without pale markings, in some specimens, however, much paler; sometimes exhibiting, as four very small pale dots upon the dorsal area, the normal depressions in the integument which indicate the points of attachment of the dorsal ventral muscles; following these on either side to the spinners are a series of slender, oblique, pale lines.

Legs stout, short, dull yellow-brown, tinged in some specimens with orange.

Sternum pale sepia-brown.

Caput broad and bluffly rounded, considerably raised behind the eyes (fig. IV. 5).

Clypeus higher than the width of the ocular area, quite smooth, devoid of hairs and bristles.

Eyes large, forming a closely situated group, the centrals of both rows being slightly smaller than the laterals. Posterior row slightly curved, its convexity directed backwards. Central posteriors one diameter apart; lateral posteriors each one and a half diameter from its adjacent central.

Anterior row straight; centrals smaller than laterals, very close together, separate one quarter of a diameter. The lateral anteriors each a little more than one diameter from its adjacent central.

The four centrals form a trapezium whose anterior side is much narrower than the posterior.

Lateral eyes of both rows situated upon slightly raised oblique tubercles (fig. IV. 5).

Falces.—Basal joint much longer than the height of the clypeus, very stout, convex and slightly divergent at the apex; its outer surface finely striated; without granulations, denticulations, or inner-frontal teeth. The upper margin of the fang-groove is armed with five stout sharp teeth, the three centrals being the longest.

Labium much hollowed out, so that the upper margin is strongly reflexed.

Maxilla as broad at the base as long, but longer than the average breadth; the outer margins obliquely rounded.

Sternum as broad as long, terminating behind between the coxal joints of the fourth pair of legs in a broad truncate prolongation.

Legs.—No spines upon the femora.

Metatarsi shorter than the tibiae and without spines.

Tibiae with two erect fine spines on the upperside; genual joint with one at its apex on the upperside.

Palpus of Male.—Humeral joint of palpus long, cubital joint without bristles, radial joint much enlarged on the upperside and produced forwards over the base of the digital joint, form-

ing a large, concave, cup-like cavity. Its apex is depressed and its outer margin is clothed with long black hairs.

The palpal organs exhibit the normal falciform process on the outside at the base, while at the apex are two spur-like apophyses, one stout, black, and sinuous, the other paler and more slender, their points curving across each other. A long circular spine, stout at the base, lies within the concavity of the apex of the digital joint, not easy to see nor of much specific importance (fig. IV. 1, 2).

The epigyne of the female is not prominent nor produced into a tongue-like or ovipositor-like process. Viewed in profile it forms a short, stout, sparsely truncate, conical prominence (fig. IV. 3, 4).

The italicized portion of the above description contains specific characters only.

This species can be distinguished in both sexes from *expertus*, Cambr., *arcanus*, Cambr., *bicolor*, Bl., *concinuus*, Th., *sylvaticus*, Bl., and *prudens*, Cambr., by the absence of femoral spines.

In the male sex, from *rufus*, Wid., and *affinis*, Bl., by the absence of a tooth in front of the basal joint of the falces upon the inner side.

From *scopiger*, Grube, and *Warburtonii*, Cambr., by the absence of the series of stiff spines upon a prominence on the inner side of the radial joint. From *Huthwaitii* by the very much larger digital joint and quite short inconspicuous radial joint of this latter species.

From *abnormis*, Bl., by its much smaller size and by the large concave radial joint above described; *niger*, F. Cambr., is also black in colour, while *abnormis*, Bl., is orange-yellow.

In the female sex, *niger*, F. Cambr., may be distinguished from *scopiger*, Grube, *Warburtonii*, Cambr., *rufus*, Wid., and *abnormis*, Bl., by the much more prominent epigyne in these species. *Huthwaitii*, Cambr., and *affinis*, Bl., are much larger spiders.

This fine spider does not seem to have been described before. Ten specimens were taken by myself on Sept. 18, 1890, beneath loose pieces of stone scattered in abundance upon the summit of Helvellyn. The females were usually found beneath a thin horizontal sheet of webbing stretched across depressions in the soil beneath the stones.

Genus MICRONETA, Menge, Simon.

This genus contains several small, slender, elegant, fine-legged, active spiders hitherto placed by English arachnologists in the genus *Neriene*. They exhibit, in common with

several more genera (*vide* Table of Genera), the metatarsi of the first and second pairs of legs shorter than the tibiae. The eyes are large and near together (closely grouped together).

The genus may be best recognized by the fact that the lateral eyes are placed upon a conspicuous oblique prominence. The caput is not so rounded and bluff as in the genus *Tmeticus*.

The falces of the males are much attenuated and divergent towards the apex and hollowed out on the inner margin, unlike those of *Leptyphantes* and *Bathyphantes*, whose falces are only very slightly divergent and narrowed at the apex. This genus exhibits no metatarsal spines.

Microneta sublimis, Cambr., 1875.

(Pl. II. fig. VII. 1, 2, 3, 4, 5.)

Neriere sublimis, Cambr. List of Aran. and Phalan. Berwickshire and Northumberland, 1875; Spid. of Dorset. p. 491.

Length of male 1 line, female 1 line.

Cephalothorax pale sepia-brown, margined and tinged along the segmentary strice with darker brown, exhibiting a darker spot at the point of convergence of the cephalic strice.

Abdomen short, convex, black, glossy, clothed with fine short pubescence.

Legs pale orange-yellow, femora brighter orange.

Sternum black, not very convex, bearing some short erect hairs.

Caput not prominent (except where the anterior central eyes project over the clypeus), bearing a few curving hairs.

Eyes of the posterior row situated in a slightly curving line, its convexity directed backwards; equidistant, separated by one diameter, the centrals slightly larger than the laterals. Eyes of the anterior row situated in a straight line, the centrals smaller than the laterals, separated from them by one diameter, from each other by half of one of their diameters.

Clypeus barely as high as the width of the ocular area, very slightly concave, bearing a single, short, upcurving bristle just below the eyes.

Falces at least four times as long as the height of the clypeus. Basal joint stout, convex, almost parallel, and not attenuated in the *female*, bearing on the inner angle two sharp teeth and some smaller ones below; in the *male* sex much more convex, very divergent and attenuated, very concave on the inner side towards the apex, bearing at the most prominent point of the angle three small teeth, also a row of fine hairs between these and the apex; furnished also with a single

tooth on either side (above and below) the point of articulation of the fang.

The basal joint is also grooved on its external lateral surface with deep transverse striations, its frontal surface bearing towards the outer margin a few minute setigerous tubercles (fig. VII. 1, 2).

Legs short and slender. Femoral dorsal spines absent (one beneath near apex); one genual and two tibial spines; no metatarsal spines. Metatarsi of first two pairs of legs shorter than the tibiæ.

Palpus of Male.—*Humeral joint* curved and slightly incrasated towards the apex (exhibiting on the inner side close to the base a small spine-bearing tubercle, apparently connected with and perhaps working upon the transverse striations on the falces).

Cubital joint as broad as long, convex above, bearing near its apex, besides a few short hairs, a single stout sinuous bristle.

Radial joint about as broad as long, wider in front, and somewhat angular and prominent on the upper anterior margin, bearing only a few short hairs.

Digital joint (viewed in profile) very slightly prominent near the base above. Palpal organs bearing at the base below on the inner side a short, stout, obtusely conical, squarely truncate prominence, curving inwards (viewed from above). This prominence (viewed in profile) is directed backwards as a stout blunt spur (fig. VII. 3, 4).

Epigyne of female appears as a conical obtusely truncate prominence, very broad (broader almost than long), slightly bilobed at the apex, which is furnished with a small, bifid, chitinous tongue, having on either side two concavities.

The form of the epigyne is almost exactly similar to that of *rurestris*, C. K., and I cannot give any character other than the deeper coloration of the cephalothorax and abdomen and the darker red-tinged legs to help to distinguish the two (fig. VII. 5).

The species was first described by the Rev. O. Pickard-Cambridge, in a list of northern spiders published in 1875*, from a specimen found upon the Cheviot Hills. No specimens have been captured since that time until Sept. 1890, when I myself had the good fortune to discover seven or eight of both sexes beneath stones upon the steep sides of one of the "passes" usually traversed in ascending Mount Helvellyn, in Cumberland. Many more specimens could doubtless have been obtained.

* "List of Araneidea and Phalangidea," Proc. Berwickshire N. H. Club vol. vii. p. 314.

The above description is taken from these specimens.

Very rarely taken, but probably common in the mountainous districts. It is recorded from the Cheviot Hills and Mount Helvellyn.

This species is remarkably similar to others of the genus found in Britain, namely *rurestris*, C. K., *subtilis*, Cambr., *innotabilis*, Cambr., while it is closely allied to two continental species, *Grouvellei*, Cambr., and *nigripes*, Sim.

The greater part of the species composing this genus are very similar in general appearance, and require very careful examination with a strong glass to determine the identity of members of the male sex, while the females seem to defy differentiation; at least M. Simon has declared that he can in many cases find no reliable characters, and I feel sure that where he has failed I am not likely to succeed. It may be that several of those now regarded as distinct species will have to be lumped together as one, while the variations may be regarded as those of localized races whose characters, though perhaps in process of development, are not yet sufficiently defined to merit the qualification *specific*.

Subjoined is a table which gives some idea of the specific characters of the males of the less obscure species.

- A. Cubital joint of palpus bearing on the upperside at the apex a tuft of long fine hairs. Humeral joint of palpus incrassated towards the apex .. *M. viaria*, Bl.
- B. Cubital joint of palpus bearing only a short sinuous bristle at its apex. Humeral joint not much incrassated towards the apex.
 - I. Clypeus higher than the width of the ocular area.
 - a. Prominence of digital joint at the base on the upperside very large and conical. Base of digital joint truncate on the inner side, not bearing a tubercle *M. conigera*, Cambr.
 - b. Prominence of digital joint at the base on the upperside not very large. Digital joint furnished at the base on the inner side with a small, conical, tubercular prominence .. *M. subtilis*, Cambr.
 - II. Clypeus as high or lower than the width of the ocular area.
 - A. Eyes of posterior row equidistant, separated by a distance equal to one of their diameters.
 - 1. Digital joint conical and very prominent on the upperside near the base. Palpal organs exhibiting no conical prominence at the base beneath *M. rurestris*, C. K.

2. Digital joint scarcely at all prominent on the upperside near the base. Palpal organs exhibiting at the base on the inner side and beneath a stout, conical, squarely truncate prominence, directed backwards and recurved inwards and upwards *M. sublimis*, Cambr.
- D. Eyes of posterior row not equidistant; the centrals of the row separated from each other by a distance greater than that separating each from the adjacent lateral eye. [Cambr. *M. innotabilis*,

Neriene decora, Cambr., which I have been unable to examine, must be closely allied to *subtilis*, Cambr., while *Neriene mollis*, Cambr., is closely allied to *rurestris*, C. K.

Good opportunities having lately offered themselves of examining a great number of recently captured specimens of the two very closely allied species *Tmeticus bicolor*, Bl., and *Tmeticus concinnus*, Th., I venture to give figures and a short description of those characters which seem to be most serviceable for distinguishing the two.

At first sight the two species appear to be merely extreme varieties in point of size of one species, and it will scarcely be finally settled as to whether the species be physiologically distinct and thus fulfil all the criteria of true species, until it be shown that those described under *concinnus*, Th., either do not pair with, or, if they do, are unfertile with those described under the name *bicolor*, Bl.

There is every variation in the size of the spiders and the position of the eyes, the height of the clypeus, and the spines beneath the tibiæ of the first two pair of legs, peculiarities of structure which form very good distinctive characters if compared in two specimens standing at the extreme opposing ends of the line, yet so variable themselves in intermediate forms as to render it almost impossible to say of many specimens whether we have before us examples of *concinnus*, Th., or *bicolor*, Bl.

One would be inclined to suppose that in cases like these we have before us excellent examples of that stopping-out process of linking characters which is carried on by the various selective influences, whether physiological or environmental, amongst a series of individuals originally of one stock now in process of being broken up into the groups which form what science knows as distinct species.

The characters given below are very variable. The most

constant and reliable seems to be that afforded by the relative position of the eyes and the height of the clypeus.

The two specimens from which the characters are sketched are from the extreme opposite ends of a long series.

Tmeticus bicolor, Bl. (Pl. II. fig. V. 1, 2.)

Neriere bicolor, Blackw.

Linyphia bicolor, Th.

Linyphia bicolor, Cambr. Spid. of Dorset, p. 206.

Size much larger.

Eyes of posterior row separated by a full diameter from each other.

Clypeus higher than the width of the ocular area.

Tibiae of first two pair of legs bearing beneath two rows of from *four to seven spines*.

Metatarsi of third and fourth pair of legs bearing one dorsal and two lateral spines.

Tmeticus concinnus, Th. (Pl. II. fig. VI.)

Linyphia concinnus, Th.

Size much smaller.

Eyes of posterior row separated by only one half the diameter of one of them.

Clypeus scarcely as high as the width of the ocular area.

Tibiae of first two pair of legs bearing a double row of from *two to four spines*.

Metatarsi of third and fourth pairs of legs bearing only one spine on the upperside.

List of Spiders described.

Leptyphantes zebrinus, Menge, p. 74.

Leptyphantes tenebricola, Wider., p. 76.

Leptyphantes pinicola, Simon, p. 78.

Tmeticus niger, F. Cambr., p. 80.

Tmeticus bicolor, Bl., p. 87.

Tmeticus concinnus, Th., p. 87.

Microneta sublimis, Cambr. p. 83.

EXPLANATION OF PLATE II.

Fig. I. *Leptyphantes zebrinus*, Menge.

1. Profile view of right palpus of the male. A, falciform process; B, lateral stylum.
2. Profile view of epigyne of female.
3. View of the caput, eyes, and clypeus from in front.
4. Profile view of cephalothorax; legs and palpi truncated.

Fig. II. Leptyphantes tenebricola, Wider.

1. Profile view of right palpus of the male. A, falciform process; B, lateral stylum.
2. Profile view of epigyne of female. 2 A. View of the apex of the epigyne from above. The letters A, B, C, D indicate the corresponding portions of structure in each view.
3. View of the caput, eyes, and clypeus from in front.
4. Profile view of the cephalothorax; legs and palpi truncated.

Fig. III. Leptyphantes pinicola, Simon.

1. Profile view of epigyne of female, exhibiting the basal joints of the third and fourth pair of legs. A, lateral stylum.
2. Profile view of right palpus of male.
- 3, 4. Other views of the lateral stylum.

Fig. IV. Tmeticus niger, sp. n.

1. Profile view of right palpus of male, showing characteristic radial joint.
2. Another profile view of radial joint, showing its concave structure.
3. Profile view of epigyne of female.
4. View of the apex of epigyne from above.
5. Caput and eyes from in front.
6. Profile outline of spider, palpi and legs truncated.

Fig. V. Tmeticus bicolor, Bl.

1. Caput, eyes, and clypeus from in front.
2. Palpus of male, showing characteristic tuft of bristles upon radial joint.

Fig. VI. Tmeticus concinnus, Thor. Caput, eyes, and clypeus from in front.*Fig. VII. Microneta sublimis*, Cambr.

1. Basal joint and fang of male from in front.
2. Basal joint and base of fang; lateral view.
3. Digital, radial, and cubital joints and palpus of male from beneath, showing at A the spur-like apophysis.
4. Profile view of right palpus of male, showing at A the spur-like apophysis.
5. View of epigyne of female from above.

VIII.—*Abstract of some Investigations into the Structure of the Oligochæta.* By FRANK E. BEDDARD, M.A., &c.*Oligochæta intermediate between the Limicolæ and Terricolæ of Claparède.*

CLAPAREDE'S division of the Oligochæta into Oligochæta Limicolæ and Oligochæta Terricolæ ("Recherches Anatomiques sur les Oligochètes," Mém. Soc. Phys. Genève, t. xvi., 1862), though certainly expressing the knowledge of his time when *Lumbricus* was the only terrestrial Annelid whose anatomy was known, has been shown to be no longer tenable. Many of the characters believed to be restricted to the Limicolæ have been discovered in Earthworms. The only

one of the points enumerated by Claparède which has hitherto held good is the absence of a vascular plexus upon the nephridia of the *Limicolæ*, and the presence of such a plexus in the *Terricolæ*.

Mr. Benham in 1886 ("Studies in Earthworms," *Quart. Journ. Micr. Sci.* vol. xxvi. pp. 215, 216) still retained the division, though with some other structural distinctions.

The *Terricolæ* are thus distinguished:—

- (1) Nephridia present in genital segments.
- (2) Abundant vascular network on nephridia.
- (3) Almost universal presence of a gizzard (exc. *Pontodrilus*).
- (4) The much smaller size of ova and the compactness of the ovary.

The first character could not now be made use of, since Vejdovsky (*Syst. u. Morph. d. Oligochaeten*, p. 150, footnote) had discovered nephridia in the genital segments of the sexually mature *Lumbriculus*.

The last-mentioned author (*loc. cit.* p. 14) dropped this scheme of classification and divided the *Oligochæta* into a series of families corresponding to the prominent generic types. The last three characters, however, still remained good, until in 1887 Giard found ("Sur un Nouveau Genre de Lombriciens phosphorescents et sur l'Espèce Type de ce Genre *Photodrilus phosphoreus*, Dugès," *Comptes Rendus*, Nov. 7, 1887) that *Photodrilus* was without a gizzard; this was extended by Rosa ("Sui Generi *Pontodrilus*, *Microscolex* e *Photodrilus*," *Boll. Mus. Zool. Torino*, vol. iii. No. 39, 1888) to *Microscolex*. *Criodrilus* also possesses no gizzard, and apparently *Pymæodrilus*. *Photodrilus* and *Pontodrilus* also render it necessary to dispense with the first of Mr. Benham's characters, for in them the nephridia do not commence until the 14th or 15th segment.

Notwithstanding these facts Rosa ("Nuova Classificazione dei Terricoli," *Boll. Mus. Zool. Torino*, vol. iii. 1888, No. 41) adhered so far to the Classification of Claparède as to retain his group *Terricolæ*; he admitted, however, the untenability of the group *Limicolæ*.

The latest contribution to the question is by Mr. Benham ("An Attempt to classify Earthworms," *Quart. Journ. Micr. Sci.* vol. xxxi. pp. 201 *et seq.*). He distinguishes two subclasses, viz. *Naidomorpha* and *Lumbricomorpha*. These are distinguished mainly on account of the occurrence of asexual reproduction in the former, and its absence in the latter. The statement that the blood in the *Naidomorpha* is uncoloured is only partially true, for in *Naiids* it is yellowish red. If it be

definitely shown that in *Ilyodrilus*, which presents many intermediate characters between Nais and Tubificidæ, there is no asexual reproduction, this division seems reasonable*.

The Lumbricomorpha are "divided roughly" into two Orders, Microdrili or "Waterworms," and Megadrili or "Earthworms." One constant difference alone is allowed to distinguish the two Orders, *i. e.* the presence or absence of a capillary network upon the nephridia.

As a matter of fact these groups might be further distinguished as follows:—

<i>Microdrili.</i>	<i>Megadrili.</i>
(1) Sexual maturity at a fixed period.	(1) Sexual maturity more or less continuous.
(2) Clitellum consisting of a single layer of modified cells only.	(2) Clitellum consisting of two distinct layers of cells.
(3) Ova of large size and few.	(3) Ova small and numerous.

This separation between Microdrili and Megadrili is, however, rendered almost impossible by the structural characters of *Ocnerodrilus*, which I have recently had the opportunity of examining. Eisen's account of the anatomy of this form ("On the Anatomy of *Ocnerodrilus*," Nova Acta Reg. Soc. Upsala, 1878), at present the only one, does not agree in every particular with my own observations. I find that the testes are in the 10th and 11th segments, and the ovary in the 13th; the sperm-sacs, which do not enclose the testes or vasa deferentia funnels, are in segments 10-13; the oviducts open into the 14th segment; the vasa deferentia open into the 17th segment in company with a glandular atrium. The clitellum extends from the 13th to the 19th segment and has the same structure as that of *Lumbricus*.

So far the characters of *Ocnerodrilus* are those of the Megadrili, but it agrees with the Microdrili in two important points, one of which has been shown by Eisen in a figure, though not commented upon. This character is the total absence of any vascular plexus round the nephridia; I may further remark that the nephridia of the posterior segments (from the 20th) differ from those of the anterior segments in being surrounded by a mass of large clear cells as in many Microdrili and in *Pontodrilus* (Perrier, "Organisation des *Pontodrilus*," Arch. Zool. Exp. t. ix. 1881). In the genital segments of a specimen with fully-developed clitellum, testes, sperm-sacs, &c., the nephridia were present with the exception of the 11th and 12th segments (and here they were

* It is practically that of d'Udekem ("Mémoire sur les Lombriciens," Première Partie. Mém. Acad. Roy. Belg. t. xxxvi.).

recognizable though very rudimentary); they commence in segment 3.

The second character in which *Ocnerodrilus* resembles the Microdrili is the large size of the ova; they are not, however, so large as in *Phreoryctes*, *Enchytræus*, &c., but considerably larger than in any earthworm known to me.

Ocnerodrilus has no gizzard; it has septal glands; the atrium is lined by a single layer of cells as in the Microdrili and *Moniligaster*. It is clear, therefore, that the only characters distinguishing the Microdrili from the Megadrili are Nos. 1 and 2 of the list given above.

It is a question whether they are sufficient, in view of important points of agreement, to distinguish two such groups. I am inclined, for the present at least, to think not, and to revert to Vejdovsky's arrangement into families.

In discussing the affinities of any particular type of Oligochæt it is therefore necessary to compare it with a particular family and not to be content with indicating resemblances to the aquatic Oligochæta or to the terrestrial Oligochæta as a whole.

I have lately received from New Zealand, through the kindness of Mr. W. Smith of Ashburton, a number of examples of an Annelid which were collected in wet soil not far from the margin of a swamp.

I am uncertain whether to refer it to the Lumbriculidæ or Phreoryctidæ; it forms in any case a new generic type for which I propose the name of *Pelodrilus*.

I have referred above to Vejdovsky's discovery that in the sexually mature *Lumbriculus* the genital segments contain nephridia; although this one exception is sufficient to prove that the absence or presence of nephridia in the genital region is not a character of first-rate classificatory significance, the fact that *Pelodrilus* agrees with *Lumbriculus* is a further proof that the Lumbriculidæ and Phreoryctidæ stand nearest to some of the simpler forms of Earthworms. I am not certain as to *Lumbriculus*, but in *Pelodrilus* there is no vascular plexus upon the nephridia. I have shown elsewhere ("On the Anatomy, Histology, and Affinities of *Phreoryctes*," Trans. Roy. Soc. Edinburgh, vol. xxxv. (1889), pt. ii. No. 16) that the gonads and their ducts in *Phreoryctes* are extremely simple in structure, and that the male gonads and ducts correspond more closely than is the rule with the female gonads and ducts. In these particulars they resemble the gonads and ducts of the young *Acanthodrilus* just escaped from the cocoon. In *Pelodrilus* the gonads lie in segments 10, 11, and

12, the testes in the two former, and the ovaries in the latter segment. As compared with *Phreoryctes*, therefore, one pair of ovaries (belonging to the 13th segment) have been lost. The sperm-ducts open by funnels into the segments containing the testes: their external apertures are upon segment xii.; there is not a common aperture for the two vasa deferentia of each side, but each opens independently, one a little in front of the other. The conditions are therefore intermediate between those of *Phreoryctes* and *Eisenia**. There are two pairs of vasa deferentia, as in both forms, but these open on to the same segment as in *Eisenia*, though separately as in *Phreoryctes*. It must be remembered, however, that at present we have no knowledge of the internal structure of *Eisenia*. In any case there is no known Limicolous Oligochæt in which the vasa deferentia open on to the exterior more than one segment behind that which contains the cœlomic funnel.

Another point in which *Pelodrilus* presents an affinity to the higher types is the specially thickened intersegmental septa of certain of the anterior segments. This fact is of some interest, because it tends to show that the medium in which the worm lives has some relation to the presence of these thick septa. *Pelodrilus* inhabits soil like Earthworms, and unlike its more immediate allies which swim in the water or burrow in the naturally soft mud at the bottom of pools and rivers.

A new Genus allied to Eclipidrilus of Eisen.

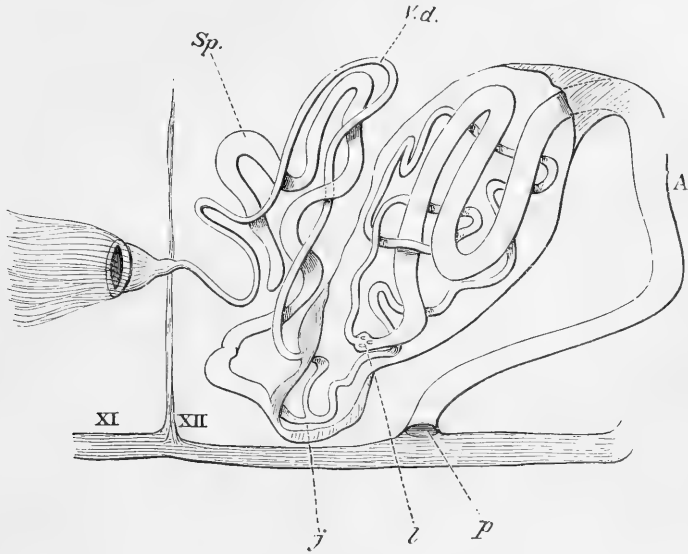
One of the most singular types of Oligochæta that has been described is Eisen's genus *Eclipidrilus* ("Eclipidrilidæ and their Anatomy," Nova Act. Soc. R. Upsala, 1881). Its main peculiarity consists in the inclusion of a vesicula seminalis within the sperm-duct; the sperm-duct apparently is not provided with a funnel of the usual pattern, but opens by three apertures placed close together into the cœlom, while the vesicula in its interior has a ciliated mouth.

I have lately received from New Zealand an Annelid which presents certain resemblances to *Eclipidrilus*. It was found by Mr. Smith, of Ashburton, in water from a well pumped up from a considerable depth, and I propose for it the name of *Phreodrilus*. The accompanying diagram shows the general arrangement of the sperm-duct, which is quite unique in its structure, unless it proves to resemble that of *Eclipidrilus*. The atrial pores are paired structures on seg-

* *Tetragonurus*, the name originally proposed by Eisen for this genus, being pre-occupied, Vaillant ("Annélides," Suites à Buffon) has suggested its replacement by the name "*Eisenia*."

ment 12. The atrium commences as a sinuous tube, which widens out to form a large thin-walled sac with muscular walls. This sac when cut open (see fig. 1) is seen to be nearly

Fig. 1.



Sperm-duct of *Phreodrilus*.

A, atrium; *l*, its junction with vas deferens; *j*, junction of the latter with caecal appendage (*Sp*); *v.d.*, vas deferens; *p*, external pore of atrium. The segments are numbered.

filled with a much coiled continuation of the atrium and the vas deferens. The vas deferens makes its exit from the atrium at a point nearly opposite to its entrance; just before this point it gives off (*j* in the figure) a diverticulum which, after being bent several times upon itself, ends blindly in the neighbourhood of the funnel in which the vas deferens terminates. The periatrinal sac is filled with ripe spermatozoa not indicated in the woodcut. It is not, however, as far as I can ascertain, a cœlomic sac; its cavity is simply produced by a splitting off of the greater part of its muscular tissue from the atrium.

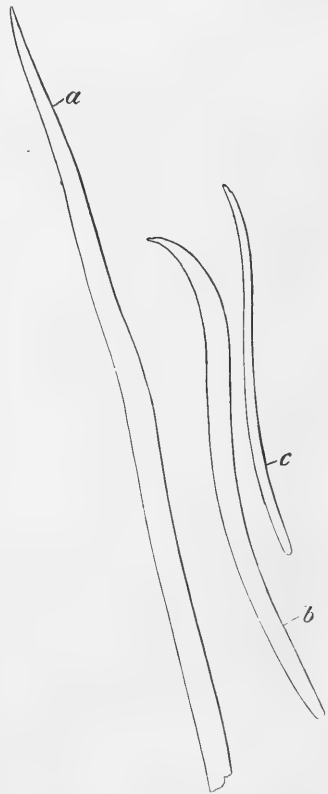
How the spermatozoa find their way in, unless it be through the gaps between the individual fibres, I cannot imagine; neither have I succeeded in finding any communication between the sac and the interior of the vas deferens. The diverticulum of the vas deferens is lined with a *non*-ciliated glandular epithelium and has a muscular covering; its structure is indeed precisely that of the unusually elongated

spermathecæ which open on to the exterior in the following segment (the 13th). I am inclined to regard the diverticulum in question as the equivalent of the second vas deferens of the Lumbriculidæ; and it may also furnish a clue to the origin of spermathecæ. It seems a reasonable hypothesis to derive these organs from diverticula of the genital ducts. At present, however, both these suggestions are put forward only tentatively.

This genus can be recognized as a perfectly distinct form by an examination of its external characters only, which is by no means always the case with the Oligochæta.

The setæ are highly characteristic, and their shape can be best appreciated by an inspection of the accompanying woodcut (fig. 2). The dorsal rows consist each of a single capilliform seta, not unlike those of the Tubificidæ (*cf. e. g.* Antonin Stolc "Monographie Českých Tubificidů, Morfologická a Systematiká Studie," Abhandl. böhm. Ges. Bd. vii. 1888, Taf. iv. fig. 13 a 1); in some of the anterior segments only was there occasionally a second seta, but of the same form. The ventral rows are made up of a series of paired setæ — one pair in each row. The two setæ of each pair are not quite alike in form, and one is markedly larger than the other. This can hardly be due to a difference in age, as every segment corresponded. These setæ are not quite similar to those of any other genus of Oligochæta. Their extremities are not bifid. I am disposed to regard this genus as the type of a new family lying between the Lumbriculidæ and the Naidomorpha, though its affinities to both are only very general; but our knowledge of the aquatic

Fig. 2.



Setæ of *Phreodrilus*.
a, dorsal seta; b, c, ventral setæ.

Oligochæta has by no means kept pace with that of the exotic forms of Earthworms, and a great many more facts will have to be accumulated before any profitable speculations can be indulged in as to the relations of different families and genera.

The Zone of Growth in Urochæta.

More than thirty years ago a note by Fritz Müller upon "*Lumbricus corethrurus*" (= *Urochæta hystrix*, Perrier, "Mémoires pour servir à l'histoire des Lombriciens terrestres," Nouv. Arch. Muséum, 1872; and *Urochæta corethrura*, id., "Organisation des Lombriciens terrestres," Arch. Zool. Exp. t. iii., 1874) was translated into these Annals ("Description of a new species of Earthworm," Ann. & Mag. Nat. Hist. 2nd ser. vol. xx. 1857, pp. 13-15) from Wiegmann's 'Archiv,' many of the facts in which seem never to have been either confirmed or refuted. I have lately received through the kindness of the authorities at Kew living examples of *Urochæta* from both Singapore and Mauritius, thus extending its known range. All the examples showed a spot at some distance from the tail end, distinguishable, as Fritz Müller correctly pointed out, by its tumid appearance, and also by the fact that the intestine here was empty of débris; this gave a whitish appearance to the part in question. In preserved specimens this region was not so obvious, but could be detected on a careful examination. Fritz Müller states that the skin here is devoid of bristles, and suggests that it is the spot where the formation of new segments takes place. I have found, by means of longitudinal sections, that the bristles are not always absent, but that they are, when present, extremely small and easily overlooked; this suggests that they are embryonic setæ*. Furthermore the epidermis in this region of the body is without the large oval glandular cells which are so characteristic a feature of the integument in all *Oligochæta*. All the cells are more or less alike. This, again, I take to be an embryonic feature. In the third place, the intestine in some individuals was very much contracted in diameter, and, as already mentioned, was empty of earth. This is not so distinctly an indication that rapid growth is going on. The nephridia, however, and the septa showed no

* In the embryo of Lumbricidæ within the cocoon, fully-developed setæ, but of small size, are found. These drop out and are replaced by setæ of the normal size. A setæ does not appear to grow in thickness, but only in length; young setæ of an adult worm consist of only the tip, which is as large as it ever will be.

signs of growth, but I may, perhaps, after examining a larger series of individuals than I have yet done, discover some indication of growth in these organs. It appears, therefore, to be likely that new segments in *Urochæta* are formed at this point, and if so, the fact is of some interest in relation to the budding of the lower forms of *Oligochæta*; but I do not yet feel able to express an opinion as to the exact connexion between the two phenomena.

A new Species of Pontodrilus.

Surgeon-Major Windle, to whom I have been indebted on former occasions for Earthworms from Bermuda, has recently forwarded a large number of specimens of *Pontodrilus*. These were collected along the sea-shore among dried seaweed and coral débris. The want of a gizzard in the aquatic *Oligochæta* has been generally put down to the soft nature of their food. *Pontodrilus Marionis*, of which I received some years ago a number of living examples from Nice through the kindness of Dr. George Hoggan, has been stated by Perrier ("Organisation des *Pontodrilus*," Arch. Zool. Exp. et Gén. t. ix. 1881, to possess no gizzard; I have, however, found that the oesophagus is locally thickened, particularly the circular muscular layer. This is certainly the equivalent of the gizzard, though the organ is not recognizable without recourse to section cutting. The new species, *Pontodrilus bermudensis*, has apparently nothing better in the way of a gizzard; as the whole alimentary tract of this Annelid was crammed with fragments of coral, sometimes of quite a large size, it seems hardly reasonable to put down the feeble development of the gizzard to the nature of the food. It would be difficult to find any substance that appears more to need a gizzard for its trituration. I take this opportunity of observing that the bodies in segments 10 and 11 doubtfully regarded by Perrier as excretory organs are testes. I should not be surprised if it were ultimately proved that Schmarda's genus *Pontoscolex* (Reise um die Erde, Bd. ii.) were this *Pontodrilus*. The irregular shape of the body caused by the masses of coral sand in the alimentary tract give the setæ the appearance of being irregularly arranged; both worms come from the West Indies and have a littoral habit.

IX.—*Notes on Slugs, chiefly in the Collection at the British Museum.* By T. D. A. COCKERELL.

[Continued from vol. vi. p. 390.]

V. *HELICARIONINÆ*.

THE Limacidæ include a number of groups which may well be regarded as subfamilies, differing in the shell, the presence or absence of a caudal mucus-pore, and in various other ways. The subfamily Helicarioninæ may be made to include all those forms which have a mucus-pore, but do not possess a typically Zonitoid or Helicoid shell; but this definition is rather a matter of convenience than an expression of naturally defined limits, for it is actually impossible to draw any hard-and-fast line between certain *Hyalina*-like forms and their Vitrinoid allies. Similarly, were it desirable to divide the group into *Vitrina*-like and slug-like forms, the genera *Girasia* and *Austenia* would offer so many puzzling intermediates that no satisfactory limits could be found. It thus happens that, although my purpose is to treat of slugs, I am obliged to include a variety of genera which possess spiral shells.

It is necessary, however, to exclude from the Helicarioninæ certain forms which are superficially very similar to them.

Otoconcha, Hutton, resembles a *Helicarion*, but has a ribbed jaw and no caudal mucus-pore.

Hemphillia, Bld. & W. G. Binn., from Oregon, is very much like a *Girasia* in appearance and has a mucus-pore; but its jaw is ribbed. *Binneya*, J. G. Cooper, resembling a *Helicarion*, has, like *Otoconcha*, a ribbed jaw and no mucus-pore. The true Vitrininæ, consisting of *Vitrina* and allied genera, lack a mucus-pore, but otherwise stand closest to Helicarioninæ.

The teeth of Helicarioninæ are of the normal Limacid type, that is to say the centrals have a large central and two smaller lateral cusps, and the laterals are bicuspid, although on both centrals and laterals there may be obscure additional cusps. The centrals and laterals are of the quadrate type, the marginals aculeate.

Durgella, W. T. Blanford, is a *Vitrina*-like genus from the Indian region, with six species, according to Godwin-Austen. It has a mucus-pore, but the dentition is very different from Helicarioninæ, and is suggestive of Selenitidæ. It may perhaps form a subfamily—Durgellinæ—under Selenitidæ.

It now remains to classify the genera of Helicarioninæ, a matter of very considerable difficulty. After examining such specimens as I could and comparing the published descriptions and figures, especially those of Godwin-Austen, I drew up in MS. a table of the species, dividing them into what seemed the most naturally defined generic units. To do this I was obliged to make as many as five new genera among the Indian forms; but from the paucity of actual material available to me I hesitate to publish these as such, and will treat them here as sections only, leaving it to students who have better opportunities to increase the number of genera as may seem desirable.

Under each genus or section indicated below I have given only the type species, as several of the named species are so imperfectly known that it is not yet possible to say definitely where they belong.

Helicarioninæ, sensu lat.

[*Macrochlamys*, Bens., = *Nanina*, Gray (type *M. indicus*, Bens.), has a Heliciform shell and does not properly belong here; but Godwin-Austen places certain *Vitrina*-like shells, here called section Pseudovitrinæ, in *Macrochlamys*.]

A. Shell whorled, truly Vitrinoid.

1. Mantle little or not extending over shell.

a. No dart-sac. Species American.

i. *Vitrinozonites*, W. G. Binn. (*V. latissimus*, Lewis.)

b. With a dart-sac or "amatorial organ." Species Asiatic*.

ii. *Cryptosoma*, Theob. (*C. præstans*, Gld.)

iii. *Macrochlamys*, sect. Pseudovitrinæ. (*M. Flemingii*, Pfr.)

2. Mantle more developed, but shell free behind and above.

a. With an "amatorial organ." Asiatic.

iv. *Austenina*, sect. Euausteninae. (*A. scutella*, Bs.)

b. With no "amatorial organ."

b¹. African v. *Africarion*, G.-A. (*A. pallens*, G.-A.)

b². Australian vi. *Helicarion* (Fér.), G.-A. (*H. Cuvieri*, Fér., *H. helenæ*, G.-A.)

[I do not pretend to understand the relationships of the very numerous species referred to *Helicarion* by authors. From the shells alone little can be judged, and it will probably be long before the animals of all are well enough known to enable us to give an approximately final arrangement.]

* For further details concerning these see Godwin-Austen, 'Land and Freshwater Mollusca of India.'

3. Mantle still more developed and more or less covering shell behind.
 - a. American. vii. *Velifera*, W. G. Binn. (*V. Gabbi*, W. G. Binn.)
 - b. Asiatic. viii. *Austenia*, sect. *Cryptausteniæ*. (*A. planospira*, Bs.)
- B. Shell more or less whorled, but not truly Vitrinoid; whorls subrudimentary.
1. Spiral whorl complete below or not presenting the appearance of a smaller shell within a larger. Asiatic.
 - a. Shell mostly exposed.
 - a¹. Shell well formed. ix. *Austenia*, Nev. (*A. gigas*, Bs.)
 - a². Shell horny. x. *Ibycus* (Heyn.), G.-A. (*I. fissidens*, Heyn., *I. sikimensis*, G.-A.)
 - b. Shell exposed only by an aperture in mantle, resembling that of *Austenia* xi. *Ibycus*, sect. *Cryptibyci*. (*I. magnificus*, G.-A., sp.)
 2. Spire presenting the appearance of a small shell within a larger.
 - a. Shell exposed only by an aperture in mantle. Australian.
 - xii. *Parmacochlea*, E. A. Smith. (*P. Fischeri*, Smith.)
 - b. Shell mostly exposed. Asiatic.
 - xiii. *Africarion*, sect. *Pseudausteniæ*. (*A. ater*, G.-A.)
 3. Shell external, mytiliform. African.
 - xiii a. *Estria*, Poirier. (*E. Alluaudi*, Poir.)
- C. Shell slug-like, hardly or not at all whorled.
1. Shell external, mytiliform. African.
 - xiv. *Aspidelus*, Morelet. (*A. Chaperi*, Morel.)
 2. Shell exposed by a hole in the mantle only or entirely covered.
 - a. Shell horny, exposed by a rather large aperture. Asiatic.
 - xv. *Girasia*, Gray. (*G. Hookeri*, Gray.)
 - b. Shell oval, rudimentary, covered, animal like *Girasia*. Asiatic.
 - xvi. *Girasia*, sect. *Cryptogirasia*. (*G. rubrum*, G.-A.)
 - c. Shell entirely concealed or exposed only by a very minute hole; mantle with pale ridges; dentition differing from *Girasia*. Asiatic xvii. *Mariaella*, Gray. (*M. Dussumieri*, Val. MS., Gray.)
 - d. Shell exposed by a small aperture or none; body more or less keeled. African. (*Urocyclidæ*, Simroth.)
 - d¹. Mantle reticulate, perforate; body without lateral ridges.
 - xviii. *Urocyclus*, Gray. (*U. Kirkii*, Gray.)
 - d². Mantle not reticulate, hardly or not perforate; body without lateral ridges; penis-retractor muscles several.
 - xix. *Elisa*, Heyn. (*E. bella*, Heyn., = *longicauda*, Fisch.)

- d*³. Keel strongly flexuose; no dart-sac.
xx. *Dendrolimax*, Dohrn. (*D. Heynemanni*,
Dohrn.)
- d*⁴. Body with lateral ridges; "a dart-gland united with penis."
xxi. *Buettneria*, Simroth. (*B. Leuckarti*,
Simr.)
- d*⁵. Dart-sacs two or more, each with two darts.
xxii. *Trichotoxon*, Simr. (*T. Heynemanni*,
Simr.)
- d*⁶. Like *Urocyclus* and *Elisa* externally; anatomy resembling
Trichotoxon, but no darts.
xxiii. *Atoxon*, Simr. (*A. Hildebrandti*, Simr.)
- d*⁷. Similar externally; vas deferens with no kalk-sac.
xxiv. *Phaneroporos*, Simr. (*P. Reinhardtii*,
Simroth.)

D. "No internal shell." Borneo.
xxv. *Daymantia*, Issel. (*D. dilecta*, Issel.)

Urocyclus and its Allies.

For a very elaborate account of these slugs see Dr. H. Simroth, "Beiträge zur Kenntniss der Nachtschnecken," in *Nova Acta Ac. Cæs. Leop.-Car. Germanicæ Nat. Cur.* 1890. In this paper several new genera are described and figured. Some of them (i. e. *Atoxon* and *Phaneroporos**) are like *Urocyclus* externally, but differ in the genitalia. I follow Dr. Simroth in keeping these as genera, although my own impulse in the matter would be to regard them merely as subgenera of *Urocyclus*.

Buettneria†, with the lateral ridges on the body, seems a conveniently-established genus, especially if it can be made to include the other ridged species, *fasciatus*, v. Mart., *acuminatus*, Poirier, and *madagascariensis*, Poirier.

Trichotoxon is very peculiar as to its dart-sacs, and apparently deserves to stand as a genus. *Dendrolimax* is sufficiently peculiar in the form of its body and very flexuose keel.

Nevertheless one suspects that when the African slugs become thoroughly well known the present established generic divisions will not be found so absolute or so trustworthy as

* I write *Phaneroporos*, as it is written so in Simroth's recent paper; but elsewhere it appears as *Phaneropus*, and Dr. Simroth has used this latter spelling in writing to me under date 28th October, 1890.

† There is a well-known genus of plants called *Buettneria*, Linn., 1767, while another genus of slugs, *Apera*, Heyn., is preoccupied by *Apera*, Adans., 1763, a subgenus of *Agrostis* with no very strong characters. The feeling seems to be that preoccupation in botany should not interfere with a zoological generic name.

they at present appear. It may be even that the whole of the present group will have to form a series of subgenera only under *Urocyclus*, in which case *T. Heynemanni*, Simr., would require a new name. The question, what constitutes a generic unit, is an extremely difficult one to answer; and in the face of the fact that genera are not by any means so naturally defined even as species one is driven to treat the whole matter as essentially one of convenience only.

For my own part I should prefer not to multiply genera more than appears absolutely necessary, and to call the minor groups simply subgenera, groups, or sections. This, however, is no better than an individual opinion, not at all shared by a numerous body of naturalists whose judgment commands respect.

Buettneria is said to have a dart-gland united with the penis, and the structure is figured by Simroth. It is worth noting that *Cryptosoma præstans*, according to Godwin-Austen's figure, has a precisely similar structure, called by Godwin-Austen a "cæcum or calc-sac."

Urocyclus Kirkii, Gray.

There is, in the British Museum, a specimen marked (in Dr. Gray's handwriting, as Mr. Atkinson informs me) "*Urocyclus Kirkii*, Cent. Africa, Dr. Kirk, 11 May, 1864." This is evidently Gray's type, although it is not very much like his figure in Proc. Zool. Soc. 1864. It agrees with the figure of it given by Heynemann, Jahrb. 1834, Taf. i. fig. 1.

From it I made the following notes:—

Mantle finely reticulate, $17\frac{1}{2}$ millim. long, with a round posterior opening about 2 millim. diam., whence run two slight grooves as figured by Heynemann. Respiratory orifice $10\frac{1}{2}$ millim. from anterior border of mantle. Mucus-pore as figured by Heynemann. Colour ochreous, bands blackish, and body with a sort of blackish interstitial marbling. Mantle greyer. Neck dark above. Sole unicolorous, central zone slightly narrower than either lateral.

Urocyclus pallescens, sp. n.

Length (in alcohol) $31\frac{1}{2}$ millim.; uniform pale greyish ochre, spotless. Mantle reticulated, the opening only a narrow slit or small, rather oblong hole, very much smaller than in *Kirkii*, and inconspicuous. Mucus-pore smaller than in *Kirkii*. Respiratory orifice as in Heynemann's figure of *fasciatus*. Reticulation on body in longitudinal squarish

series, about twelve on each side. Mantle bluntly angulate behind. Keel indistinct, no lateral ridges.

The mantle is 12 millim. long, with the slit or opening very near its hind edge.

Central area of sole about as wide as either lateral area.

Shell, long. 6, lat. 4 millim., strong, well formed.

Described from two specimens in the British Museum from Durban, Natal (*A. E. Craven*, 1875).

This species is most nearly allied to *U. flavescens*, Keferst., of which it may prove a subspecies. Keferstein's figure (Mal. Blatt. 1866, Taf. ii.) shows a slug differing from ours in the shape of the body, and especially of the mantle, and the opening in the mantle is different. The slug described by Gibbons (Quart. Journ. of Conch. 1879, p. 139) as *flavescens* appears to be *fasciatus*, Martens, belonging to a different section of the genus.

U. Kraussianus, Heyn., from the Cape region, differs from *pallescens* in its colour and in the shape of the mantle; but I have been unable to find any more exact definition of it than that given by Krauss in 1848.

Elisa longicauda (Fischer).

The British Museum contains two specimens (in alcohol) labelled "*Elisa bella*, Heyn., Madagascar, from Dr. Heyne-mann," from which I made notes:—

Length 35 millim.; mantle smoothish, not reticulate, and I detect no perforation. Median area of sole broader than either lateral area. Tail with a well-developed mucus-pore. Body strongly carinate.

The species is a variable one, presenting three forms:—

- a. *longicauda* (Fischer). Yellowish, unicolorous.
- b. *maculata* (Fischer) = *bella* (Heyn.). One of the British Museum specimens is of this form, being pale ochreous, with scattered grey-brown spots on body and mantle; sole pale ochre.
- c. *permaculata*, nov. Pale ochreous; body and mantle thickly marbled with dark brown, reducing the ground-colour in places to pale spots; sole brownish. Madagascar (British Museum, as above).

The reduced mantle-aperture and the non-reticulate mantle seem to give *Elisa* as good a right to be considered a genus as the other segregates from *Urocyclus* tabulated above. For a

very excellent account of the anatomy of *Elisa* see Simroth, Jahrb. 1883, Taf. ix. and pp. 289-312.

MARIAELLA, Gray.

Gray's type of *Mariaella* is in the British Museum labelled "*Clypeicella Dussumierii*, Val., Mahé."

It is $25\frac{1}{2}$ millim. long; ochreous, mantle and body slightly spotted with blackish; sole unicolorous, margins striate; mucus-pore strongly marked.

The shell is white, with a membranous or horny margin.

Several names have been given to *Mariaella*. *Clypeicella*, written sometimes *Clypidiella*, is the original MS. name of Valenciennes, passed over by Gray because there was a *Clypidella*, Swains.

Tennentia, applied to the Ceylon form, appears sometimes as a subgenus; but it has no standing, being *Mariaella* pure and simple. It is possible though that the Philippine *M.* (*Tennentia*) *philippinensis*, Semper, may be separable subgenerically or otherwise.

"*Mariaella*" *planulata*, Pfr., and "*M.*" *papillata*, Pfr., contained in the British Museum, are Vitrinoid shells widely separated from *Mariaella*. *Vigueneselia* was applied to *Mariaella* in 1859 by Fischer; but the true *Vigueneselia*, Desh., is a fossil and not even a mollusk.

Vega, Westerlund, founded on *V. Nordenskioldi*, West., from Ceylon, was described and figured in 1885. It appears to be a *Mariaella*.

Finally, *Dekhania*, Godwin-Austen, described as a subgenus of *Girasia*, is also simply *Mariaella*.

Mariaella Thwaitesi, Humbert.

Length (in alcohol) $21\frac{1}{2}$ millim.; mantle, long 11 millim.; respiratory orifice 5 millim. from anterior border; sole 4 millim. broad. Mantle elongate-ovate, subtruncate before and behind; apertures very minute or none. Colour of mantle grey-ochre, yellowish at edges; pale ridges run from the posterior part, one to the respiratory orifice and one subdorsally on the left side, fading anteriorly. Body greyish ochre, slightly streaked in lateral grooves with blackish posterior to mantle. Keel strong. Caudal pore well marked. Edge of foot with concolorous transverse grooves. Sole brownish ochre, unicolorous, striate at sides.

The above-described example appears to have no opening

in the mantle ; but a second specimen, only $12\frac{1}{2}$ millim. long, shows the pale apex of the shell.

Described from two specimens in the British Museum marked "Ceylon, 25 May, 1857."

I do not at all doubt that *Mariaella* is a good genus ; but the forms from the Seychelles (*Dussumieri*, Val.), from Ceylon (*Thwaitesi*, Humb.), and from South India (*Beddomei*, G.-A.) are so exceedingly allied that they can scarcely be regarded as distinct species. Very possibly the Seychelles form may have been imported from India or Ceylon. We thus arrive at this arrangement :—

MARIAELLA, Gray.

Mariaella Dussumieri, Val. MS., Gray. Seychelles Islands.

Subsp. *M. Thwaitesi* (Humb.). Ceylon.

Subsp. *M. Beddomei* (G.-Aust.). Travancore Hills, India.

Var. *nigra* (G.-Aust.). S. India.

Var. *maculosa* (G.-Aust.). S. India.

For the best account of the genus see *Dekhania* in Godwin-Austen's 'Land and Freshwater Mollusca of India,' part vi. Sept. 1887, and pl. lviii.

Limax infumatus, Fér., is apparently also to be included in *Mariaella*. It resembles *M. Beddomei*, var. *nigra*.

GIRASIA, Gray.

Girasia, Gray, Cat. Pulm. 1855, p. 61.

Parmarion, Fischer, Act. Soc. Linn. Bordeaux, 1856.

There can be no doubt that *Girasia* ought to stand in preference to Fischer's name *Parmarion*. *Girasia* is described in a British Museum Catalogue dated 29th March, 1855, and Mr. Saunders of the British Museum library informs me that this is really the date of publication. *Parmarion* is described in a paper dated June 1855, which appears in a part dated March 1856.

Girasia was practically founded on *G. Hookeri*, a well-known species of which the type still exists. *Parmarion* included four species, *infumatus*, *extraneus*, *rangianus*, and *problematicus*, all of Férussac. *P. infumatus* seems to be a *Mariaella*, *P. extraneus* is a *Girasia*, *P. problematicus* may be an *Ibycus*, while *rangianus* does not seem to belong here at all.

Girasia extranea (Fér.).*Limax extraneus*, Fér. Hist. Nat. Moll. pl. viii. f. figs. 4, 5, 6, 7.

This is evidently a true *Girasia*, and surely it must be identical with *G. Hookeri*, Gray. The aperture in the mantle, the posterior ridge or line directed towards the respiratory orifice, the characteristic shape, all are those of *Hookeri*, and the colour also agrees. Of course, assuming the identity of the two, *extranea* has priority.

Girasia extranea, var. *Hookeri* (Gray).

I will treat *Hookeri* as a variety of *extranea* in deference to the opinion of those who seem to see noteworthy differences between them; but I believe that they are practically identical.

The type specimen of *Girasia Hookeri* is in the British Museum marked "Khassya, Sir W. Hooker." It is 40 millim. long (in alcohol), colour uniform dark brown. It agrees with *Hookeri* as described and figured by Godwin-Austen.

Girasia extranea, var. *brunnea* (G.-A.).*Girasia extranea*, var. *shillongensis* (G.-A.).*Girasia extranea*, var. *maculosa* (G.-A.).

The present species is a very variable one, and these three varieties are described by Godwin-Austen under *Hookeri*. Tryon's description of var. *brunneus* (under *shillongensis*) is not correct.

Girasia depressa, subsp. nov.

G. extranea subsp., 27½ millim. long, mantle 13½ millim. long, respiratory orifice 8¼ millim. from anterior border of mantle. Colour ochreous, pale greyish below mantle anteriorly at sides. Sole unicolorous, orangy-ochre. Mucus-pore well developed. Shell brown, semitransparent, horny.

Described from an alcoholic specimen in the British Museum marked "*Girasia Hookeri*, Rve., Teria Ghat."

This subspecies (possibly species) differs from *Hookeri* or *extranea* in several ways. The mantle of *Hookeri* is strongly convex antero-posteriorly, that of *G. depressa*, viewed from the side, is practically flat. The respiratory orifice is less anterior and the orifice in the mantle above the shell is much larger in *depressa* than in *Hookeri*. The shell of *depressa*, in the specimen I examined, projects out of the opening.

The characters of the mantle in *depressa* are peculiar, for there are ridges exactly in the position of those in *Mariaella*. One of these pale ridges passes from the respiratory orifice backwards and the other from the front to the end of the mantle on the left side. There is also a sulcus, suggesting that of *Amalia*, visible as a curved line on the right side, its convexity towards the respiratory orifice.

Girasia affinis, sp. n.

Length 42 millim. (in alcohol); middle portion of mantle swollen; body high, truncate posteriorly in contraction. Aperture in mantle circular, only $3\frac{1}{2}$ millim. in diameter. Colour ochre, with grey mottling on mantle and body. Mantle without ridges. Shell brown, shiny.

Described from a specimen in the British Museum labelled "*Austenia peguensis*, Theob., Pegu (Theobald)." Certainly, from the label, this ought to be the genuine *peguensis*, and it agrees in general appearance very well with Godwin-Austen's figure of that species. But Godwin-Austen's figure is of a slug in which the shell is mainly exposed, as in *Austenia*, whereas *G. affinis* is a *Girasia* in the strictest sense. Theobald's original description says *peguensis* is like *Austenia gigas* in miniature, thus confirming Godwin-Austen's account, besides which the latter also had his specimens from Theobald.

The typical form of *peguensis* is yellowish, without spots.

It is thus plain that two very different species have been labelled *peguensis*, namely the true species of that name, well treated of by Godwin-Austen, and a species closely allied to *G. extranea*, for which I propose the name of *affinis*.

Ibycus sikkimensis (G.-Aust.) = *fissidens*, Heyn.

$27\frac{1}{2}$ millim. long (in alcohol), mantle 17 millim. long; hind of mantle to end of tail $6\frac{1}{3}$ millim., hind $6\frac{1}{3}$ millim. of mantle free, making the back altogether about $12\frac{2}{3}$ millim. long. Mantle notched in front, anterior part of mantle slightly granulose. Shell-aperture very large. Tail-gland conspicuous. Tail slightly dark-reticulate on each side of keel. General colour dull ochre, sides of neck dark grey, anterior part of mantle slightly marbled with grey. Sole unicolorous. Shell thin, chestnut-brown above, white (calcareous) below.

Known by its marbled anterior part of mantle and the short tail projecting beyond the mantle.

Described from a specimen, "purchased at Stevens," in the British Museum without locality.

Ibycus fissidens, Heyn., 1862, was very insufficiently described; but as it agrees with *sikkimensis* in all known points and was from the same neighbourhood, though at a higher altitude, there seems no reason for regarding it as distinct. Heynemann's name has priority. *Ibycus*, as a generic title, may perhaps be used for a large series of forms allied to *fissidens*, including *I. pupillaris* (Humb.) from Java.

Limax problematicus, Fér., pl. viii. f. figs. 13-17, belongs to *Ibycus*, and seems allied to *sikkimensis*.

Ibycus siamensis, sp. n.

Length about 30 millim., mantle $17\frac{1}{2}$ millim. long. Mantle prolonged anteriorly, as usual in *Ibycus*. Shell that of *Girasia*, but exposed like *Austenia*, apparently not whorled, thin, convex. There is a black band on each side of the keel, as in *Africarion ater*, vars. *aterrimus* and *cinereus*, though higher up, *i. e.* next to keel, not a little way from it. Colour dark grey above, more or less mottled with darker, sides below mantle pale. Foot-fringe alternating whitish and grey. Sole pale ochry, unicolorous.

Described from two alcoholic specimens from Siam in the British Museum. It is a rather puzzling form, in some ways resembling both *Africarion ater* and *Ibycus pupillaris* in some of their varieties. Perhaps it will prove to be a subspecies or race of *Africarion ater*.

LACONIA, Gray.

Laconia Férussaci, Gray, is founded on Férussac's figure of "*Vitрина*, sp.," on pl. viii. f. figs. 10, 11, 12. Gray gives the shell as covered by the mantle, but the figure looks as if a *Helicarion*-like shell had been removed. There is a well-formed mucus-pore. A little slug in the British Museum from Ceylon is evidently similar; the shell is gone. There is an anterior extension of the mantle.

Laconia is probably identical with *Austenia*; but as some uncertainty remains, I do not adopt the earlier name of Gray for that genus.

[To be continued.]

3 Fairfax Road, Bedford Park, Chiswick, W.,
November 3, 1890.

X.—*Notes on the Marine Crustacea Ostracoda of Norway.*
By the Rev. Canon A. M. NORMAN, M.A., D.C.L.,
F.R.S., &c.

DURING a dredging-expedition undertaken this last summer in East Finmark I explored the Varanger Fiord, and especially the fiords which run inland on its southern side close to the Russian frontier. Several arctic Ostracoda were here added to the Norwegian fauna, and the range of many species extended northwards. In noticing the species of this district I have thought it well to bring together the results of my former expeditions in 1878, 1879, and 1882 to the Norwegian coast, though most of the localities of the species belonging to the section Podocopa have been previously published in Professor Brady's and my recent monograph*. Since the publication of that work Prof. G. O. Sars has published † a revised list of the Norwegian species of this order, with descriptions of new species; but these latter do not embrace any marine forms. At the end of this paper I have added a list of twenty-three species which have been found by him and not by myself, and these, added to the ninety-five which I here record, give us one hundred and eighteen marine Ostracoda at present known in the Norwegian seas.

As it appears to me that we have now sufficient knowledge respecting the distribution of most of the species to enable us to approximately divide them into arctic, boreal, and abyssal forms, I have attempted to do this at the close of the paper. At the same time it cannot be doubted that more extended investigation in the future will lead to much modification of the assigned origin here given of species, though upon the whole it will, I think, as far as it goes, prove to be fairly correct.

The synonyms I have added are not the names now employed by Prof. G. O. Sars, but those under which he described the species in his monograph 'Oversigt af Norges marine Ostracoder,' published in 1865.

* Brady and Norman, "Monograph of the Marine and Freshwater Ostracoda of the North Atlantic and of North-western Europe" (Trans. Royal Dublin Soc. 1889).

† G. O. Sars, "Oversigt af Norges Crustaceer, II. Branchiopoda, Ostracoda, Cirrhipedia," 1890.

CRUSTACEA.

Order OSTRACODA.

Section I. PODOCOPA.

Fam. I. Cyprididæ.

Genus 1. PARACYPRIS, G. O. Sars.

Paracypris polita, G. O. Sars.

Off Sartoro, Bergen Fiord, 15-40 fath.; Hardanger Fiord, off Lervig, 20-100 fath., and Lervig Bay, 5-25 fath.; off Batalden, 200 fath.

Genus 2. PONTOCYPRIS, G. O. Sars.

Pontocypris mytiloides (Norman).

Off Bærnøstangen, in Oster Fiord, 100-200 fath.; south of Bukken, Bergen Fiord, 15-40 fath.; Haakelsund, Kors Fiord, 3-10 fath.; Lervig Bay, 3-25 fath.; Floro Bay.

Pontocypris hispida, G. O. Sars.

Hardanger Fiord, off Lervig, 210 fath., and in Lervig Bay.

Pontocypris acupunctata, G. S. Brady.

Batalden, near Floro.

Pontocypris trigonella, G. O. Sars.

Off Sartoro, Bergen Fiord, 15-40 fath.; Haakelsund, Kors Fiord, 3-10 fath.; Lervig Bay, 3-25 fath.

Genus 3. ARGILLECIA, G. O. Sars.

Argillœcia cylindrica, G. O. Sars.

Oster Fiord, 375 fath.; off Sartoro, Bergen Fiord, 15-40 fath.; Lervig Bay, 10-25 fath.; Stoksund, 80-100 fath.; off Dröbak, Christiania Fiord, 30-100 fath.; Hardanger Fiord, 210 fath.; Vadsö, 10 fath.; Klosterelv Fiord, Sydvaranger, tide-marks.

Fam. II. Bairdiidæ.

Genus 1. BAIRDIA, M'Coy.

Bairdia inflata, Norman, = *B. obliquata*, G. O. Sars.

Kors Fiord, 180 fath.; off Sartoro, Bergen Fiord, 15-40 fath.; Hardanger Fiord, off Midso Lighthouse, 50-100 fath.

Bairdia (*Bythocypris*?) *complanata*, G. S. Brady.

Off Sartoro, Bergen Fiord, 15-40 fath.; very abundant off Midso

Lighthouse, Hardanger Fiord, 50-100 fath.; south side of Kors Fiord, 180 fath.

Bairdia (Bythocypris?) obtusata, G. O. Sars.

Off Midso Lighthouse, in Hardanger Fiord, 50-210 fath.; Stok-sund, 126 fath.; Solems Fiord, Floro, 30-60 fath.

GENUS 2. MACROCYPRIS, G. S. Brady.

Macrocypris minna (Baird).

Dröbak, Christiania Fiord, 30-100 fath.; Oster Fiord, 50-375 fath.; Hardanger Fiord, 25-210 fath.; Bergen Fiord, south of Bukken, 150-200 fath.

Macrocypris angusta (G. O. Sars).

Dröbak, Christiania Fiord, 100 fath.; Hardanger Fiord, off Midso Lighthouse, 50-100 fath.; Bergen Fiord to the south of Bukken, 100-150 fath.

Fam. III. Cytheridæ.

Genus 1. CYTHERE, Müller.

Cythere lutea, Müller.

I have found this commonly between tide-marks and very shallow water throughout the entire length of Norway from Christiania Fiord to Tromsö, Varanger Fiord, and Klosterelv Fiord; and with it *Cythere viridis*, G. O. Sars, which appears to be its young.

Cythere pellucida, Baird, = *C. castanea*, G. O. Sars.

Hollingspollen, near Christiania; Lungegaards-vandet, Bergen, and off Sartoro; Vadsö and Lang and Klosterelv Fiords, Finmark.

Cythere confusa, Brady and Norm. = *C. pellucida*, auct. (non Baird).

Hollingspollen, near Christiania; Lungegaards-vandet, Bergen; Haakelsund, in Kors Fiord; Lervig Bay; Floro; Vadsö, Finmark.

Cythere porcellanea, G. S. Brady, = *C. propinqua*, G. O. Sars.

With the last two species in the first two localities given; and in Lervig Bay.

Cythere tenera, G. S. Brady.

Oster Fiord, 50-100 fath.; Lervig Bay, 25 fath.; Dröbak, 3-120 fath.; off Batalden, 200 fath.

Cythere semipunctata, G. S. Brady.

Lervig Bay, Stordöer, 3-25 fath.

Cythere corpulenta, Brady and Norm.

This is only known as yet from Oster Fiord, near Bergen, where it occurred to me in four different dredgings, ranging from 100 to 375 fathoms; but only a single specimen was taken in each case.

Cythere gibbosa, Brady & Rob.

Klosterelv Fiord, Finmark, tide-marks. This minute species, only previously known in Britain and Greenland, I have this summer met with in the above fiord, which is close to the Russian frontier.

Cythere oblonga, G. S. Brady.

Only two specimens found off Dröbak, in 30–120 fath.

Cythere leioderma, Norman.

A single specimen found in 50–60 fath. in Solems Fiord, Floro.

Cythere Robertsoni, G. S. Brady.

Dröbak, in 30–120 fath.; and Stoksund, in Hardanger Fiord, 126 fath.

Cythere convexa, Baird.

A single specimen taken in Lervig Bay, Stordöer, in 1882. This is not *Cytheropteron convexum*, G. O. Sars, which is *C. latisimum*, Norman.

Cythere marginata, Norman.

Lervig Bay, Hardanger Fiord.

Cythere limicola, Norman, = *C. nodosa*, G. O. Sars.

This species I had not succeeded in finding on former dredging-expeditions in the south and west of Norway; but in the past summer I have met with it in several localities in East Finmark, namely Vadsö, in 15–25 fath., Lang Fiord, 5–25 fath., and Bog Fiord, 20–30 fath.

Cythere cuneiformis, Brady, = *C. ventricosa*, G. O. Sars.

Lervig Bay, Stordöer, 3–25 fath.

Cythere navicula (Norman).

A single specimen in 15 fathoms off Sartoro, in Bergen Fiord.

Cythere globulifera, Brady.

Stoksund, in the Hardanger Fiord, in 126 fath.

Cythere complexa, G. S. Brady.

In the same dredging as the last, two specimens.

Cythere cluthæ, B., C., & R.

Dredged living in 125–150 fath. in the Varanger Fiord, and in 20–30 fath. on the east side of Bog Fiord, East Finmark. It is rare in the British seas, and was taken in the Greenland seas by the Nares Arctic Expedition. It is fossil in Scotch deposits. New to the Norwegian fauna.

Cythere albomaculata, Baird.

Lervig Bay, Stordöer, 5 fath. ; only very few specimens.

The following species belong to the genus *Cythereis* as defined by Prof. G. O. Sars :—

Cythere villosa (G. O. Sars).

In 0–180 fath. at Bergen, and off Sartoro, in Bergen Fiord ; Lervig Bay ; Stoksund ; and this year I have found it living between tide-marks in East Finmark at Vadsö and in Klosterelv Fiord. It is essentially a shore and shallow-water species ; the specimens in deep water were dead and had no doubt been washed into the localities where they occurred.

Cythere echinata (G. O. Sars).

Dröbak, 30–100 fath. ; Hardanger Fiord, off Midso Lighthouse, 210 fath. ; Bergen Fiord, south of Bukken, 150–200 fath. ; Oster Fiord, 375 fath.

Cythere latimarginata, Speyer, = *C. abyssicola*, G. O. Sars.

Oster Fiord, 100–200 fath. ; Bergen Fiord to the south of Bukken, 150–200 fath. ; Lervig Bay, 20 fath. ; Stoksund, Hardanger Fiord, 125 fath. ; Christiania Fiord, 30–100 fath.

Cythere crenulata (G. O. Sars).

Oster Fiord, 100–200 fath. ; off Sartoro, in Bergen Fiord, 15–40 fath. ; south side of Kors Fiord, 180 fath. ; Lervig Bay, 10–25 fath. ; Stoksund, 80–126 fath.

Cythere quadridentata, Baird.

Lervig Bay, Stordöer, 10–25 fath.

Cythere tuberculata (G. O. Sars).

Found throughout the whole length of Norway from Dröbak to East Finmark, where I have this year taken it at Vadsö in shallow water, and between tide-marks in Klosterelv Fiord.

Cythere concinna, Rupert Jones, = *Cythereis clavata*, G. O. Sars.

With similar extensive range in Norway to the last. In former years I have found it in South and West Norway, and now in East Finmark, tide-marks, living, and shallow water at Vadsö, Bog Fiord, and Klosterelv Fiord.

Cythere emarginata (G. O. Sars).

Lervig Bay, 3–24 fath.; and off Lervig, 50–100 fath., Stoksund, 80–100 fath., Haakelsund, Kors Fiord, 3–10 fath.; off Batalden, and in East Finmark, living, between tide-marks, and in shallow water, Vadsö and Klosterelv Fiord.

Cythere finmarchica (G. O. Sars).

Haakelsund, in Kors Fiord, 3–10 fath.; and in East Finmark, living, tide-marks, and shallow water at Vadsö, and in Lang Fiord, Sydvaranger.

Cythere angulata (G. O. Sars).

Hollingspollen, Dröbak, 3–10 fath.; Lervig Bay, 3–25 fath.; Haakelsund, Kors Fiord, 3–10 fath.; Lungegaards-vandet, Bergen, 0–3 fath.; off Batalden; and in East Finmark, living between tide-marks and in shallow water, Vadsö, and in the Klosterelv Fiord.

Cythere mucronata (G. O. Sars).

Stoksund, which is near the mouth of the Hardanger Fiord, in 126 fath.

Cythere mirabilis, G. S. Brady.

A fine living series from very young to adult of this beautifully sculptured species was dredged in the Varanger Fiord in 125–150 fath., and in Bog Fiord, East Finmark, in 20–30 fath. Only a single dead valve has been procured in British seas from Admiralty soundings off Lumpan Head, Lewis. Prof. Brady found it in Mr. Lamont's Spitzbergen dredgings, and it is not rare as a fossil in the glacial deposits of Scotland. New to the Norwegian fauna.

Cythere dunelmensis (Norman), = *C. horrida*, G. O. Sars.

Floro; Stoksund, 126 fath., and in East Finmark, from tide-marks, living, to 100 fath., Vadsö, and Bog and Klosterelv Fiords.

Cythere Jonesii (Baird), = *Cythereis spectabilis*, G. O. Sars.

Apparently rare on the Norwegian coast; dredged in Solems Fiord, Floro, in 50–60 fath.; off Sartoro, in Bergen Fiord, in 15 fath.; and Floro Bay.

Genus 2. CYTHERIDEA, Jones.

Cytheridea papillosa, Rupert Jones, = *Cyprideis Bairdii*, G. O. Sars.

Always on soft muddy ground, Dröbak, Lervig, Stoksund, Bergen, Floro, &c.; and in East Finmark at Vadsö, and in Lang, Bog, and Klosterelv Fiords.

Cytheridea punctillata, G. S. Brady, = *Cyprideis proxima*, G. O. Sars : Dröbak, and in East Finmark, in 5–100 fathoms, Vadsö, Lang, Bog, and Klosterelv Fiords.

Cytheridea Sorbyana, Rupert Jones, = *Cytheridea dentata* and *inermis*, G. O. Sars.

Single valves only in Stoksund, 80–100 fath. ; fine living examples in East Finmark, 5 fath., Klosterelv Fiord.

Genus 3. EUCYTHERE, G. S. Brady.

Eucythere declivis (Norman), = *Cytheropsis tenuitesta*, G. O. Sars.

Christiania, Hardanger, and Oster Fiords, and in East Finmark, in 0–25 fath., at Vadsö, and in Klosterelv Fiord.

Var. *argus*, G. O. Sars, = *Eucythere argus*, G. O. Sars.

Vadsö, East Finmark, 5–10 fath.

Genus 4. KRITHE, B., C., & R.

Krithe bartonensis (Rupert Jones), = *Ilyobates prateata*, G. O. Sars.

Dröbak, 30–100 fath. ; Hardanger Fiord, 210 fath. ; Oster Fiord 100–200 fath. ; and in East Finmark, at Vadsö, in 5–15 fath.

Krithe angusta, Brady and Norman.

This very distinct species is only as yet known in the Norwegian seas, where I took it at Dröbak, in 100 fath. ; Hardanger Fiord, off Lervig, 210 fath. ; Bergen Fiord, off Sartoro, 15–40 fath. ; and Oster Fiord, 100–375 fath.

Genus 5. LOXOCOONCHA, G. O. Sars.

Loxoconcha impressa, Baird, = *L. rhomboidea*, G. O. Sars.

Dröbak, Lervig, Stoksund, Bergen, Kors Fiord, and Floro ; but I did not meet with it in East Finmark.

Loxoconcha multifora (Norman).

Lervig Bay, 10–20 fath. ; off Sartoro, in Bergen Fiord, 15–40 fath. ; Floro Bay.

Loxoconcha tamarindus (Rupert Jones), = *L. longipes*, G. O. Sars.

Lungegaards-vandet, Bergen ; off Sartoro, 15–40 fath., and other places in the Bergen district ; at Floro ; and in East Finmark, living, between tide-marks and in shallow water, at Vadsö and Klosterelv Fiord.

Loxoconcha fragilis, G. O. Sars.

Lungegaards-vandet, Bergen ; and in East Finmark a single specimen, living, between tide-marks in Klosterelv Fiord.

Genus 6. XESTOLEBERIS, G. O. Sars.

Xestoleberis aurantia (Baird), = *X. nitida* (Lillj.), G. O. Sars.

In the Hardanger and Bergen Fiords.

Xestoleberis depressa, G. O. Sars.

In many places at Dröbak and in the Hardanger, Kors, and Bergen Fiords. On our own coast it is usually dredged, while *C. aurantia* occurs between tide-marks; but in East Finmark, where I did not meet with *C. aurantia*, the present species was living between tide-marks as well as found in 0-15 fath. at Vadsö and in Klosterelv Fiord.

Genus 7. CYTHERURA, G. O. Sars.

Cytherura affinis, G. O. Sars.

Dröbak, 120 fath., and off Midso Lighthouse, in the Hardanger Fiord, in 50-100 fath. In East Finmark I met with it in shallow water at Vadsö and living between tide-marks in Klosterelv Fiord.

Cytherura sella, G. O. Sars.

Lervig Bay and Stoksund, in 126 fath.; Vadsö, 20-30 fath.

Cytherura acuticostata, G. O. Sars.

Lervig Bay, Bergen and Oster Fiords, and Batalden, near Florø.

Cytherura striata, G. O. Sars.

Dröbak, 30-120 fath.; Haakelsund, in Kors Fiord, 3-10 fath.; Lervig Bay, 10-25 fath.

Cytherura exserta, Brady and Norm.

The types of this species were dredged by me in Stoksund.

Cytherura undata, G. O. Sars.

Dröbak, 120 fath.; Lervig Bay, 10-25 fath.; Stoksund, 126 fath.; Bukken, in Bergen Fiord, 40 fath.; off Batalden, 200 fath.; in East Finmark, living between tide-marks in Klosterelv Fiord, and dredged in 5-25 fath. at Vadsö.

Cytherura producta, G. S. Brady.

Lervig Bay and off Sartoro, in Bergen Fiord, 15-40 fath.

Cytherura grænländica, Brady and Norm.

This arctic species described from Greenland specimens I now am able to add to the Norwegian fauna, having found it living in two localities east and west of Vadsö, Finmark, in 5-25 fath.

Cytherura concentrica, B., C., & R.

Lervig Bay, 10–25 fath.; Stoksund, 80–100 fath.; off Batalden, near Floro.

Cytherura similis, G. O. Sars.

Dröbak, 120 fath.; Haakelsund, in Kors Fiord, 5–10 fath.; and in East Finmark, Vadsö, 5–25 fath.

Cytherura nigrescens (Baird).

Tide-marks along the whole coast from Christiania to Sydvaranger.

Cytherura rudis, Brady.

This species, previously only known in Greenland, is now added to the Norwegian fauna. I dredged living specimens to the east of the entrance to Vadsö Harbour, in 15–25 fath.

Cytherura cellulosa, Norman, = *C. nana*, G. O. Sars.

Bergen Fiord, off Sartoro, 15–40 fath.; Lervig Bay, 0–25 fath.; Stoksund, 80–126 fath.; Dröbak, 30–120 fath.; Haakelsund, in Kors Fiord, 3 fath.; Floro Bay; Vadsö, 20–30 fath.

Genus 8. CYTHEROPTERON, G. O. Sars.

Cytheropteron latissimum (Norman), = *C. convexum*, G. O. Sars.

Lervig Bay, 3–25 fath., and in East Finmark at Vadsö, 10–25 fath., and between tide-marks in Klosterelv Fiord.

Cytheropteron nodosum, G. S. Brady.

In 3–100 fath., Lervig Bay, and off Lervig; and off Sartoro, in Bergen Fiord; in East Finmark a single specimen at Vadsö, 15–25 fath.

Cytheropteron inflatum, B., C., & R. (?).

Stoksund, in 125 fath. Some doubt attaches to the single specimen obtained, which is not very characteristic.

Cytheropteron subcircinatum, G. O. Sars.

Lervig Bay, 2–10 fath.

Cytheropteron punctatum, Brady.

Off Sartoro, in Bergen Fiord, 15–40 fath.

Cytheropteron hamatum, G. O. Sars.

Stoksund, 80–100 fath.

Cytheropteron testudo, G. O. Sars.

A very interesting species, found by me in two places in the

Hardanger Fiord, namely off Lervig, in 210 fath., and in Stoksund, 126 fath.; also off Batalden, near Floro.

Genus 9. BYTHOCY THERE, G. O. Sars.

Bythocythere constricta, G. O. Sars.

Off Sartoro, Bergen Fiord, 20–30 fath.; Kors Fiord, 180 fath.; Floro Bay; Vadsö, East Finmark, tide-marks.

Bythocythere recta, G. S. Brady.

A single young living example dredged in about 20 fathoms to the east of Vadsö, Finmark. It occurs in the British seas, and I have taken it in the Bay of Biscay; but it is always numerically very scarce. It is a fossil in Scotch deposits. New to the Norwegian fauna.

Genus 10. PSEUDOCY THERE, G. O. Sars.

Pseudocythere caudata, G. O. Sars.

Hardanger Fiord, 25–100 fath.; off Sartoro, Bergen Fiord, 15–40 fath.; Oster Fiord, 50–100 fath.; and Vadsö, Finmark, 5–15 fath.

Genus 11. SCLEROC HILUS, G. O. Sars.

Sclerochilus contortus (Norman).

Dröbak, 120 fath.; off Sartoro, Bergen Fiord, 15–40 fath. Hardanger Fiord, 40–210 fath.; Kors Fiord, 180 fath.

Fam. IV. PARADOXOSTOMATIDÆ.

Genus PARADOXOSTOMA, Fischer.

Paradoxostoma variabile (Baird).

Found throughout the entire Norwegian coast from Dröbak to East Finmark, where I have found it during the past summer, between tide-marks at Vadsö and in Klosterelv Fiord.

Paradoxostoma ensiforme, G. S. Brady.

Lervig Bay, in Hardanger Fiord, 3–25 fath.

Paradoxostoma abbreviatum, G. O. Sars.

Lervig Bay, 3–25 fath.; Stoksund, in the Hardanger Fiord, 80–100 fath.; Haakelsund, in Kors Fiord; Lungegaards-vandet, Bergen; Batalden, near Floro, 200 fath.

Paradoxostoma pulchellum, G. O. Sars.

Lervig Bay.

Paradoxostoma orchadense, Brady and Rob.

Lervig Bay, a single specimen.

Paradoxostoma rostratum, G. O. Sars.

This species occurred to Prof. Sars as very rare in Öxfjord, Finmark. In our monograph Professor Brady and myself have introduced Sars's description and given an outline drawing from his pencil. I have now found three specimens among weeds between tide-marks at Vadsö, East Finmark. It is a very fine and distinct species, and is remarkable for its pure white colour.

Paradoxostoma productum, Brady & Norm.

Lervig Bay, 25 fath. ; two dredgings in Stoksund, in the Hardanger Fiord, in 80-126 fath. ; off Sartoro, in Bergen Fiord, 15-40 fath.

Paradoxostoma flexuosum, G. S. Brady.

Dröbak, 30-100 fath. ; Lervig Bay, 3-25 fath. ; off Sartoro, Bergen Fiord, 15-40 fath. ; Oster Fiord, 100-200 fath.

Paradoxostoma inflexum, Brady & Norm., sp. n.

Shell, seen from the side, siliquose ; greatly curved, greatest height equal to two fifths of the length, behind the middle ; anterior half of much less height than the posterior, and bending downwards ; anterior extremity narrow, but well and evenly rounded ; posterior margin much broader, and also well and evenly rounded ; dorsal margin strongly arched throughout, without any angularity in any part, posterior declination much more sudden than the anterior ; ventral margin deeply concave slightly in front of the middle, behind the middle gently convex, the hinder portion of the shell thus becoming much higher than the anterior. Seen from above very narrow, greatest width not more than half the height, sides nearly flat, both extremities very narrow, but the anterior more acute than the posterior. Length .40 millim.

Tide-marks, among weeds, Vadsö, Finmark.

There are only two Ostracoda which this very small species can be said to approach at all in shape, and of which it might be suggested that it was the young. These are *Paradoxostoma Normani* and *Sclerochilus contortus*. With the young of the same size in these species it has been compared, and it differs *in toto*.



Paradoxostoma inflexum.

The young of the former is very much shorter and higher, in fact shorter and higher than the adult, and less incurved. The young of the latter is very nearly as the adult, the extremities much more nearly equal than in this species, and consequently the whole shape different; it is also more convex. It is possible that the present species may hereafter prove to be a *Sclerochilus*, and not a *Paradoxostoma*. The specimens described had been dried before they were noticed, though living when collected.

Section II. PLATYCOPA.

Fam. Cytherellidæ.

Genus CYTHERELLA, Bosquet.

Cytherella abyssorum, G. O. Sars.

Stoksund, in Hardanger Fiord, 126 fath.; off Lervig, 200 fath.; Bergen Fiord to the south of Bukken, 150–200 fath.; Oster Fiord, 100–200 fath.; Solems Fiord, Floro, 50–60 fath.

Section III. CLADOCOPA.

Fam. Polycopidæ.

Genus POLYCOPE, G. O. Sars.

Polycope orbicularis, G. O. Sars.

Lervig Bay, 3–25 fath.; Bergen Fiord, south of Bukken, 150–200 fath.; Oster Fiord, 100–200 fath.; Bog Fiord, East Finmark, 20–30 fath.

Section IV. MYODOCOPA.

Fam. Cypridinidæ.

Genus 1. CYPRIDINA, Milne-Edwards.

Cypridina norvegica, Baird.

Hardanger Fiord, off Lervig, 150–180 fath., and in Stoksund, 80–100 fath.

Genus 2. PHILOMEDES, Lilljeborg.

Philomedes Lilljeborgii, G. O. Sars.

Dröbak, 30–100 fath.; Hardanger Fiord, off Lervig, 150–180 fath., and in Stoksund, 80–100 fath.; Bergen Fiord, south of Bukken, 150–200 fath.

Philomedes brenda, Baird.

Dröbak, 20–100 fath.; East Finmark, in Varanger, Bog, and Klosterelv Fiords, 3–100 fathoms. In one bay on the south side of Bog Fiord it occurred in extraordinary abundance in 3 fath.

Prof. Sars has met with the following twenty-three species in Norway, which I have not myself found:—

- | | |
|--|---|
| Cythere crispata, <i>G. S. Brady</i> , = <i>C. cicatricosa</i> , <i>G. O. Sars</i> . | Bythocythere insignis, <i>G. O. Sars</i> . |
| — rubida, <i>G. S. Brady</i> , = <i>C. dramensis</i> , <i>G. O. Sars</i> . | Cytherois Fischeri, <i>G. O. Sars</i> . |
| — Macallana, <i>G. S. Brady</i> . | — vitrea, <i>G. O. Sars</i> . |
| Loxoconcha guttata (<i>Norman</i>), = <i>L. granulata</i> , <i>G. O. Sars</i> . | Paradoxostoma obliquum, <i>G. O. Sars</i> . |
| Cytherura atra, <i>G. O. Sars</i> . | Polycope punctata, <i>G. O. Sars</i> . |
| — gibba (<i>Müller</i>). | — pustulata, <i>G. O. Sars</i> . |
| — clathrata, <i>G. O. Sars</i> . | Cypridina megalops, <i>G. O. Sars</i> . |
| Cytheropteron alatum, <i>G. O. Sars</i> . | Asterope norvegica, <i>G. O. Sars</i> . |
| Bythocythere turgida, <i>G. O. Sars</i> . | — abyssicola, <i>G. O. Sars</i> . |
| — dromedaria, <i>G. O. Sars</i> . | Conchœcia elegans, <i>G. O. Sars</i> . |
| — simplex (<i>Norman</i>), = <i>B. acuminata</i> , <i>G. O. Sars</i> . | — borealis, <i>G. O. Sars</i> . |
| | Halocypris obtusata, <i>G. O. Sars</i> . |

On the other hand, the thirty species which follow have occurred to me, but are not recorded by Sars as found by himself:—

- | | |
|---|---|
| Pontocypris acupunctata, <i>G. S. Brady</i> . | Cythere mirabilis, <i>G. S. Brady</i> . |
| Cythere tenera, <i>G. S. Brady</i> . | Loxoconcha multifora (<i>Norman</i>). |
| — semipunctata, <i>G. S. Brady</i> . | Cytherura exserta, <i>Brad. & Norm.</i> |
| — corpulenta, <i>Brad. & Norm.</i> | — producta, <i>G. S. Brady</i> . |
| — gibbosa, <i>Brad. & Rob.</i> | — grœnlandica, <i>Brad. & Norm.</i> |
| — oblonga, <i>G. S. Brady</i> . | — rudis, <i>G. S. Brady</i> . |
| — leioderma, <i>Norman</i> . | — concentrica, <i>B., C., & R.</i> |
| — Robertsoni, <i>G. S. Brady</i> . | Cytheropteron nodosum, <i>G. S. Brady</i> . |
| — convexa, <i>Baird</i> . | — inflatum, <i>B., C., & R.</i> |
| — marginata, <i>Norman</i> . | — punctatum, <i>G. S. Brady</i> . |
| — navicula (<i>Norman</i>). | Bythocythere recta, <i>G. S. Brady</i> . |
| — globulifera, <i>G. S. Brady</i> . | Paradoxostoma orchadense, <i>Brad. & Rob.</i> |
| — complexa, <i>G. S. Brady</i> . | — productum, <i>Brad. & Norm.</i> |
| — cluthæ, <i>B., C., & R.</i> | — inflexum, <i>Brad. & Norm.</i> |
| — albomaculata, <i>Baird</i> . | |
| — quadridentata, <i>Baird</i> . | |

Arctic Species.

- | | |
|------------------------|------------------------|
| Argillœcia cylindrica. | Cythere concinna. |
| Cythere lutea. | — emarginata. |
| — pellucida. | — finmarchica. |
| — confusa. | — angulata. |
| — porcellanea. | — mirabilis. |
| — tenera. | — dunelmensis. |
| — cluthæ. | — Jonesii. |
| — gibbosa. | Cytheridea papillosa. |
| — leioderma. | — punctillata. |
| — marginata (p). | — Sorbyana. |
| — limicola. | Eucythere declivis. |
| — globulifera. | Krithe bartonensis. |
| — villosa. | Loxoconcha tamarindus. |
| — crenulata. | — fragilis. |
| — tuberculata. | Cytherura atra. |

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|---------------------------|-----------------------------|
| Cytherura undata. | Cytheropteron montrosiense. |
| — grœnlandica. | — angulatum. |
| — nigrescens. | Bythocythere constricta. |
| — concentrica. | — turgida. |
| — similis. | — simplex. |
| — rudis. | Sclerochilus contortus. |
| — clathrata. | Paradoxostoma variabile. |
| Cytheropteron latissimum. | — flexuosum. |
| — nodosum (?). | — rostratum. |
| — inflatum. | Polycope orbicularis. |
| — hamatum. | Philomedes brenda. |

Boreal Species.

- | | |
|-------------------------|----------------------------|
| Paracypris polita. | Loxoconcha multifora. |
| Pontocypris mytiloides. | — guttata. |
| — hispida. | — impressa. |
| — acupunctata. | Xestoleberis depressa (?). |
| — trigonella. | — aurantia. |
| Bairdia inflata. | Cytherura gibba. |
| — obtusata. | — sella. |
| — complanata. | — acuticostata. |
| Cythere Macallana. | — striata. |
| — semipunctata. | — producta. |
| — crispata (?). | — cellulosa. |
| — rubida. | Cytheropteron punctatum. |
| — oblonga. | — alatum. |
| — Robertsoni. | Pseudocythere caudata. |
| — convexa. | Cytherois Fischeri. |
| — cuneiformis. | Paradoxostoma ensiforme. |
| — navicula. | — abbreviatum. |
| — albomaculata. | — pulchellum. |
| — quadridentata. | |

Abyssal Species.

- | | |
|--------------------|-----------------------|
| Macrocypris minna. | Cytherella abyssorum. |
| — angusta. | Conchœcia borealis. |
| Cythere echinata. | — elegans. |
| — latimarginata. | Halocypris obtusata. |

Species of doubtful origin.

- | | |
|------------------------|--------------------------|
| Cythere corpulenta. | Cytherois vitrea. |
| — complexa. | Paradoxostoma inflexum. |
| — mucronata. | — orchadense. |
| Krithe angusta. | — productum. |
| Cytherura affinis. | Polycope punctata. |
| — exserta. | — pustulata. |
| Cytheropteron testudo. | Cypridina norvegica. |
| — subcircinatum. | — megalops. |
| Bythocythere insignis. | Philomedes Lilljeborgii. |
| — dromedaria. | Asterope norvegica. |
| Bythocythere recta. | — abyssicola. |

XI.—*Descriptions of Ten new Species of Butterflies from the North-west Coast of Madagascar, captured by Mr. J. T. Last, in the Collection of Mr. H. Grose Smith.* By H. GROSE SMITH.

Papilio erithonioides.

Male.—*Upperside.* Both wings with markings as in *demoleus*, Linn., but on the posterior wings the stramineous band which crosses the wings before the middle is broader and the spots in the submarginal row are more lunulate; at the lower end of the dark rufous spot above the anal angle is a large subovate black spot, the middle median nervule is produced into a short tail rather more elongate than in *demoleus*.

Underside approaches nearer to *P. erithonius* than *P. demoleus*, but the anterior wings are more irrorated with stramineous scales, and on the posterior wings the central band is less rufous and broader than in *erithonius*; the curved black line which crosses the cell of that species towards its end is represented in *erithonioides* by a triangular black spot with the apex pointing outwards, and the irregular row of black bars which divides the central band is wider; the veins on the disk are black instead of stramineous, the ocellus below the costal nervule is larger; and at the anal angle, instead of the ferruginous spot crowned with a black spot centred with blue scales, is a dark rufous spot, with the black spot at its lower end as on the upperside, above which is a round black spot with a blue iris centred with brown. The submarginal lunules are more deeply incised outwardly.

Female.—*Upperside.* Both wings resemble the male, but on the posterior wings a space on each side of the large ocellus below the costal nervule is bright ferruginous; on the disk the space between the stramineous band and the row of submarginal lunules is brightly irrorated with stramineous scales, in which, between the veins, are spaces less densely irrorated with the same colour, giving the appearance of indistinct black spots, with clusters of blue scales more or less distinct below each, resembling somewhat the mottled appearance of the posterior wings of *Ophidocephalus*, Oberth. The lunules in the submarginal row are very strongly developed, the apices of each lunule being elongated towards the margin; the tail formed by the prolongation of the middle median nervule is very marked, being nearly $\frac{3}{8}$ inch long.

Underside. All the spots on both wings larger than on the upperside. Anterior wings with the first four of the sub-

marginal row of spots confluent with the marginal row, the others nearly confluent. Posterior wings with the apices of the submarginal lunules much elongated, almost extending to the marginal row, which are fully developed, the marginal lunules on each side of the tails extend down them almost to the end; across the disk the outer row of sinuate black lines is crowned with silvery blue in the middle row, the irregular black spots extend inwardly in a conical shape, and are margined outwardly with another row of bright blue lines; inside the cell at its end is a broad curved black spot centred with blue; the veins are black, broadly black on the margins. Both wings between the spots and at the base irrorated with stramineous scales. Antennæ rufous.

Expanse of wings, ♂ $3\frac{7}{8}$, ♀ $4\frac{5}{8}$ inches.

This species connects *erithonius*, which is an Asiatic, with *demoleus*, which is an African species. I have many specimens of *demoleus* from Madagascar, and was at first disposed to consider *erithonioides* a variety. The development of the tails in the female is very remarkable. This species is much larger than *erithonius*, and I have specimens of the female nearly 5 inches across the wings. A considerable series was sent.

Pieris ramona.

Male—Upperside. Both wings white. Anterior wings and inner three fourths of costal margin narrowly, thence to the apex broadly black, the black gradually narrowing along the outer margin to a little beyond the middle median nervule, where it ceases; a small black spot at the end of the cell, a cluster of black scales forming an indistinct submarginal spot between the upper and middle median nervules, the space from the outer third of the cell, and thence over the disk to the black apical band and nearly as far as the posterior angle, bright orange.

Underside. Anterior wings very pale orange stramineous, brighter towards the base, inner margin nearly white; the spots as on the upperside, but larger and very black. Posterior wings, inner half of costal margin bright orange, the rest of the wings stramineous.

Female.—Upperside. Anterior wings pale orange, costal and outer margins narrowly black, a black spot at the end of the cell; four submarginal black spots—the first below the third subcostal nervule minute, the second larger, below the first discoidal nervule, the third the largest, below the upper median nervule, the fourth below the lowest median nervule, about the same size as the third spot but less defined; a few

black scales at the posterior angle. Posterior wings brighter orange.

Underside. Anterior wings brighter, and posterior wings paler orange than on the upperside, the spots on anterior wings as on the upperside, the costal margin of posterior wings at the base bright orange.

Expanse of wings $2\frac{3}{4}$ inches.

Nearest to *P. antsianaka*, Ward, and *P. affinis*, Mab.

Mylothris majungana.

Male.—Upperside. Anterior wings milky white, with the apex from a little beyond the middle of the costal margin broadly, and thence along the outer margin gradually decreasing to the inner angle, black, the inner edge deeply dentate as in *nagare*, Grose Smith; the costal margin at the base grey, the base of the wings brightly tinged with orange. Posterior wings pale yellow, the lowest subcostal, the discoidal, and median nervules tipped with black.

Underside. Anterior wings stramineous, apex broadly fulvous, the base to the middle of the cell orange. Posterior wings bright fulvous, costal margin, from the base to the middle, orange.

Expanse of wings $1\frac{5}{8}$ inch.

Nearest to *M. Lasti*, Grose Smith, from Mombasa.

Acraea andromba.

Male.—Upperside. Resembles *A. obeira*, Hew. (*piva*, Guenée), but is smaller; the anterior wings are narrower, and the posterior wings rounder; the rufous basal colouring on the anterior wings is paler, and extends nearly to the end of the cell and to the posterior angle. On the posterior wings the rufous area extends over nearly all the wings, especially towards the anal angle, where it reaches the margin, the spots at the base and in the irregular row across the disk are comparatively smaller, the dark marginal band is more defined, in which, between the veins and touching the margin, is a row of six nearly round bright rufous spots; in *obeira* these spots are only three or four in number, are situate towards the anal angle, and are more elongate in shape.

On the underside of the posterior wings the marginal row of rufous spots is more distinct than in *A. obeira*.

The female is much paler, the coloured area of both wings being stramineous, and extending over nearly the whole of the posterior wings.

Expanse of wings, ♂ $1\frac{3}{4}$, ♀ $2\frac{1}{8}$ inches.

Hypolimnias deludens.

Male.—*Upperside*. Resembles *H. deceptor*, Trimen, from Delagoa Bay and Mombasa, but differs from it in having on the upperside of both wings a row of seven spots inside the partly obsolete submarginal row of spots of *deceptor*. In this row, on the anterior wings, the first and seventh are the largest; on the posterior wings they are all nearly the same size.

Underside. On both wings the submarginal rows of spots are very distinct. On the posterior wings the shoulder is entirely white, and the band below it is much darker, broader, and above the subcostal nervure uninterrupted, *deceptor* having above that nervure a subovate whitish-brown space. The outer marginal band of *deludens* is also much wider and darker, except near the apex and on either side of the upper median nervule, where there are paler spaces.

Female resembles *H. deceptor* ♀, but the anterior wings are shorter; on the upperside of both wings the additional row of spots is very distinct, and on the posterior wings the large central white space does not extend towards the costal margin, above the first subcostal nervule.

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

Thaleropsis kilusa.

Male.—*Upperside*. Anterior wings dark brown, with the base, a spot near the end of the cell, an oblique spot beyond the cell, another smaller below it and nearer the margin between the upper and middle median nervules, and a transverse space extending over the disk from the middle median nervule to the inner margin about its middle, interrupted in the middle below the cell, light brown. Posterior wings elongate to the anal angle, which is acuminate, light brown, with a broad dark brown band on the costal margin extending nearly to the apex, paler in the middle on the margin; the apex, costal nervure, and subcostal nervules tipped with dark brown, and a submarginal row of five dark brown lines (the two uppermost macular) between the veins from the discoidal nervule to near the anal angle.

Underside. Anterior wings black at the base, gradually becoming paler to the outer margin, where they are pinkish brown; the spots as above, but paler, the spots beyond the cell being pinkish brown, and the light brown discal space being more restricted below the cell; an indistinct submarginal row of dark spots following the outer margin. Posterior wings

pinkish brown, darker from the base to the middle, the outer edge of this space being fairly well defined and angulated outwardly on the first and third median nervule.

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

Nearest to *T. cleocharis*, Hew. The shape of the anterior wings resembles *T. ionia*, Eversm., but is more sharply scalloped on the outer margin of anterior wings, and the posterior wings are more elongate and acuminate at the anal angle than in either of the two last-named species.

Libythea ancoata.

Upperside resembles *L. cinyras*, Trim., from Mauritius, but the spots in the cell and on posterior wings smaller and greyer. It differs from *L. labdaca*, Westw., in the absence of the brownish-grey patch between the lowest median nervule and submedian nervule on the anterior wings, and on the posterior wings in the band of spots below the cell being very nearly obsolete. On the underside of the anterior wings the brown spaces within the cell are narrower than in either *cinyras* or *labdaca*. On the posterior wings at the lower side of the cell from the base to beyond its end is a somewhat curved greyish-black band followed at the middle of the outer margin by a similar patch of the same colour.

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

Deudorix derona.

Male.—*Upperside.* Anterior wings dark brown, with an orange-red patch across the middle of the wings to the inner margin; the upper part extends into the cell towards its end, and its outer and inner edges are somewhat irregular. Posterior wings, the inner half dark brown, the remainder of the wings orange-red with a narrow black margin.

Underside. Anterior wings resemble *D. dariaves*, Hew., but the inner edge of the discal band of lines is interrupted. Posterior wings with three basal red spots narrowly surrounded with black and bordered with white, a spot near the middle of the costal margin bordered inwardly with black and margined with white, two interrupted rows of lines bordered inwardly with white, and a submarginal row bordered outwardly with white; otherwise resembles *dariaves*, but the wings are more slate-coloured, and less irrorated with white, and above the anal lobe is a rather conspicuous triangular pale grey space bordered with black.

Female.—*Upperside.* Anterior wings dark grey, centred with a large pale grey patch extending from the cell and

partly in it, over the disk to the inner margin. Posterior wings slaty grey, with two large round black spots towards the anal angle near the margin, and a black spot partially covered with metallic blue scales and crowned with pale yellow in the lobe; margin narrowly black, with a narrow white line inside it; cilia white.

Underside whiter than in the male, with all the spots and lines, except towards the anal angle of posterior wings, more or less tinted with red; the outer black anal spot on posterior wings is broadly crowned with yellow, the inner black spot is obsolete and represented by a cluster of metallic blue scales.

Expanse of wings, ♂ $1\frac{1}{8}$, ♀ $1\frac{1}{4}$ inch.

Nearest to *D. dariaves*. Mons. Grandidier has figured a species called *batikeli*; Boisd., but his figure does not quite agree with the female above described, and as Mons. Mabille states that the female of his butterfly to a great extent resembles the male, and there can be no doubt that the two insects described by me are sexes of the same species, I venture to consider them distinct from Boisduval's species.

Cyclopides amena.

Upperside. Anterior wings dark brown, with a large yellow patch extending above and over the whole of the cell, except a small space at the base, extending also a little beyond and below the cell as far as the lowest median nervule; a yellow subcostal bar beyond the cell and a small yellow spot below it nearer the outer margin. Posterior wings yellow, except the space along the costal margin as far as the first subcostal nervule.

Underside as above, except that the whole of the apex of the anterior wings is broadly yellow, the two yellow subapical spots being merged in the yellow area, but indistinctly seen; a narrow black outer margin. The posterior wings all yellow, irrorated with black along the costal margin.

Expanse of wings 1 inch.

Near to *C. pardalinus*, Butl.

Tagiades samborana.

Male.—*Upperside.* Both wings pale ashy brown; anterior wings with a cluster of three vitreous spots in the middle of the wings, two small above, the other, twice their size and triangular, below the middle median nervule; a transverse dusky brown bar from the middle of the costa to nearly as far as the median nervule; a narrower bar of the same colour extends from the apex of the lower triangular spot, in

the opposite direction to the upper bar, to a little beyond the middle of the submedian nervure, a dusky spot below the cell at its junction with the lowest median nervule, and another nearer the base below it. Posterior wings with a curved row of dusky spots between the veins a little beyond the middle, the two uppermost being situated below the middle of the costal nervure and approaching the base.

Underside. Anterior wings paler than above, especially the space beneath the lower vitreous spot beyond the narrow bar (which is represented as on the upperside), where it is dusted with pale grey. Posterior wings white, except along the costal margin and apical region, where it is dusted with ashy grey, the row of spots on the upperside being represented on the underside by a row of smaller black spots, several of which are nearly obsolete.

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

XII.—*Descriptions of two new Scarabæidæ of the Genus Phanæus.* By CHARLES O. WATERHOUSE.

Phanæus Leander, Dej., in litt.

Niger; capite postice thoraceque viridibus plus minusve auratis vel cuprescentibus, nitidis, crebre rugosis; elytris æruginoso-viridibus, surdis, lato sulcatis, interstitiis anguste costiformibus, nitidis, cupreis; pygidio sat fortiter crebre punctato, nitido, viridi, apice nigro; corpore subtus cyanescenti.

♂. Capite cornu longo, acuminato, leviter curvato, crebre punctato instructo; thorace ante basin utrinque tuberculo acuto, nigro armato.

♀. Capite cornu lato, sat longo, crebre punctato, ad apicem bifurcato instructo; thorace disco medio fossa sat magna vix punctata, et supra fossam processu sat magno, lato, horizontali, antice paullo angustiore, ad apicem triangulariter exciso instructo.

Long. 13 lin.

Hab. Colombia, Santa Fé de Bogota (*Buquet*).

This species is allied to *P. hastifer*, but is quite differently coloured, and the armature of the thorax and of the head in the female are different. The thorax is coarsely rugose, obliquely declivous anteriorly, the male having two distant erect black tubercles at a short distance from the base. The female has on the head a broad, erect, slightly curved horn,

the apex of which is deeply triangularly cleft. The thorax has a smooth cavity in the middle of the disk, and projecting over this cavity there is a rather broad prominence, which is black, horizontal, and triangularly cut out at its apex. The elytra are dull dark green, with shining, sparingly punctured or wrinkled coppery costæ.

Phanæus horus.

Prasinus; capite antice nigro, angulis posticis auratis, epistomo bidentato, vertice cornu erecto, acuminato sat gracili lævissime flexuoso armato; thorace antice viridi, postice cyaneo-viridi, ad latera aurato; disco antice excavationibus duabus rotundatis approximatis (a carina divis) lævibus, et postice excavatione profunda lævi utrinque carina laminiformi sat elevata instructo, basi medio vix producta bifoveata; elytris surdis, leviter striatis, interstitiis subplanis, secundo quartoque leviter convexis, ad basin transversim impressis (basi ipsa paullo elevata) sutura elevata nitidissima, limbo sat nitido; pygidio nitido, basi sat crebre punctato; tibiis anticis, et intermediis et posticis antice tarsisque cyaneo-nigris. ♂.

Long. $9\frac{1}{2}$ lin.

Hab. Brazil.

This species appears to be nearest to *Ph. saphirinus*, Sturm, but is at once distinguished by the dull elytra. The head is similar, but there is an oblique ridge in front of the eye extending nearly to the posterior angle; the space in front of this ridge is punctured; the horn is slender and is only about $2\frac{1}{2}$ lines long. The thorax has the anterior angles very obtuse, but not so much rounded as in *Ph. saphirinus*; the sides are more punctured; the armature is on the same plan, but the three impressions or excavations are nearly equally deep and more equal in size; the ridges on each side of the posterior impression are more developed, less approximate, and more directed forward over the anterior excavations; anteriorly they unite below and join the ridge which divides the anterior excavations. The elytra are quite different and much resemble those of *Ph. splendidulus*, but the interstices are still less convex, and the foveæ so common at the base are almost entirely obliterated.

The single male example before me bears a label which is not very distinct, but appears to be "Brésil. De Cand."

XIII.—*Descriptions of some new Species of Lepidoptera collected by Mr. Herbert Ward at Bangala, on the Congo.* By
EMILY MARY SHARPE.

Romaleosoma rubronotata, sp. n.

General colour black, green, and yellow.

Fore wing: costa and hind margin black, with a broad band of black extending from the hind margin to the costal nervure, crossing the middle of the wing. There is a small subapical patch of green and a larger patch of the same colour on the inner margin. There is no sign of any red at the base.

Hind wing: hind margin scalloped with white, with a very broad border of black followed by a subterminal border of heavy black spots shaded with green. From the costa, crossing the disk, is a band of deep ochre. The basal area is green, and at the base one small spot of red.

Underside: *fore wing* yellowish or greenish yellow, with markings and spots of black; three very distinct black spots in the discoidal cell, with a black transverse mark at the end of the cell, and a row of hastate black markings, increasing in size towards the inner margin. The small patch of red at the base is rather distinct.

The hind wing has the whole of the basal area ochre-yellow, with a patch of green in the discoidal cell; three distinct black spots in the cell, with an exterior row of larger black spots. The subterminal row on the hind margin is heavily marked with black hastate spots, with a narrow border of green dividing the row from the black hind margin.

Romaleosoma themis, Hübner.

General colour black, green, and yellow.

Fore wing: costa and hind margin black; from the costal nervure crossing the apical portion is a band of deep yellow. There is a small patch of green on the inner margin and at the base a little mark of red.

Hind wing: whole of the basal area bluish green, with a broad hind marginal border of black, which terminates in two black spots towards the inner margin. The red patch at the base of the wing is very indistinct.

Underside: hind margin black, with a subterminal row of black hastate spots; the band of yellow strongly marked; at end of the discoidal cell a narrow transverse band of black; the inside of the cell pale blue, with two black spots of different size. The red at the base of the wing is very large.

The hind wing has the hind margin black, with a subterminal narrow border of blue, followed by a row of black hastate spots. The inner margin and discal portion yellow. From the costa there is a row of black spots varying in size; the cell blue as in the fore wing, marked with some black spots. The red patch at the base

The *female* differs a great deal from that of *R. themis*, the large patch being entirely white instead of yellow; this patch is tinged with blue towards the base. On the inner margin the large patch of bluish white extends to the first median nervule and almost unites with the large white apical patch on the fore wing. The red basal patch not very distinct, but visible between the median and submedian nervules. The basal area, discoidal cell, and hind margin black, the latter being scalloped and showing the white fringe between the nervules very distinctly.

The hind wing very dark green, with one small red spot at the base. The whole of the central area yellow, and the hind margin with a very broad black border.

The underside is very similar to that of *R. themis*, Hübn., but is much paler and all the markings and spots are very distinct.

Exp., ♂ 3.25, ♀ 4.1 inches.

The type is in the collection of Mr. Philip Crowley.

Romaleosoma Herberti, sp. n.

General colour of fore wing ochre, with greenish reflexions and a distinct band of rich ochre before the subapical area.

Fore wing: white apical patch large.

Black subapical patch interrupted in the centre by two ovate greenish spots.

Costal margin ochre.

In both species the hind margin has a broad dark border, though

is much larger and distinctly marked.

The *female* is much blacker, with a bluish patch on the inner margin. Near the apical portion of the fore wing is a large yellow patch, bigger than in the male.

The hind wing has the central area blue, with a broad black border on the hind margin. The red at the base of both wings is visible, though rather smaller on the hind wing.

The underside is so exactly like that of the male that it is unnecessary to describe it.

Romaleosoma Crockeri, Butler.

General colour of fore wing black, with greenish reflexions towards the inner margin and basal area; the band before the subapical area pale ochre.

Fore wing: white apical patch small.

Black subapical patch nearly uniform, with no green spots.

Costal margin ochre.

this border is much darker in *R. Crockeri*; there is a distinct dark shading along the costa and each side of the transverse ochraceous bands, being much darker and more pronounced in *R. Crockeri*, Butl.

Hind wing ochraceous, with greenish reflexions and broad dark green subterminal band, the white on the scalloped hind margin very distinct. No black basal area.

Underside: very similar to that of *R. Crockeri*, the general colour being more yellow, with the black markings much fainter. In the discoidal cell there are only two small black spots on the fore wing, with a small patch of apple-green in the cell.

Hind wing: on the costal margin is a streak of crimson; the discoidal cell green, and the inner margin deep yellow, as in *R. Crockeri*.

The *female* ochraceous, with the costa, apex, and hind margin deep brown.

The yellow transverse band, from the costal margin to the hind margin, rather wider than in the male.

The hind wing has the whole of the basal area ochraceous, with a broad hind marginal border brown.

Underside much paler, with the light green patch and three black spots in the discoidal cell, on the fore wing. The discoidal

Hind wing: with a large basal area of dark green, with the discal portion ochre, which colour occupies the centre of the wing, this again shading into green near the black hind margin, which is very broad, and shows very indistinctly the white on the scalloped edge.

Underside: deep yellow, with the discoidal cell green, and three black spots very distinct in the cell. At the end of the discoidal cell there are two black transverse lines, the outer one near the apex, extending to the first median nervule of the fore wing.

Hind wing yellow, with a broad deep crimson streak on the costal margin.

The discoidal cell green, with two black spots in the cell near the base; round this green patch is a row of black spots between the nervules, commencing above the subcostal nervule to just below the discoidal or radial nervule; there is also a small black transverse line.

The *female* is very similar to the male, but is larger.

cell green, with one black spot, on the hind wing.

Exp., ♂ 3·5, ♀ 4·0 inches.

Hab. Bangala.

Romaleosoma sarita, sp. n.

General colour bright green, with markings of black or very dark green.

Fore wing: a broad band of black from the base of the discoidal cell extending to the hind margin, with a small white fringe to the latter. There is a triangular patch of green on the apical portion, and a patch of green on the inner margin extending to the base of the wing.

Hind wing: bright green, with the hind margin black; there is a submarginal row of green spots of small size, which becomes more indistinct as they approach the costa.

Underside: greener, with costal and discoidal cell deep yellow, with three small black spots in the cell, on the fore wing.

Hind wing: green, with the whole of the inner margin deep yellow as in *R. francina*, but there is no visible marking or spot.

Exp. 3·5 inches.

Hab. Bangala.

Romaleosoma francina, Godt.

General colour steel-green, with a transverse line of pale yellow, with some blue and black spots.

Fore wing: bright steel-green, with a very indistinct transverse yellow band from the costa to the border on the hind margin. In the discoidal cell there are three black spots, with two of the spots forming a bar at the end of the cell.

Hind wing: basal area steel-green, with one very large black spot at the end of the discoidal cell; there are two smaller spots in the cell. The hind margin has a very broad black border, this border being divided by a row of blue spots varying in size.

Underside: bright red, and in the discoidal cell of both wings are some black spots varying in size. On the hind wing, from the middle of the costa, is a narrow transverse band of silvery white.

LEPIDOPTERA HETEROCERA.

Fam. Nyctemeridæ.

Girpa Wardi, sp. n.

General colour creamy white, with the costa, apex, and hind margin black.

Fore wing: the black patch

Girpa circumdata, Walk.

General colour creamy white, with the costa, apex, and hind margin black.

Fore wing: no black at the

at the base of the wing much larger in size, and extending along the inner margin, which greatly reduces the size of the white portion; this white patch extends up to the discoidal cell. The black apical patch is relieved by a small white ovate spot.

Hind wing: white, with a very broad border of black on the hind margin; there is also a small patch of black at the base.

Underside same as above; at the base of both wings is a patch of rufous, rather larger in size than in *G. circumdata*.

Hab. Bangala.

I add the description of another apparently new species of Moth.

Otroeda Jonesi, sp. n.

General colour smoky brown, with the costa, apical portion, and hind margin of the fore wing rather darker brown. On the hind marginal border is a row of six white spots varying in size.

Near the end of the discoidal cell, and below the subcostal nervure, is a transverse band of white, increasing in width a little above the posterior angle; a second band of white a little below the apex of the fore wing.

At the posterior angle are three small white spots extending up towards the apex. The submedian nervure, from the base to the hind margin, has a very distinct streak of white; there are also some other streaks of white, one near the costal margin and another in the discoidal cell, with two larger white streaks, much longer, just below the cell.

base, the white patch on the inner margin extending to the base of the wing. The black apical patch is relieved by a small white ovate spot.

Hind wing: whole of the basal area white, with an irregular border of black on the hind margin. At the base there is no black visible as in the fore wing.

Underside exactly the same as the upperside; at the base of both wings a small patch of rufous, this colour being less plainly marked on the hind wing.

Otroeda hesperia, Cram.

General colour white, with the costa, apical portion, and hind margin of the fore wing brownish black. On this black border is a subterminal row of six white spots varying in size.

About the middle of the fore wing, from the costa, crossing at the end of the discoidal cell, is a transverse band of brown, decreasing to a point towards the first median nervule, and sometimes joining the black border on the hind margin. Near the base is a second brown band crossing from the costa through the middle of the discoidal cell and joining the submedian nervure at the posterior angle. From the base, pointing to the hind margin, are a number of brown streaks.

Hind wing entirely smoky brown, with a very broad hind marginal border of dark brown, relieved by a row of white spots on the fringe, and a subterminal row of eight white spots varying very much in size. A yellow patch at the anal angle is also visible, though much darker in colour.

The underside is very similar to the upperside in markings, though the general colour is rather paler.

Hab. Ogowé River, Gaboon, (J. W. Jones).

Hind wing entirely white, with a border of brownish black on the hind margin. On this border is a subterminal row of white spots, as on the fore wing, with the exception of another row of white spots on the fringe, this row being very distinct on the hind wing. On the fore wing there are only four white spots commencing from the posterior angle. A yellow patch above this black hind marginal border is very distinct, and in some specimens extends to the middle of the wing, while the other half is pure white.

XIV.—Notes on some Shells recently received by the British Museum. By EDGAR A. SMITH.

FROM time to time the British Museum has been indebted to Mr. John Brazier, of Sydney, for very valuable donations of Mollusca and other specimens. A recent consignment contains a series of interesting species, upon some of which I have made the following notes. I also add descriptions of such as appear to be new, and finally append a list of the species of Land-shells at present known from Woodlark Island and the D'Entrecasteaux Group. I also take this opportunity of mentioning an omission in my paper on the land and freshwater shells of the Louisiade Archipelago, published in the 'Annals' for September 1889. *Helix diomedes* of Brazier*, unfortunately, was not referred to.

1. *Pupinella Angasi* (Brazier).

Pupina Angasi, Brazier, Proc. Linn. Soc. N. S. W. vol. i. p. 5.

Pupinella louisiadensis, Smith, Ann. Mag. Nat. Hist. 1889, vol. iv. p. 204, pl. xiii. figs. 3, 4.

Hab. New Guinea (*Brazier olim*); Rossel Island, Louisiade Group (*Brazier in litt. and Thomson*).

I described this species under the name of *P. louisiadensis*,

* Proc. Linn. Soc. N. S. W. vol. ii. p. 121.

being ignorant of Mr. Brazier's paper in the Proc. Linn. Soc. N. S. Wales.

Mr. Brazier has kindly called my attention to his description, and sent a splendid series of specimens (including the actual types) of his *Pupina Angasi*, which at once proves its identity with *P. louisiadensis*.

Another species of *Pupinella* from the Louisiade Archipelago has also received the name *Angasi*. This species was described by H. Adams in the Proc. Zool. Soc. for 1875. His description was read in April and published in August. Mr. Brazier's species appears to take a few months' priority, and must therefore be retained; the description was read in January of the same year, and published (so I am informed by Mr. Brazier) the following May. Under these circumstances I have much pleasure in adopting for the shell described by Adams the name "*Pupinella Smithii*, Brazier," as kindly suggested by Mr. Brazier in a letter dated April 15th of this year.

2. *Pupinella Braziera* (Smith).

Megalomastoma Braziera, Smith, Ann. Mag. Nat. Hist. 1888, vol. xix. p. 424, pl. xv. fig. 15.

Hab. Ferguson Island and Cape Pierson, Normanby Island, D'Entrecasteaux group, south-east of British New Guinea.

Since describing this species, I have had an opportunity of examining a series of specimens of the genus *Pupinella* from the Louisiade Islands, which shows that the characteristic notches in the labrum vary considerably in depth and other respects in species otherwise very much alike.

Quite a transition from a largely developed loop-like slit on the columellar side to a mere indication of a notch is observable in *P. grandis*, *Macgregori*, *minor*, *Smithii*, *Mouliniana*, *Angasi* (Brazier), and *Rosseliana*. The study of these forms now points to the conclusion that the present species should also be located in the genus *Pupinella*, and not in *Megalomastoma*. The labral notch may be said to have entirely disappeared in this species, which, however, still possesses certain characters in common with several of the other species, namely, the uniform reddish colour, the well-thickened reflexed peristome, which is united to the body-whorl above in the same manner, the circum-umbilical ridge or keel, and the sudden descent and contraction of the body-whorl near the aperture.

3. *Helix (Geotrochus) woodlarkiana* (Souverbie).

Hab. Woodlark Island (*Souverbie*), Normanby Island, D'Entrecasteaux Group (*Brazier*).

The three specimens sent by Mr. Brazier from the above locality differ in markings. All, however, are similar in form, and agree in having the characteristic brownish or violet stain at the upper part of the reflexed columella. One specimen is waxy white, varied with opaque creamy white, interrupted, obliquely arcuate streaks upon the upper part of the body-whorl, and the spiral zones, as described in the type, are only faintly noticeable. The peristome in this example is of a brown flesh-tint, in the two other specimens it is white. Souverbie's figure does not at all well show the pretty interrupted bands which ornament the upper surface. The keeled periphery appears to be constantly white.

4. *Helix (Geotrochus) Boyeri*, Fischer & Bernardi.

Hab. Admiralty Islands (*F. & B.*); Louisiade Archipelago (*Angas*); east end of Woodlark Island (*Brazier*).

Two specimens from Woodlark Island evidently belong to this species, but are differently coloured from the type. One is uniformly very light brown, with the exception of the white lip and a small lilac stain in the umbilical region. The other is cream-white, with two spiral brown bands, of which one above the periphery is a little broader than the other below it, and revolves up the spire. The slight prominence on the inner columellar edge shown in the figure is only present in one of the specimens at hand.

5. *Helix (Papuina) albocarinata*, Smith.

Hab. South Cape, British New Guinea; also east end of Woodlark Island (*Brazier*).

The two specimens from Woodlark Island undoubtedly belong to this species. They agree in every particular with the type, excepting that one has a few narrow interrupted opaque white zones on the upper as well as the lower surface, whereas the other has none, being uniformly semipellucid, with the exception of the opaque keel at the periphery. This specimen also is a trifle less elevated than the type. All have the yellowish stripe behind the slightly expanded lip.

6. *Helix (Hadra) bourkensis*, sp. n.

Testa anguste umbilicata, depresso globosa, subtenuis, nitida, flavescens, zonis duabus rufo-fuscis supra medium ornata; anfractus

5½, convexiusculi, sublente accrescentes, sutura subprofunda sejuncti, incrementi lineis tenuibus striati, superne minute granulati, ultimus antice vix descendens, ad peripheriam rotundatus, inferne quam supra nitidior, haud granulatus; spira brevis ad apicem obtusa; apertura late lunata, pallide fuscescens, zona lata saturatiore superne ornata; peristoma tenue, pallidum, leviter expansum, margine columellari dilatato et reflexo, umbilicum semiobtegente.

Diam. maj. 20 millim., min. 17½, alt. 14½; apertura 10 longa, 9½ lata.

Hab. Bourke, Darling River, New South Wales (*Brazier*).

This species in general appearance is considerably like *H. Broughami*, Angas, and *H. Angasiana*, Pfeiffer. The banding is exactly the same as that of the latter species, but its epidermis is yellower. It is also distinguished by its less globose form, smaller body-whorl, its more glossy surface, especially the under surface, the much smaller umbilicus and much thinner peristome, and a different granular sculpture on the spire. *H. Broughami* has an additional brown band below the periphery, has a finer granulation above, the umbilicus is more open and surrounded by a coloured zone, and the aperture is wider. *H. Stutchburyi*, Pfr., is a smaller form, more finely granular above, and in the type the spiral zones are much narrower than in the present and the two above-named species.

7. *Helicina woodlarkensis*, sp. n.

Testa parva, breviter trochiformis, solidiuscula, pallide corneo-lutea, concolor, inferne nitidior quam supra, undique spiraliter tenuiter sulcata, lineis incrementi obliquis striata; anfract. 5, celeriter crescentes, subplani, ultimus in medio acute angulatus, infra convexiusculus, callo basali pellucido munitus; spira breviter conica, ad apicem haud acuta; apertura subobliqua, longit. totius ⅔ fere æquans; peristoma pallidum, mediocriter expansum, operculum fere album, externe leviter concavum.

Alt. 6 millim., diam. maj. 8½, min. 7; apertura 3⅔ longa, 3 lata.

Hab. Woodlark Island (*Brazier*).

This species in form and sculpture is very like *H. reticulata*, Pfr. It is, however, somewhat larger, has no variegated markings, the outer lip is more expanded, and the operculum is differently coloured. *H. reticulata* occurs at Cape York and other places in North-east Australia. The "Cape Flattering," mentioned by Sowerby*, should of course be Cape Flattery on the North Queensland coast. His figure of that species represents the spire rather too much raised.

* Thesaurus Con. vol. iii. pl. vii. f. 231-2.

8. *Scalaria ballinensis*, sp. n.

Testa elongata, pyramidalis, imperforata, lævigata, haud costulata, albida vel pallide fuscescens, paulo nitida; anfractus normales 9, mediocriter convexi, regulariter sub lente accrescentes, lineis incrementi conspicuis obliquis, hic illic subvariciformibus, striisque spiralibus tenuibus subobsoletis sculpti, superne ad suturam leviter obliquam irregulariter crenulati, ultimus circa medium porca obtusa angulatus; apertura parva, ovato-circularis, longit. totius $\frac{1}{4}$ adæquans; columella obliqua, inferne incrassata, subeffusa; labrum vix incrassatum.

Longit. 17 millim., diam. $6\frac{1}{3}$; apertura $4\frac{1}{4}$ longa, 3 lata.

Hab. Ballina, near mouth of the Richmond River, New South Wales.

This species is remarkable on account of the smoothness of the whorls and the absence of ribs so characteristic of *Scalaria*. Of the four specimens presented to the British Museum by Mr. Brazier, one only presents any colouring. The total whiteness of the remaining three may be due to bleaching, as they appear to be dead shells. The coloured example is pale brown, crossed here and there by a few oblique whitish lines or pseudo-varices, which evidently mark periods of growth. Behind the outer lip and parallel with it is an orange stripe, particularly noticeable within the aperture. The apex of all the specimens being broken away, I am unable to describe the nuclear whorls. The form and proportion of the whorls of this species are fairly well illustrated by *Sc. (Acirsa) borealis*, Beck.

*List of Land-Shells of Woodlark Island.*1. *Helix (Geotrochus) woodlarkiana*, Souverbie.

Helix (Geotrochus) woodlarkiana, Souverbie, Journ. de Conch. 1863, pp. 76, 172, pl. v. f. 2.

Hab. Woodlark Island (*Souverbie*).

2. *Helix (Geotrochus) Boyeri*, Fischer & Bernardi.

Helix (Geotrochus) Boyeri, Fischer & Bernardi, Journ. de Conch. 1856, vol. v. p. 297, pl. 9. ff. 8, 9.

Hab. Woodlark Island (*Brazier*).

3. *Helix (Papuina) albocarinata*, Smith.

Helix (Papuina) albocarinata, Smith, Ann. Mag. Nat. Hist. 1867, vol. xix. p. 422, pl. xv. f. 12.

Hab. Woodlark Island (*Brazier*).

4. *Partula similaris*, Hartmann.

Partula similaris, Hartmann, Proc. Acad. Nat. Sci. Philad. 1886, p. 30.

Hab. Woodlark Island (*Brazier*).

5. *Partula woodlarkiana*, Hartmann.

Partula woodlarkiana, Hartmann, Proc. Acad. Nat. Sci. Philad. 1886, p. 33.

Hab. Woodlark Island (*Brazier*).

6. *Pupina Moulinsiana*, Fischer & Bernardi.

Pupina Moulinsiana, Fischer & Bernardi, Journ. de Conch. 1857, vol. v. p. 299, pl. ix. ff. 6, 7.

Hab. Woodlark Island (*Montrouzier & Brazier*).

7. *Helicina Fischeriana*, Montrouzier.

Helicina Fischeriana, Montrouzier, Journ. de Conch. 1863, pp. 76, 171, pl. v. f. 3.

Hab. Woodlark Island (*Montrouzier*).

8. *Helicina woodlarkensis*, sp. n.

Hab. Woodlark Island (*Brazier*).

Species from the D'Entrecasteaux Group.

In the Annals and Mag. Nat. Hist. 1883, vol. xi. p. 191, I described four species of *Helix*, viz. *H. oxystoma*, *H. latiaxis*, *H. Tapparoonii*, and *H. Gervardi*, as coming from this group of islands.

Mr. Brazier, in the Proc. Linn. Soc. New South Wales, 1884, vol. ix. p. 804, has pointed out that these species were collected on the mainland of New Guinea itself, inland from Port Moresby. Excluding these species, there appear to be only two land-shells at present known from these islands, namely, *Pupinella Brazieræ*, Smith, and *Helix (Geotrochus) woodlarkiana*, Soubervie, both of which I have above referred to.

XV.—*Descriptions of Eight new Species of Chalcosiidæ.*

By HERBERT DRUCE, F.L.S. &c.

THE specimens are all in my own collection.

Trypanophora anchora, sp. n.

Primaries and secondaries chrome-yellow with the veins, a band crossing the middle of the wing and the outer margin

of both wings broadly black, the underside the same as above ; the head and thorax black, the collar, tegulæ, and a large spot at the base of the thorax chrome-yellow, the abdomen black banded with chrome-yellow, the anus black, antennæ and legs black.

Expanse 2 inches.

Hab. Sumatra.

This species is very distinct from any known to me.

Pompelion philippensis, sp. n.

Primaries dark brown, shot with bright dark blue along the costal margin and at the apex, the same as in *Pompelion ampliatus*, Butler. Secondaries dark brown, with a large purplish-blue patch at the apex, somewhat the same as in *Pompelion marginator*, Guer., but shading off to silky white on the costal margin. On the underside this species closely resembles *P. marginator*, but has the veins more distinctly marked with blue-green. The head and antennæ black, the collar bright carmine, the tegulæ deep blue ; the thorax and the upperside of the abdomen deep black ; the underside of the thorax and the abdomen bright carmine, the latter banded with black ; the anus bright carmine, the legs blue-black.

Expanse 3 to 3½ inches.

Hab. Philippine Islands, Mindanao.

This species is allied to *P. marginator* and *P. ampliatus*, from which it is readily distinguished by the silky white mark near the apex of the secondaries.

Pompelion anethussa, sp. n.

Primaries dark brown, the costal margin and the apex shaded with dark blue. Secondaries dark brown, with a large bright blue patch at the apex, which extends partly round the outer margin ; the outer margin from the anal angle to the blue patch near the apex broadly bordered with brownish white. The underside of both wings pale brown, the costal and outer half of the primaries thickly irrorated with green scales. The head, thorax, and upperside of the abdomen deep black, the anus and underside red.

Expanse 2½ inches.

Hab. Malay Peninsula, Province Wellesley.

This species seems to be allied to *P. acrocyanæa*, De Haan, from which it is at once distinguished by the pale margin to the secondaries, and also to *P. valentula*, Swinhoe, but it is a much smaller insect than that species.

Amesia striata, sp. n.

Primaries and secondaries dark brown. The primaries with two spots in the middle of the cell, and two spots at the end of the cell, two streaks from the base along the inner margin all white, and two rows of large white spots extend from the costal margin near the apex to the inner margin and anal angle. Secondaries with a marginal row of large white spots, above which is a row of small white streaks extending from the costal margin round the outside of the cell to the inner margin above the anal angle. The underside of both wings brown, with all the white markings as above, but very much more distinct. The head, antennæ, thorax, abdomen, and legs black; the tegulæ black with bluish-white tips, the abdomen with a central row of white spots extending from the base to the anus, the underside banded with white; the palpi black above, on the underside white.

Expanse 3 inches.

Hab. Borneo, Labuan.

This insect has a remarkable resemblance to *Danaïs vulgaris*, Butler, from the same locality.

Epyrgis Distanti, sp. n.

Primaries and secondaries creamy white, with the veins of both wings edged with brown; the primaries are dark brown close to the base, with a small but very distinct white dot on the base of the subcostal nervure. The underside the same as above, but with the brown markings slightly narrower. The head, antennæ, thorax, and abdomen dark brown; the front of the head, the collar, and tegulæ white; the three anal segments of the abdomen shot with bright blue, on the underside the abdomen white banded with bluish black; the legs brownish white.

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

Hab. Malay Peninsula, Province Wellesley.

A fine distinct species, quite unlike any other known to me. I have much pleasure in naming it after Mr. Distant, whose work on the Malayan Rhopalocera is well known.

Chatamla antianira, sp. n.

Primaries, the basal half bright yellow, the apical half dark purplish black, crossed by two bands of bluish-white semihyaline spots; the basal portion of the wing is marked with a rather wide >shaped band, that extends from the costal to the inner margin, a black streak extends from the

base to the middle of the > shaped mark. Secondaries bright yellow; a wide purplish band crosses the middle of the wing but does not reach either margin, below which is a waved band and a submarginal row of spots that extend from the costal margin to the inner margin, both purplish black; the outer margin and the veins up to the middle of the wing purplish black. The underside the same as above. The head, thorax, and abdomen bright yellow; the thorax banded with black; antennæ bluish black; the legs brownish yellow. The female is like the male, but slightly paler in colour.

Expanse ♂ ♀ 3 inches.

Hab. Sumatra.

This species is nearly an exact mimic of *Euschemia subrepleta*, Walk.

Chatamla lyra, sp. n.

Primaries purplish black, with all the markings semi-hyaline bluish white. Secondaries, the basal portion of the wing bluish grey, very slightly hyaline; a large elongated broad purplish-black band about the middle, but not reaching the margins, below which the wing is bright yellow crossed by a waved band of purplish black from the apex to the inner margin, a marginal row of spots and the outer margin purplish black. The head and the abdomen yellow; the tegulæ, thorax, base of the abdomen, and antennæ bluish black; the thorax with a greyish shade; the underside as above.

Expanse 3 inches.

Hab. Nias Island.

This species is very like *Euschemia regalis*, Butl., but has much more yellow on the secondaries.

Milleria lyra, sp. n.

Allied to *M. ficta*, Walker, but differs as follows:—

Male.—Upperside: the primaries and secondaries are pure white instead of cream-colour, the black border to the primaries is very much narrower, and the submarginal row of white spots are larger and more distinct; the secondaries are without any of the black markings on the outer margin near the apex. Underside: primaries as above; secondaries with the yellow portion of the wing smaller and darker in colour than in *M. ficta*; a submarginal row of elongated white markings extends from the apex to the inner margin slightly above the anal angle. Female: primaries and secondaries

greyish black, the primaries with a greyish-white spot at the end of the cell. The basal half of the secondaries greyish white, slightly tinged with yellow on the inner margin above the anal angle. The underside of both wings greyish black; primaries with two spots at the end of the cell, and a marginal row of spots extending from the costal margin close to the apex to the anal angle. Secondaries with four white elongated streaks close to the apex, and a large chrome-yellow patch on the inner margin. The head, thorax, abdomen, antennæ, and legs black.

Expanse ♂ 2 inches, ♀ 2¼ inches.

Hab. Malay Peninsula, Sungei Ujong.

XVI.—*Further note on Francolinus Hildebrandti, Cabanis, and Observations on Pternistes Humboldti, Peters.* By W. R. OGILVIE-GRANT (Nat. Hist. Mus.).

IN the Ann. & Mag. Nat. Hist. 1889, iv. p. 145, I published the singular fact, previously suspected by myself, and afterwards proved by Mr. Hunter, that *Francolinus Altumi*, Fischer and Reichenow, is the male of *F. Hildebrandti*, Cabanis, and that the latter name, having priority, must stand. Mr. H. C. V. Hunter, to whom we are indebted for a fine series of these specimens, writes as follows in Appendix I. to Sir John Willoughby's 'East Africa and its Big Game,' p. 292:—"That these are one species there is little doubt. Both Dr. Abbott and I myself sexed a great number of these birds; all the *Hildebrandti* turning out to be females, and all the *Altumi* males. The Wa-čaga boys daily brought in many of them to camp alive, probably caught in the same trap, and at least fifty birds were sexed with the above result. They also, like *Schuetti*, live in thick low bush, and were rarely shot." I mentioned the above discovery to Capt. Shelley, who recorded the bare fact in his paper on the birds collected by Mr. Hunter in Eastern Africa (P. Z. S. 1889, p. 370), but without giving any reason or referring to my paper as quoted above. By some extraordinary accident he also included *F. Schuetti* in their synonymy, placing all three names under the heading *Francolinus Altumi*. This error called forth a somewhat indignant reply from Herr Matschie (J. f. O. 1889, p. 340), in which he very rightly ridicules the idea of *F. Schuetti* being synonymous with *F. Hildebrandti* and *F. Altumi*, and remarks that it may not be absolutely

impossible for *F. Hildebrandti* to be the young of *F. Altumi*, in which case the former name would have priority. But it is perfectly clear that the type *F. Hildebrandti* is a fully adult female, and exactly similar to many others before me.

Dr. Reichenow (J. f. O. 1890, p. 77) supplements Herr Matschie's remarks as follows:—"The description of *F. Hildebrandti* is founded on a female specimen. Comparing this specimen with an apparently equally adult female of *F. Altumi* in the Berlin collection, the former is distinguished by having the ground-colour of the upper parts rust-colour, while in the latter it is olive-grey*. The underside in the former is intense rust-brown, in the latter it is fawn-colour; and the former has uniform reddish-brown cheeks, which in the latter are grey-brown with black streaks. The male of *F. Hildebrandti* is still unknown, and may, like the male of *F. Altumi*, have the underparts spotted with black."

It will naturally strike anybody reading the above that Dr. Reichenow, while denying the truth of my statement, here records for the *first time* the extraordinary fact that the male and female of his *F. Altumi* are totally different from one another! A fact unique among Francolins apparently causes him no surprise, and is not thought worthy of previous record! The description given of his so-called adult female in the Berlin Museum, which he compares with the type of *F. Hildebrandti*, is so meagre that it is difficult to form a very definite opinion, but I should gather from his remarks that his specimen is probably an immature male with the sex wrongly determined.

With regard to the identity of *Pternistes Humboldti*, Peters, with *P. leucoparæus*, Fischer and Reichenow, determined by Capt. Shelley and myself and recorded by him in the above-mentioned paper, Herr Matschie (J. f. O. 1889, p. 340) remarks:—"P. leucoparæus is considerably nearer to *P. nudicollis* than to *P. Humboldti*. *P. leucoparæus* and *P. nudicollis* are both grey-brown above, with black shaft-streaks without a trace of bands. *P. Humboldti* is yellowish brown above, with light bands on the back and tail, which bands are edged with dark towards the ends of the feathers. *P. leucoparæus* differs from *P. nudicollis* by the white throat-streak proceeding from the angle of the mouth, which in *P. nudicollis*

* All the specimens in the British Museum, both male (*F. Altumi*) and female (*F. Hildebrandti*), have the upper parts exactly alike, the ground-colour being rust-colour, shading into greyish olive towards the edges of some of the feathers.

collis is black with a white edge to each feather*, as well as by the white head-feathers, which have a black shaft-streak and a black border, whilst in *P. nudicollis* these feathers are grey, with a black shaft-streak but no border."

Reichenow supplements these remarks (J. f. O. 1890, p. 77) by saying:—"P. *Humboldti* cannot possibly be the same as *P. leucoparæus*, and should rather be united with *P. nudicollis*, which last species it resembles in having the cheeks striped with black, while in *P. leucoparæus* they are white; besides, it is much smaller."

The possibility of *P. leucoparæus* being the adult of *P. Humboldti* is not apparently entertained by either of the above writers; nevertheless there can be no doubt that this is so.

The translation of the original description of *P. Humboldti* given by Peters (Mon. Ak. Berl. 1854, p. 134) is as follows:—"Francolinus *Humboldtii*, n. sp.—Mandible, ophthalmic region, chin, throat, and feet blood-red; upper parts brown, ornamented with black spots and bars; sides of the neck white, with lanceolate black spots; front of the neck and breast greyish buff, with black spots; feathers of the thighs black, white in the middle. Total length 12·4 inches, bill 1·04, wing 6·4, tarsus 1·96, middle toe with nail 1·68. Tette."

From this description, as well as from the above remarks made from the type specimen in Berlin by the above-mentioned writers, I gather without doubt that the type of *P. Humboldti* is a young bird; and, in fact, I have before me an immature specimen from Dar-es-Salaam [no. 3 *infra*] which agrees almost exactly with Peters's description, but is somewhat older. The British Museum collection contains four specimens of *P. Humboldti*, on which I make the following notes, clearly proving the identity of *P. leucoparæus* with this species:—

No. 1 (♀), ad., Zambesi (Sir J. Kirk).—Most of the feathers in the centre of the breast and belly black; feathers of the back with dark shaft-streaks, some of the scapulars and outer secondaries barred and spotted with black; feathers behind the gape white, on the sides of the neck black with white edges; no spurs. Wing 6·7, tarsus 2·1.

* In fully adult specimens of *P. nudicollis* the feathers from the angle of the mouth and on the fore part of the cheeks are jet-black; it is only in younger specimens that they are edged with white. In *P. Humboldti* the young have the feathers on these parts white with black shaft-streaks, while in the adult they are pure white.

No. 2 (♂), ad., Mazoro, north of the mouth of the Zambesi (Earl Russell).—Feathers of the middle of the breast and belly quite black; shaft-streaks on the back much fainter than in No. 1; feathers behind the gape white and, passing down the sides of the neck, entirely surround the naked throat; sides of the neck black; long spurs with a rudimentary second pair on each tarsus. Wing 7·4, tarsus 2·4.

No. 3 (♀), immature, Dar-es-Salaam (Sir John Kirk).—Most of the feathers on the centre of the breast and belly white, with wide black margins and black shafts; on the back like No. 1, but more black cross bars and spots; *feathers from the gape white with black shafts*, and on the sides of the neck black with white edges; no spurs. Wing 6·4, tarsus 2·1.

No. 4, ♀ ad., River Tana, Sept. 1888 (H. C. V. Hunter, Esq.).—Breast and back like No. 1; feathers behind gape white, and, passing down the sides of the neck, surround the bare throat; sides of the neck black with white edges; no spurs. Wing 7·1, tarsus 2·1.

No. 1 and No. 2 come from near the locality (Tette) whence the type of *P. Humboldti* was originally described; No. 3 almost exactly answers the description of that type; while No. 4 comes from the same locality (Osi River) whence *P. leucoparæus* was obtained, and both in plumage and sex corresponds exactly with Fischer and Reichenow's description. As there is not the slightest doubt that these four specimens represent only one species, it is evident that *P. leucoparæus* is synonymous with *P. Humboldti*.

XVII.—*A few Remarks on Prof. Packard's Papers entitled "Life-History of Drepana arcuata" and "Hints on the Evolution of the Bristles, Spines, and Tubercles of certain Caterpillars"* (Proc. Boston Soc. Nat. Hist. vol. xxiv. pp. 482-559). By A. G. BUTLER, F.L.S., F.Z.S., &c.

THE above-mentioned very suggestive papers, for a copy of which I am indebted to their indefatigable author, constitute one continuous article, containing much valuable information diligently brought into a small compass.

Whilst admitting the force of many of Prof. Packard's arguments and the truth of most of the facts upon which they are based, it appears to me that at the outset there is one great difficulty, viz. :—If the arboreal habits of many moth-caterpillars have tended to produce hairs and spines, why is it that the greater number of butterfly-caterpillars so ornamented feed upon low plants—the *Vanessæ* on nettles and thistles, the *Argynnides* on species of *Viola*, the Satyridæ and Hesperiidæ on grasses and low-growing plants? Why, again, are many of the most hairy moth-caterpillars, such as that of *Euprepia caja*, confined to low herbage?

Prof. Packard has shown that the spines and humps of many larvæ tend to assimilate them to their surroundings, thus rendering them more liable to be overlooked by insectivorous animals; the existence of this resemblance, which nobody will be inclined to deny, since all field-entomologists have repeatedly observed it, can be explained by the action of natural selection in preserving those individuals which tend thus to become less conspicuous. In the case of spined Geometrid larvæ already assimilated to twigs it seems only natural that the atrophy of the abdominal legs on the looping portion of the larva should render outgrowths from other portions of the same segments more probable, and when such outgrowths tended more perfectly to conceal the larvæ from observation there can be little doubt that they would be retained.

A few of Prof. Packard's observations are open to question, and to these I would now briefly advert.

Speaking of the larva of *Dryopteris* at p. 490 he says it "is as well fitted as that of *Drepana* by its protective mimicry to avoid the gaze of birds and insect-enemies, while its longer bizarre 'tail' renders it still more forbidding to any insect assailants." Is this an ascertained fact or only a supposition? Has any bird ever whispered to Prof. Packard that a caterpillar with a "tail" or with caudal appendages of any kind is forbidding? Is not all the talk about terrifying colours, processes, and attitudes in caterpillars pure conjecture, which experiment proves or will prove to be erroneous?

The larva of *Cerura vinula* has two caudal processes with exsertile tentacles, used for driving off ichneumons; but the fact that these processes are so used (as I have observed personally) is not sufficient; they are also supposed to alarm birds, although they certainly do not.

In like manner the colouring of certain caterpillars is said by many able writers to serve as a danger-signal. It is quite

true that gaudily-coloured caterpillars are frequently avoided or very cautiously approached by insect-enemies; but it is assuming too much to declare that fear based upon reasoning is the explanation of the respect shown to such colouring; it appears to me to result rather from want of familiarity with or dislike to meddle with startlingly coloured larvæ, and can as little be attributed to reason as the dislike shown by most birds for white clothing or straw hats.

P. 497: “As hairy caterpillars are not usually devoured by birds, these hairs and spines have originated through natural selection and are danger-signals, indicating to birds that the wearers of such hirsute and bristling armature are inedible.” This statement is far too broad; for, although non-insectivorous birds naturally do not touch hairy larvæ, they are known to be eaten by the Cuckoo, and I have proved repeatedly that the Missel-Thrush, Song-Thrush, Blackbird, and Chaffinch do not hesitate to kill and eat them. I have never known any bird to show apparent fear of them.

“Every one knows how efficacious any hairs or bristles are in deterring ichneumons and *Tachinæ* from ovipositing on caterpillars, and it is well known that naked or slightly piliferous larvæ are more subject to their attacks than those which are densely hairy or spinose.”

I think if Prof. Packard were to collect full-grown larvæ of *Euprepia caja* in England he would find (as I have done repeatedly) that these densely hairy larvæ are more subject to the attacks of ichneumons than almost any caterpillar excepting that of *Ganoris brassicæ*. I should say that at least one in five perishes from this cause, and I have even known it worse than that, for I remember on one occasion that I only reared two out of a score of these larvæ, all the rest being filled with ichneumon-maggots.

P. 509 (note): “It may be questioned whether any wingless female Lepidoptera live on herbaceous plants.” Well, the larva of *Orgyia antiqua* is omnivorous and the larvæ of *Nyssia* feed on trees or low plants (according to Stainton); so that this question has already been answered.

I have thought it fair to call attention to these little blemishes in a paper the value of which I do not for a moment wish to depreciate, because in the present day some of the disciples of Darwin are, as it seems to me, far too eager to attempt to explain facts which at present we have not sufficient data upon which to argue. One thing is certain, and that is, that so long as we assume that all living creatures are endowed with the same likes and dislikes which we our-

selves possess, and upon such an absurd assumption build up a theory, we shall hopelessly grope for real light on the problems of Nature.

XVIII.—*Description of a new Genus and Species of Rhynchophorous Coleoptera.* By D. SHARP.

IN the summer of 1890, I received from Mr. Bartlett-Calvert, of Santiago, some specimens of a handsome weevil that he and Dr. Philippi thought would probably be new. It was accompanied by the following information:—"The weevils were found by me last year on the Pichi Nitrou Cordillera of Araucania, living on the *Araucaria imbricata*. The weevil lives in the body of the *Araucaria*, which it appears to mine in all directions, the pupa being buried in the rotten débris and frass; it lives at the height of 2300 metres, and I found it on nearly all the old trees, but never more than four or six specimens on each, and always in pairs, these being embedded in the crevices formed by the scab-like bark of the tree; some were feeding on the odorous resin which exudes from the lacerated trunk. The imago was found in the months of January and February." The larva and pupa were also found by Mr. Bartlett-Calvert and transmitted to me, but arrived in a state of complete disintegration.

On examining the insect thus alluded to, I was much interested to find that it is very closely allied to our genus *Hylobius*; a genus attached, so far as I know, exclusively to Coniferæ, and extending throughout the northern hemisphere, but apparently most numerous in species in E. Siberia, N. China, and Japan. Mr. Calvert's genus, which I propose to call *Calvertius*, is almost equally closely allied to the genus *Heilipus*, which in Tropical America is extremely numerous in species, some hundreds having been already described. Lacordaire considers *Heilipus* to be a composite genus, and it is therefore, without a knowledge of all its species, not quite legitimate to infer that some of them may not prove to be congeneric with *Calvertius*; but, so far as I can ascertain, this is not the case, and Mr. Pascoe, who has given more attention than any other entomologist to the big S. American genus, has been kind enough to inform me that he does not know any species of it to which *Calvertius* is specially allied.

CALVERTIUS, gen. nov. (*Hylobiides*, Lac.).

Rostrum cylindricum, modice elongatum; antennæ maris fere ad apicem, feminae bene ante medium, insertæ; scapo elongato, clava irregulari, ab articulo octo vix abrupte discreta. Scrobes latae, laterales, antè superne visibiles, postè superne occultæ. Oculi sat magni, transversi, subtus paulo angustiores. Tibiæ anteriores subcompressæ, intus minute serratæ vel tuberculatæ, ad apicem extus unco curvato armatæ. Metasternum modice elongatum. Coxæ anteriores parum prominulæ, contiguæ; prosternum antè minus profunde emarginatum. Coxæ intermediæ distantibus. Femora omnia haud clavata, fere simplices, subtus tuberculo minuto munita.

This insect is systematically closely allied to *Hylobius*, though differing in numerous details of minor importance; the rostrum, however, is more elongate and cylindrical, the antennæ are differently inserted in the two sexes, the femora are more linear, and the uncus of the front tibia is placed at the outer angle and is not directed abruptly inwards. In the form of the rostrum and front tibiæ *Calvertius* agrees better with *Heilipus*, but from all the forms of that great but composite genus it may be distinguished by the sublinear minutely tuberculate femora, and by the insertion of the antennæ being different in the two sexes.

Calvertius araucariæ, sp. n.

Suboblongus, nodulosus, rufo-niger, antennis nigris; thorace inæquali, lateribus plus minusve lobato-dilatatis; elytris tuberculis rufis fere in seriebus obliquis dispositis.

Long. absque rostro 15–18 millim.

Hab. Chili; in *Araucariam imbricatam*; cujus lignum annosum larva destruit.

Rostrum 4 or 5 millim. long, cylindrical, dull, much punctured, of a piceous colour; antennæ inserted in the male very near the tip, in the female about one third of the length behind it; eyes above rather widely separated, with a small deep canaliculiform fovea between them. Thorax with the surface very uneven, constricted near the front, and on each side expanded; there is a broad, vague, longitudinal impression along the middle near the base, this becomes furcate about the middle, and on the middle of the front there is another vague depression; the elevated parts are irregularly sculptured, almost as if corroded. The elytra are rather

oblong in form, with the shoulders almost rectangular; their surface bears numerous large, pale red nodules, with smaller asperities and irregularly arranged small depressions between them. The legs are obscure red, the tarsi blackish red.

Cambridge,
November 1890.

MISCELLANEOUS.

Phosphorescent Centipedes.

THAT there are luminous Myriopods has been known for many years, as also the fact that they occur only among the family Geophilidæ of the Chilopod Myriopoda. Both sexes are luminous, sometimes quite intensely so, and the luminosity spreads out over the whole ventral surface of the animal. If one of these Geophilids is taken up the luminous matter communicates to the hand of the observer or to anything else with which the specimen comes into contact.

There is considerable dispute regarding the origin of this phosphorescent matter. According to Dr. R. Dubois it is contained in the epithelial cell of the digestive tube, and the emission of the light depends on the moulting of the digestive tube. Mr. Macé, on the contrary, contends that the luminous matter is a glandular excretion, and that these glands (*glandes préanales*) are situated on the last two segments of the animal. Mr. J. Gazagnaire has satisfied himself that the luminous matter is secreted from glands situated on the sternal and episternal plates. Upon pressure these glands secrete a yellowish viscous substance, having a peculiar odour, and which is highly phosphorescent.

In a more recent article (*Mém. de la Soc. Zool. de France*, t. iii. 1890, pp. 136-146) Mr. Gazagnaire reviews all previous observations on luminous Geophilids, and finds that, so far as the European fauna is concerned, luminous specimens were found only between the end of September and beginning of November. The luminosity appears, therefore, only at a certain epoch in the life-history of these Myriopods. Further, in all more carefully recorded cases luminous specimens were never found singly, but always in pairs or in companies of three or more specimens. The few and fragmentary observations that have hitherto been made on the mode of reproduction in these animals seem to prove that the fecundation of the female takes place in autumn, or just at the time when the luminous specimens are found; and Mr. Gazagnaire is thus fully justified in connecting the appearance of luminosity with the excitement caused by sexual instinct.

In Algiers, Mr. Gazagnaire observed luminous specimens of *Orya barbarica* in the month of April; and he concludes that in other countries and in consequence of altered climatic conditions the period of luminosity probably differs from that observed in Europe.—*Insect Life*, vol. iii. no. 4, p. 173.

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[SIXTH SERIES.]

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XIX.—*On the Adaptation of Mammals to Aquatic Life.*
By Dr. WILLY KÜKENTHAL, Ritter-Professor of Phylogeny in the University of Jena*.

THE organization of the mammal is fitted for the life on dry land, just as that of the fish and the bird is adapted to an existence, in the one case in the water, in the other in the air; and we can form a good idea of the intensity of the struggle for existence when we observe how large a number of mammals has been driven from the surface of the land. The majority of the orders belonging to this class contain representatives which have adopted either a burrowing subterranean, an aerial, or an aquatic mode of life. The latter especially is of frequent occurrence, and we see how entire orders of mammals, such as the Whales, the Sirenians, and the Seals, have been driven into the water. Orders too, otherwise terrestrial, contain solitary representatives which have abandoned the terrestrial life, such as *Platypus* among the Monotremata and *Chironectes variegatus* among the Marsupialia, while among the Rodents we have a larger number:—

* Translated from the 'Zoologische Jahrbücher,' Abtheilung für Systematik, Geographie, und Biologie der Thiere, Bd. v. Heft 3, Jena, October 1890, pp. 373-379.

the Yellow-bellied Water-Mouse (*Hydromys chryso-gaster*);
Holochilus;
 the Water-Vole (*Arvicola amphibius*);
 the Musk-Rat (*Fiber zibethicus*);
 the Beaver (*Castor fiber*); and
 the Capybara (*Hydrochærus capybara*).

Among the Insectivora :

the Water-Shrew (*Sorex fodiens*) and
 the Desman (*Myogale*).

Among the Ungulata (Artiodactyla) :

the Hippopotamus (*Hippopotamus amphibius*).

Among the Carnivora :

the Otter (*Lutra*) and
 the Sea-Otter (*Enhydris*).

On a closer examination of these more or less exclusively aquatic creatures we find that, notwithstanding the variety of orders to which they belong, they nevertheless possess many common structural features, and we shall be perfectly safe in ascribing these points of agreement to the influence of the aquatic life.

Owing to adaptation to the life in water, therefore, changes have taken place in the organization of these animals. The extent of these changes will vary in direct ratio with the time during which the influence of the water has been operating; or, in other words, the changes will be greater or less according as a longer or shorter time has elapsed since the animals in question exchanged the terrestrial for the aquatic life. We have further to consider that many of the aquatic mammals which we have enumerated live by no means entirely in the water, but are at times land-dwellers as well. The next point to be ascertained is whether these changes are always manifested in the same direction.

In the case of a large number of forms, in order to become acquainted with the changes which have taken place, it is sufficient to compare the animals with their nearest relations on land. But, as a matter of course, closely allied terrestrial forms are to be found in the case of those mammals alone which have only recently adopted the water as their element; those which have been aquatic for a long time will be able to show no relations on land, since both the water as well as the land branch have struck off from one another in diverging

directions. Thus we are at once able to assign the water-rat to the voles (*Arvicolidæ*), the otter to the martens; but of the seals we are only able to say in a general way that they are allied to the Carnivores, as the Sirenians are to the Ungulates; while of the relationships of the typical aquatic mammals, the whales, we at present know nothing. Not that no hypotheses have been set up to explain the origin of the whales! The question of their descent has been largely ventilated, and the majority of the zoologists who have attacked the problem have not been behindhand with their answer. Let us pass over for the nonce the views of the older authors, and devote ourselves to the most modern theories of the phylogeny of the Cetacea!

Some naturalists consider the whales to have sprung directly from the hypothetical Pro-Mammalia, and to be therefore closely allied to the Reptiles, basing their hypothesis on similarities in structure, particularly with certain extinct reptiles, the Ichthyosauri; others place them near the Ungulates, with which they are supposed to be connected through the Sirenians. By other authors, again, the whales are held to be allied to the seals or to the Carnivora in general; nay, they are even said to lead to the seals through the Sirenians; and of the most recent workers at the group, one (Weber) comes to the conclusion that the whales possess certain characters pointing to affinities with the Carnivora, particularly with the seals, and others which suggest a relationship to the Ungulates; while the other investigator (Leboucq) is convinced, from the results of his work on the flipper, that in the whales we have extremely ancient mammals, whose ancestors never lived on land, but were only swamp-dwellers.

This is briefly what the most modern theories of the phylogeny of the whales amount to, and the views expressed are so divergent as not to convey an exalted idea of the present position of phylogenetic science. The thought involuntarily strikes us whether the method of phylogenetic inquiry may not in this case be somewhat inefficient. If we follow in detail the path which the various investigators, among them the foremost zoologists of the age, have each one pursued, we find that, of the various methods of obtaining phylogenetic knowledge, it has always been that of comparative anatomy which they have adopted, and that it has ever been similarities in structure with another group of animals which have persuaded them, according as they attached greater or less importance thereto, to connect the whales with the Ichthyosaurs, the Seals, or the Carnivores, with the Sirenians or the Ungulates.

Here lies, in my opinion, the chief weakness, from which all these hypotheses suffer; for we can quite easily conceive that two animals which exhibit many points of structural agreement may nevertheless not be allied to one another, but, as branches of two perfectly distinct orders, have gradually acquired similar characteristics through similar adaptation. It shall be my task to prove this with special reference to the hand of the aquatic Mammalia.

It must be laid down from the outset as a fundamental principle that all mammals living in water have sprung from terrestrial forms. It is not merely considerations of a general nature which lead to the advancement of this proposition; the proof has also been furnished in detail with the greatest certainty, and there is scarcely anything new to add to it*.

We will now, omitting a detailed account of the resemblances which have resulted from the adaptation to an aquatic existence, devote our attention in the first place to a brief general consideration of the external bodily form. It is doubtless hardly necessary to draw especial attention to the purely hypothetical nature of this method of examination.

All water-mammals have acquired a more fish-like form the longer and the more exclusively they have adapted themselves to the aquatic mode of life. There is no question thereby of any retrogression; the elongated, gradually diminishing form of body is the most practical for all vertebrates which move by swimming.

One section of the aquatic Mammalia is permanently confined to the water; another periodically spends a longer or shorter portion of its life on land, and from this there arises a highly important difference. In the case of those animals which dwell for a time upon dry ground we shall find that the extremities have not become so entirely adapted to the functions of swimming as in the case of the others. Anterior as well as posterior extremities are used upon the land as legs and in the water as paddles, and the principal alteration which we notice in animals of this class consists in an increase in the size of the hind limb, which, for mechanical reasons, is more utilized in swimming than the anterior extremity. This difference in size may be often noticed in very pregnant fashion in the case of the aquatic Mammals to which we have alluded.

In the case of those animals which remain permanently in the water the function of the extremities as ambulatory organs entirely disappears, and we are confronted with a modification which is of great importance for locomotion in water, in that

* For the Cetaceans see, for instance, Weber, "Ueber die cetoide Natur der Promammalia," *Anatomischer Anzeiger*, 1887, p. 42.

the tail supersedes the posterior extremities as a motive organ. This new method of locomotion, which possesses as great an advantage over the movement by means of the extremities as does the screw-steamer over the row-boat, brought into existence two very noticeable changes in the form of the body—in the first place the loss of the hind limbs, and then the transformation of the tail by expansion into a caudal fin.

In the case also of many temporarily aquatic animals the tail has already begun to take part in the function of swimming, and in consequence thereof has undergone an expansion, which is in most cases horizontal, as in the platypus or the beaver, the musk-rat and the desman alone possessing a laterally compressed tail. Nevertheless the functional importance of the caudal extremity cannot outweigh that of the hind limbs, since the latter are essential to the power of locomotion upon dry land which these animals possess.

The transition from the one principle to the other can be beautifully traced in the case of the seals; for the eared seals pass a relatively large proportion of their time on land, and consequently their hinder extremities still possess the power of locomotion, their position with relation to the body is similar to what obtains in the case of other land-animals, and in the water fore and hind limbs are equally utilized in the action of swimming. The true seals, on the other hand, live much more exclusively in the water, and therefore the function of swimming predominates and is transferred to the hind limbs, which, projecting from the body posteriorly, have assumed a tail-like shape and perform similar movements to those of, let us say, the tail of the whale, while the fore limbs relinquish the functions of mere oars, and are employed more for the purposes of balancing and turning.

The new method of motion attains its highest development in the Sirenians and the whales; the powerfully expanded caudal fin has become the sole motile organ, the anterior extremities functioning henceforth as rudders. We therefore see that in the practice of swimming by the series of aquatic mammals a new principle is gradually evolved, in that the motive power is transferred to the hinder end of the body, the consequence of which is the assumption of a more and more fish-like form.

The lines which we must consider the phylogenetic development of these processes to have followed have already been traced in a masterly manner by Roux*.

* W. Roux, "Beiträge zur Morphologie der functionellen Anpassung. —I. Structur eines hoch differenzirten bindegewebigen Organes (der Schwanzflosse des Delphin)," *Archiv f. Anat. u. Physiol.* 1883, p. 76.

author the only new element necessary for the earliest origin of the dolphin's caudal fin, as well as the attainment of its highest perfection, consisted in rough embryonic variations, which presented something approaching the form of a fin-like appendage, so that therefore this new formation is to be regarded as the product of individual selection in the Darwinian sense. The internal structure of the caudal fin of connective tissue, which is so extraordinarily practical and constructed according to mechanical laws, cannot, on the other hand, be explained by means of selection alone; it is a functional adaptation, a specialization of the qualities of the tissues.

What we have thus far established is this: in consequence of adaptation to the aquatic life the external form of the mammals concerned assumes a special fish-like shape; this transformation is intensified in the case of those mammals which remain permanently in the water, for in them a quicker and more agile motion is obtained by the substitution of the complicated lashing action of the tail for the oar-like action of the extremities. Every function of the hind limbs is suspended, and they therefore disappear, while the tail undergoes that expansion by which its utility is increased, and so becomes the caudal fin. In the case of the seals a transition is observable, in so far as one division, the true seals, use the posterior limbs in swimming in a similar manner to that in which the whales use their tail. It may here suffice to state that, from the standpoint of comparative anatomy, the attempt has been made (Ryder)* to explain the caudal fin of the whale and the hind feet of the seal as homologous structures.

Thus we see how similarity of outward form results from similar adaptation, in the present instance to life in water; and in the various aquatic mammals, to which we have alluded, we can trace this in all its varying stages.

These phenomena appear more distinct and applicable as direct proofs when we select separate systems of organs for the purpose of examination. It seems simplest to select the external body-covering of the aquatic mammals for the purpose of examination. We may state forthwith that great differences will be found between temporarily and permanently aquatic mammals as regards the partial transformation of the integument. Temporarily aquatic mammals, for instance, cannot do without a covering of hair, which to the others becomes a useless encumbrance. The changes which we

* John Ryder, "On the Development of the Cetacea, together with a Consideration of the probable Homologies of the Flukes of Cetaceans and Sirenians," United States Comm. of Fish and Fisheries, 1885, p. 427.

observe in the integument of the former are therefore comparatively small. They retain a thick fur of short close-lying hair, which, being well impregnated with grease, preserves the skin from saturation and also from loss of moisture when the animal leaves the water. In consequence of the more equable temperature of the water the shedding of the coat does not proceed so vigorously as in those of the nearest allies of these creatures on land.

Now while in the case of those animals which only seek the water for short periods the hair is quite efficient for the purpose of regulating the radiation of heat from the body, it is not so in the case of those which remain in the water for a longer time. Water is a better conductor of heat than air, and we therefore see how animals, especially where the temperature of the water is low, as in the polar regions, are clothed with a layer of fat lying beneath the cutis, which checks the radiation of heat better than could a coat of hair. The more absolutely the animal adapts itself to the life in water the less will be the use of the hairy covering, owing to the shortness of the stay on land; and, as a matter of fact, in the order of seals, hand in hand with the biological observations of the longer or shorter time spent on land by the various species, we can determine the presence of a denser covering of hair or detect a thinning of the coat, corresponding with the gradual increase of the layer of blubber.

In those mammals which live entirely in the water the coat of hair disappears. Thus adult Sirenians exhibit only scanty vestiges of such a covering, while their embryos still exhibit traces of a thick coat of hair extending over the whole body, including the limbs and tail.

In two embryos of *Manatus*, respectively 11 and 26 centim. long, I find the following appearance:—The integument of the smaller of the two is still smooth, with the exception of a number of regularly arranged small brown papillæ, which are gathered together on both sides of the upper lip; in the larger specimen fine stiff hairs project from the papillæ, which are disposed in longitudinal rows, and the external coat now acquires a resemblance to that of the Indian elephant, in which likewise stiff hairs about 1 centim. in length are arranged at certain intervals from one another in longitudinal rows; but besides this, the skin of the embryo of *Manatus* exhibits a vast number of very fine openings between the papillæ, which must be regarded as the mouths of follicles belonging to finer hairs. The anterior extremities and the tail also exhibit this hairy covering. On both sides of the upper lip the vibrissæ, which persist in the adult, have grown

stronger. Precisely similar relations are found in *Halicore dugong*. A large embryo, 5 feet 4 inches long, described by Turner *, shows, besides isolated silky hairs arranged in rows and more numerous on the head and trunk than on the limbs, follicle-mouths closely packed between these, belonging to very fine hairs which have not appeared.

It follows that there can be no doubt that the Sirenians have sprung from animals with a thick covering of hair.

A precisely similar hairy covering is also found in the hippopotamus †. While old specimens possess thick bristles upon the upper and under lip, which become sparser on the dorsal surface of the head and trunk, the skin of the head and neck of a new-born animal exhibits a tolerably thick coat of lanugo-like hairs, which therefore subsequently disappear. But the whales also show vestiges of a former hairy coat, and in this respect the Balænoidea are most noticeable; even in adult animals solitary stiff bristles are still to be found in the cephalic region.

In a rorqual (*Balænoptera musculus*) 62 feet long I found at the tip of the lower jaw a triangular patch, 15 by 6·5 centim., of regularly arranged pits, which are to be regarded as the remains of hair-follicles. These pits, which were about 2 millim. broad and 1 millim. deep, were disposed in about a dozen rows, the longest of which contained twenty-six pits. The terrestrial ancestors of the whalebone whales therefore, besides having a coat of hair over the whole body, also possessed a thick tuft of vibrissæ upon the chin, much in the same way as the walrus or the bearded seal bear them on both sides of the upper lip in front. Embryos of the latter animals exhibit areas of pits in this region, just as regularly arranged as in the adult rorqual.

On the body of the same rorqual I found scattered hairs arranged as follows:—On the upper jaw they stood in rows close to the mouth; nearer the dorsal region they got more irregular, and disappeared behind the blow-hole. The lower jaw likewise possessed hairs arranged in three rows lying one above the other on each side; those of the lowest row in particular were surrounded by rings of pigment about the size of a cherry. The distance between each hair was about 1 foot.

Nearly all these brittle hairs, which were about one inch in

* Turner, "On the Placentation of *Halicore dugong*," Trans. Roy. Soc. Edinb. vol. xxxv. part 2 (1889).

† Vide Weber, "Ueber die Haut von *Hippopotamus amphibius*," Studien über Säugethiere, Jena, 1886, p. 3.

length and darkly pigmented on the upper jaw, but pale on the lower, sprang not directly from the surface of the skin, but were sunk in deeply pigmented pits. Such pits were moreover to be found spread over the body as far as the middle and especially numerous on the back, yet without any hairs springing from them. Some were deeper, some shallower, some merely indicated by a spot of pigment. We are therefore entitled to say that the last vestiges of a hairy coat are found on the entire anterior half of the body in the adult porqual.

In the whalebone whales the remains of a former covering of hair are still quite distinct; in this respect a sharp contrast is afforded by the toothed whales, which (with the exception of *Inia*) possess no hairs in the adult state, and in embryonic life only a few tactile hairs on both sides of the upper lip. That even these may be absent is proved by the white whale and the narwhal, in which not even traces of hairs are found at any period of their development.

Throughout the series of aquatic mammals we have learnt to recognize the reduction of the hairy coat as a striking phenomenon of adaptation, and have been able to follow its disappearance step by step both with the aid of comparative anatomy and also developmentally. The more the animals develop from temporary into permanent inhabitants of the water, of less use does the coat of hair become; owing to the change of medium and consequent better conduction of heat, it is no longer sufficient to protect the body from loss of warmth, and it is superseded by the layer of blubber beneath the skin.

The further phenomena of adaptation as seen in the skin are of a more secondary nature; integumentary glands, smooth musculature, and integumentary nerves undergo gradual reduction, ending in complete disappearance.

Now in wishing to institute investigations into the relationships of these animals we must not adduce the similarities to be found in the structure of the integument as proofs of their affinity; for these converging resemblances have arisen independently of one another. The influence of the aquatic life on the integument manifests itself in the same direction. Only those features can be used as phylogenetic connecting-links which have persisted independently of these influences.

Still confining our attention to the whales, we at once find a marked difference within the order, in that the bearded whales throughout exhibit a relatively much richer covering of hair than the toothed whales. The mode of life of both is precisely similar, and we must therefore conclude that the

bearded whales have not been exposed to the influence of aquatic life so long as the others.

A second and quite fundamental difference between the integument of the two groups lies in the appearance in the toothed whales of remains of a dermal armature*.

A whale which inhabits Indian rivers, *Neomeris phocaenoides*, exhibits on the dorsal surface a large number of plates, regularly fitted to one another and each bearing a tubercle. These closely adjoining plates form a long narrow area, besides which plates still exist on the anterior margin of the flippers and round the blow-hole. That we are here not dealing with a casual malformation is shown by the embryology of the animal; for in an embryo of this rare whale we find in place of the dermal scutes, in precisely the same position, tubercles which cover the body to the number of many hundreds, and on its anterior portion are arranged in rows.

It might here be asked, "Is this appearance ancestral or something newly acquired?" Reasoning by analogy we must decide in favour of the former. In the first place there are a number of reptiles which are undergoing the loss of their dermal armature in precisely the same way, e. g. *Heloderma* or *Dermochelys*, the rudiments of whose dorsal coat of mail are found in the embryo as a number of longitudinally disposed rows of tubercles; secondly, palæontology affords us direct proof that the dermal armature of terrestrial ancestors disappears through adaptation to a pelagic mode of life. We must therefore regard the appearance described in *Neomeris* as a dermal armature in process of degeneration.

This conclusion coincides with the view that the group of whales originated in fresh water. *Platanista* and *Inia* also have preserved certain tolerably general mammalian characteristics †.

In this way, too, certain recent statements are rendered intelligible, according to which tubercles occur on the back, in point of fact on the anterior edge of the dorsal fin, in porpoises, the near allies of *Neomeris*. While the common porpoise (*Phocaena communis*) possesses only a single row of such tubercles, they run in three rows along the dorsal fin of another species (*Phocaena spinipinnis*). In the porpoises therefore we find the last vestige of that dermal armature which is still so distinctly developed in *Neomeris*.

One conclusion only is possible from what has been stated,

* Kükenthal, "Ueber Reste eines Hautpanzers bei Zahnwalen," Anat. Anzeiger, 1890, no. 8, p. 237.

† Cf. W. H. Flower, "Die Wale in Vergangenheit und Gegenwart und ihr wahrscheinlicher Ursprung," Kosmos, Bd. xiii. 1883, p. 531.

namely that the ancestors of the toothed whales were terrestrial animals with a dermal armature. It follows from this that on the one hand a great gulf is fixed between the whalebone and the toothed whales, and that on the other we must relinquish all attempts at bringing the toothed whales into any close relation whatsoever with the Ungulates or the Carnivores. The toothed whales branched off from terrestrial ancestors at a time when the latter still possessed an exoskeleton of epidermic scales, such as, for instance, a division of the Edentata still bears as, perhaps, an ancient heirloom. I would here like to quote a statement made by Baume when discussing the question whether the carapace of the armadillo is or is not acquired:—"There is nothing to prevent us from deriving the Mammalia, including even the Placentalia, from armour-bearing ancestors" *.

As a new instance of adaptation to the aquatic life we have now learnt to recognize the gradual disappearance of the dermal armature of terrestrial ancestors. It is not only in the group of toothed whales that this is seen; we already find the same phenomenon at an earlier period of the earth's history. It is assumed by recent investigators that the Ichthyosauri, which were pelagic animals, sprang from land-inhabiting reptiles. According to Fraas † the epidermic exoskeleton has disappeared in these creatures, with the exception of remains of horny scales, which are to be found on the anterior margin of the paddles (as in *Neomeris*). "The integument of the *Ichthyosaurus*, as has been clearly proved by our discoveries, was a completely naked and deeply pigmented skin, for the most part entirely without an armature of scales, whether horny or bony plates, with the exception of a region on the front margin of the paddle, which was protected by a longitudinal row of horny scales."

A more perfect analogy could hardly be found. On the one hand in the reptiles, on the other in the mammals, the dermal armature has been lost owing to adaptation to the aquatic life; in both cases it persists in a vestigial condition on the anterior margin of the flippers. The reason why the remains of the armature should have persisted so long at precisely this point is readily understood when we reflect on the speed with which these animals cleave the water and the necessity for keeping these parts of the body rigid.

The comparative examination of the integument of the aquatic mammals proved to us how it was possible for resem-

* Baume, 'Odontologische Forschungen,' Leipzig, 1882, p. 197.

† E. Fraas, "Ueber die Finne von *Ichthyosaurus*," Jahreshefte Ver. für Vaterl. Naturkunde in Württemberg, 1888.

blances to arise owing to convergence, and to be therefore of no value in tracing phylogenetic affinities. Moreover the differences in the structure of the skin in the case of the whalebone and toothed whales came into much greater prominence after the results of convergence had been eliminated. On the ground of these differences alone we are justified in maintaining that the toothed whales are of much earlier origin than the whalebone whales, and that the terrestrial ancestors of the two divisions were not identical; and with this we arrive at the first justification for the assertion that *the whales are of diphyletic origin.*

This assertion admits of being proved equally well with the help of other systems of organs. The fore limb appears to be particularly well adapted for this purpose.

The great difference which we noticed even in the skin of aquatic mammals, according as the particular animals were exclusively water-dwellers or merely amphibious, is intensified in the case of the fore limb. It is not until we reach the animals which pass the whole of their time in water that we find the fore limb developing into a fin. The tendency towards the formation of swimming-membranes between the digits is common to all the water-mammals. In exact ratio to the degree of general adaptation to aquatic life do we find this membrane either just indicated, or uniting the digits, or finally enveloping them so that they are no longer visible from the exterior. The comparative anatomy of the creatures which we shall now proceed to indicate exhibits the progressive development of the swimming-membranes. In a certain number of aquatic mammals, such as *Arvicola amphibius*, *Hydromys chrysogaster*, *Fiber zibethicus*, and others, no swimming-membranes whatever are to be found; others, as *Hydrochaerus*, possess rudiments; others, such as the beaver, have webs on the hind feet only, which then have to perform the bulk of the work in swimming; others again, as *Ornithorhynchus*, *Lutra*, and *Enhydris*, have webs reaching to the claws on the fore as well as on the hind feet; while in the case of others the swimming-membranes are expanded by means of strands of connective tissue which project beneath the terminal phalanges, as in the Pinnipedia, until finally the whole fore limb is enveloped in the swimming-membrane, as in the Sirenians, which still show traces of nails, and in the whalebone and toothed whales, which have lost even these. Leboucq's* statements about rudiments of nails having been

* Fl. Leboucq, "Recherches sur la morphologie de la main chez les mammifères marins," Archives de Biologie, tom. ix., 1889.

found in embryos of the latter seem to me not wholly free from doubt.

In the land-mammals the various divisions of the fore limb have different functions, to which they are adapted; the structure of these divisions is consequently not the same, but rather each is adapted to its own particular function. Now as the fore limb comes to be used more and more as a fin the degree of differentiation of the various parts diminishes, their functions are more nearly the same, and the consequence of this will be that skeleton and musculature will both be influenced thereby. As a matter of fact we can trace the loss of differentiation between the various skeletal parts of the hand in the series of aquatic mammals, while at the same time there sets in a gradual reduction of the joints which bind these parts together. The changes therefore which the anterior extremity has to undergo in the process of being transformed into a flipper rest on purely mechanical grounds. On similar grounds it appears more advantageous for the long phalanges to become somewhat more flexible. Now how is this brought about?

We all know that the ossification of the finger-joints takes place in such a way that each skeletal element is preformed in cartilage, in the middle of which there subsequently appears a bony centre, the diaphysis. The ossification of one of the cartilaginous ends now proceeds from this diaphysis, while the other, the epiphysis, receives a separate osseous germ of its own, which does not unite with the diaphysis until later. *Now in order to produce more flexible elements an incomplete ossification takes place in the aquatic mammals; a retardation of the process sets in.* This retarded ossification shows itself primarily in the diminished size of the diaphysis and the increased size of the epiphysis, while the latter unites with the former either only incompletely or else not at all. Of this we have a whole series of instances among the aquatic mammals. At the same time, however, a retardation also sets in in the ossification of the other end of the joint; the formation of the diaphysis is already to a certain degree completed, while this end still remains cartilaginous; finally a separate osseous germ will appear in it, and so we have the formation of double epiphyses. We find indications of these double epiphyses in the metacarpals of *Platypus*; we find them further advanced in the hands of seals and Sirenians, and fully developed in the whalebone and toothed whales.

That it actually is an instance of adaptation to the aquatic life with which we are dealing, is proved by the fact that it is only in aquatic mammals that double epiphyses are found.

If we examine the extent to which this phenomenon occurs in the fore limbs of each of the aquatic mammals which I have enumerated, we shall find that the skeleton of the manus has undergone least modification in those animals which exhibit least material modifications in other respects also, the only noticeable change being that the epiphyses become larger and more distinct.

In *Hydromys chrysogaster* and *Hydrochaerus capybara* the ossification is slightly more tardy, and we already perceive indications of double epiphyses, just as in the metacarpals of *Ornithorhynchus*; in the case of the otter it has already been remarked by Allen Thomson * that "the ossific union of the epiphyses in these animals seems to be comparatively tardy." In the case of the beaver this is equally true. We have therefore a whole series of transitions between hands with one epiphysis and those with two epiphyses on each finger-joint. As for the seals, it has been stated by Weber †:—"In the Pinnipedia the ossification of the hand takes place on the usual plan, in that proximal epiphyses only are developed; in the foot, however, all the phalanges, with the exception of the last, have a distal epiphysis in addition to the usual proximal one." This assertion is not strictly accurate; it has already been stated by Flower, in his 'Osteology of the Mammalia,' ‡ that *Macrorhinus leoninus* has double epiphyses in the hand, a discovery which I was myself able to confirm. I found double epiphyses in hand and foot in the following Pinnipedes—*Macrorhinus leoninus*, *Stenorhynchus leptonyx*, *Otaria jubata*, and *Arctocephalus cinereus*; indications in *Trichechus rosmarus*; in the foot only in *Cystophora cristata*.

In the Sirenians, too, I have the same state of things to report. That ossification takes place tardily in these animals also I found from examination of the hand of an embryo 20 centim. in length, in which the terminal phalanges were still cartilaginous, while in the remainder the diaphyses were visible as small round nodules. The consequence of this is that in the adult there is a tendency towards the formation of double epiphyses.

Thus in *Manatus senegalensis* the distal epiphyses of the metacarpals are frequently separate ossifications, while in *Halicore dugong* double epiphyses, which ossify later and are completely separated, are found.

* Allen Thomson, "On the Difference in the Mode of Ossification of the First and other Metacarpal and Metatarsal Bones," Journ. Anat. & Phys. 1869, p. 131.

† Weber, 'Studien an Säugethieren,' p. 170.

‡ Flower, 'Osteology of Mammalia,' 1885, p. 347.

Now it is apparently a deep and impassable gulf which separates the fore limb of all other mammals from that of the whalebone and toothed whales; for while all other mammals have three phalanges on each finger, with the exception of the thumb, which has only two, both kinds of whales have a larger number. This phenomenon is known as hyperphalangy, and no less than three hypotheses have been formulated in recent times in order to explain it. According to the first hypothesis the flippers of whales have no connexion whatever with the fore limbs of land-mammals, but are ancient organs which have been inherited from swamp-inhabiting creatures (*Leboucq*). According to the second theory, the supernumerary phalanges have arisen through the secondary division of a strand of cartilage attached to the last phalanx, such as has been stated to exist in the seals (*Weber, Ryder, Baur*). The third view is the one recently advanced by Howes*, namely that the supernumerary phalanges arise from intercalary syndesmoses, as in the Amphibia.

It seems to me that none of these three hypotheses are tenable, and in their stead I would suggest a fourth, namely that the hyperphalangy is explicable by the process of double epiphysis formation; owing to the ever-increasing similarity of the various parts and the retardation of ossification, the epiphyses have attained a size equal to that of the diaphyses, and have become equivalent to them. This change took place a long time ago, and no longer admits of direct proof.

I have previously† insisted on the fact that the entire Cetacean finger corresponds to the typical Mammalian finger and that the phalanges only are of different value.

The question will now arise whether we have an instance in nature of the way in which an increase of phalanges takes place. If this process is actually going on anywhere, it must, from what has gone before, be found among the aquatic Mammalia; and it has actually been asserted by Baur‡ that a fourth phalanx has been found in Sirenia. He writes:—"Flower says, in the last edition of his 'Osteology of the Mammalia,' that the number of phalanges in the Sirenia is never increased beyond the limit usual in the Mammalia—that is, three. But Dr. H. Gadow, in Cambridge, England,

* G. B. Howes, "Observations upon the Morphology and Genesis of Supernumerary Phalanges, with especial reference to those of the Amphibia," Proc. Zool. Soc. London, Dec. 4, 1888, p. 495.

† Cf. Anat. Anzeiger, 1888, nos. 22 and 30, and no. 2, 1890; also Denkschriften der medic.-naturwiss. Gesellschaft, Jena, 1889, Bd. iii.

‡ Baur, "On the Morphology and Origin of the Ichthyopterygia," American Naturalist, 1887, p. 840.

showed me a manus of *Manatus americanus* prepared in alcohol, which contained a fourth small ossified phalange in the third digit, and one of *Halicore dugong* which contained an ossified fourth phalange at the fourth and a cartilaginous fourth in the third digit."

Before this Brandt* had described a supernumerary phalanx in *Manatus* and in *Halicore*, and Leboucq † likewise found one on the third finger of the right hand of a sea-cow's skeleton. My own investigations upon this point were not successful: in a manatee-fœtus of 20 centim. I found, as did Leboucq in his fœtal *Halicore*, the third phalanx still completely cartilaginous. Ossification had proceeded very slowly; in the first and second phalanges only small round nodules of bone had formed. Nor did I discover a fourth phalanx in any of the numerous skeletons which I examined; it might, however, have been lost in the process of preparation.

At my request Dr. Gadow forwarded me drawings and detailed descriptions of the above-mentioned fore limbs, from which it appears that in the fourth finger of the *Halicore* there is no joint between the third phalanx and the new nodule of bone, which is therefore to be regarded as a distal bony germ belonging to the terminal phalanx. On the other hand, there is a joint between phalanges iii. and iv. of the third finger. In the same way the third finger of the hand of the manatee shows no joint between phalanx iii. and the new and very small bony nodule.

It follows that we are entitled to speak of a fourth finger-joint in one case only, namely in the third finger of the *Halicore*; in the two other cases a joint between the third phalanx and the new nodule of bone has not yet been found, and the latter is nothing more than the ossification of a distal epiphysis within the cartilage.

There is no question that in the latter case we have the commencement of the formation of a new phalanx.

We have therefore established the fact that a fourth phalanx does occur as a "sport" in the Sirenia. It is very small and not separated from the preceding phalanx, but united with it by cartilage, and can equally well be regarded as an intra-cartilaginous ossified distal epiphysis of the third phalanx. That a true phalanx can arise from it is shown by a case in which a joint is formed between the new nodule of bone and the third phalanx.

* Brandt, "Symbolæ Sirenologicæ," Mémoires Acad. St. Pétersbourg (6^e série), Sc. Nat. t. v., 1849.

† Leboucq, "Recherches sur la morphologie de la main chez les Mammifères marins: Pinnipèdes, Siréniens, Cétacés," Arch. Biologie, t. ix., 1889, p. 626.

That which is only commencing to take place in the Sirenia and is found as a rare variation has already been consummated in the whales, and is of quite general occurrence. The original different morphological value of the several secondary phalanges is no longer embryologically visible; but, on the contrary, diaphyses and epiphyses are separated and arise as equivalent pieces of cartilage, while simple symphyses have been formed in place of the joints.

The process of separate epiphysis-formation in the manus of the whale appears to have undergone a further development in a proximal direction. The wrist-bones, which ossify very late, are indeed affected less, or even not at all, though it is stated by Flower * that in the cachalot there exists a species of epiphysis-ossification in the carpus, there being a central nucleus and a peripheral fringe of bone. Much more frequent are the cases in which the radius and ulna form large double epiphyses, the bony centres of which may remain separate. I have already, in the case of an advanced embryo of *Phocena communis* †, drawn attention to the manner in which it is possible for new skeletal parts to arise owing to this retarded ossification of the epiphyses, and I am now able to allude to the hand of an adult whale ‡, *Hyperoodon rostratus*, in which the double epiphyses of the radius and ulna have developed into independent skeletal elements, with their own bony centres. The tendency towards a formation of epiphyses in the bony parts of the fore arm is already commencing anew, in that a narrow border next to the old epiphysis is incompletely ossified.

We have thus seen how the process of the formation of small skeletal parts, which has long found expression in the case of the fingers, is commencing in the bones of the fore arm also, and that therefore the process is not standing still. We find a further proof of this in the occurrence of double epiphyses on the secondary phalanges. In this case also is retarded ossification the cause of their formation. These secondary double epiphyses, again, may now ossify on their own account, and with this there commences the formation of tertiary phalanges. This process is beginning to take place in certain toothed whales only. Thus I find it in a hand of

* Flower, "On the Osteology of the Sperm Whale," Trans. Zool. Soc. London, vol. vi.

† Kükenthal, "Ueber die Hand der Cetaceen (dritte Mittheilung)," Anat. Anzeiger, 1890, no. 2.

‡ Preserved in the museum of the College of Surgeons, London, the Cetacean material of which institution was most readily placed at my disposition by Prof. Stewart.

Delphinus delphis, where the ossified secondary epiphyses are completely separated from the secondary phalanx; I find the same thing in *Tursiops tursio* and *Lagenorhynchus albirostris*. This process of the formation of tertiary phalanges, which is now progressing, will arrive at completion when the secondary phalanges and the secondary epiphyses shall have attained an equal size; and this will ensue from the progressive retardation of the ossification.

Now, since from the skeletogenous tissue of the fingers in the one case the three phalanges of the typical Mammalian hand are preformed in cartilage, while in the other there results the formation of a number of cartilaginous pieces, the term "phalanx" will gradually lose its meaning for the latter. Functions become simplified more and more, and the finger is built up from a series of small skeletal elements, which are only partially ossified. A distinction of function is perceptible only in so far as the fifth finger of many toothed whales is utilized to an increased extent as a supporting organ. The flipper of the toothed whales is in fact more or less inflected on this side, and the fifth digit has to undertake the task of supporting the expanse of surface which results from the inflexion. We therefore also see how the fifth finger materially exceeds the others in breadth. In consequence of the retarded ossification, which we have established as a process of perfectly general occurrence in the Cetacean flipper, the bony nuclei will no longer suffice for the support of an entire pseudo-phalanx; and we therefore find that they have a lateral origin, and leave a broad cartilaginous mass on the outer side of each phalanx. A further consequence of the great increase in the breadth of the finger is that the separation of the several finger-joints is no longer complete; the dividing groove no longer extends across the entire breadth of the finger, but there ensues a bifurcation on both sides, so that a new cartilaginous piece is detached. With this there commences that splitting-off process, which finally leads to a longitudinal division of the finger. The split-off portions of the newly-formed series now receive bony nuclei on their own account. This splitting-process, authenticated by me in the case of several whales and confirmed by Leboucq, is particularly well seen in certain individuals of the white whale, where I have described it both in the adult and in a small embryo*. Thus the process of the formation of small skeletal parts proceeds, in this case also hand in hand with retarded ossification.

* Kükenenthal, "Ueber die Hand der Cetaceen," 1 und 2 Mittheilung, Anat. Anzeiger, 1888, nos. 22 and 30.

With this the climax is reached in the development of the flipper in existing mammals; the modifications of the skeleton become so important that finally the idea of phalanges completely disappears. Not that the transformation-process stops here, however; the changes may proceed yet further, and analogy will show how we have to imagine that this further transformation will take place in the distant future. For we find that in earlier periods of the earth's history there took place the same process of the formation of flippers from the fore limbs of terrestrial animals, namely in the case of the Plesiosauri and Ichthyosauri; while in the latter it reached a much higher degree of development than has yet been attained in existing whales. All that we know about the position of the two groups is that they are not to be regarded as directly connected with one another*, but that both must have sprung from land-reptiles. The latter assertion is opposed to the views of Gegenbaur †, who, on the ground of the resemblance of the extremities, placed them near the fishes; in this he has been recently upheld by D'Arcy W. Thompson ‡. Later discoveries §, however, point with certainty to the conclusion that this resemblance is merely due to convergence and that the ancestors of both groups were land-reptiles. The flipper of the Plesiosauri was the less differentiated of the two; it stood in relation to that of the Ichthyosauri as the flipper of the whalebone whales does to that of the Odontoceti. In the oldest Plesiosaurs the hyperphalangy was still very limited, the separate bones of the hand and the forearm having as yet undergone very little differentiation. I find this in the impression of an as yet undescribed skeleton of a *Mesosaurus* from the Karroo formation || (a *Plesiosaurus* therefore), the hand of which has undergone very little differentiation; its five distal carpals bearing five long metacarpals, to which are affixed two, three, four, five, and four phalanges. The process of retarded ossification makes itself here already perceptible, for *the phalanges carry double epiphyses*. But even the most highly differentiated *Plesiosaurus*-flippers still show a

* Zittel, 'Handbuch der Paläontologie,' p. 478.

† Gegenbaur, "Ueber das Gliedmassenskelet der Enaliosauren," Jenaische Zeitschrift, 1870, pp. 340 *et seq.*

‡ D'Arcy W. Thompson, "On the Hind Limb of *Ichthyosaurus* and on the Morphology of Vertebrate Limbs," Journ. Anat. & Phys. vol. xx., 1886.

§ H. G. Seeley, "On *Neusticosaurus pusillus* (Fraas), an Amphibious Reptile having affinities with the Terrestrial *Nothosauria* and with the Marine *Plesiosauria*," Quart. Journ. Geol. Soc. Lond. vol. xxxviii., 1882. Cf. also Fraas, Baur, Zittel, *loc. cit.*

|| Preserved in the Natural-History Museum, London; Mr. Smith Woodward was kind enough to draw my attention to the specimen.

limited number of phalanges—nine at the most—and distinctly differentiated forearm, carpal, and metacarpal bones. The Ichthyosauri, on the other hand, have a flipper considerably further developed; the process of the division of the finger-rays into a number of small sections has led to a very great hyperphalangy, in addition to which a longitudinal division has set in, such as I have described for the toothed whales, and both processes have undergone further development; the bones of the carpus and forearm too have decreased in size, and in accordance with their simplified function have become mere supporting elements. The most ancient Ichthyosauri, however, show less differentiation in the skeleton of the flipper*; but subsequently we find not only longitudinal division of the fifth digit, but even manifold formation of secondary rays at its side, with dichotomy of other fingers; thus, *Ichthyosaurus longimanus*, for instance, shows four rays one behind the other on the ulnar side, that is nine in all, and in the hand of another *Ichthyosaurus* we find, on tracing the edge of the flipper, as many as fifteen longitudinal rays.

The Ichthyosauri led a life precisely similar to that of the whales. Thus Fraas writes†:—“In the case of *Ichthyosaurus*, where not only the entire carpus, but also the radius and ulna, have been transformed into jointless supporting plates for the flipper, locomotion upon land was absolutely impossible.” In consequence of this their limbs were very similar to those of the whales; the flipper of the Ichthyosauri also was ensheathed in a leathery skin; as in the toothed whales the fore flipper was readily bent backwards, and the skeleton followed the curve. Now it seems to me probable, from what has been stated, that the whale’s flipper will undergo a further development on the lines followed by that of the Ichthyosaurs, and that the longitudinal fission of the finger of the toothed whales is a process which is as yet in its infancy and which, after further progressing, would finally increase the resemblance to the flipper of the Ichthyosaurs. I therefore regard this longitudinal fission as a new development which is now taking place; and this is a view which I have previously expressed. The explanation of this phenomenon given by Leboucq‡—“Cette tendance au dédoublement dans le sens longitudinal existant dans certains doigts des cétacés

* *Vide* Baur, “On the Morphology and Origin of the Ichthyopterygia,” *American Naturalist*, 1887, p. 840.

† *Loc. cit.* p. 297.

‡ Leboucq, “Recherches sur la morphologie de la main chez les Mammifères marins,” *Arch. Biologie*, 1889, p. 112.

peut être considérée comme un caractère tout-à-fait primitif”
—I can by no means agree to.

To sum up our results. In the aquatic Mammalia there sets in a retardation in the ossification of the skeleton of the hand, a consequence of which is the formation of double epiphyses in each finger-joint. Since each finger-joint thus acquires three divisions, which, owing to reduction, that is the loss of separate functions, become continually more alike, the number of original finger-joints will be doubled. The number of the secondary finger-joints will therefore in the highest case amount to twelve.

The question now suggests itself whether this process can still be followed embryologically. It must be admitted at the outset that this is doubtful, since this transformation took place so long ago, and the principle of making the separate parts resemble one another in form was so speedy in its effect, that it seems practically hopeless to expect that we can still trace the various stages in the development of the embryo. I might express myself in the words of Pfitzner* :—“ In osteology in particular is ontogeny an auxiliary as inefficient as it is untrustworthy ; we have to rely almost entirely on comparative anatomy and variation.” All that we can determine is that from an embryonic tissue there develop pieces of cartilage which are separate from one another and which correspond to the secondary phalanges. There is no question of supplementary division of the cartilaginous tissue ; all changes which subsequently took place are traceable to fusion. The whole of the secondary phalanges of the whale’s hand are therefore to be found already in their places. Any supplementary division of the cartilage is consequently excluded.

This method of formation renders it impossible to trace the origin of hyperphalangy embryologically ; I would only mention that in a very small embryo of *Globiocephalus* there is a considerable difference in size between the secondary metacarpalia and the remaining divisions of the phalanges, in that the former, particularly in the first finger, are very much more minute ; in the next stages of development, however, this difference is already obliterated. This difference in size points to the mode of origin of the secondary metacarpal. The fact that it still finds expression here is intelligible when we reflect that the process of hyperphalangy must have commenced at the tip of the finger, and with the division of the original metacarpal has reached its latest stage.

Now if our theory is correct the number of phalanges should

* W. Pfitzner, “ Die kleine Zehe,” Archiv f. Anat. u. Physiol. 1890, pp. 12 *et seq.*

not exceed twelve in one finger, and this (with a single exception) is in fact the case. No whale exhibits more than twelve phalanges with the exception of *Globiocephalus melas*. In this whale two varieties are distinguishable, in one of which the second finger has twelve phalanges or less, while in the other an increase of phalanges beyond twelve has taken place. We have now to inquire where this augmentation has been effected. According to our theory it must be a third series of phalanges which has been formed by division of the secondary ones, and this moreover at the tip of the finger. This is actually the case; in three embryonic hands I find ten to be the constant number of the phalanges of the third finger; in the second finger, on the contrary, the numbers are eleven, fifteen, and seventeen. In all three the relative position of the first eleven phalanges has not changed in the least; they are to be regarded as homologous with one another. But while the eleventh phalanx is terminal in one case, in another four, and in a third case as many as six, phalanges have been intercalated in front of it, thereby materially altering the arrangement. Where there has been an increase of phalanges the second finger greatly exceeds the third, while it otherwise is of the same length. The increase of segments has therefore affected the tip of the finger in this case.

I must not omit to state that there is nothing to show that the new terminal phalanges have been derived from the proliferation and secondary division of what was previously the terminal phalanx. They are segments which decrease regularly in size, are well separated from one another, and which came into existence as separate rudiments with the earliest development of the cartilage. To my mind we have no alternative but to accept the process of the cleavage of the secondary end-phalanges into tertiary, as resulting from the formation of double epiphyses.

Now it is an apparently inexplicable fact that the whales possess more phalanges in each finger in the immature state than they do in the adult, as has been found to be the case in the whole of the embryos examined by Leboucq and myself with this object; nay, it appears to stand in direct contradiction to my theory of the gradual development of the many-jointed condition. On these grounds it has therefore been also suggested by one investigator of Cetacean anatomy (Leboucq) that the hand of the whale as it is is a very ancient organ.

As a matter of fact, however, the whale's hand is modified by the action of two very different processes, which both exist independently of one another; the one is attributable to the

principle of the formation of small skeletal parts, the other comes into action in aquatic mammals, which use their fore limbs no longer for rowing, but merely for steering and balancing purposes. For the latter function a long fore limb is not only unnecessary but even actually in the way; and so a shortening of the limb will take place, which will commence at the distal end. Practical observations are in entire accordance with this; the whole of the Cetacean fingers examined for the purpose show that the diminution in the number of phalanges which takes place in the course of individual development arises from the fusion of the small terminal phalanges.

This fusion of terminal phalanges is also found in other aquatic mammals; thus I was able to determine its presence as a variation in *Manatus senegalensis*, in which it affected the third and fourth fingers.

Now how are we to explain the origin of hyperphalangy phylogenetically?

As the fore limb of the terrestrial ancestors of the toothed as well as the whalebone whales developed more and more into the flipper, the skeleton was also affected thereby, in that a retardation of ossification set in. In consequence of this retardation there arose the formation of double epiphyses, which attained to the size of the diaphysis, while their bony nuclei remained separate. The functions of the finger-joints became more and more alike, in that they had to relinquish all their differences of action and to become modified into mere supporting organs; and this similarity likewise extended to the diaphysis and epiphysis of each finger-joint; they, too, had only to undertake a supporting function. Now the office of the flippers of the whale as rudders entails the avoidance of large bones; and this necessity was met first by retarding the ossification of the diaphyses, and making the two epiphyses equivalent to it, and subsequently by separating the latter from the former; so that in the place of the single skeletal element there develop three similar smaller ones. Where will this process first come into action? Clearly where the retardation in the ossification is most pronounced, and this is the case in the terminal phalanx. The first secondary phalanges will be developed in the terminal phalanx (as, for instance, in the case of *Manatus* and *Halicore*); the further advance of the process affects the other finger-joints also, and finally begins to take place in the bones of the forearm of certain whales. Simultaneously with this process the several division-products grew to resemble one another, owing to their having similar functions to perform; the morphological

value of the sections became much less, and we therefore see within the limits of each species a certain amount of variation in their number. The tendency to the formation of small skeletal divisions, to which the retarded ossification and the formation of double epiphyses originally lent an impetus, was at length carried so far that the fingers also began to split in a longitudinal direction, as is seen in the much expanded fifth digit of *Odontocetes*. In the whales the process of modifying the skeleton of the flipper has not yet said its last word; we see how new double epiphyses are already arising again in the secondary finger-joints and how in the case of a toothed whale, *Globiocephalus*, the same process of increasing the number of segments at the tip of the second finger has already commenced anew, so that therefore it comes in this case to the formation of tertiary phalanges. A portion of the *Globiocephali* do not yet exhibit this process; the majority, on the other hand, have already acquired it.

Precisely the same transformation of the skeleton was experienced in earlier periods of the earth's history by the hands of reptiles now extinct, the Plesiosaurs and Ichthyosaurs, which likewise became adapted to the aquatic life. In the case of the former the process ceased at a comparatively early stage, much as it is seen in existing whalebone whales; the Ichthyosaurs, on the other hand, carried it much further. While the paddles of some Ichthyosaurs (those of the older forms) show the greatest similarity to those of the toothed whales, in the more recent Ichthyosaurs the modification is much greater.

The transformation of the fore limb into the swimming-paddle is therefore regulated by the same laws in widely distant groups. Whalebone whales and toothed whales, Plesiosaurs and Ichthyosaurs—four groups, not traceable to one another, but originating from different terrestrial ancestors—have acquired precisely similar anterior extremities as a result of the operation of the same laws on the modification of the fore limb. The phenomenon of convergence is here revealed with the utmost distinctness. It appears as if the various flippers were approaching a single type, which has received its fullest expression in the fin of the fish.

Once again we arrive at the conviction, as we have already done in considering the integument of the aquatic mammals, that a large series of resemblances in the structure of the flippers is but the result of convergence, and that it is a mistake to bestow on them phylogenetic value. These must be eliminated if we would compare the extremities of whalebone and toothed whales with one another. After we have

recognized the points of resemblance as convergent developments of independent origin the structural differences of the two flippers appear much more clearly defined. The contrast between the much greater advance of hyperphalangy in all the toothed whales and its more limited development in the whalebone whales strikes us at once. But there is also a plastic difference to be noticed, in so far as the whalebone whales possess elongated flippers with a straight radial edge, while in the toothed whales the radial edge of the flipper is more or less curved, so that the flipper has acquired a sickle-like form. This difference is not so trivial as it at first sight appears. It has exerted a powerful influence on the skeleton of the hand. In the whalebone whales the flipper appears to be least modified in the smooth whales (the *Balænidæ*), where we get a rounder form of flipper whose five fingers are all developed with a very small amount of hyperphalangy; in the fin-whales (the *Balænopteridæ*), on the other hand, we find an elongated instead of a rounded flipper, with a straight radial edge, and the consequence of this is the degeneration and disappearance of the thumb. Rudiments of it are still seen in the embryo, which afterwards disappear through fusion. Hyperphalangy has already made a certain advance. In the toothed whales, on the contrary, the finger-rays have adapted themselves to the inflexion of the flipper, and the whole of the five digits are always present. Two different types of flippers are therefore observable in the two groups—the whalebone whales with long extended flippers, the toothed whales with incurved ones. In the former the thumb is lost, in the latter it persists. This is already a highly important difference in the structure of the flipper in the two groups. The disposition of the carpal bones constitutes a further fundamental difference. We find that the carpus in the adult in many toothed whales and in the embryonic state in many others exhibits an arrangement which is otherwise not characteristic of the Mammalian class; there are present not only the three proximal but also five distal carpalia, whereas all other mammals only possess four distal carpals; there is a pisiform and a præpollex, while the centrale, which in the rest of the *Mammalia* is only found occasionally and in embryonic stages, here often persists and is even found double. The number of the carpal elements thus reaches twelve; their arrangement is a perfectly typical one, such as must be imagined for the hypothetical, most complicated, and therefore most ancient Mammalian carpus; and the carpus of the toothed whales displays the greatest agreement with the typical Reptilian carpus, such, for

instance, as has been preserved with but little modification in the Chelonia. All this is not found in the whalebone whales, whose carpus consists of remarkably fewer elements. Where changes do show themselves in the carpus they are never cases of fission, but rather of fusion. This observation, which we owe to Gegenbaur, is of universal application; those carpi are therefore to be regarded as the more ancient which exhibit the greater number of component parts. These are the carpi of the toothed whales. We therefore conclude from the comparison of the structure of the carpus in the toothed and whalebone whales that the former animals are the more ancient. If we likewise take into consideration the difference in the manner of the further development of the flippers, we again arrive at the conclusion that the toothed whales were developed from land-mammals at a much earlier epoch than whalebone whales, and that therefore the two groups cannot be directly related to one another.

Our investigations into the structure and development of the flippers have therefore yielded the same result as the investigation of the integument. What were hitherto regarded as resemblances and indications of phylogenetic relationships are merely convergences which have arisen according to the same developmental laws.

With this the series of systems of organs which are modified by adaptation to aquatic life is by no means exhausted, and the studies which I have prosecuted on a tolerably comprehensive material into the dentition, the respiratory organs, &c. contain much that is perhaps of more general interest. Since these investigations, however, have not been entirely concluded, I have confined myself in this paper to a couple of systems of organs. From these the method of investigation may at once be perceived.

The earlier investigations for the purpose of elucidating the phylogeny of the mammals to which I have directed attention have yielded contradictory results, since their proofs were based on a series of common characters. By bringing biology and physiology into the sphere of our observations we have recognized these common characters as resemblances or convergent developments, which have arisen through the adaptation of originally dissimilar organs to new and precisely similar conditions of existence. In the case which we have been considering, the modification of the organs of the various animals is controlled by laws of general application, laws which are even partially attributable to mechanical principles. Now when we thus betook ourselves to the investigation of phylogeny from our altered standpoint, equipped in this

instance with a method as yet unused, we were compelled to annul the relations which had hitherto been established, and out of a single Mammalian order even to form two others, genetically very distinct, namely those of the toothed and whalebone whales. And thus we have demolished, instead of reconstructing. Yet we have gained something in return—a firmer basis, on which we may distinguish what is ancestral from that which is newly acquired.

XX.—*Lepidoptera from the Sabaki River, East Africa, with Descriptions of new Species*. By G. F. HAMPSON, B.A., Coll. Exon., Oxon.

THE following is an account of a small collection of Lepidoptera made by Mr. Keith Anstruther, of the British East-Africa Co.'s service, in the Sabaki River district; and as very few species have been recorded from the interior of East Africa, and none from this district, I give a list of them in full. The types of the new species have been presented to the Natural-History Museum.

RHOPALOCERA.

1. *Limnas Klugii*, Bull.

2. *Limnas chrysippus*, Linn.

The small dark African form.

3. *Tirumala petiverana*, Doubl. & Hew.

MYCALESIS, subgen. nov. MONOTRICTIS.

With a glandular pouch and tuft of hairs on both fore and hind wings, thus belonging to Mr. Moore's first group of subgenera of *Mycalesis*.

Allied to the subgenera *Virapa* and *Garesis*. Male with the glandular pouch on the fore wing, a small oval patch below the submedian nervure only, and covered with short scales, and no tuft of long hairs. Fore wing with the apex rounded as in *Garesis*; the inner and outer margins more rounded; costal, subcostal, and median veins swollen at the base; the venation similar. Hind wing with the costa highly arched, as in *Virapa*; the first subcostal much curved up, as in that genus, not swollen at the base as in *Garesis*. Eyes slightly hairy.

Type *M. (Monotrichtis) safitza*, Hew.

4. *Mycalesis (Monotrichtis) safitza*, Hew.

Var. *injusta*, Wllgr.—Probably the dimorphic form with small ocelli.

5. *Mycalesis (Monotrichtis) evenus*, Hpff.

Var. *caffra*, Wllgr.—Probably the dimorphic form with small ocelli.

6. *Ypthima asterope*, Klug.

7. *Melanitis bankia*, Fabr.

8. *Acræa acara*, Hew.

9. *Acræa anemosa*, Hew.

Acræa arctecincta, Butl.

The spots on the underside of the black band of the hind wing are much smaller than in the typical form.

10. *Acræa mutuata*, Grose Smith.

11. *Acræa natalica*, Boisd.

12. *Acræa oncea*, Hett.

With only the lower of the two spots at end of cell of fore wing, and the spots on the hind wing reduced.

13. *Acræa mombasæ*, Grose Smith.

14. *Acræa bræsia*, Godm.

15. *Acræa perrupta*, Butl.

16. *Acræa punctatissima*, Boisd.

17. *Eurytela dryope*, Cram.

18. *Byblia ilithya*, Drury.

19. *Byblia acheloia*, Wllgr.

20. *Junonia crebrene*, Butl.

21. *Junonia ænone*, Linn.

(*Junonia clelia*, Cram.)

22. *Junonia natalica*, Feld.

23. *Diadema misippus*, Linn.

24. *Protogoniamorpha nebulosa*, Trimen.

25. *Hamanumida dædalus*, Fabr.

26. *Euryphene violacea*, Butl.

27. *Harma achlys*, Hpff.
28. *Charaxes saturnus*, Butl.
29. *Philognoma varanes*, Cram.
30. *Terias orientis*, Butl.
31. *Terias zoë*, Hpff.
32. *Teracolus protomedia*, Klug.
33. *Teracolus dynamene*, Klug.
34. *Teracolus eris*, Klug.

Differs from the figure of the type in having a white spot near outer margin and white at hinder angle of fore wing. *T. abyssinicus*, Butl., is almost certainly the female of *eris*; and the South-African form, *T. Johnstoni*, Butl., and *T. maimuna*, Kirby, from West Africa, differ only in the female sex.

35. *Teracolus imperator*, Butl.
36. *Teracolus phlegyas*, Butl.
37. *Teracolus phænius*, Butl.
38. *Teracolus exole*, Reiche.
39. *Teracolus bifasciatus*, Sharpe.

Male.—Expanse $1\frac{1}{2}$ inch. Fore wing white, with the apical area orange; costa black from one third from base to apex, and the outer margin black from apex to near hinder angle, the black margin extending as black triangular marks into the orange area, the nervules in which are black towards outer margin; a black band along inner margin below the submedian nervure from base to one fourth from outer angle, expanding at its termination to the first median nervule. Hind wing white, with a small black patch at base and black triangular marks on nervules at outer margin.

Underside pure white; fore wing with a small black spot at end of cell; a subapical orange band from near the costa to near centre of outer margin; apex suffused with yellow; slight traces of the black band on inner margin.

Hind wing with a brilliant orange streak along two thirds of costa, widest at base; a small black spot on an orange one at end of cell.

A pair from the Sabaki District.

Miss Sharpe's type is a female, which sex is very near *T. eione*, Boisd., but with the maculate subapical orange bands of fore wing quite separated from one another by a black band.

The male is very near *T. comptus*, Butl., which has the under-side slightly suffused with yellow; the other males of the group have yellow in the cell of the fore wing on the under-side.

40. *Teracolus incretus*, Butl.
 41. *Belenois thysa*, Hpff., var. *subrata*, Butl.
 42. *Belenois gidica*, Gdt.
 43. *Belenois severina*, Cram.
 44. *Pinacopteryx liliana*, Grose Smith.
 (*Pinacopteryx nigropunctata*, Sharpe.)
 45. *Eronia dilatata*, Butl.
 46. *Nepheronia thalassina*, Bois.
 47. *Papilio philonoë*, Ward.
 48. *Papilio demoleus*, Linn.
 49. *Papilio erinus*, Gray.
 50. *Papilio dardanus*, Brown.

Papilio dardanus, Brown, Illustr. Zool. p. 51, pl. xxii. (1776).
Papilio merope, Cram. Pap. Ex. ii. t. cli. (1779).

The males are the dark southern form with the black band of hind wing complete and wider than in var. *tibullus*, Kirby; the tail black, with yellow tip. The female is of the white *niaveus* type, but with the streaks of the subapical band of fore wing short; it resembles *tibullus* ♀, except that it has a subapical white spot to the fore wing.

51. *Papilio constantinus*, Ward.
 52. *Papilio colonna*, Ward.
 (*Papilio tragicus*, Butl.)
 53. *Papilio porthaon*, Hew.
 54. *Papilio utuba*, sp. n.

Expanse 4 inches.

Female allied to *P. nyassæ*, Butl., from which it differs in all the markings of the upperside being wider and a bluer green in colour; the two last bands across the cell of the fore wing towards its termination are joined together above the median nervure, forming a U-shaped mark; there is a distinct round spot between the fourth and fifth subcostal nervules close to their junction in continuation of the two spots from the costa. In the hind wing the union of the two common spots near the inner margin is distinct.

Underside similar to that of *P. nyassæ*.

This species belongs to the group which has no black and crimson spot in the cell of the hind wing on the underside, of which the other species, *P. porthaon*, *policens*, and *evombar*, are amply distinct. *P. anthus* and *lurlinus*, with the black and crimson spot, are very like *P. nyassæ* and *utuba* on the upperside.

55. *Coladenia maculata*, sp. n.

Expanse $1\frac{2}{3}$ inch.

Male.—Allied to *C. galenus*, Fabr. Fore wing with the spot below the median nervure similar to that species, and not small as in *biseriata*, Butl., or large and run into the median band as in *meditrina*, Hew.; the median band broader than in *galenus* and *biseriata*, and the spot below the first median nervule large and joined to the band (in *meditrina* the markings are large, run together, and cover the greater part of the fore wing); the three irregularly placed spots towards the apex and outer margin are large and nearly joined.

Hind wing with the spot in the cell as in *galenus*, it being absent in the other two species; the markings towards outer margin large and more joined together than in the other species, with a black patch on them between the second subcostal and first discoidal nervules, as in *meditrina*.

HETEROCERA.

Lithosiidæ.

56. *Egybolia Vaillantina*, Stoll.

Nyctemeridæ.

57. *Terina fulva*, sp. n.

Expanse 2 inches.

Male.—Allied to *T. tenuis*, Butl.: of a more yellow fulvous. Fore wing with the black of the apical patch running more into the upper extremity of the cell and along the median nervure at the lower extremity; the subapical white patch is large and has a small white spot below it. Hind wing with the black border only extending along the apical third of the outer margin and irregular in width.

Saturnidæ.

58. *Henucha dentata*, sp. n.

Expanse $2\frac{5}{8}$ inches.

Female.—Closely allied to *H. Delegorqueti*, Boisd.; the outer margin of the fore wing much more irregular, being bowed outwards at middle and more dentate; the outer margin of hind wing also is slightly more dentate. Both wings are much more suffused with fuscous than in *Delegorqueti*, and the white band inwardly banding the outer area reaches the inner margin of fore and hind wings close to the outer and anal angles, instead of a good distance inside them.

Ommatophoridæ.

59. *Cyligramma argillosa*, Walk.

Ophiusidæ.

60. *Achæa Lienardi*, Walk.

XXI.—*Critical Notes on the Genus Tebennophorus and the recent Literature relating to it.* By HENRY A. PILSBRY, Conservator of the Conchological Section, Academy of Natural Sciences of Philadelphia.

THE slugs of this genus having been commented upon lately by a number of English and continental authors, who have arrived at very different results, it has occurred to the writer that a presentation of the subject by one who has studied the species in their native forests would not be without interest.

Firstly, regarding the proper name for the genus. We will consider the several designations in the order of their publication.

In 1817 Blainville proposed a genus *Limacella* with the following characters:—

“Body limaciform, entirely naked, provided with a foot as wide as itself, but separated by a groove.

“Orifices of the organs of generation widely separated and communicating between each other by a furrow which occupies the entire right margin of the body.”

Blainville refers to his plate ii. fig. v, illustrating the type species, *L. lactiformis*.

A moment's reflection will convince any competent mala-

cologist that the above description does not indicate *Tebennophorus*, a slug in which the genital organs have a common outlet. It cannot be supposed that Blainville has made a mistake in observation, because in the same paper he describes at length the external anatomy of *Veronicella*, and correctly locates the orifices. The figure given is equally non-committal; so much so that Mr. Cockerell (who supposes *Limacella* to equal *Tebennophorus*) really cites "figures 4, 5" instead of 5 only*—his inability to tell Blainville's figure of *Limacella* (fig. 5) from that of *Veronicella* (fig. 4) being evidence enough that the former is not generically recognizable. As to the fact that Mr. Cockerell has found a couple of slugs under the name "*Limacella lactescens*" in the British Museum, which he supposes are the types of *L. lactiformis*, it is absolutely irrelevant to the subject. What evidence is there beyond the merest guess-work that they are Blainville's types? And even if they were (a most improbable hypothesis!), their mere existence does not constitute publication. We have nothing to judge *Limacella* by save the original figures and description, and these certainly indicate a type of slug different from *Tebennophorus*.

It may also be noted that the name *Limacella* is preoccupied, having been used by Brard in 1815. If we care to be really consistent we must use *Limacella* in place of *Agriolimax*!

The second name for the genus is *Philomycus*, Rafinesque. This genus, says its author, "differs from *Limax* by no visible mantle, the longer pair of tentacula terminal and club-shaped, the shorter tentacula lateral and oblong." Rafinesque describes four species and says there are many more in the United States. Not one of those he described has been identified with any certainty, and only two species of *Tebennophorus* occur in the regions visited by him. Rafinesque also describes the genus *Eumeles*—"differs from *Limax* by no visible mantle, the four tentacula almost in one row in front and cylindrical, nearly equal, the smallest pair between the larger ones." Of this genus he describes two species, one of which, *E. nebulosus*, has been recognized by Mr. Cockerell, whose penetration and facilities have enabled him to identify new or old species which have escaped the observation of specialists on the American fauna.

We will not comment on these Rafinesquian genera; those who find slugs corresponding to them should of course use the

* That this is not mere inadvertence on Mr. Cockerell's part is demonstrated by his remarks on Blainville's fig. 4 on p. 380 of the 'Annals' for November 1890.

names. *Eumeles* is especially remarkable, and we would invite the attention of conchologists who hunt slugs (in old collections of museums and elsewhere) to the unusual arrangement of the tentacles in this genus, and to the fact that a number of Rafinesque's species are still at large.

The genus *Meghimatium*, v. Hasselt, 1824, was founded on a species of this genus from Java, and was quite recognizably described. The names *Tebennophorus*, Binn., and *Incilaria*, Benson, were both proposed in 1842, the probable priority being in favour of the first.

Morse in 1864 established the genus *Pallifera* for a species with ribbed jaw.

This review shows that several names for the genus, more or less certainly applying to it, were proposed anterior to 1842, the date of *Tebennophorus*. Of these names *Philomycus* and *Meghimatium* are the only ones available, *Eumeles* and *Limacella* being clearly inapplicable. Since continental authors generally have adopted the name *Philomycus*, it seems advisable to retain that designation for the genus if *Tebennophorus* must be rejected.

Philadelphia,
December 2, 1890.

XXII.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.*—No. 21. *Note on the Results of the last Season's Deep-sea Dredging.* By J. WOOD-MASON, Superintendent of the Indian Museum, and Professor of Comparative Anatomy in the Medical College of Bengal, and A. ALCOCK, M.B., Surgeon I. M. S., Surgeon-Naturalist to the Survey.

[Continued from p. 19.]

Phylum **APPENDICULATA.**

Branch **CHÆTOPODA.**

Fragments from mud from 89 to 93 fathoms, from 1310 fathoms, and from sand from 98 to 102 fathoms, in the Bay of Bengal.

Branch ARTHROPODA.

Class CRUSTACEA.

Of this class fifty-three species were obtained, of which fifty-one belong to the Malacostraca, and two to the Entomostraca.

Grade MALACOSTRACA.

Amongst the fifty-one species belonging to this subclass every order except Amphipoda and Cumacea is represented, as follows:—

Order SCHIZOPODA.

Family Lophogastridæ.

GNATHOPHAUSIA, Suhm.

At Stations 100 and 102, at 840 and 920 to 690 fathoms respectively, two fine specimens were obtained. They are of the usual uniform deep lake-colour, and they represent the two sections into which Sars has divided this genus.

1. *Gnathophausia Sarsii*, sp. n., Wood-Mason.

Belongs to the second section of the genus, in which it is nearest allied to *Gnathophausia Willemoesii*. The carapace covers the basal third of the first abdominal somite and has its dorsal spine produced as far as the posterior end of the third abdominal tergum; its extreme edge is expanded at the postero-inferior angle into a conspicuous rectangular lamina, into which neither its lower lateral keel nor its raised rim enters. The rostrum, which has lost its tip, appears to have been of the same form and proportions. Ocular and antennal spines well developed, divergent; the former are slightly curved and rather longer and slenderer than the latter. There are no branchiostegal spines. The upper half of the posterior margin of the carapace on each side and the lateral edges of the dorsal spine are minutely denticulated. Each of the five anterior abdominal terga has a dorsal keel produced posteriorly into a short sharp spine, and two subdorsal keels, and the posterior lobes of the pleura acuminate. The telson is tricarinate, having a fine median carina in addition to the much coarser sublateral ones, and appears to be more produced at the tip than in any other species.

Length from tip of rostrum to apex of telson 75 millim.

2. *Gnathophausia gracilis*, Suhm, var. *brevispinis*.

Gnathophausia gracilis, Suhm, Trans. Linn. Soc. Lond., Zool. ser. 2, vol. i. p. 33, pl. ix. fig. 1; Sars, Chall. Rep. vol. xiii. pt. xxxvii. Schizop. p. 48, pl. vii. figs. 6-10.

Our specimen differs from the one figured by Suhm in the small size of the spines of the infero-posterior corners of the carapace, the lower one of which is reduced to a minute outstanding point only visible when the animal is viewed from above. It may perhaps be found to differ also in the form and relative proportions of the wing-like antennal and branchiostegal spines, as well as in other respects, when better specimens of the typical form shall be available for comparison. In the meantime it will suffice to indicate it as a variety.

Length from tip of rostrum to apex of telson 82 millim.

Both the above specimens would appear to be males.

Order DECAPODA.

Family Penæidæ.

HYMENOPENÆUS, S. I. Smith.

3. *Hymenopenæus* ? *microps*, S. I. Smith.

Hymenopenæus ? *microps*, S. I. Smith, Ann. Rep. Comm. Fish. 1884, p. 413 [69], pl. x. fig. 1.

Three specimens have been obtained—a male and a female from Station 104, 1000 fathoms, and a male from Station 105, 740 fathoms—of a species answering to Prof. Smith's diagnosis. They are all coloured a very deep vinous purple mottled with black, and are still of a deep wine-red, except the last two pairs of legs.

SOLENOCERA, Lucas.

4. *Solenocera Hextii*, sp. n., Wood-Mason.

A strikingly beautiful Penæid of a bright pink colour was obtained in fair abundance at Stations 81 and 96, in 89 to 102 fathoms. It is remarkable for the great development of the respiratory mechanism in all its parts, especially the branchial chambers, the afferent and efferent divisions of which are sharply defined externally by the special prominence of the coincident parts of the branchiostegite, and also for the form of the antennules. These are shorter

and broader than those of any of the described species, and their inner or ensheathing branch is much less deeply semi-tubular, being indeed only slightly incurved along its lower margin and forming by its union with its fellow of the opposite side a strongly compressed tube, of which the lumen appears to be entirely filled by the two flat outer or olfactory branches of opposite sides. There is little doubt that this special development of the antennules has a causal relation to the presence of delicate sense-organs, which, owing to some unknown circumstances in the surroundings of the animal, stand in special need of protection.

This form had previously been found at 65 fathoms off Chittagong, at 68 fathoms off the Mahánadi Delta, and at 70 fathoms off the Godávari Delta.

GENNADAS, Spence Bate.

5. *Gennadas parvus*, Spence Bate.

Gennadas parvus, Spence Bate, Ann. & Mag. Nat. Hist. (5) viii. p. 191; and 'Challenger' Macrura, 1888, p. 340, pl. lix.

A male and a female from Station 101, 922 fathoms, and Station 103, 1260 fathoms respectively, belong, there is little doubt, to the above species, which has such a wide geographical and bathymetrical range. Both were of a uniform deep lake-colour. *Amalpenæus elegans*, S. I. Smith, is probably the same species.

HEPOMADUS, Spence Bate.

6. *Hepomadus ? tener*, S. I. Smith.

Hepomadus ? tener, S. I. Smith, Ann. Rep. Comm. Fish. 1884, p. 409 [65], pl. ix. figs. 7 and 8.

A female specimen was obtained at Station 97, 1310 fathoms, but is too much macerated for exact determination. Its colour in the fresh state was bright orange.

HEMIPENÆUS, Spence Bate.

7. *Hemipenæus Carpenteri*, sp. n., Wood-Mason.

Is closely allied to *Hemipenæus spinidorsalis*, Spence Bate, but differs in the following relations:—The thoracic legs are shorter, the three anterior pairs have the ischiopodite stouter, and longer in proportion to the succeeding joint, and the two last pairs are more filiform; the exopodites of the abdominal appendages are much longer; the rostrum is much weaker

and also shorter, barely reaching the apex of the basal joint of the antennular peduncle; the cervical suture appears to be more distinct in its dorsal part; and the hooked spine of the third abdominal tergum springs right from the anterior end instead of from the middle of the crest.

One female specimen from Station 97, 1310 fathoms.

Colours in the fresh state bright orange.

Length from tip of antennal scale to tip of caudal swimmeret in a straight line 118 millim.; length of exopodite of first abdominal appendage 42 millim.; length of carapace from middle of posterior margin to tip of rostrum 32.5 millim.; length of third thoracic leg 46 millim.

Family Sergestidæ.

SERGESTES, Milne-Edwards.

8. *Sergestes bisulcatus*, sp. n., Wood-Mason.

Closely allied to *S. robustus* and *S. mollis*, S. I. Smith, but readily distinguishable from both in the cervical being no less distinct across the back of the carapace than the gastro-hepatic groove. It differs from *S. mollis*, and apparently agrees with *S. robustus*, in the relative proportions of the joints of the antennular peduncles and in the form and proportions of the eyes, which are comparatively short and very distinctly widened from base of peduncle to apex of depressed hemispherical cornea; and it agrees with *S. mollis* and differs from *S. robustus* in the size of the rostrum.

Colour in the fresh state deep crimson-lake.

A female from Station 100, 840 fathoms, and a male from Station 105, 740 fathoms.

Length of male from tip of rostrum to apex of telson 60 millim., of female 63 millim.

9. *Sergestes ? arcticus*, Kröyer.

Sergestes arcticus, Kröyer, Monog. Fremstill af Kraeb. *Sergestes*, pp. 24, 60, tabs. iii. and v.; Spence Bate, 'Challenger' *Macrura*, p. 436.

Our only specimen wants the spine on the outer margin of the exopodite of the caudal swimmeret said to be present in *S. arcticus*.

Colour in the fresh state deep crimson-lake.

From Station 101, 922 fathoms.

Family **Glyphocrangonidæ.**

GLYPHOCRANGON, A. Milne-Edwards.

The described species may, with the undescribed ones in our collection, be artificially arranged in three groups as follows:—

(1) Species with the anterior moiety of the fourth or lateral crest * produced and expanded at its anterior end into a single huge vertically-compressed spine, which extends far beyond the level of the supraorbital margin of the carapace, and with the ridges and other elevations of the dorsal integument generally more or less sharp and roughly tuberculose.—*G. aculeatum*, A. M.-Edw., Spence Bate (= *G. Agassizii*, S. I. Smith), *G. regalis*, Spence Bate, and the following species, which, though not belonging to last season's collection, we think may be appropriately described here.

10. [*Glyphocrangon investigatoris*, sp. n., Wood-Mason.

Allied to *G. aculeata* and *G. regalis*, but distinguishable at a glance from the former by the posterior moiety of the third carapacial crest not being produced anteriorly into a spine and from both by its much more tuberculose cephalothorax and abdomen. From the latter, to which it is the more nearly allied, it further differs in having the posterior moiety of the third and fourth crests dentate and the lateral margins and carinæ of the telson sharply tuberculate for rather more than the basal third of their length. From *G. spinicauda*, A. M.-Edw., which, from Spence Bate's remark, would appear also to belong to this group, it differs in having the anterior moiety of the fourth crest undivided.

"The ground-colour" of this striking form "is old ivory-white with orange-white markings on tips of spines, &c.; the eyes are magenta." (*G. M. Giles.*)

Twenty-four specimens, of which three are adult (two of them ovigerous) females, were obtained at a single haul in lat. 19° 35' N., long. 92° 24' E., in 272 fathoms.

Length of rostrum 14.5 millim., of carapace from orbital to posterior margin 25 millim., of abdomen 51 millim.; total

* To facilitate the following descriptions the carapacial crests, of which there are seven pairs, may be named "dorsal," "subdorsal," "sublateral," "lateral," "submarginal," "antemarginal," and "marginal," or may be simply numbered 1 to 7 in the order of their succession from the mid-dorsal line downwards on each side. The specific characters are taken from the four uppermost.

length 90·5 millim.; width between points of spines of lateral crests 20 millim.

A single adult (ovigerous) female was subsequently obtained in lat. 20° 17' 30" N., long. 88° 50' E., in 193 fathoms, in company with *Nephropsis Carpenteri*.]

(2) Species with the anterior moiety of the fourth crest divided into two parts produced anteriorly into moderate spines, the anterior of which never approaches the level of the supraorbital margin, and with the ridges and other elevations of the dorsal integument more or less sharp and roughly tuberculose.—*G. sculptus*, S. I. Smith, *G. granulosis*, *G. podager*, and *G. rimapes*, Spence Bate, and the following:—

11. *Glyphocrangon priononota*, sp. n., Wood-Mason.

Allied to *G. sculptus* and *G. granulosis*, but distinguishable at a glance from the former by the great strength and distinctness of all the crests, but especially of the dorsal and subdorsal (first and second), which are strongly toothed; by the posterior moiety of the sublateral (third) crest not terminating anteriorly in a tubercle; by the anterior moiety of the lateral (fourth) crest being merely divided by a notch and not reduced to two spines; by its more strongly tuberculate abdomen; by the pleura of the fifth abdominal somite being bispinose instead of trispinose; by the form of the dactylopodites of the fourth and fifth pair, which are simply pointed; by the teeth at the base of the rostrum being larger than the teeth of the rostrum itself; and probably in other details. It apparently agrees with *G. granulosis* in the strength and armature of the dorsal and subdorsal crests, but it differs in its narrower body; in the rostrum extending fully one third of its length beyond the antennary peduncle; in the posterior moieties of the sublateral and lateral (third and fourth) crests not being tuberculose, and the former of them not ending anteriorly in a strong cusp; and in the spines of the anterior moiety of the lateral (fourth) crest not being so large. From comparison with *G. podager* and *G. rimapes* it is altogether excluded by the simple dactylopodites of its fourth and fifth pairs of legs.

Two males and one female from Station 104, 1000 fathoms.

Colours in the fresh state deep pink; colour of eyes in spirit dark purple.

Length of rostrum 21·75 millim., of carapace from orbital to posterior margin 22 millim., of abdomen 59 millim.; total length 107 millim.

(3) Species in which the anterior moiety of the fourth crest is undivided and terminates anteriorly in a single small spine, and the ridges and tubercles of the occasionally pubescent dorsal integument are more or less blunt and smooth.—*G. longirostris*, S. I. Smith, *G. hastacauda* and *G. acuminata*, Spence Bate, ?*G. nobilis*, A. Milne-Edwards, and the two following species, of which the first, though belonging to the collection of a previous season, may fitly be introduced here:—

12. [*Glyphocrangon Gilesii*, sp. n., Wood-Mason.

Distinguished not only from all the other members of its group, but also from all the other species of the genus, by possessing the full complement of complete crests on both divisions of the carapace, the anterior moiety of the third crest being developed and produced anteriorly into a small spine just as in the case of the fourth crest. The gastric moiety of the second crest is divided into three parts, the foremost of which is produced into a minute spinule. There is a small tubercle in the gastro-rostral groove between the front ends of the dorsal (first) crests. With these exceptions the integument of the carapace is quite smooth and, except on the summits of the crests, which are very distinctly foveolate-rugose, somewhat polished. Except for the median crests and transverse grooves the sculpture of the abdominal terga is obsolete. The pleura of the four intermediate somites are bispinose at the extremities, with the smaller tooth posterior in the first three and anterior in the last, where the posterior spine rivals the single spine of the last pleuron. The antennal spine is longer and horizontally more expanded than the antero-lateral, which is invisible from above. The dactylo-podites of the fourth and fifth pairs of legs are lanceolate and simply acute at the tips.

A single female was obtained on the 8th December, 1887, eight miles south-east of Cinque Island, in the Andaman Sea, in 500 fathoms; bottom green mud.

The colour in spirit is ivory-white, with the tips of the spines, rostrum, and telson and the summits of the crests pale orange.

Length of rostrum 11 millim., of carapace 13·75, of abdomen 33; total 56·75 millim.]

13. *Glyphocrangon unguiculata*, sp. n., Wood-Mason.

Closely allied to the preceding; differs in the carapace and abdomen being covered with a very thin, filmy, delicate, and

deciduous velvety pubescence; in the anterior moiety of the sublateral crest being reduced to a thin, interrupted, unarmed wrinkle; in the anterior or gastric moiety of the subdorsal crest being broken up into a diffused, coarsish, subtuberculose wrinkling, terminated anteriorly by a spine; in the dorsal crests being subtuberculose; in the antennal and anterolateral spines being more divergent in a side view, or, in other words, less horizontal; in the postero-inferior angle of the second and third abdominal pleura being angular rather than spinose; and, finally, in the outer margin of the dactylopodites of the fourth and fifth pair of legs being produced near the apex into a minute incurved claw.

Two egg-laden females from Station 105, 740 fathoms.

Colour in life delicate pink; eyes in spirit dark purple.

Total length from tip of rostrum to apex of telson 73.5 millim.; of carapace, from supra-orbital to posterior margin, 18 millim.; of rostrum, from supra-orbital margin to apex, 13 millim.; of abdomen with telson 44 millim.

Family Miersiidæ.

EPHYRINA, S. I. Smith.

Ephyrina, S. I. Smith, Proc. U. S. Nat. Mus. 1885, p. 506.

Tropiocaris, Spence Bate, 'Challenger' Macrura, 1888, p. 835, pl. cxxxvi. fig. 1.

14. *Ephyrina Hoskynii*, sp. n., Wood-Mason.

Closely allied to *Ephyrina Benedicti*, S. I. Smith (= *Tropiocaris planipes*, Spence Bate), but differs in having the carapace and the rostrum shorter, the latter not quite reaching the corneæ and terminating abruptly in a vertical sinuous margin; the eyes apparently smaller, and the third abdominal segment non-produced.

This exceedingly delicate specimen was in the fresh state of a dark red colour.

From Station 105, 740 fathoms.

Length from front margin of rostrum to apex of telson 60 millim.

HOPLOPHORUS, Milne-Edwards.

15. *Hoplophorus Smithii*, sp. n., Wood-Mason.

A small species from Station 62, 1439 fathoms, and Station 103, 1260 fathoms, apparently distinguished from previously described species by the smallness of the spine at the postero-

inferior angle of the carapace and by the pleura of the first abdominal somite being strongly emarginate, but not spinose, at its antero-inferior angle. The efferent branchial channel is extremely large. The rostrum, which is $\frac{13}{8}$ -toothed, descends to the first infra-marginal tooth, whence it is straight and slightly ascendant; its length, measured from its tip to the supra-orbital margin, is equal to the interval between the last-named point and the hinder margin of the second abdominal somite. The spiniform process of the third abdominal tergum is more than twice as large as those of the two other segments, which are subequal.

Colours in life bright pink, in spirit strongly iridescent.

The specimen from Station 103 measures 50 millim. from tip of rostrum to apex of telson; it was alive and active when brought on board.

ACANTHEPHYRA, A. Milne-Edwards.

16. *Acanthephyra curtirostris*, sp. n., Wood-Mason.

Closely allied to *A. acutifrons*, Spence Bate, differing therefrom in its shorter and smaller carapace and in its much less produced rostrum, which does not reach beyond the middle of the terminal joint of the antennular peduncle and is armed on its upper margin with nine minute saw-like teeth, on its lower with a single strongish spine. The ocular papilla embraces the cornea.

Two males from Station 100, 840 fathoms, and one from Station 104, 1000 fathoms.

Length from tip of rostrum to apex of telson 85 millim.

17. *Acanthephyra brachytelsonis*, Spence Bate.

Acanthephyra brachytelsonis, Spence Bate, 'Challenger' Macrura, 1888, p. 753, pl. cxxvi. fig. 7.

From Station 104, 1000 fathoms, eight specimens, of which two are fine adult males, and two mutilated specimens from 740 fathoms at Station 105.

Colours in the fresh state deep crimson-lake.

Length from tip of rostrum to apex of telson about 120 millim.

Family Alphæidæ.

DORODOTES, Spence Bate.

18. *Dorodotes reflexus*, Spence Bate.

Dorodotes reflexus, Spence Bate, 'Challenger' Macrura, p. 678, pl. cxvi. fig. 3.

Six fine males from Station 97, 1310 fathoms, coloured bright pink, and one ovigerous female of moderate size from Station 62, 1439 fathoms.

The eggs are of two sizes and colours, the smaller being light brown, the larger bright pink like the mother, the difference in colour and size being due to the formation of an embryo.

When brought on board the carapace of every specimen was covered with a thick greasy secretion, probably cuticular in origin: in spirit the carapace still has a greasy appearance.

HETEROCARPUS, A. Milne-Edwards.

19. *Heterocarpus Alphonsi*, Spence Bate.

Heterocarpus Alphonsi, Spence Bate, 'Challenger' Macrura, 1888, p. 632, pl. cxii. fig. 1.

Nine specimens, of which four are adult males, one an ovigerous female, and four immature males, were obtained at Station 105, 740 fathoms.

The colour in the fresh state is deep pink.

Length of male, from tip of rostrum to apex of telson, 137 millim.; of female 163 millim.

Family Pasiphaidæ.

PARAPASIPHÆ, S. I. Smith.

20. *Parapasiphaë latirostris*, sp. n., Wood-Mason.

This fine species is distinguished by its high and short foliaceous rostrum, which barely reaches to the extremity of the eyes, is strongly arched above, is bispinose at its apex, and is preceded by five or six small teeth on the gastric region; by the corneæ occupying the whole extent of the apex of the depressed peduncles; and by the crest of the fourth abdominal tergum being produced backwards in the middle line into a sharp spine.

The single specimen is a female.

It was obtained at Station 105, in 740 fathoms, and in the fresh state was coloured a deep lurid red.

Length 103 millim.

21. *Parapasiphaë Alcocki*, sp. n., Wood-Mason.

A smaller species taken at Station 101, 922 fathoms. It is distinguished by its short eye-stalks and globular corneæ,

and by the form of the rostrum, which terminates abruptly a little behind the anterior margin of the carapace in a vertical sinuous edge, much as in *Ephyrina Hoskynii*.

Colour in the fresh state deep crimson-lake.

One male specimen, measuring 64 millim. from the anterior margin of carapace to apex of telson.

Family Nematocarcinidæ.

NEMATOCARCINUS, A. Milne-Edwards.

22. *Nematocarcinus tenuipes*, Spence Bate.

Nematocarcinus tenuipes, Spence Bate, 'Challenger' Macrura, 1888, p. 812, pl. cxxxii. fig. 6.

Station 97, 1310 fathoms, four specimens; Station 104, 1000 fathoms, two specimens.

Colours in the fresh state bright orange.

Family Homaridæ.

PHOBERUS, A. Milne-Edwards.

23. *Phoberus cæcus*, A. Milne-Edwards, var. nov. *sublevis*, Wood-Mason.

Phoberus cæcus, A. Milne-Edwards, Ann. Sci. Nat. (6) xi. 1881, 4, p. 1.
Phoberus tenuimanus, Spence Bate, 'Challenger' Macrura, 1888, p. 171,
pls. xxi., xxii.

Our specimen differs from those of the 'Blake' and 'Challenger,' which seem to be identical, only in having one spine instead of three on the upper margin of the rostrum, and the carapace and dorsal integument generally less spinose.

Length from tip of rostrum to apex of telson 118 millim.; from extremity of extended chelæ to apex of telson 177 millim.

Colour delicate pink.

One male specimen from Station 105, 740 fathoms.

NEPHROPSIS, Wood-Mason.

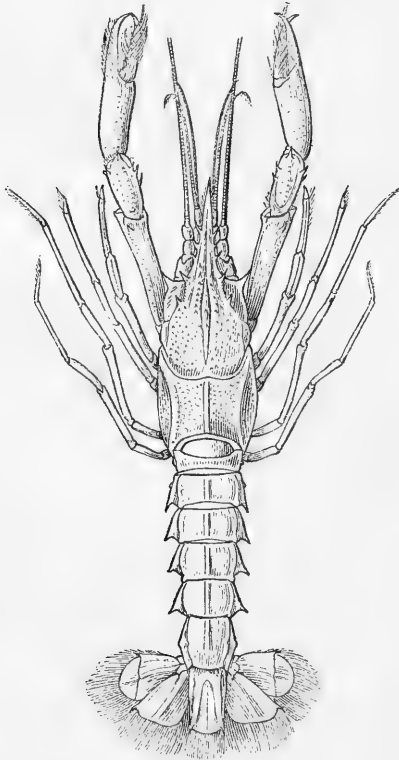
24. *Nephropsis atlantica*, Norman.

Nephropsis atlantica, Norman, Proc. Roy. Soc. Edinb. 1881-82, vol. xi. p. 684.

Six specimens (four males and two females), from Station 105, 740 fathoms, agreeing with Canon Norman's excellent description of the male.

The species is abundantly distinct from *N. Agassizii* (= *aculeatus*), which, so far as the figure goes, is indistinguishable from *N. Stewartii*.

Fig. 4.



Nephropsis atlantica, Norman, ♂, nat. size.

Of our specimens one has three pairs, one two and a half pairs, three two pairs, and one a pair and a half of lateral spines on the rostral margins.

Colours in life pink, with a broad white longitudinal dorsal stripe.

Family **Thalassinidæ**.

CALLIANASSA, Leach.

25. *Callianassa*, sp.

Two specimens, probably male and female, of a small species from Station 76, 93 fathoms.

Colours in life deep-sea pink.

Family Eryontidæ.

WILLEMOESIA, Grote.

26. *Willemoesia forceps*, A. Milne-Edwards.

Willemoesia forceps, A. Milne-Edwards, Bull. Mus. Comp. Zool. vol. viii. 1880, p. 64.

One female specimen, of a bright pink colour, in length (measured from front margin of carapace to apex of telson) 99 millim., from Station 62, 1439 fathoms; and one male and one female specimen, of a milk-white colour, measuring respectively 84 millim. and 82 millim., from Station 97, 1310 fathoms.

PENTACHELES, Spence Bate.

27. *Pentacheles*, sp.

A single specimen, with the chelipeds wanting, from Station 105, 740 fathoms.

Colour pale pink.

28. ? *Pentacheles* (?immature).

At Station 102, 920 to 690 fathoms, a very remarkable specimen was obtained, which may best be described for our present purpose as a *Pentacheles* with a globularly inflated carapace and all the spines of its dorsal integument of larva-like length and sharpness. It recalls a good deal the curious larva which Spence Bate has described and figured ('Challenger' Macrura, fig. 30, after a drawing by Willemoes von Suhm) under the name of "*Eryoneicus cæcus*." We believe that notwithstanding its great size—36 millim. in length—it is an immature form of some species of *Pentacheles*, bearing to the adult form a relation similar to that which exists between a just-hatched and an adult crayfish.

Our specimen speaks to the accuracy of Willemoes von Suhm's drawing of that which, there is little doubt, is only a very much younger stage.

Length 36 millim.

Colour in the fresh state pink.

Family Parapaguridæ.

PARAPAGURUS, S. I. Smith.

29. *Parapagurus abyssorum*, A. Milne-Edwards, MS.

Parapagurus abyssorum, Henderson, 'Challenger' Anomura, p. 87, pl. ix. fig. 2.

One fine specimen at Station 105, 740 fathoms.

Colour in the fresh state pink.

The animal was sheltered in a fine colony of an *Epizoanthus* similar to the figure of *Epizoanthus paguriphilus*, Verrill, in Professor S. I. Smith's paper in Proc. U. S. Nat. Mus. vol. iii. 1883.

PAGURODES, Henderson.

30. *Pagurodes*, sp.

All the dead shells of *Rostellaria delicatula* brought up at Stations 81 and 96 were tenanted by a small hermit-crab which fits fairly well into this genus. Its colour in the fresh state was bright pink, similar to the colour of the animals whose shells were appropriated.

Family Galatheidæ.

GALACANTHA, A. Milne-Edwards.

31. *Galacantha areolata*, sp. n., Wood-Mason.

A fine species closely allied to *Galacantha rostrata*, A. Milne-Edwards, but differing in its more distinctly areolated and more coarsely granulated carapace, and by having the apex of the horizontal portion of the rostrum short and minutely bifid, as well as in some other particulars.

One male specimen from Station 97, 1310 fathoms.

Colour, including the corneæ, dull milky orange.

Length 46 millim.

MUNIDOPSIS, Whiteaves.

32. *Munidopsis ciliata*, sp. n., Wood-Mason.

Closely allied to *Munidopsis brevimana*, Henderson, differing in having the transverse scale-like elevations of the carapace (which apparently also differ in form and distribution) and the ridges of the abdomen fringed with forwardly-directed hairs; and the lateral margins of the carapace armed with six spines, of which the foremost is only half the size of the supra-antennal, while the first of the four between the two divisions of the cervical groove is much larger than the supra-antennal, and the sixth is about the same size as the first and third.

One male specimen from Station 97, 1310 fathoms.

Colours in the fresh state milk-white.

Total length from apex of rostrum to apex of telson 35 millim.; length of carapace from posterior margin to apex of

rostrum 18 millim.; breadth of carapace between posterior and second third 10·5 millim.; length of chelipeds 19 millim.; length of rostrum 5 millim.

33. *Munidopsis stylirostris*, sp. n., Wood-Mason.

Allied to *Munidopsis curvirostra*, Whiteaves, differing in the somewhat slenderer rostrum passing off more suddenly from the fore margin of the carapace; in the spine of the antero-lateral angle being larger; in the presence behind the root of the rostrum of a pair of minute forwardly-directed spinules supported on small eminences, in place of the pair of well-developed spines seen in the same position in the preceding and other species; in the absence of medio-dorsal spines on the carapace and abdominal terga; and in the spinose chelipeds and legs. In the chelipeds the basipodite bears a spine at the apex of its hinder angle; the ischiopodite two near the apex, one below, the other above; the meropodite four, two above and two below, at the apex, besides three or four on the shaft towards the distal end; and the carpopodite also four in a similar position; while the chelæ, in which the fingers are equal in length to the palms, are unarmed. In the legs the carpopodite and meropodite each bear a spine at the upper apex. The corneæ appear to be narrower and more elongated, being distinctly cylindrical in the basal half.

Colour in the fresh state dull orange-pink, including the corneæ: in spirit pure ivory-white, with the non-faceted corneæ yellow.

Two female specimens from Station 105, 740 fathoms.

Total length 54 millim.; length of carapace 18·5, of rostrum 11 millim.; breadth of carapace between tridentate lobes behind antero-lateral tooth 15·5 millim.; length of chelipeds 40 millim.

ELASMONOTUS, A. Milne-Edwards.

34. *Elasmonotus Edwardsii*, sp. n., Wood-Mason.

Body and all the appendages completely clothed with a dense velvety pubescence. The carapace is moderately convex in all directions, but especially transversely and over the gastric region, which is delimited from the bisected cardiac region and from the hepatic regions by a transverse groove. The rostrum is porrect, acute, triangular, with straight sides and roof-shaped dorsal surface. The anterior margin of the carapace is armed rather farther from the middle line than

from the antero-lateral angle with a small triangular spine, the point of which is opposite the chink-like interval between the eyes and the antennal bases; the antero-lateral angle is slightly produced, and the interval between it and the supra-antennal spine is roundly emarginate; the lateral margin is divided by two notches into two lobes, the anterior and shorter of which, answering to the interval between the two divisions of the cervical groove, is vertically compressed, somewhat expanded laterally, subacute at the edge, and produced anteriorly into a blunt tooth; the peduncles of the eyes are indistinguishably ankylosed together and immovably united with the rostrum and antennular sternum, and give off from their inner side a long spine, which, being applied by its base to the under surface of the rostrum, presents the appearance of an orbital eave terminating anteriorly in a preocular spine, while the cornea on its outer side looks like an eye retracted into its orbit. The chelipeds and legs are short and stout; the ischiopodites of the former are armed at the apex above and below with one spine, the meropodites with four along their posterior angles (two on their inner and two on their outer apices), the carpopodites with one on the inner side; while the second, third, and fourth pairs of legs are armed on the upper margin of the meropodites with increasing series of seven, six, and five spines respectively, and on the upper margin of the carpopodites with three.

One male from Station 97, 1310 fathoms, the colour in the fresh state being milk-white, including the corneæ. In spirit the corneæ are yellow.

Total length 45 millim.; length of carapace 24 millim., of rostrum, from rostro-ocular suture to apex, 6 millim.; breadth of carapace across anterior lobes 15.4, of chelipeds 24 millim.

It is a remarkable circumstance that no specimens of the genera *Galathea*, *Munida*, and *Eumunida* were obtained during the past season, although in previous seasons specimens of one or other of them have not been uncommon in the trawl and on the tangles.

[To be continued.]

XXIII.—*On some Disputed Points in Teleostean Embryology.*

By J. T. CUNNINGHAM, M.A., Naturalist to the Marine Biological Association.

AT the time when Balfour wrote his 'Comparative Embryology' less was known concerning the development of the Teleostei than concerning that of any other class of the Vertebrata. But since that time explorations in this field have been very numerous, and the results obtained have not only brought our knowledge of Teleostean development up to the level of that of the embryology of Elasmobranchs, but have in many cases given quite a new meaning to processes previously observed in the development of other types. Interpretations and conceptions that appeared satisfactory when founded on a comparison of Elasmobranchs, Amphibia, and Sauropsida have been found to be inconsistent with the phenomena presented by Teleostean ova, and have therefore had to be either modified or abandoned. But the absence of anything like sound criticism in biology allows all the numerous memoirs and papers that have been published on the subject during recent years to claim equal authority, although there is little agreement or harmony among them. My purpose in this paper is to draw attention to the points which have been firmly established by satisfactory evidence and to distinguish the sound from the unsound among recent descriptions and arguments.

The Structure of the Mature Ovum.

The ovum at the moment it leaves the oviduct of the female consists of the ovicell enveloped by a capsule or membrane which is everywhere in contact with it. The ovicell consists of a small quantity of protoplasm and a larger quantity of nutritive material or deutoplasm. In the usual type of pelagic ovum the deutoplasm forms a continuous homogeneous mass which is transparent, and the protoplasm forms a complete thin envelope around it. In many ova, *e. g.* those of many species of the Gadidæ and Pleuronectidæ, there is no other element in the ovicell than the pellucid yolk and the peripheral pellicle of protoplasm; but in many other pelagic ova, *e. g.* those of the gurnard (*Trigla*) and mackerel (*Scomber scomber*), there is in addition a somewhat large globule of oil. In some ova there are numerous oil-globules. Professor W. C. M'Intosh, in his review of my 'Treatise on the Sole' (11),

says that I do not now hold the view that oil-globules occur in the perivitelline space. It is true that in a paper published in 1885, when I described the movement of the oil-globule of the egg of *Trigla gurnardus*, I was led into the error in supposing that the oil-globule moved between the naked surface of the yolk and the vitelline membrane. At that time I gave no further study to the ovum of the gurnard nor had I studied any other ovum containing oil-globules; but before the paper by Professors M'Intosh and E. E. Prince was published I had, in my paper on the development of Teleosteans occurring in the neighbourhood of Plymouth (4), already explained that the oil-globule in the ovum of the mackerel and the gurnard is situated within the thin pellicle of protoplasm which encloses the yolk. My words were:—“Thus it is evident that the yolk is to be regarded as a liquid enclosed within a layer of protoplasm continuous with the blastoderm, and at the surface of this liquid, next the protoplasmic layer, moves the oil-globule.”

Of course these remarks of mine were intended to apply to *Scomber* and *Trigla* only, not to the relations of the oil-globules in all ova. But Prof. Prince, the pupil and fellow-worker of Prof. M'Intosh, in his paper on what he was pleased to call “oleaginous spheres” in Teleostean ova (8), stated that in some eggs the oil-globules occur outside the yolk *in the perivitelline space*. His words are (*loc. cit.* p. 88):—“The oil-globule in truth occupies different situations in different species, occurring within the yolk-mass or outside it in the perivitelline space, or rather in a fossa or pocket indenting the surface of the yolk. Examples of the latter condition are afforded by the Gadoid ovum studied by Hæckel and by *Motella mustela*, *Lophius piscatorius*, *Molva vulgaris*, and other forms.” In the recent large memoir of Professors M'Intosh and Prince (9) I find no reference to or contradiction of this statement, and yet there can be little doubt that it is as erroneous as my own earlier remark concerning the oil-globule in *Trigla*—the truth being that in the cases mentioned by Prince the oil-globules are enveloped by a protoplasmic pellicle continuous with the protoplasmic layer which envelops the yolk and are therefore immovable. In fact in the case of *Trigla* and *Scomber* in the course of development the oil-globule becomes enveloped by the protoplasm of the periblast, and the periblast is formed by the increase in thickness of the original protoplasmic envelope of the yolk.

In all non-pelagic ova, and in some pelagic, the yolk itself, apart from the presence of oil-globules, is heterogeneous and discontinuous. It usually in this case consists of a large

number of yolk-spherules of various sizes, strictly comparable with the yolk-spherules of an Elasmobranch or Sauropsidan. In all cases where such separate yolk-spherules occur they are separated by strands and bands of protoplasm which are ultimately continuous with the protoplasm of the blastodisc and the cortical protoplasm of the vitellus.

I pointed out in my paper in the 'Journal of the Marine Biological Association' (4) that the continuous homogeneous yolk of the typical pelagic ovum was to be regarded as a single large yolk-sphere representing the numerous yolk-spherules of such an egg as that of the herring or salmon, fused together, all the protoplasm being thus driven to the external surface of the vitellus. And I also pointed out that eggs like that of the sole with a single external layer of yolk-segments formed an intermediate condition, in which, while most of the yolk-spherules had fused together, a few still remained separated by protoplasmic partitions. Development shows this to be the true account of the matter, for in the ovarian development of typical pelagic ova the homogeneous yolk is actually produced by the coalescence of distinct yolk-spherules. Agassiz and Whitman, in one of their beautiful memoirs (7), describe a layer of yolk-segments exactly similar to that in the sole, in an egg which they identify as that of *Temnodon saltator*. They fail to find any explanation of these yolk-segments, but they distinctly retract their previous conclusion that the segments indicated a partial segmentation of the yolk connected with the segmentation of the blastoderm, and partially representing the segmentation of the yolk in the Amphibian ovum. Examination of sections has shown them that these yolk-segments have nothing to do with either the segmentation of the blastoderm or the nuclei of the periblast.

In spite of this retraction by Agassiz and Whitman of their previous conclusion M'Intosh and Prince in their large memoir (9, p. 720) still refer to the yolk-segments in the eggs of *Temnodon saltator* and of the common sole as a rudimentary survival of the nucleated yolk-cells formed by the process of segmentation in the ova of Amphibians, *Petro-myzon*, &c. The memoir of Agassiz and Whitman in which they repudiate this interpretation is mentioned by M'Intosh and Prince in their bibliographical list; but apparently Professor Prince, who we are told is responsible for the embryological part of the memoir, had not read all the works he refers to. Professor Prince does not allude to the obvious obstacle to any comparison between the yolk-segments in the egg of the sole and the yolk-cells of the Amphibian ovum, namely that the former are developed in the ovary long before ferti-

zation has occurred or segmentation has commenced. He even goes so far as to include the yolk-segments in pelagic Clupeoid ova, *e. g.* that of the sprat, in his interpretation. If he followed out this interpretation to its logical consequences he would have to maintain that segmentation in the Clupeoids and the sole proceeds to a great extent in the ovary before the egg is extruded and before it has been fertilized.

The capsule which contains the ovicell may be a single continuous layer or may consist of two more or less distinct layers. It has been usually held, in accordance with the definitions adopted by Balfour in his 'Comparative Embryology,' that a vitelline membrane is a primary egg-membrane formed in the ovary by the protoplasm of the ovum, while an egg-membrane formed by the follicular epithelium is to be called a chorion. The term *zona radiata* is, according to Balfour, to be applied to vitelline membranes which contain numerous radial pores. Thus it is clear that a vitelline membrane may or may not be a *zona radiata*, but a *zona radiata* is always a vitelline membrane. Therefore it was scarcely necessary for Prof. McIntosh to say that in my 'Treatise on the Sole' I call the *zona radiata* the vitelline membrane.

But it must be remembered that it is customary to call the envelope of the Teleostean egg the vitelline membrane, although it has not yet been proved beyond a doubt that it is formed by the action of the protoplasm of the ovum. I have shown conclusively that the processes of the egg-capsule in *Myxine* are formed last in the development of that capsule in the ovary; the internal part of the capsule is formed first, and it increases in thickness by addition to the outer side. Now the action of the ovum itself could only add new material to the internal surface of the egg-capsule, not to the external surface. Therefore the egg-capsule in *Myxine* must be formed in part at least by the follicular epithelium. Since many Teleostean ova possess processes of the capsule similar to those of *Myxine*, *e. g.* *Belone*, the outer part of the envelope of these ova must also be formed by the follicular epithelium; for the processes are the last part of the egg-membrane to be developed, not the first. Whether in some ova the whole of the egg-membrane is developed by the egg from without inwards, or whether part is always derived from the egg and part from the follicular epithelium has not yet been proved. Meantime, where, as in the sole's ovum, a single membrane only is discernible, I see no objection to following the example of such writers as Hæckel, Kölliker, and Waldeyer, and calling it simply the vitelline membrane. The term *zona radiata* is

not a satisfactory one, for zona means a girdle or belt and not a hollow sphere like the membrane to which it is applied, while radiata certainly does not mean "provided with minute tubes vertical to the surfaces." The large memoir of Professors M'Intosh and Prince (9) gives no fresh evidence as to the development of the vitelline membrane; the paper of Iwakawa (12) to which they refer is not conclusive, nor are Scharff's observations in his paper "On the Intra-Ovarian Egg of some Osseous Fishes" (13).

Segmentation.

It will be convenient to take Balfour's summary of the then state of knowledge in his 'Comparative Embryology' (1885) as our starting-point in considering this question. At that time the process of segmentation had not been followed step by step from its beginning to its end. Balfour says:—"In hardened specimens a small cavity amongst the segmentation-spheres may be present at any early stage; but it is probably an artificial product, and in any case has nothing to do with the true segmentation-cavity, which does not appear till near the close of segmentation. The peripheral layer of granular matter continuous with the germinal disk does not undergo division, but it becomes during the segmentation specially thickened; and, while remaining thicker in this region, gradually grows inwards, so as to form a continuous subblastodermic layer. In this layer nuclei appear which are equivalent to those in the Elasmobranch ovum. A considerable number of these nuclei often become visible simultaneously, and they are usually believed to arise spontaneously, though this is still doubtful. Around these nuclei portions of protoplasm are segmented off, and cells are thus formed which enter the blastoderm and have nearly the same destination as the homologous cells of the Elasmobranch ovum. During the later stages of segmentation one end of the blastoderm becomes thickened and forms the embryonic swelling, and a cavity appears between the blastoderm and the yolk which is excentrically situated near the non-embryonic part of the blastoderm. This cavity is the true segmentation-cavity.

"In *Leuciscus rutilus* Bambeke describes a cavity as appearing in the middle of the blastoderm during the later stages of segmentation. From his figures it might be supposed that this cavity was equivalent to the segmentation-cavity of Elasmobranchs in its earliest condition; but Bambeke states that it disappears and has no connexion with

the true segmentation-cavity. Bambeke and other investigators have failed to recognize the homology of the segmentation-cavity in Teleostei, Elasmobranchii, Amphibia, &c."

In his account of segmentation in the general portion of his work Balfour says that simple segmentation leads to the formation of a hollow vesicle or blastosphere enclosing a central cavity, which is called the segmentation-cavity or cavity of von Baer. In German works this cavity is called sometimes "Furchungshöhle," sometimes "Keimhöhle;" and some English embryologists speak of it as the subgerminal cavity or germinal cavity.

In my paper "On the Relations of the Yolk to the Gastrula in Teleosteans" (2) I described the history and relations of the segmentation-cavity as they are seen in the living pelagic and transparent ova of the cod, haddock, and whiting. I showed there that the segmentation-cavity does not become visible as a distinct space between the centre of the blastoderm and the protoplasmic envelope of the yolk (periblast) until the commencement of the invagination or the appearance of the hypoblastic ring. I showed that the cavity never exists beneath the germinal ring nor beneath the embryonic or dorsal rudiment. I showed that in the process of the envelopment of the yolk by the blastoderm the whole of the germinal ring becomes used up in the formation and increase of the dorsal rudiment, and that the central part of the blastoderm with the segmentation-cavity beneath it comes to form the ventral portion or yolk-sac of the embryo and larva.

Before this paper of mine was written Agassiz and Whitman, in a paper "On the Development of some Pelagic Fish-Eggs" (6) had demonstrated very clearly and conclusively the exact nature of the processes which take place during segmentation in the pelagic ovum. Hoffmann (14) had previously asserted, and supported the assertion with beautiful ideal figures having no relation to reality, that the first nuclear division took place horizontally and produced two new nuclei, one vertically above the other, the upper giving rise afterwards to the cells of the blastoderm, the multiplication of the lower forming the nuclei of the unsegmented periblast. Agassiz and Whitman showed that up to the four-cell stage there is no distinction between periblast and blastoderm, the cells being continuous with one another below and externally with the protoplasmic pellicle which envelops the yolk. But at the sixteen-cell stage they showed that the four central cells have separated from a thin layer of protoplasm below which covers the yolk, and are thus definitely limited and defined on all sides, while the twelve marginal cells remain continuous with

both the subblastodermic protoplasmic layer and the protoplasmic envelope of the yolk outside the blastoderm. Thus the segmentation-cavity is *potentially* established at this early stage, though there is no actual space between the central cells of the blastoderm and the subblastodermic protoplasm. Both the four central cells and the twelve marginal cells now go on dividing, the former principally dividing in the horizontal plane so as to form several layers of cells. When a marginal nucleus divides it divides vertically, its two halves lying horizontally side by side; the internal half becomes completely separate and joins the blastoderm, while the external half remains continuous with the cortical protoplasm of the ovum. At a later stage the nuclei divide faster than the protoplasm, and while some cells are separated off from the marginal cell to join the blastoderm, the multiplying nuclei extend into the cortical protoplasm both internally beneath the blastoderm and externally outside the blastoderm. Thus the nucleated syncytium called the periblast comes to be established. Finally the centre of the blastoderm becomes thinner and lifts itself up from the subblastodermic periblast, and thus the actual segmentation-cavity is established. At the same time the cells which are constantly being separated off from the marginal periblast pass inwards and form a definite layer beneath the germinal ring.

Now let us turn to the account of these processes given by M'Intosh and Prince in their bulky memoir in the *Edinburgh Transactions* (9). They say that the blastodisc is formed by the segregation at one pole of protoplasm, which, moreover, constitutes a superficial and tenacious layer around the vitellus; and that this layer is itself derived by centrifugal transference from the scattered protoplasm mingled with the general matrix of the yolk. These authors entirely ignore the distinction which exists with regard to the relations of the protoplasm between pelagic eggs with a continuous yolk and other eggs with a discontinuous yolk made up of yolk-spheres. In the former case, as I have shown in my memoir "*On the Eggs and Larvæ of Teleosteans*" (5), all the protoplasm of the ovum at the time of deposition is cortical, and there is no "scattered protoplasm mingled with the general matrix of the yolk." In the herring's egg and all eggs with discontinuous yolk the yolk-spherules are contained in a network of protoplasm. In the former case the protoplasm collects to form the blastodisc only from the cortex; in the latter case it collects from the internal network as well. M'Intosh and Prince cite various authors in support of the idea that the protoplasm during development is nourished and grows at the expense of

he yolk ; but surely that fact is sufficiently obvious—what else is the yolk for ?

M'Intosh and Prince have not fully grasped the meaning of my remarks concerning the segmentation in my paper "On the Relations of the Yolk to the Gastrula." I said that the first cleavage of the blastodisc into two cells represented theoretically the division of the whole ovum into two similar cells, each containing a cap of protoplasm and a large quantity of yolk, although actually the two cells are continuous inferiorly and the yolk is continuous throughout. They say it is difficult to maintain such a relation of blastomeres and yolk when the morula is reached. By morula they apparently mean the segmented blastoderm. But it is obvious enough from my papers and from those of the most reliable embryologists that at this stage the same relation is maintained between the undivided nucleated periblast and the yolk which it envelops. These portions of the ovum together represent and are homologous with, as I said in the paper referred to, the nucleated yolk-cells of the frog's ovum.

M'Intosh and Prince deny the correctness of Agassiz and Whitman's statement that there is a definite separation during the later stages of segmentation between the central part of the blastoderm and the subblastodermic periblast. They say that the line of demarcation is broken in sections by knob-like processes which project from the blastoderm into the yolk ; but the figure they refer to in support of this statement does not include the yolk at all ! In fact the figures they give of sections of the blastoderm are quite unsatisfactory, and seem to indicate that the sections themselves were too imperfect to prove anything. At any rate my own sections of the ova of the mackerel at different stages of segmentation entirely confirm the results of Agassiz and Whitman so far as concerns the complete demarcation between the central cells of the blastoderm and the subblastodermic periblast. I differ, however, from those authors in denying that there is actually any space beneath the blastoderm in the living ovum ; the surface of the subblastodermic layer, though distinct from, is in contact with, the lower surface of the blastodermic cells.

I fully agree with M'Intosh and Prince when they state that a cavity appears between the under surface of the central portion of the blastoderm and the periblast after the stage of simple segmentation is completed. But they say, "We speak of it as a germinal cavity, and do so advisedly, for it is not the cavity of Von Baer, better known as the blastocœl or segmentation-cavity." It will probably be difficult to convince these authors that this cavity is, as Balfour and the

most reputed embryologists have always maintained, the same thing as the segmentation-cavity in other ova ; for they do not seem to admit the fact that all ova are homologous, and that the various modes of development, leaving aside those exhibited by Cœlenterata and Crustacea, are modifications of one fundamental plan. But I would point out that the term germinal cavity is synonymous with segmentation-cavity, and that if they wish to maintain that the cavity in Teleostean ova is something else, they ought to give it some other name. These authors admit that Balfour's segmentation-cavity in Elasmobranchs is homologous with the segmentation-cavity of Amphibians, although, as they also admit and as Balfour states, the floor of the cavity in Elasmobranchs is at one stage formed by the yolk with its external protoplasmic layer, as in Teleostei. The basis of the surprising conclusion of M'Intosh and Prince is obvious enough. They speak of the Teleostean germ after segmentation as a morula which flattens out and becomes lifted up and separated by a chamber from the appended trophic mass. That is to say, they regard the yolk with its envelope of nucleated protoplasm as something distinct from the germ, and the germ, or, to use the proper term, the blastoderm, as alone homologous with the morula of an egg with simple equal segmentation, such as that of *Amphioxus*. But, as is satisfactorily shown by Balfour's *Comp. Embryology*, chap. xi. vol. ii., and by my paper "On the Relations of the Yolk to the Gastrula" (2), not to mention numerous other papers by different embryologists, the Teleostean egg must be compared whole for whole with any other egg. The yolk is not something added on to the outside of the egg, but is an accumulation of food-material within the egg itself. As development proceeds certain cells are separated, while others, namely the nucleated periblast, contain the whole yolk ; and it is as certain as any other ascertained relation in embryology that the periblast and the yolk are homologous with the yolk-cells in the Amphibian ovum, which there form the floor of the segmentation-cavity. That this is so is conclusively proved by the fact, demonstrated in my paper on Kupffer's vesicle, that the periblast gives rise to cells which form the floor of the intestine, as do the yolk-cells in Amphibians. My account of Kupffer's vesicle, excepting that part which refers to the formation of the floor of the gut from the periblast, has been entirely confirmed by a paper published last year (15) by Henry V. Wilson in America.

In the light of the above considerations it is somewhat extraordinary that Prof. M'Intosh, in his review of my work on the sole (11), should write, "He prefers the term 'seg-

mental cavity' to Prof. Ed. E. Prince's less ambiguous term 'germinal cavity.'" The term I used was segmentation-cavity, not segmental cavity; and how anyone can maintain that that term, whose meaning has been firmly established by Balfour and every other leading embryologist, is more ambiguous than Prince's use of the term germinal cavity, utterly passes my comprehension.

But we cannot yet leave the account given by M'Intosh and Prince of the segmentation-cavity. They speak of another cavity observed in some Teleostean ova as representing the true blastocœl; but it is generally admitted by recent observers that there is but one cavity—that which M'Intosh and Prince call the germinal cavity, and it is this alone which I am discussing. Those authors proceed to argue that this cavity, having been, as they think, proved not to be the *blastocœl*, is really the *enterocœl* or cavity of invagination. It would take too much space to summarize their arguments. It will be sufficient to mention one or two facts which entirely disprove their conclusion. They say that the cavity is roofed over by endoderm- and epiblast-cells. It is a simple fact, which admits of no dispute, that the portion of the blastoderm which forms the roof of the cavity does not consist of endoderm at all, but wholly and exclusively of epiblast. The hypoblast or endoderm is represented by the lowest layer of the germinal ring and by certain cells derived at a later stage from the periblast; the germinal ring all goes to form the dorsal rudiment of the embryo. No part of the outer covering of M'Intosh and Prince's "germinal cavity" ever has anything whatever to do with the formation of the intestine, and therefore has nothing to do with the hypoblast. Now an enterocœl must be entirely surrounded by hypoblast; what, then, becomes of the extraordinary proposition of the St. Andrews embryologists?

The Periblast.

I have previously referred to the account given by Agassiz and Whitman (6) of the origin of the nucleated periblast. I fully accept their conclusions as to the origin of the first nuclei in that layer; but I consider that their figures indicate a different subsequent history of the layer from that which they describe in their text. I believe, as I have said before, that as the nuclei of the marginal cells from the sixteen-cell stage onwards continually divide, cell-division also takes place in these cells, but at a slower rate than the nuclear division. In consequence of this new cells are continually being sepa-

rated from the ring of periblast *at the same time that* the nuclei in that ring continually become more numerous and extend outwards and inwards from the marginal region of the blastoderm. Agassiz and Whitman do not admit that cells are separated from the periblastic layer after it is once formed. They admit apparently that the marginal cells of the blastoderm, which are continuous inferiorly with the sub-blastodermic and extra-blastodermic pellicle of protoplasm, continue to divide almost up to the appearance of the actual segmentation-cavity, and that the inner cells join the blastoderm while the outer remain continuous with the protoplasmic envelope of the yolk. But after this time, when the nucleated syncytial periblast is definitely formed, they say it remains at every stage so perfectly distinct from every other portion of the embryo that they see no ground for suspecting that it enters into any of the permanent embryonic layers. The hypoblast they believe to arise from the division and centripetal ingrowth of cells from the margin of the disk.

I believe myself, from a comparison of the various descriptions published and from my own observations, that some portion or other of the periblast is always, throughout its existence, budding off cells, which go to join the blastoderm or tissues of the embryo.

In this belief I agree to some extent with Brook. This observer, in his paper "On the Germinal Layers in Teleostei" (16), leaves the question of the first origin of the nuclei in the periblast open, his preparations of the herring's ovum not having afforded conclusive evidence on the subject. But he maintains that the hypoblast of the germinal ring is formed by cells segmented off from the nucleated periblast beneath the ring. I think he is most likely right, and therefore I have to abandon the view I formerly took, that the hypoblast layer was formed solely by a centripetal ingrowth from the edge of the blastoderm. Of course my general view of the morphological significance of the "invagination" in the Teleostean ovum remains unaltered.

Next we have my own conclusions concerning the segmenting off of cells from the periblast at a much later stage to form the floor of the intestine in the region of Kupffer's vesicle (1); my views on this point I see as yet no reason to change.

Again, in the late embryonic history of the mackerel the large oil-globule becomes entirely surrounded by periblast. No ingrowth of cells from any part of the embryo ever occurs between the oil-globule and the periblast, yet nevertheless stellate chromatophores exactly similar to those of the mesoblast of the skin make their appearance on the deep internal

surface of the oil-globule. These pigment-cells must have been derived from the periblast, and afford an undeniable example of mesoblastic cells formed directly from that layer. The occurrence and significance of these chromatophores was, I believe, first pointed out by John A. Ryder (17), in the 'American Naturalist,' Extra, November 1886; they have also been described and discussed by myself in my paper in the Journ. Mar. Biol. Assoc. (4). In the same paper I described the occurrence of black chromatophores at the surface of the periblast in the embryo of *Pleuronectes microcephalus*; these pigment-cells are also developed directly from the periblast, no extension of the lateral mesoblast over the yolk having taken place.

Finally, it has been maintained by Ryder and others that colourless blood-cells are segmented off from the periblast and enter the venous sinus and heart. I have not observed this myself; but there seems to be good evidence for its occurrence.

Thus the periblast with the yolk is evidently equivalent to the yolk-cells of the Amphibian ovum, and, like those cells, continues throughout development to take part in the segmentation, though in a different fashion, a part of the periblast remaining unsegmented, although nucleated, until the final absorption of the yolk. Both the yolk-cells and the periblast may be termed after a certain stage primitive hypoblast, provided it be remembered that a great part of the primitive hypoblast gives rise to mesoblastic cells. This last fact is well brought out by Shipley in his paper "On the Development of *Petromyzon*," where he says:—"The first formation of the mesoblastic plates appears to take place by a differentiation of the hypoblastic yolk-cells *in situ*, and not from invaginated cells." This differentiation consists chiefly in subdivision, by which small cells of the mesoblast are produced from the large yolk-cells. In fact a little consideration shows that the segmentation of cells from the Teleostean periblast to form hypoblast and mesoblastic tissues corresponds perfectly with the subdivision of the yolk-cells in *Petromyzon* and Amphibians which gives rise to hypoblast and mesoblast in those forms.

Relation of Oil-globules to Periblast.

As I have already said, in the mature undeveloped ovum oil-globules are sometimes free in the yolk, sometimes fixed by envelopment in the cortical protoplasm of the egg. But in all cases, so far as my experience goes, the oil-globules are during deve-

lopment enveloped by the protoplasm of the periblast. A very interesting movement of the oil-globules during development is seen in that of the sole's ovum. The small oil-globules here are enveloped by the cortical protoplasm, and nearly all of them are at first situated in an irregular ring of groups not far from the edge of the blastoderm. As the blastoderm advances the periblastic protoplasm is continually increasing in thickness and extent by assimilation of the yolk, and when the ring of oil-globules is overtaken by the advancing periblast beneath the blastoderm it is carried along bodily in the advance of the periblast, so that ultimately the groups of oil-globules are translated to a position beneath the lateral region of the embryonic dorsal rudiment. Nothing could illustrate more beautifully the fact that the embryonic dorsal rudiment is formed by the concrescence of the two halves of the germinal ring. This fact alone proves the truth of the theory of concrescence. Prof. M'Intosh, in his review (11), says that I now locate the oil-globules of the sole's ovum beneath the trunk of the embryo sole. But the position in which I have represented them in my 'Treatise' is the same as that in which I represented them in my paper in the 'Journal of the Marine Biological Association' in 1889. M'Intosh and Prince, in their memoir (9), say that the subsequent arrangement of the oil-globules under the developing embryo indicates probably that something like a streaming of the protoplasm of the periblast takes place about the period of the closure of the blastopore, so as to carry the globules under the developing embryo. It is rare that the globules ever lie beneath the axial region of the embryonic rudiment, and the supposed streaming of the protoplasm is merely the coalescence of the edges of the germinal ring, with its subjacent periblast, to form the embryonic dorsal rudiment. The vesicular layer of the yolk in the sole's egg extends *pari passu* with the extension of the periblast and blastoderm.

Later History of the Segmentation-Cavity, Formation of the Heart, &c.

As the blastoderm gradually increases in extent and grows over the yolk the segmentation-cavity also becomes much extended, and separates the epiblast from the periblast everywhere except beneath the embryonic shield and germinal ring. It must be remembered that sections show that the mesoblast layer is entirely confined to the embryonic shield and germinal ring, at least until the closure of the blastopore. In eggs such as those of the Salmonidæ and those of *Cyclopterus*, *Cottus*, &c.,

in fact in all eggs which exhibit vitelline vessels, the segmentation-cavity is obliterated after the closure of the blastopore by the production of mesoblast between the epiblast and periblast. This mesoblast is produced partly by the extension of the mesoblastic layer from the lateral region of the dorsal embryonic rudiment, partly, I believe, by the formation of mesoblastic cells from the periblast. In the mesoblast thus produced around the yolk, tubes are hollowed out to form the vitelline arteries and veins, the veins becoming continuous with the cavity of the heart, which is formed in a similar way in the mesoblast ventral to the pharynx.

In pelagic ova and in the ova of the herring the course of affairs is somewhat different. In these ova and the larvæ hatched from them there are no vitelline blood-vessels. In them the segmentation-cavity may, and probably does, disappear for a time after the closure of the blastopore in consequence of its epiblastic and periblastic walls coming into contact. But the lateral mesoblastic plates do not extend into it and obliterate it. When the heart commences to be formed the segmentation-cavity seems to reappear; that is to say, a cavity appears between the periblast and the epiblast of the yolk-sac. This cavity is continuous all round the ventral region and sides of the yolk, and anteriorly it is in communication by a definite large aperture with the posterior end of the auricle of the heart. But this cavity is theoretically no longer the segmentation-cavity; it is, at least on its inner or periblastic side, partially lined by mesoblastic cells, namely chromatophores produced from the periblast. Morphologically, as I have pointed out in my paper in the 'Journal of the Marine Biological Association' (4), this cavity is homologous with the vitelline blood-vessels in the salmon embryo, and, like those vessels, it is continuous with the auricle of the heart. It is shut off from the pericardium by a definite continuous mesoblastic membrane, and it is also completely separated from the body-cavity formed in the mesoblast at the sides of the embryo. It is not till a late stage of development, namely when the yolk has been entirely absorbed, that the mesoblast is sufficiently developed ventrally to divide up this perivitelline blood-sinus into separate blood-vessels, the blood-vessels which in the adult form the veins and arteries of the viscera.

I claim the credit of having been the first to give this explanation of the fact that in pelagic ova the heart is in open communication posteriorly with a continuous cavity round the yolk, a cavity which appears to be the segmentation-cavity. Shipley (19) has shown that an exactly similar

relation exists in *Petromyzon*; but he merely says that the perivitelline space is part of the segmentation-cavity, and that it subsequently becomes shut off by the downgrowth of the mesoblast, and forms the subintestinal vein. He makes no comparison between the perivitelline blood-sinus and the vitelline blood-vessels of other forms.

If M'Intosh and Prince had really understood the later history of the segmentation-cavity they would never have argued that it was the gastrula-cavity. The gastrula-cavity must by its definition become the lumen of the intestine, and the segmentation- or "germinal" cavity never has any connexion with the lumen of the intestine. I have shown that the real representative of the gastrula-cavity in Teleosteans is Kupffer's vesicle.

Ryder in 1884 (18) was of opinion that the segmentation-cavity in the later stages was "synonymous" with the body-cavity; whether he still holds this opinion I do not know, but it is evident from the above that it is entirely erroneous; the segmentation-cavity has as little to do with the body-cavity as it has with the gastrula-cavity. The apparent continuity in development of the segmentation-cavity with the perivitelline blood-sinus is due entirely to the retarded development of the mesoblast in pelagic ova and certain others; while the obliteration of the segmentation-cavity by the mesoblast, which takes place in Amphibian and many Teleostean ova, is represented in pelagic Teleostean ova by the formation of mesoblastic cells from the periblast. The cavity ceases to be a segmentation-cavity and becomes a perivitelline blood-sinus as soon as any definite mesoblastic cells are produced on its inner wall.

The account given by M'Intosh and Prince (9) of the development of the heart is, as a whole, to me quite incomprehensible, while many of the separate statements in that account are, I venture to say, erroneous. One of these statements is that "the heart usually pushes down before it a delicate stratum of hypoblastic cells; but this limiting ventral layer apparently becomes obliterated anteriorly, and the pericardial chamber is open to the subembryonic space, which is undoubtedly the persisting germinal cavity." This is the most extraordinary confusion. What has the hypoblast to do with the formation of the heart? Is it conceivable that the germinal cavity, which, according to these authors, is the gastrula or intestinal cavity, can be open to the pericardial cavity? Of course it is known that in certain forms the original gastrula-cavity segments off portions which form the body-cavity—*Amphioxus*, for instance. But in Teleosteans

the body-cavity is formed as a "schizocoel," and never has any connexion with either the lumen of the intestine or the gastrula-cavity or the segmentation-cavity. In fact I can state, from my own observations, that the pericardial cavity has no communication with the perivitelline cavity; and the same conclusion is confirmed by Shipley's observations on *Petromyzon*. In the nine quarto pages which M'Intosh and Prince devote to the development of the heart and blood-vessels I can find nowhere any mention of the fact that the auricle is open posteriorly to the perivitelline blood-sinus, which has the same position as the segmentation-cavity of an earlier stage. It seems as though these observers had either overlooked the posterior opening of the heart or had mistaken it for an opening into the pericardium*.

Chromatophores.

Chromatophores may be developed both in larval and adult Teleosteans in other parts of the mesoblastic tissues besides the derma; but as a rule the coloration of the fish depends chiefly on the chromatophores present in the skin. In all the species which have come under my own observation the chromatophores in the skin of the larva or embryo at their earliest appearance are in all respects similar to those of the adult both in colour and in structure. For instance, in the adult mackerel there are black chromatophores and green chromatophores, and in the larva also black and green chromatophores appear. Similarly in the Pleuronectidæ the colour of the adult depends on the distribution of the black and yellow or orange chromatophores. I am leaving the iridocytes, whose colour-effect does not depend on pigment, out of consideration. In larval flat-fishes the only chromatophores developed are the black and the yellow or orange. Professor M'Intosh, in his review of my book on the sole, says, "The pigment of the larval sole in Scotland appears to differ materially from that of the larval sole at Plymouth, since it is not truly yellow, but dull stone-grey or dull yellowish white, and this afterwards changes into the ochreous hue so charac-

* It must be added here that what I and most other writers on this subject have called the "pericardium" in the Teleostean embryo or larva is not exactly the same thing as the pericardium of the adult. I believe that the embryonic pericardium is merely a portion of the general coelom or body-cavity, the first part of that cavity to be developed ventrally. I believe that as the yolk disappears this embryonic pericardium extends backwards and becomes continuous with the lateral body-cavities, the adult pericardium being afterwards separated from the general body-cavity.

teristic of the post-larval sole." This seems to me a disingenuous style of criticism, unless, indeed, Prof. M'Intosh really believes that the larval sole has different colours in different places. The latter alternative is improbable; and if my reviewer thinks it more polite to suggest indirectly that I have blundered than candidly to express a doubt of the accuracy of my observation, I can only say that I do not agree with him. However, the discrepancy between our descriptions of the colour is easily explained. The yellow chromatophores of the larval sole do appear stone-grey, and often quite a silvery grey, when seen by reflected light either with the unaided eye or with the microscope; but when seen by transmitted light under the microscope they are yellow. The difference between these scattered larval chromatophores and those of the adult is merely due to the smaller quantity of the pigment and the absence of the opaque iridocytes from the skin in the larva. As to the post-larval sole referred to by Prof. M'Intosh and figured in the Scottish Fishery Board Report, 1889 (10), I cannot without further evidence accept the identification. It is not strictly speaking post-larval; all stages up to the commencement of the metamorphosis, that is all symmetrical stages, should be called larval. I have seen larvæ of the sole of a corresponding stage, as well as in subsequent stages, and in all the anterior margin of the head is much blunter and the mouth much more ventral than in Prof. M'Intosh's figure.

Development of the Generative Organs.

Hector F. E. Jungersen, in a masterly paper, has recently given a very complete and interesting account of the development of the ovaries and testes in Teleosteans. He has shown that in the Physoclist forms which he investigated the cavity of the ovary originates somewhat as McLeod described in *Belone*, namely by the formation of a groove on the surface of the genital ridge and the subsequent closing of this groove to form a canal. He has also shown that in the Physostomous forms, namely Cyprinoids, the cavity of the closed ovary is formed in the same way as that observed by me in *Clupea sprattus*, that is, not by the formation of a groove in the genital ridge, but by the coalescence of the lower edge of the genital ridge with another thinner ridge which projects from the peritoneum on the outer or lateral side of the genital ridge. Jungersen describes the genital cells as appearing in the mesoblastic tissue at the dorsal side of the body-cavity on either side of the mesentery. He shows

that this tissue is not properly speaking an epithelium, but a mass of cells of two kinds, namely genital cells distinguished by their large size and what he calls stroma-cells. Jungersen represents the genital cells at all stages, although they multiply by division, as uninucleate.

M^cIntosh and Prince have not included the later development of the generative organs in their researches; but they give an account of the genital cells at the earliest stage which is in striking contrast to any previously given. They state that each of the primitive ova is "a more or less perfect sphere and encloses numerous minute nucleated bodies." They point out that these ova are quite unlike the primitive ova of Elasmobranchs as described by Balfour, for these latter are uninucleate. It is obvious that these authors have either misunderstood the structure of the primitive ova which they saw, or the multinucleate cells they describe were not primitive ova at all, but something else. It is at all events certain that the primitive ova of Teleosteans are, like the ova of most other animals, large cells with a single large nucleus.

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XXIV.—*Notes on the Synonymy of some Species of Scolopendridæ, with Descriptions of new Genera and Species of the Group.* By R. I. POCOCK, of the British Museum (Natural History).

[Concluded from p. 68.]

[Plate V.]

ARTHORRHABDUS, gen. nov.

(ἄρθρον, a joint, and ῥάβδος, a staff.)

Head-plate entire, without sulci, not covered posteriorly by the first dorsal plate, but separated from it mesially by a space occupied by a horny membrane, which is united to the first tergite and appears to represent the basal plate.

Eyes, mouth-parts, and stigmata as in *Cormocephalus*.

Anal somite resembling that of *Cupipes*, the pleuræ being truncate, the legs stout, and the claw long and serrate.

Other characters, which may or may not prove to be of

generic value, will be found in the description of the single species of which the genus is composed.

This genus is evidently related to *Scolopendra*, *Cormocephalus*, and *Cupipes*. From all, however, it may be recognized by the structure of the head and its relations with the first tergite. It further differs from *Cupipes* in the structure of its stigmata, and from *Cormocephalus* in the arrangement of the spines on the anal femora and in the size of the claw of the anal leg. In the structure of its head and first tergite it comes near *Asanada*; but this last genus may be at once detected by its smooth and almost covered anal pleuræ.

Arthrorhabdus formosus, sp. n. (Pl. V. figs. 1-1 d.)

Body robust and parallel-sided.

Colour olivaceous, sometimes rufescent posteriorly; antennæ deep blue-green.

Head-plate punctured, not sulcate either longitudinally or transversely.

Antennæ short, attenuate, composed of seventeen segments, whereof the basal five are bare and the rest pubescent.

Maxillary sternite feebly sulcate anteriorly, punctured, the prosternal plates longer than wide, wider distally than proximally, each bearing four distinct teeth, of which the external one is more distinct than the three internal ones; basal tooth long, sharp, subdentate, on a level with the prosternal plates.

Tergites.—The first not overlapping the head-plate (the basal plate being visible), not sulcate, the second feebly sulcate, the third to the twentieth strongly bisulcate, all with simple margins, the twentieth only showing faint signs of having raised margins.

Sternites bisulcate, with a median abbreviated impression.

Anal somite.—Tergite with a faint median sulcus and raised lateral margins; pleuræ narrow, closely porous, the process very small, conical, and tipped with two minute spines; sternite longer than wide, nearly parallel-sided, with rounded posterior angles; legs short and stout; femur flat internally, with one strong spine on its upper inner edge, two on its under inner edge, one on the postero-inferior edge of the inner surface, and sometimes one or two minute spines on the inferior surface, the process is large, conical, and tipped with two spines; first tarsal segment anteriorly excavated beneath; the claw long, longer than the first tarsal segment, strong, carinate and serrate beneath, not spurred.

Legs terminated by strong and strongly bicalcarate claws, the proximal tarsal segment of all (except of the twentieth

pair) furnished with an infero-anterior spine; in the first pair of legs there is an additional spine above the normal one; proximal tarsal segment longer than the distal.

Stigmata elongate, as in *Cormocephalus*.

Length up to 50 millim.

Locality Port Elizabeth (South Africa); a number of specimens collected by Mr. H. A. Spencer, one sent to the Museum by Mr. J. M. Leslie; and also one ticketed merely "S. Africa," from the collection of Dr. Quain.

PITHOPUS, nom. nov.

(πίθος, a cask or jar, and πούς, foot; so called from the shape of the segments of the anal legs.)

Rhoda, Meinert, Trans. Am. Phil. Soc. 1886, p. 188, nom. præocc.
(*Rhode*, Simon, Arachnida, 1882; *Rhodea*, Adams, Mollusca, 1857.)

In its truncate anal pleuræ, thick anal legs, and strong serrate claw with which these limbs are armed, this genus resembles *Cupipes*. It differs, however, from *Cupipes* in its large elongate stigmata. Moreover, it may be recognized from all the genera of Scolopendridæ, which have the tarso-metatarsus composed of two segments, in that the proximal segment is shorter than the distal. In this respect the genus appears to me to approach *Theatops*.

Pithopus inermis, sp. n. (Pl. V. figs. 2-2 d.)

Body slender and almost parallel-sided.

Colour ochraceous, anteriorly and posteriorly more or less rufous, shining.

Head-plate convex, punctured, with a posterior transverse arched sulcus and a median longitudinal sulcus in its hinder half.

Antennæ attenuate, moderately long, composed of eighteen segments, whereof the basal six are bare and the rest pubescent.

Maxillary sternite punctured, marked in front with a transverse irregularly branched sulcus, from the middle point of which there runs forward a median sulcus, which soon bifurcates and meets on each side the sulcus marking the prosternal plate; prosternal plates in contact, quadrate, longer than wide, each bearing three teeth, whereof the external is separate and distinct and the two internal fused and indistinct; basal tooth well developed, on a level with the prosternal plates, subdentate.

Tergites.—The first not sulcate, the second with two feeble

sulci, the rest (except the anal) strongly bisulcate; all of them (except the anal) immarginate.

Sternites strongly bisulcate.

Anal somite.—*Tergite* with raised lateral margins and a median sulcus; *pleuræ* narrow, densely porous, without a process, with a single small spine in the position of the process; *sternite* nearly oblong, longer than wide, with rounded lateral angles; *legs* stout, short; femur convex externally, flattened internally, the process long, conical, and armed with two spines, the upper inner edge furnished with one or two strong spines, the inner surface with from seven to nine smaller spines, of which two are on the posterior margin and the rest irregularly scattered, and the under inner edge with two stronger spines; patella flattened internally with a smooth prominence on its under inner edge; first tarsal segment anteriorly excavated beneath; claw long, finely keeled and anteriorly serrate beneath, without spurs.

Legs with strong and strongly bicalcarate claws and unarmed tarsi; proximal tarsal segment shorter than the distal.

Stigmata long and slit-like, especially in the anterior part of the body.

Length (of largest specimen) 80 millim.; width of head 4 millim., of maxillary sternite 5, of anal tergite 4.5.

Two specimens (one measuring 60 millim. long) from Iguarassu (Brazil), collected by Mr. H. N. Ridley and Mr. G. A. Ramage.

Pithopus calcaratus, sp. n. (Pl. V. fig. 2 e.)

Body slender, almost parallel-sided, slightly wider at the posterior end.

Colour wholly ochraceous, shining.

Head-plate punctured, with a complete median longitudinal sulcus and a posterior arched transverse sulcus.

Antennæ of moderate length, very thick at the base, attenuate, composed of nineteen segments, whereof the basal six are bare and the rest pubescent.

Maxillary sternite punctured, sulcate in front, as in the case of *P. inermis*; prosternal plates long, almost in contact, each bearing three indistinctly defined blunt teeth; basal tooth long, on a level with the prosternal plates.

Tergites.—The first overlapping the head-plate, not sulcate; from the second to the twentieth strongly bisulcate, with a faint longitudinal impression between the sulci, and at each of the anterior angles there is a short oblique sulcus; all (except the twenty-first) with simple unraised margins.

Sternites smooth, strongly bisulcate.

Anal somite.—*Tergite* with strongly raised margins and a median longitudinal sulcus; *pleuræ* densely porous, narrow, truncate, with one small spine in the middle of the posterior border and one small one in the position of the process; *sternite* much longer than wide, nearly parallel-sided, with obtusely rounded posterior angles; *legs* short and thick; femur with a strongly developed bifid process, with two strong spines on its upper inner edge, two smaller ones on its inner posterior edge, three (two large and one small) on its under inner edge, and about six on its inner surface; patella flattened on its inner surface, with an inferior posterior smooth prominence; the other segments cylindrical throughout; claw strong but not carinate beneath.

Legs with strong and strongly bicalcarate claws, the first tarsal segment of all—with the exception of the first (? of the second and third) and the twentieth—armed with a spur.

Length about 50 millim.; width of head 2·5, of anal tergite 3·3.

A single specimen from Bahia (*H.M.S. 'Challenger'*).

In most of its features this species closely resembles the preceding. It differs, however, in having the proximal tarsal segment of its legs armed beneath with a spur.

The diagnosis of *P. Thayeri*, Meinert (sub *Rhoda*), is too brief for the satisfactory determination of the species. Consequently either of the two here described may prove to be synonymous with it. Dr. Meinert, however, says that there are only two spines on the inner surface of the femur of the anal leg, whereas in both of these forms there are from seven to nine spines in this position. Dr. Meinert makes no mention either of the spine-armature of the walking-legs or of the presence or absence of sulci on the head and first tergite. Another peculiarity of these two species is the large size of the prescutal pieces of the tergites, especially in the hinder half of the body.

It is interesting to note the close similarity that exists between the description of *P. calcaratus* and that of *Scolopendropsis bahiensis* of Brandt, given by Gervais in vol. iv. of the 'Insectes Aptères.' In fact, were it not for Gervais's statement that *Scolopendropsis* possesses twenty-three pairs of legs, I should have thought that the two descriptions applied to the same species.

PSEUDOCRYPTOPS, gen. nov.

Head-plate about as wide as long, narrowed anteriorly, not

sulcate, covered posteriorly by the first dorsal plate, and covering the maxillary feet.

Antennæ very short and exceedingly stout at the base. Two distinct *eyes* on each side and two much less distinctly defined ones beneath them on the deflexed margin of the head-plate.

Basal plate invisible.

Second tergite as long as the first.

Stigmata conspicuous, elongate; nine pairs, the seventh somite devoid of them.

Tarso-metatarsus of all the legs bisegmented, the distal segment much shorter than the proximal.

Anal somite small; the *pleuræ* almost covered, without spines and without pores; *sternite* exceedingly wide; *legs* not spinous, thick, claw small.

Whether all the characters here given are of generic value can only be decided by the discovery of other species of the genus; moreover, perhaps some of the features described as specific will prove to be of generic importance.

This genus is very peculiar. In the structure of its anal somite it is not distinct from *Asanada*—the two genera in fact may be recognized from all others by possessing exceedingly small, almost covered, truncate, and perfectly smooth anal *pleuræ*. But in the shape of its head, the structure of its antennæ, the degree of development of the ocelli, and the relative sizes of the first and second dorsal plates *Pseudocryptops* stands quite alone.

Pseudocryptops Walkeri, sp. n. (Pl. V. figs. 3-3c.)

Colour flavous, head-plate and maxillary feet slightly darker.

Body slender, narrower anteriorly.

Head-plate covering the maxillary feet laterally and far overlapping them anteriorly.

Antennæ in contact in the middle line, very short, being not longer than the head-plate, very stout proximally, their width at the base being equal to about one third of their length, becoming gradually slender towards the apex, composed of seventeen hirsute segments, whereof the distal only is ovate.

Palpi of the third pair of gnathites without a claw.

Maxillary sternite with a faint median sulcus; prosternal plates distinct, each furnished with three strong conical teeth; the basal tooth long, strong, and distinctly dentate; the fang or claw strong and lightly curved.

Tergites.—The first slightly wider than the head, not sul-

cate; the second as wide as the first; from the fourth to the twentieth bisulcate, the sulci, however, on the nineteenth and twentieth being less conspicuous; all the tergites with unraised margins; the tergites lightly wrinkled, about as long as wide, gradually increasing in length and width from the fourth to the nineteenth; the nineteenth is thus the largest of all; prescuta distinct.

Sternites smooth, strongly and conspicuously bisulcate.

Anal somite much smaller than the nineteenth; *tergite* with strongly raised margins, angularly produced posterior border, not mesially sulcate, posteriorly depressed; *pleuræ* not porous, not spined, almost concealed; *sternite* very wide, as wide as the nineteenth somite, projecting as far posteriorly as the hinder border of the pleuræ, with convex posterior border; *legs* stout, not in contact, the segments subcylindrical and becoming progressively more slender distally; the patella with a deep superior sulcus; the claw not large, inferiorly serrate, not spurred.

Legs with unarmed tarsi; claws armed with two spurs.

Length 35 millim., of antennæ $1\frac{1}{2}$ millim.

A single specimen from Perim Island, in the Red Sea, off the coast of Abyssinia, collected by Mr. J. J. Walker, to whom I have great pleasure in dedicating the species.

PARACRYPTOPS, gen. nov.

Closely allied to *Cryptops*, but differing in the following respects:—

Maxillary sternite furnished with two distinct, somewhat rounded, prosternal plates.

Claws of maxillipedes exceedingly short, so short as to be incapable of meeting in the middle line.

Paracryptops Weberi, sp. n.

Testaceous, head and anal somite ochraceous. Body more or less hirsute.

Length 14 millim.

Locality. Maumerie (Flores). Two specimens collected by Dr. R. Max Weber.

This new species will be fully described and figured in Dr. Max Weber's 'Zool. Ergebnisse einer Reise in Niederländisch Ost-Indien.'

The accompanying synopsis of the Scolopendridæ will

serve to show how the new genera here characterized stand towards each other and towards those that have been previously made known:—

a. Body bearing twenty-three pairs of legs.

a¹. Head furnished with four eyes on each side.

Scolopendropsis, Brandt. Type *bahiensis*, Brandt.

b¹. Eyes absent; tarso-metatarsus of most of the legs composed of a single segment; prosternal plates of maxillipeds absent.

a². Seventh somite without stigmata.

Otocryptops, Haase. Type *rubiginosus* (L. Koch).

b². Seventh somite with a pair of stigmata.

a³. Anal leg armed with a claw and with bisegmented tarso-metatarsus *Scolopocryptops*, Newport. Type *Miersii*, Newport.

b³. Anal leg without a claw and with multiarticulated tarso-metatarsus *Newportia*, Gervais. Type *longitarsis* (Newport).

b. Body bearing twenty-one pairs of legs.

a⁴. Eyes absent; tarso-metatarsus of most of the legs composed of a single segment.

a⁵. Anal somite small and with slender legs.

a⁶. Without prosternal plates; fang of maxillipede long.

Cryptops, Leach. Type *hortensis*, Leach.

b⁶. With distinct prosternal plates; fang of maxillipede very short *Paracryptops*, gen. nov. Type *Weberi*, sp. n.

b⁵. Anal somite very large and with thick legs.

a⁷. With nineteen pairs of stigmata.

Plutonium, Cavanna. Type *Zwierlinii*, Cavanna.

b⁷. With nine pairs of stigmata.

Theatops, Newport*. Type *posticus* (Say).

b⁴. With four eyes on each side of the head; tarso-metatarsus of all the legs composed of two segments.

a⁸. Seventh somite without stigmata.

a⁹. Anal legs armed with a claw and with subcylindrical segments.

a¹⁰. Proximal segment of tarso-metatarsus shorter than the distal; stigmata of third somite very long.

Pithopus †, nom. nov. Type *Thayeri* (Meinert).

b¹⁰. Proximal segment of tarso-metatarsus longer than the distal.

* Syn. *Opisthemega*, Wood.

† Syn. *Rhoda*, Meinert (nom. præocc.).

- a*¹¹. Anal pleuræ very small, without pores and without spines.
- a*¹². Antennæ longer; head not covering the maxillipedes.
Asanada, Meinert. Type *brevicornis*, Mein.
- b*¹². Antennæ very short; head covering the maxillipedes.
Pseudocryptops, gen. nov. Type *Walkeri*, sp. n.
- b*¹¹. Anal pleuræ larger, porous and spined.
- a*¹³. Head not covered posteriorly by the first tergite.
- a*¹⁴. Basal plate visible between the head and first tergite; claw of anal leg very long.
Arthrorhabdus, gen. nov. Type *formosus*, sp. n.
- b*¹⁴. Basal plate absent; claw of anal leg small.
Scolopendra * (Linn.), Leach. Type *gigantea*, Linn.
- b*¹³. Head covered posteriorly by the first tergite.
- a*¹⁵. Head sulcate; tarsi unspined; basal plate visible.
- a*¹⁶. Stigmata large, triangular; anal legs thinner and claw smaller.
Cormocephalus, Newport. Type *rubriceps*, Newp.
- b*¹⁶. Stigmata small; anal legs thicker, claw long.
Cupipes, Kohlrausch. Type *amphieurys*, Kohl.
- b*¹⁵. Head not sulcate; basal plate invisible; stigmata ear-shaped.
Otostigma, Porath †. Type *carinatum*, Porath.
- b*⁹. Anal legs not provided with a claw and with the three distal segments enormously widened and leaf-like.
Alipes, Imhoff ‡. Type *multicostis*, Imhoff.
- b*⁸. Seventh somite bearing a pair of stigmata.
- a*¹⁷. Stigmata small, not sieve-like.

* Syn. *Rhombcephalus*, Newport; *Euryolithobius*, Butler.

† Syn. *Branchiotrema*, Kohlrausch.

‡ Syn. *Eucorybas*, Gerstaecker.

- a^{18} . Stigmata of the third somite ear-shaped.
Rhysida, Wood *. Type *lithobioides*, (Newp.).
 b^{18} . Stigmata of the third somite sigmoid or S-shaped.
Trematoptychus, Peters †. Type *afer*, Peters.
 b^{17} . Stigmata very large and sieve-like.
 a^{19} . Prosternal plates present; legs and pleuræ spined.
 a^{20} . Prosternal plates small; a distinct basal tooth on the maxillipede.
Ethmophorus, gen. nov. Type *monticola*, sp. n.
 b^{20} . Prosternal plates very large; no basal tooth on the maxillipede.
Heterostoma ‡, Newport. Type *trigonopoda* (Leach).
 b^{19} . Prosternal plates wholly absent; pleuræ not spined.
Anodontostoma, Tömösvary §. Type *octosulcatum*, Tömösvary.

Of these genera the following three are known to me only from description:—*Scolopendropsis*, *Plutonium*, and *Anodontostoma*.

EXPLANATION OF THE PLATES.

PLATE IV.

- Fig. 1.* *Heterostoma longicauda*, sp. n. Anal somite, external view.
Fig. 1 a. Ditto. Anal femur, upperside.
Fig. 1 b. Ditto. Anal femur, underside.
Fig. 2. *Heterostoma viridipes*, sp. n. Anal somite, external view.
Fig. 3. *Heterostoma rubripes*, var. *grossipes*, nov. Anal somite, from above.
Fig. 3 a. Ditto. Anal femur, from below.
Fig. 4. *Ethmophorus monticola*, gen. et sp. nov. Anal somite, external view.
Fig. 4 a. Ditto. Maxillary sternite and feet.
Fig. 5. *Rhysida longicornis*, sp. n. Anal femur, internal view.
Fig. 6. *Rhysida calcarata*, sp. n. Anal femur, internal view (σ).
Fig. 6 a. Ditto. Ditto (♀).

* Syn. *Branchiostoma*, Newport (nom. præocc.).

† Syn. *Ptychotrema*, Peters.

‡ Syn. *Dacetum*, Koch.

§ Syn. *Edentistoma*, Tömösvary.

- Fig. 7. *Scolopendra* (?) *cuivis*, sp. n. Nat. size.
 Fig. 8. *Cormocephalus cupipes*, sp. n. Anal somite, upperside.
 Fig. 9. *Cormocephalus inermipes*, sp. n. Anal leg, from above.
 Fig. 9 a. Ditto. Prosternal plates.
 Fig. 10. *Cormocephalus dentipes*, sp. n. Anal leg, internal view.

PLATE V.

- Fig. 1. *Arthrorhabdus formosus*, gen. et sp. nov. Head, dorsal view.
 Fig. 1 a. Ditto. Anal somite, from below.
 Fig. 1 b. Ditto. Anal somite, from the side.
 Fig. 1 c. Ditto. Femur of anal leg, from inner side.
 Fig. 1 d. Ditto. Stigma of third somite.
 Fig. 2. *Pithopus inermis*, sp. n. Head, dorsal view.
 Fig. 2 a. Ditto. Anal somite, from below.
 Fig. 2 b. Ditto. Anal somite from the side.
 Fig. 2 c. Ditto. Femur of anal leg, from inner side.
 Fig. 2 d. Ditto. Stigma of third somite.
 Fig. 2 e. *Pithopus calcaratus*, sp. n. Tarso-metatarsus of twentieth somite.
 Fig. 3. *Pseudocryptops Walkeri*, gen. et sp. nov. Head, dorsal view.
 Fig. 3 a. Ditto. Anal somite, from below.
 Fig. 3 b. Ditto. Anal somite, from the side.
 Fig. 3 c. Ditto. Stigma of third somite.

BIBLIOGRAPHICAL NOTICE.

The Birds of Norfolk. By HENRY STEVENSON, F.L.S.; continued by THOMAS SOUTHWELL, F.Z.S. 3 vols., 8vo. Norwich and London, 1866-90.

HOWEVER it is to be accounted for, the fact remains that in no county of England has natural history been more assiduously, and therefore more successfully, cultivated than in Norfolk. The assiduity is a point on which we would especially dwell, since we live in days when what passes for work is knocked off as though speed were its only test and the quality of the "output" a matter beneath the notice of the modern biologist. But it has yet to be proved that what is known in another branch of art as "jerry-building" will pay in the end when applied to authorship; and from our own point of view, perhaps rather antiquated, we are inclined to say that it will not. We seem to have heard not so very long ago of a heaven-sent genius, who, having applied himself (except when he was otherwise engaged) for a couple of years to a line of study entirely new to him—it was a portion of the anatomy of a particular class of the animal kingdom—was at the end of that time enabled to set the subject in a wholly different light! That he did so we can readily believe; but we might put beside it the fact that other men, who had received no spiritual commission and were perhaps only plodding slaves of the scalpel, had employed themselves on the same inquiries ten or even twenty times as long, and yet had failed to arrive at conclusions they would feel warranted in laying before the

scientific public—possibly through excessive modesty, possibly through entertaining a higher opinion of the perception of that scientific public for recognizing the bad and the ridiculous. Now it appears from the memoir given of the author of the work before us that he laboured continuously for the ten years from 1853 to 1863 before he trusted himself to write out a short account of each of the species which he had to include in his intended book. These short accounts formed the basis of the several articles, but were greatly expanded and in most cases entirely rewritten before they were given to the world. This process took him three years longer with regard to those contained in his first volume, which was published late in 1866, for we are told that so great was Mr. Stevenson's desire for accuracy and completeness that in some cases even sheets which had been printed off were cancelled in favour of others with more correct or more recent information. The final preparation of the second volume, containing matters of far greater interest than the first, occupied nearly four years more, and then he began the third and concluding one—but unfortunately ill health supervened, and, after making desultory progress from time to time, actual work upon it may be said to have been discontinued in 1877, when, to the despair not only of Norfolk naturalists, but of all who had become acquainted with the first two volumes, there seemed little or no chance of its ever being completed, though it was known that a considerable portion had been printed off and that the author was continually adding to his notes. Eleven years later he was removed by death, after long and acute suffering; and then, to the marvellous credit of the county concerned, it proved to possess in Mr. Southwell an ornithologist, already tried we may remark, certainly not inferior essentially to Mr. Stevenson, and therefore fully capable of completing the unfinished work—

Primo avulso non deficit alter—

and, moreover, of continuing it in almost exactly the same style, the difference observable being slight. There was certainly much of the newspaper-writer about Mr. Stevenson, which rendered him somewhat careless of the extent of his articles, whereas Mr. Southwell, possibly constrained by considerations of space, has carefully compressed all he has to say, though what he says is just as happily expressed. He had of course his predecessor's notes, or more than notes, to guide him; but his own assiduity in filling up the blank spaces between them and in collecting additional information is evident, and consequently we have the whole work in a fashion that should satisfy the most exacting critic.

Among the many local ornithologies that have now appeared the present decidedly holds, and most likely will long hold, the first place; and the reason is doubtless due to the thorough acquaintance of the original author and his successor with all that relates to their subject. They not only knew the birds of which they treat and the ground they haunt, but the men who have been most conversant with them. Norfolk, like every other part of this island, has its

extinct species—extinct, that is, within its limits—and respecting these species it would seem as if no scrap of intelligence has been overlooked, and every clue that offered followed, until the account may be called exhaustive. The value of the information thus given is manifest now, and will year by year increase as an historic record. Yet alongside of the extermination or rarification of many species may be set the consoling fact that there are others which have a happier fate, and, as Mr. Southwell is able to declare, occur and actually breed more numerous in Norfolk than heretofore—a result that in the case of the Gadwall, the Shoveler, the Pochard, and the Tufted Duck he does not hesitate to ascribe to recent legislation in establishing a close time during which the lives of these and many more should be safe. But of the vanished or vanishing species the number must be far larger. The Pelican and the Crane ceased as inhabitants before the time of contemporary records, but the existence of the Cormorant is testified by documentary evidence. The Bustard, as all know, has been banished from this county, its last stronghold in England, and the story of its banishment is told by Mr. Stevenson as it was never told before; while Mr. Southwell adds an hardly less interesting appendix to it in recounting an attempt, unique in the annals of British ornithology, but unfortunately frustrated by the weather and thus unsuccessful, to induce a fine male that appeared in 1876 to prolong his stay and take to himself a wife, provided by Lord Lilford's thoughtfulness. The Avoset and the Godwit are also gone, and the Ruff survives, it is believed, but in one locality; while those delights of the seaside, the Terns, have only a few remaining haunts, about which Mr. Southwell is discreetly vague, since no birds are more exposed to persecution or have everywhere more rapidly decreased in numbers around our coasts, so as to be threatened with extinction.

Space fails us to enter as we should wish on many other merits of this meritorious work. Seldom can it have been that the place of an author dying with an incomplete book on hand has been so satisfactorily supplied; and greatly indebted as all British ornithologists are known to be to Mr. Stevenson, Mr. Southwell's labours demand, and if we are not much mistaken will receive, no small portion of their gratitude. Let us add that this concluding volume is not only illustrated, but really embellished, by three unpublished plates by Mr. Wolf—a rare thing to see in these days—and one of them, representing the home of the Black-headed Gull on Scoulton Mere, is a picture which must charm anyone with an eye to the beauties of nature.

MISCELLANEOUS.

Stray Notes on the Nomenclature &c. of some British Starfishes.

By F. JEFFREY BELL.

In making a critical revision of the names to be applied to our British Starfishes I have made some slight observations which may be worth publishing.

Ann. & Mag. N. Hist. Ser. 6. Vol. vii.

16

1. *On the Date of Dr. Gray's "Synopsis of the Genera and Species of Starfishes."*

There is considerable difference as to whether the date of publication of this paper was 1840 or 1841; nearly half the writers on the subject, and among them one of the most careful—Dr. Norman—write 1841; as a matter of fact both parts of the paper were published in this Journal in 1840, the first half in November, the second in December.

2. *Hippasterias phrygiana.*

The name *equestris* must not be applied to this species; Linnæus in both the tenth (p. 662) and twelfth (p. 1100) editions of the Syst. Nat. quotes figures from Linck which are representations of at least two species; it is necessary therefore to decide by the other figures, namely that from Barrelier ('*Icones Plantarum*,' 1714, fig. 1285), which is first quoted, and that from Seba (*Theat. iii. pl. viii. figs. 6 and 8*); both these are illustrations of an *Astropecten*. Moreover Linnæus gives as habitat the Mediterranean, whence the *Astropecten* might well come, but the *Goniaster* not.

3. *The Use of the Generic Name Palmipes.*

Nothing perhaps illustrates better the inconvenience caused by those who refuse to acknowledge the very reasonable convention that the names of our genera and species are to be based on Linnæus's '*Systema Naturæ*,' and that pre-Linnean names are not to be used, than the name *Palmipes*.

In 1834 Nardo distinctly indicated ('*Isis*,' col. 716) what he meant by *Anseropoda*, and Agassiz in 1835 (*Mém. Soc. Neuchâtel*, i. p. 192) wrote "*Palmipes*, Link (*Pulmastiérie*, De Bl.; *Anseropoda*, Nardo)." Agassiz quotes "*P. membranaceus*, Link," but gives no reference; Mr. Sladen, however (*Chall. Rep., Ast. p. 393*), writes "*Palmipes membranaceus*, Linck, 1733, *De Stellis marinis*, p. 29, pl. i. no. 2;" but no such words occur in the copy of Linck which I have now before me; in fact the pre-Linneans have to write in their "specific" names from such sentences as "*Stella Cartilaginea*, Aldrovandi, p. 743, malo dicere *membranaceam*," and so on; while the description of the figure runs—"Stella quinquefida *Palmipes* seu *Cartilaginea*, Ald." Will Mr. Sladen tell us what part of the last sentence contains the specific and which the generic name?

In his defence of the use of Linckian names Mr. Sladen speaks of those who "still adhere to the letter rather than the spirit of this canon of name-priority;" but in his ardour he has forgotten that he has no mandate from Linck to ascribe to him words that he never used or collocations which he never made.

And as to the question of priority, surely it is, save only as regards fixity of nomenclature, what Darwin called a trumpety affair; but if priority is to be pressed by the pre-Linneans, why do they neglect our great countryman Llyud, and why do they not follow Müller

and Troschel in using the term *Asteriscus*, which in 1703 was definitely proposed for what we must henceforward know as *Anseropoda placenta*?

4. *Porania pulvillus*.

Mr. Sladen (*t. c.* p. 360) writes

“*Porania pulvillus* (O. F. Müller), Norman,”

by which I presume he intends to signify—though various other suggestions have been made to me by skilled zoologists—that Norman first put the *A. pulvillus* of O. F. Müller into the genus *Porania*. That is what I imagine this collocation of terms represents; but I suppose I am wrong, for, as everybody knows, Gray did it in 1848.

5. *Date of Cœlasterias*.

Mr. Sladen (*s. v.*) writes “Verrill, *Trans. Conn. Acad. Arts & Sci.* 1871 (1867),” the meaning of which is unintelligible to me. In 1867 one hundred and fifty separate copies of Prof. Verrill’s paper were, he states, issued; the separate copy in the library of the Zoological Department (presented by the author to Dr. Gray) bears date 1867; but as it includes a note respecting the fire, which destroyed the publications of the academy and necessitated their being reprinted, dated 1869, it is clear that it was not issued till two years after the date it bears. The matter is only of importance on the ground of accuracy.

6. *Lophaster furcifer*.

Mr. Sladen gives *Chœtaster borealis*, 1844 (it should be 1845), in his synonymy, and does not explain why he prefers a name of later date (1846). I presume his reason is the same as mine; the earlier name is a *nomen nudum*.

7. *Marginaster*.

Mr. Sladen (*Chall. Rep.* p. 364) refers to the ‘Bulletin’ of the *Mus. Comp. Zool.* vol. ix. p. 16; this is quite unnecessary, as Prof. Perrier does not even pretend to there describe the generic characters of his new form; the description given three years later (*Nouv. Arch.* vi. 1884, p. 229) is short enough.

8. *On the Presence of Rare Forms on the East Coast.*

Dr. Norman stated in his well-known paper (‘*Annals*,’ xv. 1865) that *Anseropoda placenta* descends the east coast as far as the Moray Firth; Mr. Sim has sent it to the British Museum from Aberdeen. Similarly *Porania pulvillus*, stated by Dr. Norman to be “wholly absent on the east,” has been sent us from Ross-shire by Dr. Sutherland. I should be glad to hear of other localities on our eastern shores whence collectors have obtained these two forms, or, indeed, of other species of Echinoderms rare to the North Sea.

Dates of the Parts of P. S. Pallas's 'Icones Insect. p. Ross. Sibir.' and 'Nov. spec. Quadr. Glirium.'

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

GENTLEMEN,—As there appears to be some doubt as to the exact dates of publication of the parts of the above works, the following notes may be of service to your readers * :—

PALLAS, PETER SIMON. Icones | Insectorum | praesertim | Rossiae Sibiriaeque | peculiarium | quae | collegit et descriptionibus | illustravit | Petrus Simon Pallas | M.D. | Academicus Petropolitano | Erlangae | sumtu Wolfgangi Waltheri. |
C10 IO CCLXXXI.

Part I., pp 1–56, 3 pls. (A, B, C). 1781. [Cf. *Gött. gelehr. Anz.* (Zug.), 1782, p. 651; Böhmer, *Bibl. script. hist. nat.*, Zool. ii. (2), 1786, p. 169.]

Part II., pp. 57–96, pls. D, E, F. 1782. [Cf. Dryander, *Cat. Bibl. Banks*, ii. 1796, p. 214.]

Part III., pp. 97–104, pls. G, H. 1798. [Cf. Dryander, *loc. cit.* (not received 1796); Engleman; Hagen; et alii].

Part IV. Hagen, *Bibl. Ent.* 1863 (ii.), p. 25, is the only bibliographer who refers to a 4th and 5th part; but as we are certain that p. 96 closed the 2nd part and pp. 97–104 all belong to sig. N, we may presume that Hagen was wrong in adding the Part IV. It is probable that the pls. I and K which he refers to as having seen, were intended for Part IV. [his "Heft 5"].

PALLAS, PETER SIMON. Novae species | Quadrupedum | e | Glirium ordine | cum | illustrationibus variis | complurium ex hoc ordine animalium | auctore | Petro Sim. Pallas | Academico Petropolitano | Erlangae | sumtu Wolfgangi Waltheri. C10 IO CCLXXXVIII. | All bibliographers agree that this was published in two parts—I., 1778; II., 1779. In the *Gött. gelehr. Anz.* (Zug.), 1779, p. 472, "Fasc. I. sumtu Waltheri. 1778. Quart mit 5 Kupferplatten [i., ii., iii., iv A., iv B.] S. 70 † [pp. 1–70]," is reviewed; hence it is evident that Fasc. II. consisted of pp. 71–388, pls. v.–xxvii.

C. DAVIES SHERBORN
(Index gen. et sp. anim.).

Natural-History Museum,
London, S.W.

* These dates are further supported by a difference in the paper of the copy in the Natural-History Museum at pages 57 and 97.

† Sig. I consists of 6 pp.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 39. MARCH 1891.

XXV.—*The Ornithosaurian Pelvis.* By H. G. SEELEY, F.R.S., Professor of Geography in King's College, London.

IN vertebrate osteology the arrangement of the bones which compose the pelvic girdle contributes one of the most distinctive characteristics of a natural group of animals. It may pervade a subclass or be limited to an order. It constitutes a plan of structures which never varies so far from its type as to merge in the pelvic plan of another animal type. It thus becomes a convenience in classification. And when the pelvic structures of different groups of animals are compared and arranged in order of their community of plan, they constitute a classification which is often suggestive of original community of structure. The existing warm-blood groups of animals—Monodelphia, Didelphia, Ornithodelphia, Aves—are remarkable for fixity of pelvic plan; but it is among Aves that variation has the widest range, so that median symphysis of the pelvic bones in the genus *Struthio*, for example, makes a divergence from the Ratite pelvic plan, which shows that no importance in classification necessarily attaches to such a condition of ossification. The more variable pelvic plans of the Reptilia and Amphibia suggest that the ordinal groups in those classes of animals have the morphological value of subclasses when compared with the orders of Birds or Mammals.

This divergence of type, which is not entirely to be connected with functional modification of structure, is conspicuous between terrestrial and aquatic Amphibia, between Crocodiles and Chelonians, and Chelonians and Lizards, in a way not known between orders of mammals or birds.

The extinct orders of animals commonly known as the Fossil Reptilia, which fill the morphological interval between Amphibians and Mammals, Reptiles and Birds, are all marked by distinctive forms or plans of the pelvic bones, though their characters have not yet been fully described or established in all these groups. Enough, however, is known to show that while the pelvic characters appear to approximate the Ornithischia to embryonic birds, the Saurischia approximate to types like Sauropterygia, Anomodontia, and Ornithosauria. It is, however, impossible to consider the significance of these resemblances so long as the true nature of the pelvis in the Ornithosauria remains undetermined; and as my own views have undergone some change since the 'Ornithosauria' was published in 1870, I propose to set out the evidence obtained in 1878, when, with the aid of the Government-Grant Fund of the Royal Society, I studied the Ornithosaurs from the Lithographic Stone and the Lias preserved in the museums of Germany, and the conclusions which this study suggests.

The chief difficulties consist in determining whether the Ornithosaurian pelvis is composed of three bones or four bones, whether the pubic bone enters into the acetabulum for the femur, and how the fourth bone, if such exists, is conditioned with regard to the other elements of the pelvis. Von Meyer is the earliest writer on this subject whose opinion need be quoted. I have stated his views fully in my "Remarks on *Dimorphodon*"*, and they might be left with the refutation then formally given, if it were not that Professor Karl Zittel, in his 'Handbuch der Palæontologie,' has (pp. 786, 787) repeated the original errors both by description and figures. Professor Zittel quotes the 'Ornithosauria' and my "Remarks on *Dimorphodon*," yet adopts the view that in Ornithosaurs the ilium and ischium combine to inclose the ovate acetabulum, entirely excluding the pubis, which is then regarded as a free bone meeting its fellow in the median line. This free bone I have regarded as the prepubic bone. In a matter of this sort the weight of authority in favour of a point of structure, which is not a matter of interpretation, but of fact, goes for nothing. There is no doubt that Zittel has the support of Sir R. Owen; but I do not so read the views

* Ann. & Mag. Nat. Hist., August 1870.

of Wagner and Quenstedt. If authority went for anything, I might mention that Professor Huxley, in his 'Anatomy of Vertebrated Animals,' 1870, adopted the view that the pubic bone enters into the acetabulum and that the separate bone is the prepubis as the more probable interpretation of the pelvis. Till better specimens are discovered this condition of the pelvis must rest upon the evidence in the museums at Cambridge and Stuttgart. The absence of sutures in the Munich specimens is of no more value as evidence of structure than the absence of sutures in the pelvis of an adult bird. The sutures between the pubis and ischium and ilium are seen in the imperfect examples of the innominate bones of *Ornithocheirus* preserved in the Woodwardian Museum. In the 'Ornithosauria' *, plate viii., I have drawn some of these specimens; and the explanation of fig. 1 (specimen 1, tablet 10), is "Fragment of a large right os innominatum; the faint Y-shaped lines in the acetabulum indicate the limits of the three component pelvic bones." In figure 2 (specimen 4 on tablet 10) that portion of the vertical suture between the pubis and ischium is drawn which extends between the obturator foramen and the acetabular border †. These specimens therefore, if there were no others, demonstrate the formation of the pelvic acetabulum by three constituent bones and a vertical suture dividing the pubis from the ischium; and in my judgment they are conclusive that the pubis forms the anterior side of the plate of bone below the acetabulum not only in *Ornithocheirus*, but in *Dimorphodon* and all other genera of Ornithosauria. The only complete specimen in which the suture is seen between the pubis and ischium is the fossil figured by Dr. Oscar Fraas as *Pterodactylus suevicus*, which I regard as a new species. If the absence of sutures in the Ornithosaurian pelvis were evidence that they had not existed, there would be no justification for identifying the ischium in the way which has been generally done; and the innominate bone might have been supposed to have been unsegmented. This hypothesis is, however, as gratuitous and contrary to fact as that which Dr. Zittel adopts. It is not that there is any *à priori* improbability in the exclusion of the os pubis from the acetabulum, for this condition is one of the generic characters by which the Sauropterygian genus *Colymbosaurus* is defined. But in Ornithosaurs an independent

* Published, I believe, in January 1870.

† I have also figured the visceral aspect of a separate ischium, which shows the suture with the ilium and a small portion of the vertical suture with the pubis (tablet 10, no. 2, 'Ornithosauria,' p. 59, pl. viii. fig. 4).

judgment may be formed by anyone who takes the trouble to examine the fossils to which I have referred; and I invite such study.

Another interpretation of the Ornithosaurian pelvis has been given by Mr. J. W. Hulke, F.R.S., in a memoir on the fossil Crocodilia of the Oxford Clay*, who has also propounded the view that the prepubic bones have no existence. But he does not agree with Zittel in identifying the prepubis of my descriptions as the pubic bone, but supposes that ossification to be a fractured portion of the pubis. The author remarks:—"These parts are, I suggest, susceptible of another reading; the paddle- or fan-like bone as H. von Meyer described it, with narrow short shaft and expanded opposite end, is not, I submit, a bone complete in itself, but merely the ventral symphyseal portion of an os pubis constructed and associated with the other pelvic elements after the common Lacertilian plan." No evidence is offered in support of this generalization, nor is it elucidated with diagrams. Speaking of the pubis in the genus *Rhamphorhynchus* the author observes:—"The os pubis in this genus has the form of a flattened bar bent angularly near its middle; one limb of it passes from the acetabulum downwards and forwards in an approximately vertical plane, roughly parallel to that laid through the median axial plane of the pelvis; whilst the other limb, passing transversely to this axis, meets the corresponding limb of the os pubis of the other side, and unites with it in a median symphysis." Again no evidence is offered in support. A question of this nature can only be determined by evidence. I have seen no specimen which lends the faintest support to the idea that the bones which I have termed prepubic are fractured portions of the pubic bones. If they were to be so interpreted the usual conditions of fractured surface might be expected. The only specimen quoted as sustaining the proposed new interpretation is indicated by the footnote "*Zittel, Rhamph. Gemm. Palæontogr. Bd. xxix. iii. F. v. Taf. xii. fig. 2.*" A cast of this specimen is contained in the museum of the Royal College of Surgeons; but I fail to find either in the cast or the figure any demonstration of the nature of the relation of the pubic bone to the transverse bony bar in front of the pelvis. The ventral extremity of the pubis appears to be broken, but there is no evidence that the extremity of the transverse bar is broken. Seeing how frequently the pelvic sutures are obliterated, there would have been nothing remarkable if these bones had been blended with the other pelvic

* Proc. Zool. Soc. for 1888, p. 431.

elements and subsequently broken away; but there is no evidence of fracture. No specimen is known in which this bone is blended with the pubis; and if such a specimen were available, it would not prove that the bone in question is a portion of the pubis, if other specimens showed it as a separate ossification. Ornithosaurs are fossilized in every conceivable position, yet it is rare for the bones of the skeleton to be broken, and frequently almost every bone is in its natural connexion. Yet these prepubic bones are nearly always a little displaced from the other parts of the pelvis. I believe the condition of the pubis in every known Ornithosaur in which it is imbedded in stone warrants me in affirming that it gives no evidence of fracture; but there is in a few examples some evidence in favour of articulation at its ventral end. I therefore conclude that the prepubic bones may still be accepted as constituent elements of the Ornithosaurian skeleton. The bone has not been found in the order Ornithocheiroidea from the Cretaceous beds of Europe or America; and the supposed lateral position which I suggested for it in 1864-70 was based on a small pit on the anterior pubic border, which is inconclusive and otherwise unsupported by evidence. Its position was different in the Pterodactylia. Professor von Quenstedt, who enriched his specimens with almost incredible manual labour, cleaned away the matrix from the underside of the pelvis in his type specimen of *Cycnorhamphus suevicus*. He then found on the inner border of the pubic bone a short articular tubercle placed towards the ilium. He supposes this part of the pelvis to be displaced, and suggests that the tubercle gave attachment to the fourth bone of the pelvis, which he compared to the marsupial bone in Mammalia. This is the only fossil in which an author has described and figured an articular facet for the prepubic bone. I have seen that specimen and discussed the question with von Quenstedt, and can only say that I am unable to accept the interpretation as quite satisfactory, because it is unparalleled by any other example. The specimen of *Rhamphorhynchus Gemmingi* figured by Zittel also exposes the interior of the pelvis; but there is no indication of a tubercle for articulation with the prepubis. The anterior margin of the pubis is rounded. The bone is drawn by Zittel as though fractured ventrally at a point where it obviously thickens; and it seems to me probable from this fact and other evidence of the pelvic structure in this species given by von Meyer that the ventral part of the pubis is broken away.

If the pubic bone were bent and fractured as a condition of fossilization, it might be expected in the different families of

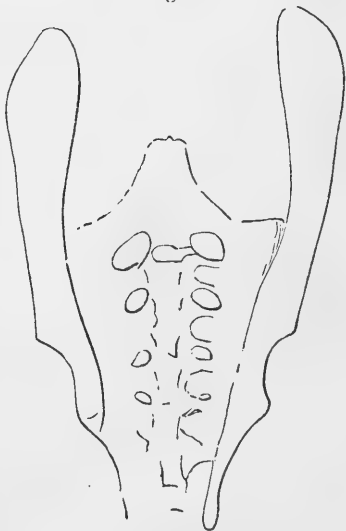
the subclass or order that the fracture would sometimes take place on one side only and that sometimes fragments of the broken bone would remain in contact with the part of the pubis with which it is supposed to have been continuous, while the prepubic elements might also be expected to show evidence of fracture; but there is no specimen in which a recognizable portion of the element termed prepubic is seen coossified with the pubic bone; and even when the pelvic sutures between the other bones are preserved there is no evidence of fracture, but sharply defined separation of these prepubic ossifications from the pubic bones, as in the specimen of *Cynnorhamphus* at Stuttgart.

The bones, even when not ankylosed together, have usually remained in nearer contact with each other than with the pubic bones; and this seems to me better consistent with separate ossification than with fracture. Moreover they always show forms and proportions which suggest complete ossifications; and this does not seem to be evidence to support the hypothesis that these bones are fractured portions of the pubis.

The following facts contribute towards a clearer conception of the pelvis.

If we examine a specimen like that named *Pterodactylus grandipelvis* (von Meyer, Rept. lithog. Schiefer, T. viii. fig. 1) it is manifest that the sacrum widens anteriorly in the transverse direction (fig. 1). The same character is shown in a sacrum of *Rhamphocephalus* from the Stonesfield Slate, in the collection of the Rev. P. B. Brodie, F.G.S. It is at present uncertain whether the character is common to all Ornithosauria. From this condition of the sacrum it follows that since the bones in the ischiac region of the pelvis approximate towards each other closer than those in the pubic region, the pubic bones cannot meet in a median symphysis unless they are longer than the ischia, which, I submit, is never the case.

Fig. 1.

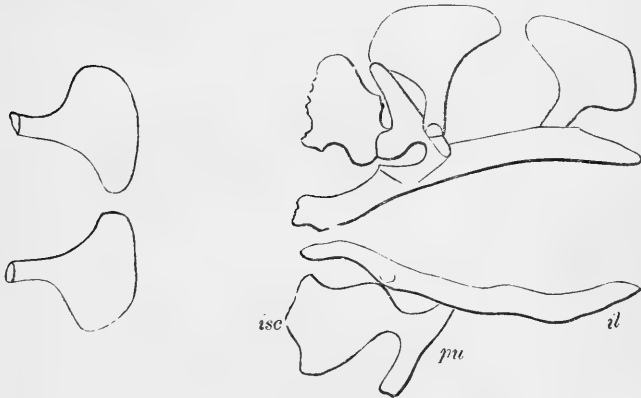


Pt. grandipelvis.
(Meyer, *l. c.* T. viii. fig. 1.)

I would next direct attention to the Munich specimen named

by von Meyer *Pterodactylus dubius* (*l. c.* T. vi. fig. 1; also Wagner, *Abh. München*, Bd. vi. T. vi. fig. 1, and Bd. viii. t. xvi.). It is the only difficult specimen that I have seen. First the iliac bones are connected with the sacrum and the pubic and ischiac bones are displaced outward to the right and left sides of the body (fig. 2). On the left side the pubis

Fig. 2.



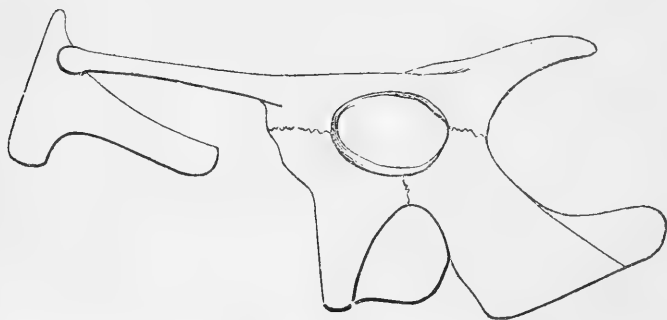
Pterodactylus dubius. (Meyer, *l. c.* T. vi. fig. 1.)

and ischium are in natural association. Wagner introduced a division between the bones (*pu* and *isc*) which v. Meyer does not draw and which I do not find in my own note; and it seems to me to be introduced from the contour of the displaced pubis seen on the right side. The pubis may be compared with the corresponding element in the os innominatum of *Rhamphorhynchus longimanus*. In (*Pt.*) *dubius* it has the same straight anterior border, with a posterior inclination; but there is a large wide and deep ventral notch dividing the pubis from the ischium, except in the small connecting symphyseal area below the acetabulum. No other specimen shows this notch, and in *Rhamphorhynchus* and some other genera the corresponding space is covered by a thin ossification. On the right side are the two prepubic bones with their free expanded median borders approximating and almost in contact, and the narrow stalk of the right bone in near contact with the proximal border of the pubis; but there is no indication of the stalk-like process figured by Quenstedt on either the proximal or distal internal surface of the pubis. Yet if the bones which I regard as prepubic are traced off

and completed symmetrically, it will be found that their expansions extend laterally far beyond the ilium, showing that they were inclined to each other. Their stalk articular ends might be in contact with the proximal ends of the pubes so far as this specimen is concerned. Specimens which expose the ventral surface of the pelvis have the prepubic bones often parallel to each other and their stalks separated by a width which would not be less than that between the pubic bones. This may be seen in Quenstedt's figure of (*Pt.*) *Cygnorhamphus suevicus* ('Ueber *Pterodactylus suevicus* &c.,' Tübingen, 1855) and in Fraas's figure of *Rhamphorhynchus suevicus* (Jahreshefte Vereins vaterl. Natur. Württem. xi. T. ii. 1855); and, on the whole, specimens which show a lateral aspect of the pelvis commonly have the stalk of the bone in a superior position, though exceptions occur, as in the type of *Pterodactylus longirostris*, in which the bone is displaced ventrally.

An instructive lateral aspect of the pelvis is seen in the Stuttgart specimen, no. 5802, from the Lithographic Slate of Nusplingen (fig. 3), which is figured by Fraas in the 'Palæontographica' (N. F. v. 4 (xxv.), T. xxii.) as *Pterodactylus suevicus* of Quenstedt. A cursory examination shows it not

Fig. 3.

Pelvis of *Cygnorhamphus Fraasii* (posterior angle of ischium restored).

to belong to that species, even if it belongs to the same genus, for the prepubic bones are of dissimilar forms and proportions to those of *Cygnorhamphus suevicus*. It moreover has the acetabulum much larger. The humerus, ulna, and radius, femur, tibia, and fibula are all relatively longer in the Stuttgart specimen, without a corresponding elongation of the wing phalanges; and therefore I shall speak of this specimen as

Cycnorhamphus Fraasii. In the drawing, which I copy from my note-book, it is manifest that the pubis and ischium are closely comparable with the same bones in (*Pterodactylus dubius*), except that a thin osseous plate extends backward from the anterior thicker part of the pubis, so as to fill in much of the deep notch which in *Pt. dubius* appears to divide the pubic and ischiac bones, and which would otherwise be seen in *Cycnorhamphus Fraasii*. It will also be seen that the ventral border of the ischium is straight, and I suggest that these straight borders not improbably met in a median symphysis. Still they are not thickened at the ventral border, as is usual in a median union; but then there is a like condition in Crocodiles in the borders of the ischia which are in median contact. If the ischia converged ventrally at all, the narrow posterior width of the sacrum shows that they must have had a median union. The shortness of the pubis similarly shows that no median union of the ventral margins of those bones could take place. But if the thickened anterior ventral end of the pubis is compared with the stalk of the prepubic bone, a suggestive correspondence in size of the two parts is seen; and I regard the two bones as having been in articular contact, so that the prepubic bones made an anterior median ventral symphysis corresponding to that usually made by the pubes. This interpretation is not easily harmonized with that offered by Quenstedt without adopting his hypothesis of displacement of the pubis in *Cycnorhamphus suevicus*, always supposing that the tubercle to which he believes the prepubic bone to have been attached really carried that element in the skeleton.

The value of evidence in this matter of the nature of the prepubic bone depends partly on its cumulative character. I therefore transcribe the following memoranda from my note-book on specimens at Munich.

Fig. 4.



Pterodactylus longirostris.
(Meyer, l. c. T. ii. fig. 1.)

Fig. 5.



Pt. micronyx.
(*Id. ibid.* T. iv. fig. 5.)

Fig. 6.



Pt. micronyx.
(*Id. ibid.* T. iv. fig. 4.)

In *Pterodactylus vulturinus* (Wagner) the antero-posterior extent of the pelvic bones is $3\frac{2}{10}$ inches. The sacrum con-

sists apparently of not more than three vertebræ. The pubis is partly crushed inward in the middle line and the pubic bones converge forward. The ischium also appears to have extended inward to the middle line of the vertebræ. The part of the ilium anterior to the acetabulum appears to be thin and free from the vertebræ; the depth of this plate is about $\frac{3}{10}$ inch. The prepubic bones are preserved on both the right and left sides; that on the left side is $1\frac{1}{20}$ inch long, it has a slender shaft for nearly an inch, and then expands like a fan to a transverse width of $1\frac{1}{20}$ inch; this expanded part is thin and rests upon the ilium.

In *Pterodactylus longirostris* (Cuvier) the pubis is partly obscured because the femur is preserved *in situ*. The ilium, which is pointed and long anteriorly, short and truncated posteriorly, is $\frac{9}{20}$ inch long. The vertical depth of the pelvic bones is $\frac{9}{20}$ inch. On the ventral border there is a slight notch between the ischium and pubis, showing the latter to be the smaller bone. The antero-posterior measurement over these bones is $\frac{9}{20}$ inch. The prepubic bone is relatively large, $\frac{9}{20}$ inch long, and expands anteriorly in a fan form to a transverse width of $\frac{4}{10}$ inch (fig. 4).

In *Pterodactylus rhamphastinus* (Wagner) the ilium extends $1\frac{3}{10}$ inch in front of the femur. The prepubic bone is $\frac{7}{10}$ inch long and expands in a fan form at its free end.

In *Pterodactylus Kochi* (Wagner) the pelvis is badly preserved. It has the prepubic bone widely expanded at its free end.

In *Pterodactylus micronyx* (v. Meyer) the ilium is spear-shaped anteriorly. The ischium and pubis are displaced and imperfect. The prepubic bones have the shaft slender and long; the expanded end is fan-shaped (figs. 5, 6). The bone is fully $\frac{3}{10}$ inch long.

In *Pterodactylus medius* (Münster) the ilium is $1\frac{4}{10}$ inch long, of which one inch is anterior to the head of the femur. The pubic and ischiac bones are well developed. The prepubic bones have a fan shape, appear to be $\frac{6}{10}$ inch long, and about half an inch wide at the expanded end.

These examples may be sufficient to show how slightly the prepubic bone varies in type among the short-tailed animals which comprise the suborder Pterodactylia of de Blainville. The prepubis is approximately one half the length of the ilium in all the species. The small size of the specimens and the nature of the matrix have not been favourable for displaying the articular facet of the slender shaft; but in every case the termination of the prepubic bone is a clean-cut transverse line, and I have never observed any circumstance

which would lead me to doubt its being an articular facet. In the Pterodactylia the prepubic bones are never anchylosed together. On the other hand, the other pelvic bones are commonly anchylosed together in genera from the Lias and Oolites. In *Pt. dubius* there may be some ground for doubt whether the pubis and ischium are not really one bone, as von Meyer believed, because ossification appears to be incomplete, and yet the two bones are blended, without trace of suture; but it is more probable that ossification has obliterated the suture. It is these circumstances which led me to adopt the view that the ventral part of such an ischio-pubis would have a tendency to be limited to the ischiac region, because the pubic part, freed from the usual mechanical stimulants to ossification, would have a tendency to undergo atrophy and shorten more and more, until the prepubis was brought into contact with the prominence which alone remained to mark the position of the pubis, as in Crocodiles.

In the Rhamphorhynchidæ* the prepubic bones are much more unsymmetrical, and commonly have the form of a capital Y (figs. 7, 8), in which one limb of the fork is reduced in length or may be absent, though the latter condition may be a generic difference. In this family the pelvis is relatively small; the anterior process of the ilium is relatively deep and in marked contrast with the rod-like anterior process of other family types.

My own notes, written from the specimens at Munich, are as follows:—

“*Rhamphorhynchus Münsteri*, var. *longimanus* (Wagner).—The prepubis is shaped something like a boomerang and measures $1\frac{1}{20}$ inch from end to end. It is angular in front, with a projecting process in about the middle of the lateral border.” In other species this angular process is absent, and the bones of the right and left sides are united together by median symphysis into a bow-shaped bone without trace of median suture.

“*Rh. Münsteri* (Goldf.).—The prepubic bones, attached to

Fig. 7.



Rhamph. Gemmingi.
Prepubic Bones. (Meyer,
l. c. T. ix. fig. 1.)

Fig. 8.



Rhamph. Gemmingi?
Prepubic Bones. (*Id.*
ibid. T. x. fig. 3.)

* Ann. & Mag. Nat. Hist., August 1870.

the anterior side of the pubis, extend forward in a bow and appear to be anchylosed mesially. The median part between the two limbs of this bone measures $\frac{6}{10}$ inch transversely and the transverse measurement between its extremities is $1\frac{3}{10}$ inch. This therefore gives the approximate width between the points of the pubis with which this bone articulated. The ischium and pubis are rather thick bones, show no trace of a dividing suture, are directed somewhat backward, and, as usual, are imperforate. There seems to be a small foramen in the position of the obturator foramen of Cretaceous genera, and in those genera the foramen lies in the ischio-pubic suture."

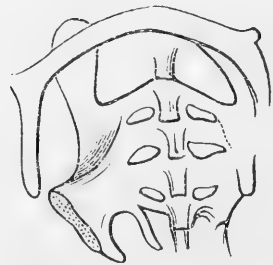
In another specimen, marked "*Rh. Münsteri* (Goldf.), = *Rh. Gemmingi* (v. Meyer)," the sacrum appears to include three or four vertebræ. The ilium, which is blended with the sacral ribs, is $1\frac{6}{10}$ inch long, and is prolonged for about the same distance on each side of the acetabulum. The anterior process deepens as it extends forward, and it is about $\frac{2}{10}$ inch longer than the slender posterior process. A minute obturator foramen marks the union of the ischium and pubis, which are directed somewhat backward and blended into a compact os innominatum. The pubis is thick and strong. The pre-pubic bones appear blended into a bow-shaped bar. It consists of a middle straight portion and right and left parts which are inclined to it, though not quite symmetrical as preserved. Each of these three parts would measure about $\frac{3}{8}$ inch in length. The transverse measurement over the

Fig. 9.



Rhamphorhynchus longimanus.
(Wagn. Abh. Münch. viii. T. xvi.)

Fig. 10.

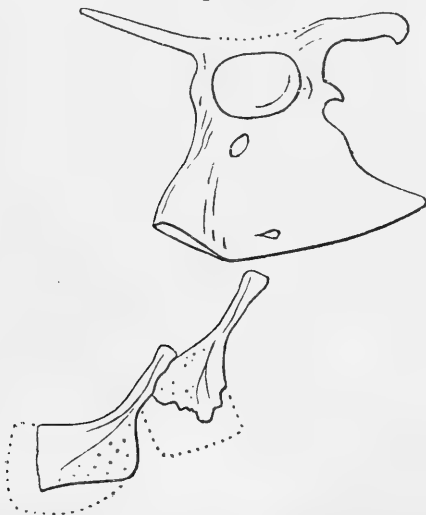


Rh. Gemmingi. (Zittel, Pal.
xxix. T. xii. fig. 2.)

extremities of the bone is $1\frac{3}{10}$ inch. The bone is thicker and less bent on the left side than on the right side.

Finally, Dr. Zittel has published a figure which shows the interior of the pelvis, with the prepubis extending as a bar immediately in front of it (fig. 10), though, as in other specimens, its contours are not perfectly displayed. This fossil appears to prove that there is no articulation for the prepubic bone such as was found by v. Quenstedt, and identified possibly in harmony with the figure of *Pt. dubius*. Hence the facet may have a pathological interpretation. No specimen has shown a facet on the anterior margin of the pubis for articulation with the prepubis; and therefore the only position left for its articulation is the anterior ventral margin of the pubic bone, where there is often a suggestive correspondence in thickness between the extremity of the pubic bone and the diameter of the shaft of the prepubic bone. The extremity of the united pubis and ischium in Zittel's specimen is manifestly imperfect, as shown by the pelvis referred by Wagner to *Rh. longimanus*; but there is some evidence that the ischia met in the mesial line in species of the Rhamphorhynchidæ.

Fig. 11.



Dimorphodon macronyx. From a specimen in the British Museum.
Nat. size.

Another piece of evidence as to the structure of the pelvis is furnished by *Dimorphodon macronyx* (fig. 11). The ilium is

nearly $1\frac{2}{3}$ inch long, and is formed on the plan of that bone in *Pterodactylus longirostris*. It is prolonged anteriorly as a slender pointed rod $\frac{5}{8}$ inch long, and posteriorly as a thickened bar $\frac{3}{8}$ inch long, which is truncated with a slightly hamate downward curve. The depth to the inferior border of the ischium is more than an inch. This border is straight. The anterior pubic region is somewhat thickened, and its ventral border meets that of the ischium at an angle, where the thickened bone does not show either fracture or a definite articular face. Below the ventral border lie two unsymmetrical prepubic bones rather over an inch long and slightly overlapping each other. I suppose these bones to have met in the median ventral line. They are thin, expanded, slightly curved, with a longitudinal ridge which separates a side which is smooth from one which is granular. The thin plate is imperfect in both bones, though the outlines are indicated. This form of prepubis is quite distinct from that of the *Pterodactylæ*, and makes some approach to that of *Rhamphorhynchus* in its curved form. The terminal expansion of the slender shaft or stalk of the bone is such as I have only seen in association with an articular surface.

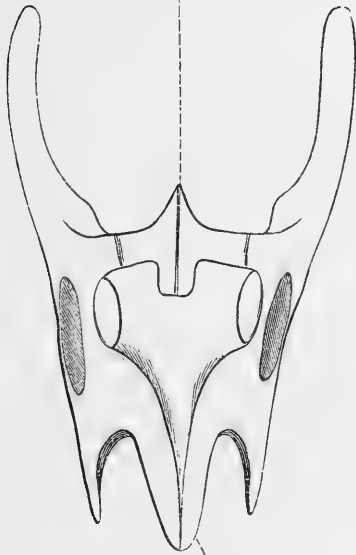
In endeavouring to restore the pelvis it is necessary to remember that there is no conclusive evidence of the relations of the ischia to each other at their ventral approximation other than evidence that they were not ankylosed together. It is not certain that they were in close contact, though this is probable, seeing that the prepubic bones certainly were ankylosed together in some species of *Rhamphorhynchus*; and this median union of the prepubic bones appears to have inclosed a median pelvic vacuity which was usually heart-shaped or kite-shaped, being wide in front and narrow behind. This may be seen in the annexed restorations of the ventral aspect of the pelvic bones, which I have made from models giving the minimum approximation to the ischia (figs. 12, 13).

It is probable that the pelvis was narrower in *Dimorphodon* than this figure indicates; but I see no reason to think that the aspect of the fresh skeleton differed materially in these genera from the restoration here given. The remarkable structural feature shown is the ventral divergence of the pubic bones from the median line of the body, the prolongation of the pubic arch to a median symphysis by means of the prepubic bones, and the probable median union of the posterior angles of the ischia. There is no evidence of the limit to which pubic bones may be absorbed; but if the prepubis were to come to be attached in the region of the obturator foramen, the bone would still be long enough to meet its

fellow in the median line if the ischiac margins came together, as in Crocodiles; and the prepubis would then have the position of the bone in Crocodiles which most authors identify as

Fig. 12.

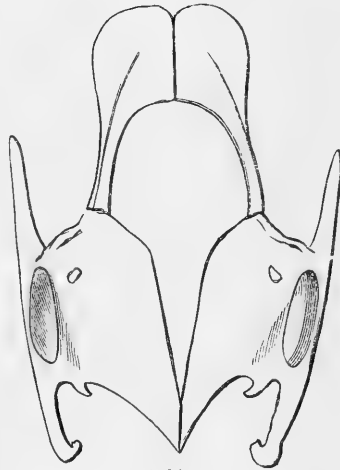
prepubis.



ischium.

Fig. 13.

prepubis.



ischium.

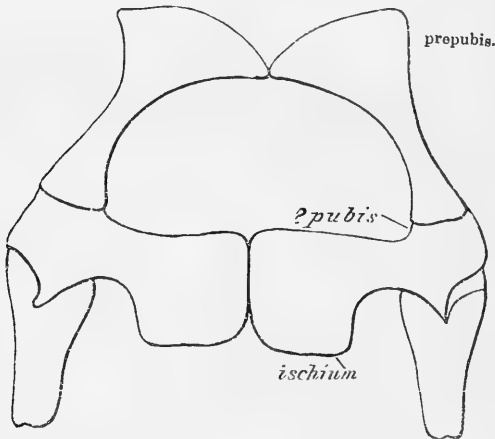
Fig. 12.—Restored Ventral Aspect of Pelvis of *Cycnorhamphus Fraasii*.
 Fig. 13.—Restored Ventral Aspect of Pelvis of *Dimorphodon macronyx*.

the pubis, but which I have supposed to be the prepubic bone. I have stated the reasons for that identification already *; but if a pelvis like that of the Alligator (fig. 14) is compared with that of an Ornithosaur, say *Cycnorhamphus*, in which the shape of the ischium can be seen, it will be found that the two bones are very similar in form—as similar as are the prepubes. In many Ornithosaurs, such as *Pt. dubius*, the connexion between the ischium and pubis is a narrow process. If then the pubis dwindles away till the prepubis completely takes its place, except that it never enters the acetabular cup, we have the change which would convert the pelvis of an Ornithosaur into that of a Crocodile. Thus we may accept

* Proc. Roy. Soc. vol. xliii. p. 237.

the Crocodilian theory of the Ornithosaurian pelvis enunciated by von Meyer and adopted by Owen and Zittel, if we first conceive that the pubic bone has been practically eliminated

Fig. 14.

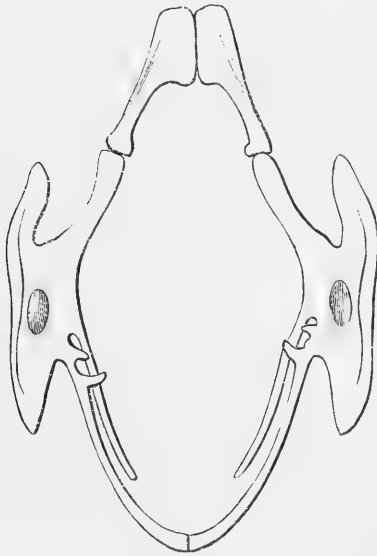


Ventral Aspect of Pelvis of Alligator.

from the pelvis of the Crocodile. Further evidence of this elimination is, I think, to be found among existing birds and among the fossil reptiles named Ornithischia, which have the pubic bones less developed than among Ornithosaurs. In the *Iguanodon bernissartensis* (fig. 15) the pubic bone is very short as compared with the ischium. The pubis resembles in a general way that of an embryo bird in having distinct anterior and posterior limbs. The slender short posterior limb of the pubis extends backward parallel to the slender ischium, as in adult birds; but the anterior limb is wider, stouter, and directed forward, but is still short as compared with the ischium. It is obvious that, as in Ornithosaurs, there is no possibility among Ornithischia of the pubic bones meeting ventrally in a median symphysis. But the wide, forwardly-directed process of the pubis resembles in its extension the ventral process of the pubis in many Ornithosaurs. Further forward in the skeleton are found the pair of bones which have been variously regarded as clavicles and sternal bones in species of *Iguanodon* and allied genera. These bones present the most remarkable resemblance in form to the pre-pubic bones in *Dimorphodon*, and from their relation to each other seen in *Iguanodon* I conclude that they may be identified

as the prepubic bones of the Ornithischian skeleton. I have already pointed out that they resemble the anterior pair of ventral bones in the pelvis of a Crocodile; and this identification of the prepubic bones in the Ornithischia makes a further approximation to the condition in the Crocodile, because they are found in a type in which the pubis is less developed than in the Ornithosauria. If there is a difficulty in adopting this osteological reading it does not arise from any differences in form between the bones in question in Ornithosauria, Ornithischia, and Crocodilia, but rather from the fact that the anterior pubic process of Iguanodonts, as preserved, is always thin and shows no articular facet at its extremity, while the bone which I would attach there (fig. 15) has a stout shaft and an expanded articular end, which was oblique and rough and shown by one specimen in the British Museum to have had a

Fig. 15.



Restoration of Ventral Aspect of Pelvis of *Iguanodon*.

cartilaginous surface. These dissimilar conditions of the corresponding portions of the pubic and prepubic bones appear to characterize Ornithosaurs; so that, although unexpected in *Iguanodon*, they are perhaps not so antagonistic to coadaptation of the bones as might at first thought appear. This

identification of the prepubic bone, which rests on inductive evidence, is the more interesting since it shows that the main pelvic differences between the Ornithosauria and Ornithischia are in the less breadth of the ischium, in the prolongation backward of a posterior pubic process, and the greater depth of the ilium. The pelvic features in which the two groups agree appear to be the development of the anterior and posterior processes to the ilium, the posterior approximation of the ischium, the short development of the anterior process of the pubis, and the possession of prepubic bones. The distinctive pelvic character is the development of the posterior process of the pubis; and although this process attains a similar development in birds, birds have practically lost the anterior processes of the pubes and have entirely lost the prepubic bones.

Thus, considering pelvic characters only, there is a certain

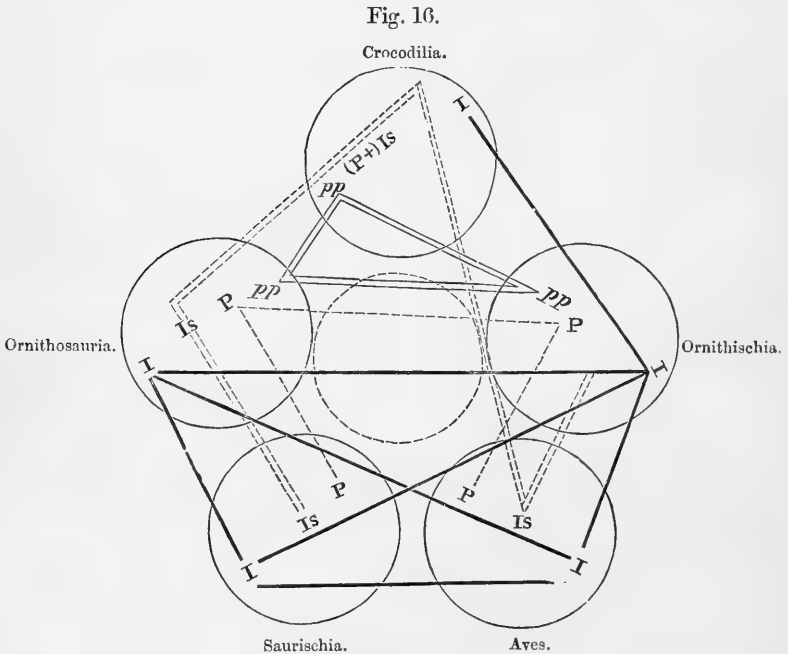


Diagram of Pelvic Relationship in the Ornithomorpha.

community of structure between the Ornithosauria, Ornithischia, and Crocodilia in the possession of prepubic bones, and between Saurischia and Aves in wanting those bones.

The osseous resemblances between these groups of animals may be better summarized in a diagram (fig. 16)*, where the letters I, Is, P, *pp*, stand respectively for ilium, ischium, pubis, and prepubis in the several groups of animals, and the lines drawn from one group to another show the resemblances between the bones. From this it would appear that the relations of the Ornithosauria seen in the pelvis are closer with extinct than with the existing groups. This conclusion is of some importance, since the Ornithosauria may be associated with Birds from the resemblances in their brains, and associated with Birds and Saurischia from possessing a pneumatic skeleton, though it is less developed in the latter group than in the others. These resemblances, when better evidenced by the discovery or description of specimens which show the bones in complete natural connexion, may justify the linking of these orders together in a natural alliance (the *Ornithomorpha*) expressive of their common origin.

The Classification of the subclass Ornithosauria which seems to me best supported by facts is the following division:—

Order 1. ORNITHOCHEIROIDEA.

Family Ornithocheiridæ.

Family Pteranodontidæ.

Suborder 2. PTERODACTYLIA.

Family Pterodactylidæ.

Order 3. PTERODERMATA.

Family Dimorphodontidæ.

Family Rhamphorhynchidæ.

Here the Orders are founded upon the organs of flight, brain, skull, and pelvis; the Families in the first Order are based provisionally on the dentition, and in the third Order upon pelvic characters.

* The central circle is provisionally given to the Aristosuchia, which have the skeleton pneumatic, pubes directed forward, anchylosed to the prepubes, which are anchylosed together. No posterior limb to the pubis.

XXVI.—*Note on a Couple of Abnormalities.* By W. BLAXLAND BENHAM, D.Sc., University College, London.

[Plate III.]

AMONGST the large number of crayfish (*Astacus fluviatilis*) dissected annually in the zoological classes here I have noticed from time to time certain abnormalities in regard to the genital apertures in females, usually a doubling of the pore on one side—that is, in addition to the normal pore on the base of the 11th appendage there is a second pore on that of the 12th.

A short time ago (Nov. 24, 1890) one of my students drew my attention to a female specimen, which, in addition to the normal genital apertures, presented a pair of apertures on the bases of the 13th appendages, occupying, that is, the normal position of the genital apertures of a male (see Pl. III. fig. 1). On dissecting the specimen I find that the ovary is normal, but that there are *two oviducts on each side, one passing into the base of the 11th appendage, the other into that of the 13th appendage* (see fig. 2) to the so-called “male pore.” There appears to be no trace of a testis and no evidence of an hermaphrodite condition. The abdominal appendages are normally female. Taken in conjunction with the abnormalities which I had already observed, this gives a possibility of a pore and duct for each of the last three ambulatory appendages.

It is still a moot point whether genital ducts in the Arthropoda are derived from nephridia; but there is some evidence tending to support this idea. In *Peripatus* there is a pair of nephridia in each of the leg-segments, except in the segment containing the genital duct (in *P. novæ zelandiæ*), which opens in the same position as a nephridium and which Gaffron has shown possesses an “end-sac” similar to that of the nephridia. In *Lepas*, amongst the Crustacea, Hoek (in ‘Challenger’ Reports) figures sections through the “segmental organ” (“shell-gland”) of the 2nd maxillary segment, and through the terminal portion of the oviduct, at the base of the next appendage (first cirrus), and points out the similarity between them. In *Nebalia* the “shell-gland” of the maxillary segment and the “green-gland” of the antennary segment coexist (Claus, Arb. Zool. Inst. Wien, vol. viii. 1889); in other Crustacea one of these glands is present, but not the other.

These and other facts appear to point to the possession originally by Arthropoda of a pair of segmental organs

("nephridia") in each segment; most are suppressed in the Crustacea, though those of the second antennary segment and of the second maxillary segment remain, and with the genital ducts in the 11th and 13th (and 12th in abnormal forms) help to fill up the series.

It is of course for such suggestions as these that the present abnormality is worthy of record.

The second case is that of a common earthworm—*Lumbricus herculeus*, Savigny (= *L. agricola*, Hoffmeister). I have examined some thousands of specimens of this species for class-work and other purposes, but this is the only case of an *asymmetrical* condition that has come under my notice*. Externally the asymmetry affects the male and female apertures (see fig. 3); both these are normally placed on the animal's left side, *i. e.* the oviduct opens on the 14th segment, the sperm-duct on the 15th. On the *right* side, however, each of these pores is one segment in front, *viz.* on the 13th and 14th segments.

The clitellum is normal and symmetrical.

Of the internal organs (fig. 4) both genital system and alimentary system present asymmetry in certain segments. The organs of the left side are normally placed and fully developed; but *on the right* there is only *one spermatheca*, lying in segment ix.; and instead of the usual three spermsacs only those in segments ix. and xi. are present; *that of the twelfth segment is absent*. The ovary of this side is in segment xii. instead of in xiii. The testes and funnels are normal on both sides.

Of the alimentary system the calciferous glands are affected on the right side, that of segment xii. being absent.

With regard to abnormalities in earthworms, Beddard has recorded a large number of cases for *Perionyx excavatus*†, and has recently noted a case, *e. g.* *Perichæta Forbesi*‡, in which the spermathecae are asymmetrically developed (and this in each of the two specimens in his possession), there being two on one side and one on the other, in the same segment; I have already noted a similar condition in *Microchæta Rappi*§.

Michaelsen ||, in a just-published paper, records certain

* A second similar example came under my observation while this note was in the press.

† Proc. Zool. Soc. 1886, p. 308.

‡ Proc. Zool. Soc. 1890, p. 65.

§ Quart. Journ. Micr. Sci. xxvi.

|| Jahrb. d. Hamburg. Wiss. Anat. viii.

asymmetrical and abnormal positions of the genital pores in *Allurus*, sp.

For the present I content myself with merely noting without comment these interesting abnormalities.

EXPLANATION OF PLATE III.

Astacus fluviatilis.

Fig. 1. View of ventral surface of abnormal specimen of female crayfish, sufficient to show the position of the second genital aperture (*o.p.* 2) on each side, *o.p.* 1 being the normal oviducal pore; X., XI., XII., XIII., indicate the last four ambulatory limbs, which are represented as cut short; *Ab.* 1 the first abdominal sternum with normal female appendages.

Fig. 2. Side view of the same crayfish partially dissected; the hinder part of the carapace (*ca*) has been removed, the epimeron (*ep*) and gills have been cut away; the bases of the ambulatory appendages (10, 11, 12, 13) are represented; *o* is the normal ovary, *o.d.* 1 the normal oviduct, *o.d.* 2 the accessory oviduct passing into appendage 13; *Li.*, liver, underlying ovary; *Ab.* 1, *Ab.* 2, the first and second abdominal segments.

Lumbricus herculeus.

Fig. 3. Ventral view of segments XII. to XVI., showing on the animal's left side the normal oviducal pore (♀) and spermiducal pore (♂), and on the right side the abnormal position of these apertures.

Fig. 4. Dissection of segments IX. to XIII., to show the asymmetrical condition of internal structures. The normal condition obtains on the left side, the abnormal on the right; *spth.*¹, *spth.*², the spermathecae; *ov.*, abnormally placed ovary; *cal.*, calciferous gland; *æs.*, œsophagus. None of the structures have been cut or removed, the calciferous gland and sperm-sac of segment XII. being absent.

XXVII.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.*—No. 21. *Note on the Results of the last Season's Deep-sea Dredging.* By J. WOOD-MASON, Superintendent of the Indian Museum, and Professor of Comparative Anatomy in the Medical College of Bengal, and A. ALCOCK, M.B., Surgeon I. M. S., Surgeon-Naturalist to the Survey.

[Concluded from p. 202.]

Family **Inachidæ**.

PLATYMAIA, Miers.

35. *Platymaia Wyville-Thomsoni*, Miers.

Platymaia Wyville-Thomsoni, Miers, 'Challenger' Brachyura, 1886, p. 13, pl. ii. fig. 1.

Three specimens (one male and two ovigerous females), from Station 56, 240 to 220 fathoms.

The male measures:—

	millim.
Length of carapace	93
Greatest breadth of carapace	97
Expanse of legs	700

The largest female measures :—

	millim.
Length of carapace	80
Greatest breadth of carapace	82
Expanse of legs	400

All our specimens, including those taken on previous occasions, greatly exceed the 'Challenger' specimens in size. The males run much larger than the females, and the great chelæ are greatly enlarged, with the palms inflated and armed with three rows of slender hooked spines.

Our specimens differ from the type in a number of details, which do not justify the description of a new species without actual comparison with the type.

ECHINOPLAX, Miers.

36. *Echinoplax pungens*, sp. n., Wood-Mason.

Differs from *Echinoplax Moseleyi*, Miers, in its much larger size; in its much more numerous, more thickset, and longer spines; in its more regularly and symmetrically pyriform carapace; in its thicker legs; in its smaller eyes, which, when laid back, do not nearly reach to the spine which limits the ocular cavity posteriorly; and by the broader abdomen of the female.

Colour in the fresh state a brilliant straw-colour.

Five female specimens from Station 56, 240 to 220 fathoms, the largest of them measuring 340 millim. in expanse of legs, 60 millim. in breadth of carapace across the branchial regions, and 88 millim. in length of carapace from its hinder margin to the tips of the rostral spines.

Smaller specimens have a much more spiny abdomen and are generally more spiny than larger ones.

37. *Encephaloides Armstrongi*, gen. et sp. n., Wood-Mason.

Remarkable for the large size of the branchial chambers, which are so inflated as to meet together over the back in a straight suture. Both the afferent and the efferent branchial openings are also very large.

In the female the cavity of the brood-pouch communicates with the branchial chambers by two canals, formed by deep

notches in the posterior angles of the thorax and by the base of the abdomen, whereby in all probability a current of fresh water is caused to flow over the eggs. The rostrum is triangular and shaped like the beak of a bird, and the antennary flagella are visible from above beyond its margins. The eyes, which are very small, are retractile against the sides of the carapace, and the narrow orbital cave is provided with a minute spine anteriorly and posteriorly. The legs are long and slender, with their segments, including even the tapering dactylopodites, cylindrical.

Numerous specimens were obtained at Stations 81 and 96, and at Station 76 over two hundred were taken, almost all of them being males. This form, in fact, is characteristic of the infra-littoral of the Bay of Bengal, near the 100-fathom limit, from the coast of Arrakan to the Godávári.

Colours in the fresh state:—Carapace pinkish yellow, ambulatory legs pink.

Measurements.

	Male.	Female.
	millim.	millim.
Length of carapace	41.5	28
Breadth of carapace	42	27
Height of branchial regions	20.5	12
Expanse of first pair of ambulatory legs.	335	134
Length of chelipeds	74	33

ANAMATHIA, S. I. Smith.

38. *Anamathia Livermori*, sp. n., Wood-Mason.

Closely allied to *Anamathia pulchra*, Miers, differing in having the carpopodite and propodite of the chelipeds rounded instead of carinate.

The spines of the rostrum are as long as the distance in a straight line from the hinder margin of the carapace to the gastric spine. The carapace bears twenty spines disposed in five longitudinal rows, namely two lateral of three spines each, one dorsal of four, and two subdorsal of five each including the postoculars.

A male and two females from Station 56, 240 to 220 fathoms.

Length of the largest specimen 22 millim.

PUGETTIA, Dana.

39. *Pugettia globulifera*, sp. n., Wood-Mason.

Allied to *Pugettia velutina*, Miers, with which it agrees in

the possession of two foliaceous tubercles on the inflected portion of the carapace on each side, and in the form of the orbits and postocular lobes; but from which it differs in the spines of the sides of the hepatic region being all but erect and expanded at the base into huge pear-shaped tubercles, which present themselves in an underview as two great smooth and polished white hemispherical bosses at the antero-lateral angles of the buccal frame; also in its foliaceously-carinated chelipeds and in the club-shaped setæ with which its ambulatory legs are garnished.

Station 56, 240 to 220 fathoms.

Length 15·5 millim.

OXYPLEURODON, Miers.

40. *Oxypleurodon cuneus*, sp. n., Wood-Mason.

Allied both to *Oxypleurodon Stimpsoni*, Miers, from 375 fathoms off the Philippines, and to *Sphenocarcinus corrosus*, A. M.-Edw., from 100 fathoms off Barbadoes; resembling the former in the form, number, and distribution of the carapacial prominences, and the latter in the form though not in the structure of the rostrum. In *Oxypleurodon Stimpsoni* the rostrum is formed by two horns which diverge widely from the level of the anterior end of the orbit, in *Sphenocarcinus corrosus* by two horns uniting together in the middle line to form an apically bifid wedge-shaped mass, and in the new species the carapace is produced into a long, slender, tapering rostrum, which is minutely bifid at the extremity. All the joints, except the dactylopodites, of all the legs are strongly crested dorsally.

Length of carapace, from tip of rostrum to posterior margin, 18·7 millim.; breadth between points of branchial eminences 13·7 millim.

Two males and one ovigerous female from Station 56, 240 to 220 fathoms.

DOCLEA, Leach.

41. *Doclea ovis* (Herbst).

One young specimen from Station 96, 98 to 102 fathoms.

Family Cancridæ.

42. *Nectopanope rhodobaphes*, gen. et sp. n., Wood-Mason.

Carapace about $1\frac{1}{3}$ times as broad as long. Frontal

margin straight, entire—being only obsoletely bilobed—divided from the supra-orbital margin on each side by a slight notch for the reception of the first joint of the flagellum of the antennæ. Supra-orbital margin with one fissure, infra-orbital entire. Antero-lateral margins shorter than the postero-lateral, arched, armed with three teeth, including the extra-orbital angle. Branchial regions swollen, separated from the gastric by a V-shaped impression, from the cardiac by their own prominence, and by a slight transverse depression from the hepatic, which is separated from the gastric in a similar manner. Afferent and efferent branchial apertures large; the outer wall of the large efferent canal forms a sub-carinated elevation of the anterior pleural region. Chelipeds large, smooth, with a strong groove near the lower margin of the produced portion of the propodite on the outside; the upper margin of the propodite subcarinate; the carpopodite smooth, subquadrate, with a small spine at the inner angle; and the meropodite with a short sharp spine near the apex of its posterior angle. Ambulatory legs rather weak, the first three pairs subequal, the last shorter, with the meropodite curved in correspondence with the convexity of the branchial regions of the carapace; the dactylopodites are compressed-styliform, with a groove on each side and a slight fringe of setæ on the upper and lower margins, those of the last pair being, like their propodites, shorter and broader and fringed, especially below, with longer setæ; the ambulatory legs in fact are subnatatory, and agree in structure with those of the Portunidæ. Integument everywhere polished and glabrous, except for the presence of a few scattered setæ on the dorsal surface of the legs and for the dactylopoditic fringes.

In life this crab was of a beautiful deep-sea pink, with a dotted, V-shaped, white mark between the gastric and branchial regions.

One specimen was obtained at Station 96, 98 to 102 fathoms; the length of its carapace is 21·4 millim., and the greatest breadth between the points of the third teeth 29 millim.

The following species is referred provisionally to the same genus, though it differs in having the first tooth of the antero-lateral margin distinct from the orbit, and the legs, especially the last pair, not nearly so distinctly natatory.

43. *Nectopanope longipes*, sp. n., Wood-Mason.

Differs from the preceding in its branchial regions not

being inflated; in the form of the teeth of the antero-lateral margins of the carapace, the first of which is a rectangular plate entirely separate from the extra-orbital angle, while the two remaining are sharp and conical; in its relatively longer legs, which are setose at their extremities, with the dactylo-podites of the last pair not much more expanded than those of the preceding pairs; in having the upper surface of the carapace dull and minutely granulose, and the fingers of the chelipeds black.

One male and one female, juv., from Station 56, 240 to 220 fathoms.

Length of carapace 8.5 millim., breadth 11.7 millim.

44. *Sphenomerus trapezioides*, gen. et sp. n., Wood-Mason.

Carapace about $1\frac{3}{4}$ times as broad as long; its upper surface is smooth, polished, and tolerably convex in all directions, but especially antero-posteriorly; and it is devoid of all grooves except two faint crescentic ones, which separate the cardiac from the branchial regions. The deflexed and somewhat produced frontal margin is divided by a distinct notch into two truncate-rounded lobes, and is without granules or raised rim, as are also the entire upper and lower orbital margins. The antero-lateral margins, which are only about two thirds the length of the postero-lateral, form with the frontal margin a semicircular outline; each bears a minute spine at the extra-orbital angle, followed at equal distances by two smaller ones. There is also a small spine at the internal infra-orbital angle. The basal joint of the antennæ is not much developed and the flagellum occupies the internal orbital hiatus. The external maxillipeds have the mero-podite slightly oblong, with the succeeding joint articulated to its truncated antero-internal angle. The abdomen of the male is six-jointed, the third and fourth segments being almost indistinguishably ankylosed together.

Chelipeds in both sexes extending far beyond the carapace, massive, and of unequal size, the right being much larger than the left; the fingers are broadly banded with black across their middle, the palms are smooth, the wrist is rounded and smooth, with a minute spine on its inner side; the mero-podite is wedge-shaped at its proximal end and bears six to eight small spines on its thickened distal end, as in *Trapezia*. Ambulatory legs weak and narrow, with the two terminal joints articulated together and constructed as in *Trapezia*.

From Station 56, 240 to 220 fathoms.

Length of carapace 8.5 millim.; breadth between last pair of antero-lateral tubercles 11 millim.

This species was taken near the same place in a previous season.

Family Leucosiidæ.

45. *Parilia Alcocki*, gen. et sp. n., Wood-Mason.

This crab is remarkable not only for the great size to which it attains—equalling though not exceeding the *Myropsis goliath* of A. Milne-Edwards—but also for the great development of the respiratory mechanism. The finely and sharply granulated carapace is distinctly broader than long. When viewed from above it appears hexagonal in outline, the interval between the outer canthi of the afferent branchial apertures forming the wide and straight anterior side; the intervals between the outer canthus of the afferent branchial apertures and the last antero-lateral tooth of each side, the nearly straight antero-lateral sides; the intervals between the last antero-lateral tooth and the posterior branchial spine of each side, the very strongly arched postero-lateral sides; and the interval between the posterior branchial spines of opposite sides, the posterior side of the hexagon. It is depressed in front and strongly swollen behind, both vertically and horizontally, but especially horizontally, so as in a side view to appear wedge-shaped. The regions are well-marked, the much inflated branchials being sharply marked off from the elongated *fleur-de-lys*-shaped gastro-cardiac and from the hepatics by a deep groove, which, commencing behind the cardiac protuberance, passes forwards and inwards, and then curves boldly forwards and outwards to the first antero-lateral tooth on each side, and is deeply indented at intervals in its course. The hinder margin bears three short conical spines, of which the middle is small and tends to degenerate with age into a mere clump of granules. Above the marginal spines, on the vertical hinder surface, is a transverse row of three similar spines, of which two are on the branchial regions and the third and smallest arises from the middle of the cardiac boss, whence a carina passes forwards along the mid-dorsal line nearly to the frontal margin. The antero-lateral margin bears four spiniform tubercles, one in the middle of the length of the pterygostomian ridge (which, in the absence of an hepatic ridge, functions as a portion of the antero-lateral margin), and three separated from each other by equal intervals and from the pterygostomian by an interval equal to the sum of their own interspaces.

The two antennular lobes of the front, which is much as

in *Myra* and *Ilia*, are dorsally carinate. The supra-orbital margin is marked by two fissures; the infra-orbital is a stoutish triangular tooth, separated externally from the supra-orbital by an angular notch, internally by a wide hiatus from the front, and inferiorly from the notched upper edge of the afferent branchial opening by a considerable space. The structure of the orbit is in fact to all intents and purposes identical with that of *Ilia*, the only difference being that the extra-orbital notch forms a third fissure in the latter, whereas in *Myra* the notched edge of the afferent branchial opening forms, or comes into such close relation with the orbit that it seems to form, the lower margin of the latter, and that which answers to the lower orbital rim of *Parilia* is an extra-orbital lobe separated from the supra-orbital margin by a third and from the functional infra orbital margin by a fourth fissure.

The little lobe which in *Myra* bounds the outer notch of the upper margin of the afferent branchial aperture and does not extend beyond the level of the extra-orbital lobe, is in *Parilia* laterally expanded to a huge extent on each side, so as to form the enormously wide orifices of the afferent branchial channels, and thus to treble the apparent width of the front. The exognaths of the external maxillipeds are commensurately and concomitantly widened, and are segments of a circle larger than a semicircle, thus exceeding in width the same parts even in *Philyra*; they are truncate at the extremity, and when closed leave a wide chink-like opening between themselves and the sides of the carapace.

The chelipeds are long, slender, and cylindrical, being about twice as long as the carapace in adult females and males of the same size, but no less than $4\frac{1}{2}$ times as long as the carapace in giant specimens of the latter sex; they are finely and sharply granulated, especially on the upper surface, from the base to the insertion of the dactylopodite, whence they are smooth; the meropodites are about equal to the carpopodite with propodite up to the insertion of the dactylopodite, which is scarcely more than half the length of the propodite without its prolongation in females and in males of the same moderate size; the propodite increases slightly in vertical width to the insertion of the dactylopodite. The legs are of moderate length and strength and are almost smooth; their meropodite is almost equal to the propodite and dactylopodite together; the dactylopodites, which are strongly fringed on the upper and lower edges, are so twisted and curved that their smooth and transversely convex sides are directed forwards and upwards, and backwards and downwards

respectively, while their dorsal and ventral edges have become upper and lower.

The abdomen of the male is only five-jointed, the third, fourth, and fifth joints being ankylosed together. That of the female has the full number of distinct joints; the abdomen and sternum securely interlock, the sterna of the latter giving off a forwardly-increasing series of laminar processes which project downwards and inwards over the edges of the former; there is an erect spine on the sternum between the genital apertures, and the spacious brood-cavity communicates with the branchial cavity by a hole near each posterior angle of the thorax.

The eggs are very small, and in the specimen examined few.

Colours in life:—Carapace deep pink, fading gradually to pale straw-colour at the posterior margin; legs pink, with the articulations, like the chelæ, white.

Twenty-eight males at Station 96, 98 to 102 fathoms; previously obtained (ten females) off the Godávari Delta in 70 fathoms and (three males and one female) off the Mahánadi Delta in 68 fathoms.

	Female. millim.	Male. millim.
Length of carapace	32	53
Breadth of carapace between last pair of antero-lateral tubercles.....	37	63·5
Length of exognaths of external maxillipeds	9	15·5
Breadth of exognaths of external maxillipeds	6	10
Length of chelipeds	67	250
Length of meropodites of chelipeds....	26·5	115
Length of propodites to insertion of dactylopodites	20·5	95
Length of dactylopodites.....	11	26·5

RANDALLIA, Stimpson.

46. *Randallia pustulosa*, sp. n., Wood-Mason.

Carapace above covered tolerably thickly with unequally large, rounded, submammillated, granulose tubercles, with much smaller ones interspersed. Of the largest tubercles one is on the hinder end of the prominent pterygostomial ridge, three are on the lateral margin, and two on the postero-lateral margin on each side. The regions are very distinctly marked out by grooves, the cardiac being especially deeply circumscribed, and the hepatic being separated from the gastric by a

fine groove which runs from the cervical without interruption to the outer of the two supra-orbital fissures. A huge recurved spine arises from the middle of the cardiac boss in addition to the two blunt triangular spines at the hinder margin of the carapace. The chelipeds are cylindrical and finely and sharply granulated; the meropodite is but little longer than the carpopodite with the palmar part of the propodite, which last is a little inflated in its basal half and about as long as the dactylopodite. The legs are not very strongly granulated: their dactylopodites have the same structure as in *Parilia Alcocki*. The abdomen, which interlocks with the thorax much in the same perfect way as in the last-named species, is five-jointed, the fourth, fifth, and sixth segments being ankylosed together; the seventh is acuminate triangular. The brood-cavity communicates by holes with the branchial cavity. The afferent branchial apertures are large and prominent; their carapacial border is divided by a fissure into two lobes, an outer with rounded and an inner with sinuous margin.

One female specimen from Station 56, 240 to 220 fathoms.

Length of carapace 32 millim.; breadth of carapace between last pair of lateral tubercles 33 millim.; length of chelipeds 65 millim., of their meropodite 26·5 millim., of palm of propodites 15 millim., of their dactylopodites 15 millim.

Family Raninidæ.

LYREIDUS, De Haan.

47. *Lyreidus gracilis*, Wood-Mason.

Lyreidus gracilis, Wood-Mason, Journ. Asiat. Soc. Beng. 1888, vol. lvi. pt. ii. p. 376.

From Station 56, 240 to 220 fathoms.

Family Homolidæ.

[HOMOLA, Leach.

1. *Homola barbata* (Herbst).

?2. *Homola vigil*, A. M.-Edw.

PAROMOLA, gen. nov., Wood-Mason.

The basal joint of the eye-peduncle is elongated and the eye reaches the commencing orbit through a gap in the anterior

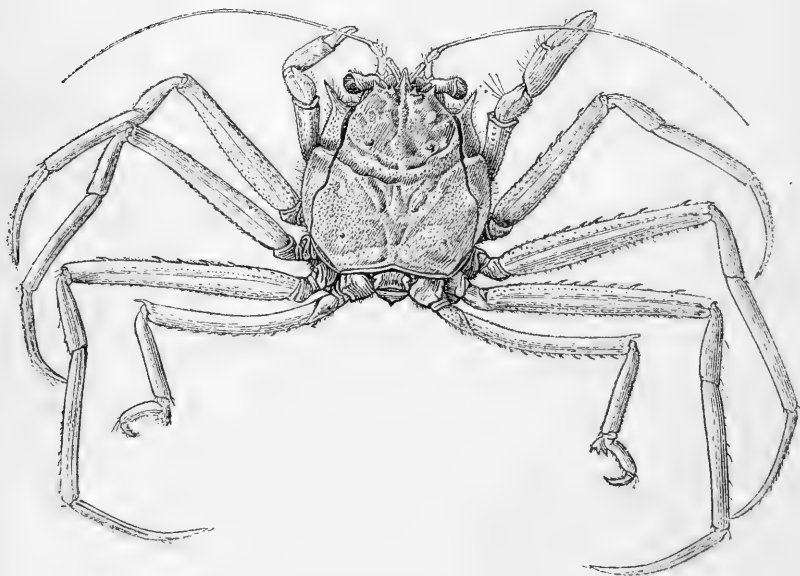
margin of the carapace between the rostral and supra-orbital spines. The orbit is a wide and shallow cavity, the bottom of which is still some distance behind the anterior margin, and it is defined externally by two spines. The very distinct and throughout dorsal *linea anomurica* runs to the base of the supra-orbital spine. The carapace is decidedly macrurous in form, thick, with the imperfectly-formed lateral margins twice interrupted by regional grooves. The last two joints of the fifth pair of legs form a perfect subchela, the dactylo-podite coming into complete relation with the basal toothed process of the propodite.

For *Homola Cuvieri* (Risso).

48. *Paromolopsis Boasi*, gen. et sp. n., Wood-Mason.

The basal joint of the eye-peduncle is elongated, and the eye reaches the orbit through a gap in the anterior margin of

Fig. 5.



Paromolopsis Boasi. From a photograph, natural size.

the carapace between the supra-orbital and antennal spines. The sides of the head are more produced, and the consequently more developed orbits are bounded externally by one very

large spine, the extra-orbital angle, which all but reaches the level of the rostrum.

The carapace, of an elegant urn-shaped outline, is depressed, with distinct carinated lateral margins, which are only once interrupted; it is, in fact, more brachyurous; the areolation, however, differs in no essential particular from that of other forms.

The *linea anomurica* is very distinct, dorsal in position, and runs to the interval between the supra-orbital and antennal spines. The last two joints of the fifth pair of legs form an imperfect subchela, the short dactylopodite not nearly reaching the nevertheless well-developed toothed process of the base of the propodite; their meropodites reach the end of the extra-orbital angle when laid forwards.

Colour in life red.

One specimen from off North Sentinel Island (Andamans), 480 fathoms.]

49. *Hypsophrys superciliosa*, gen. et sp. n., Wood-Mason.

The basal segment of the eye-peduncle not being elongated the eyes do not extend beyond the edges of the decurved lateral parts of the anterior margin of the carapace, and there are hence no orbits. The surface included between the anterior margin of the carapace above and at the sides on the one hand, and the antennary sternum on the other, is, above the ocular sternum, of considerable vertical extent, and is angulated supero-internally on each side of the rostrum for the reception of the longitudinally-plicated antennules; it is apparently made up of the ocular and antennular sterna and descending laminae of the fore margin of the carapace. The stout triangular and decurved rostrum extends but little beyond the antennal spines, the rostral and supra-orbital spines are small, sharp, recurved, and superior; the anterior margin of the carapace terminates below in a sharp antennal spine. The carapace is pubescent, thick, of somewhat macrurous form, anteriorly, in front of the two spines which are placed on the lateral lobes between the two divisions of the cervical groove, semicircular in outline, with the upper surface convexly declivous; behind these two spines it is parallel-sided, with the middle part of the upper surface flat and the lateral parts rounded; it bears two spines in the position of those which form the outer boundary of the orbit in *Paromolopsis Cuvieri*, with which it agrees exactly in areolation and tolerably closely in the degree to which the hepatic regions are advanced; the lateral margins are still less marked, being

only indicated by a few epibranchial spinelets. The *linea anomurica* is not apparent without dissection. The chelipeds, which agree in all essentials with *P. Cuvieri*, and the first three pairs of legs, which are very long and slender and armed with spines along both edges of the meropodites, are hairy, the former equally so throughout, the latter chiefly on the meropodites. The last pair of legs is weak, unarmed, and almost devoid of setæ, and differs from those of all the other species of the group with which we are acquainted in the form of its subchelæ, in which the dactylus is minute and folds back upon the slightly enlarged distal end of the propodite; its meropodites when laid forwards reach the spines of the antero-lateral margin.

The eggs are very small, and in the only ovigerous female examined are present in such volume as to cause the complete extension of the abdomen.

Colours in life pale pink, with the fringes of the chelæ black.

	Male. millim.	Female. millim.
Length of carapace from apex to hinder margin	16.25	20.5
Breadth between spines at junction of arched fore- with parallel hinder-sided part	13.25	17
Length of chelipeds	36	42
Expanse of legs	115	120

Four specimens, two males and two females, of which only one pair is in good order, were obtained at Station 105, depth 740 fathoms.

Order ISOPODA.

Family Bathynomidæ.

50. *Bathynomus giganteus*, A. M.-Edw.

Bathynomus giganteus, A. Milne-Edwards, Comptes Rendus, 1879, t. lxxxviii. pp. 21-23; A. Agassiz, Three Cruises of the 'Blake,' 1888, vol. ii. p. 49, fig. 252.

Three females of this remarkable form were taken at Station 105, in 740 fathoms. They measure 160, 195, and 200 millim. respectively in length, in a straight line from the front of the head to the extremity of the telson. As the genital apertures are not traceable, and as the largest oostegal plate measures only 8 millim. in length in the largest speci-

men and only 4 millim. in the smallest, it is presumable to infer that the specimens are not adults.

The living animal is of a pale lilac colour.

Bathynomus was first obtained by the 'Blake' in 955 brasses north of Tortugas Reef in the Gulf of Mexico.

Order STOMATOPODA.

SQUILLA, auctorum.

51. *Squilla tenuispinis*, sp. n., Wood-Mason.

Carapace small, with the antero-lateral angles produced suddenly to a small sharp spine, which does not project beyond the middle of the anterior margin, with its three carinæ evanescent at both ends in the præcervical part and at the anterior end only in the postcervical part, and with the postero-lateral angles rounded. Rostrum semioval, about as long as broad, with a faint median longitudinal ridge on its distal half, but without raised rims, covering only the middle of the base of the antennular somite, which is produced at each of its antero-lateral angles into a sharp spine a trifle longer than the antero-lateral spines of the carapace. Eyes asymmetrical in themselves, rather small, the greatest width of their conjoined lobes little exceeding the length of the rostrum.

Tergum of fifth thoracic somite curved forwards at its outer ends, which are terminated by a small spine; terga of the sixth and seventh triangularly produced and terminated by a small spine postero-laterally. First to fifth abdominal terga provided with eight carinæ, two submedian, two sublateral, two lateral, and two marginal, all the marginal, all the lateral except the first, and all the sublateral except the first and second ending posteriorly in a small spine; sixth tergum furnished with six coarser carinæ, two submedian, two lateral, and two marginal, all terminating in larger spines than those of the preceding somites, especially the marginal, which are prolonged into an acuminate spine nearly as long, but not nearly as stout, as the marginal and submedian spines of the telson. Telson transverse, furnished above with a strong, median, roof-shaped carina terminating posteriorly in a long and fine spine, which projects for some distance into the median notch of the hinder margin, and on the margin with six long and acuminate spines in three pairs, of which the submedian enclose an acute angle and have their inner edges for about half their length from the base minutely spinulose; the lateral are the longest and separated from the submedian by ten spinules (of which

the two extreme are larger than the rest), and the marginal are about the same length as the submedian and separated from the lateral by one spinule. The spine of the basal joint of the caudal appendages is divided into two long and acuminate lobes, of which the inner is about one and a third times as long as the outer and bears the usual minute cusp on its outer side.

The dactylopodite of the raptorial limbs is armed with four teeth, including the terminal claw on its inner edge, and is notched near the base of its outer edge.

Colour in life deep pink.

Total length from tip of rostrum to tips of submedian spines of telson 61 millim.

A single male was obtained at Station 96, in 90 to 100 fathoms.

A single young female specimen measuring only 37 millim. had previously been taken off Cheduba, Arrakan coast, at about the same depth.

Grade ENTOMOSTRACA.

Order CIRRIPELIA.

SCALPELLUM.

52. *Scalpellum*, sp.

From Station 56, 240 to 220 fathoms, on a dead *Gorgonia* with a black polished stem.

53. *Scalpellum*, sp.

From Station 96, 98 to 102 fathoms, a small cluster on a fragment of dead *Gorgonia*.

XXVIII.—*Bathynectes*, Stimpson, a British Genus of Crustacea *Brachyura*. By the Rev. Canon A. M. NORMAN, M.A., D.C.L., F.R.S., &c.

IN 1871 Stimpson established a genus, *Bathynectes*, to receive certain crabs nearly related to the genus *Portunus*, which had been dredged in 100–200 fathoms by Pourtalès in the Gulf-stream in the Straits of Florida. In 1877 Bovallius procured

a Portunid from the fishing-banks off the west of Norway, where it was living in 100–200 fathoms, for which he established the genus *Thranites*, which genus is undoubtedly synonymous with the *Bathynectes* of Stimpson. The species is also the same; but I am of opinion that the crustacean had long before been described by O. G. Costa in the ‘Fauna del Regno di Napoli,’ in which work a fine plate illustrates it. I will now proceed to describe the genus and its representatives.

Family Portunidæ.

Subfamily PORTUNINÆ.

Genus BATHYNECTES, Stimpson, 1871,
= *Thranites*, Bovallius, 1877.

Stimpson’s characters are as follows:—

“Very near *Portunus*, but differing in its antero-lateral teeth, which are not like those of a saw, but are somewhat spiniform and separated by considerable intervals. The front also has no median tooth, and the hiatus of the orbit is widely open, not being filled by the basal joint of the external antennæ, which is narrow and firmly soldered anteriorly to the process of the front. The meros joint of the external maxillipeds is as broad as long, and does not project anteriorly, but fits accurately to the anterior edge of the buccal area. The ambulatory feet are very slender; those of the first pair much shorter than those of the second; second and third pairs very long, the third longest; fourth pair two thirds as long as the third.” To these characters may be added that the ultimate joint of the fourth pair is flattened into a swimming-blade, as in *Portunus*, and is not furnished with any median rib. A transverse ridge crosses the carapace, and unites the bases of the greatly developed posterior lateral spines, which much exceed the preceding spines in size and are sharply acute.

In the adult of the typical species the frontal margin is furnished with four teeth, so that, as Stimpson says, there is no median tooth; but in the young these teeth are much less acute, and might be described as lobes, and the central pair are united into one process, which is emarginate distally, this emargination indicating the separation which afterwards takes place in this process into two entirely distinct teeth.

1. *Bathynectes superba* (O. G. Costa).

- Portunus superbus*, O. G. Costa, Fauna del Regno di Napoli, Addizioni a i Decapodi Brachyuri, p. 19, pl. vii. *
1871. *Bathynectes longispina*, Stimpson, Prelim. Rep. Crust. Gulf-stream, Bull. Soc. Comp. Zool. vol. ii. p. 146 (♂).
1871. *Bathynectes brevispina*, id. ibid. p. 147 (♀).
1877. *Thranites velox*, Bovallius, Öfvers. af Kongl. Vet. Akad. Förhandl. 1876, no. 9, p. 59, pls. xiv., xv.
1879. *Bathynectes longispina*, A. Milne-Edwards, Crust. Rég. Mexicaine, p. 234, pl. xlii. fig. 1 (♂ junior).
1879. *Bathynectes brevispina*, id. ibid. p. 235 (♀ adult).
1881. *Thranites velox*, Bovallius, loc. cit. 1881, no. 2, p. 9, pl. ii.
1882. *Bathynectes longispina*, A. Milne-Edwards, Institut de France, Comptes rendus sommaire d'un explor. zool. faite dans l'Atlantique à bord du navire 'Le Travailleur,' p. 10.
1883. *Bathynectes longispina*, S. I. Smith, Proc. U. S. Nat. Mus. vol. vi. no. 2, p. 17.
1885. *Portunus superbus*, Carus, Prod. Faun. Medit. vol. i. p. 517.
1886. *Thranites velox*, G. O. Sars, Den Norske Nordhavs Exped. xv., Zool. Crust. ii. p. 1.
1890. *Bathynectes longispina*, G. C. Bourne, Journ. Marine Biol. Assoc. United Kingdom, vol. i. p. 314 (name only).

Frontal margin divided in the young into three lobes, the outer blunt, the median emarginate; in adult the median is divided into two distinctly separated processes, and all four at that age become pointed. First and second antero-lateral teeth less acute than the third and fourth; the fifth greatly developed, long, cylindrical, and acute, and (like the carapace) scabrous; this spine-like process is often three times as long as the fourth tooth. The chelipedes have the meros furnished with two teeth on the inner margin at a little more than half of its length, one of these teeth being situated on the upper and the other on the lower edge: carpus distally produced on the inner side into a large and very acute falcate process, which itself is armed with three acute teeth; on the back of the carpus are two well-developed teeth and many smaller tuberculiform processes: hand with six carinæ, the first or inner and second crowned with tubercles, and the first also terminating in a large acute tooth; third not elevated, formed by a series of small tubercles; fourth and fifth are ribs, which are not usually tuberculated; sixth faintly marked, passing down the middle of the inferior surface and running out to the end of the thumb. The carapace is sub-hexagonal and its surface is granulated; a well-marked ridge

* Unfortunately there is no means of determining the dates of publication of the parts of the 'Fauna del Regno di Napoli;' but the publication at any rate precedes that of Stimpson by fifteen or twenty years.

runs across the middle, uniting the bases of the posterior lateral spines.

It is possible that *Portunus superbus* is distinct from *Bathynectes longispina*. My supposition is that it is a very large male. It in all points appears to agree with *B. longispina*, except the frontal margin, which is furnished with four well-developed acute spines, while the inner orbital spines are so much developed that they are represented in the plate as large as these spines. But Bovallius has shown that great changes take place in these frontal spines according to the size of the individual; and on pl. ii. figs. 1-4 he represents four stages of growth, showing that the older the example is the more distinct and the more acute these spines become.

British Habitat. A specimen was submitted to me for identification in 1889 by Mr. G. C. Bourne which had been trawled by him in H.M.S. 'Research' in 400 fathoms off the south-west of Ireland.

Distribution. A single male was dredged by the 'Porcupine' Expedition of 1869, Stat. 65, which is some 45 miles north-west of Shetland, in lat. $61^{\circ} 10' N.$, long. $2^{\circ} 21' W.$, in 345 fathoms. This station is close on the boundary-line of the British area*.

The example of *Portunus superbus* was procured by Costa in the Mediterranean near Naples. The specimens described by Stimpson were from Pourtales's Gulf-stream dredgings, and were obtained off Sand Key, West Key, American Shoal, and the Marquesas Keys, in 100-150 fathoms. More recently it has been taken by the United States Fish Commission off Martha's Vineyard and Delaware Bay, N.E. America, in 86-225 fath. I have had the opportunity of comparing one of these specimens (the male, taken at Stat. 1097, off Martha's Vineyard, 158 fath.), for which I am indebted to the U. S. National Museum, with the 'Porcupine' specimen, with which it in every respect agrees. Four specimens have been obtained off the coast of Norway to the north-west of Bergen, which came into the hands of Dr. Bovallius; and a fifth was taken near the same place by the Norwegian North-Atlantic Expedition, as recorded by Prof. G. O. Sars. More recently Prof. A. Milne-Edwards has noticed its occurrence off Cape Ortegal, Spain, in 900 metres, where it was dredged by 'Le Travailleur.'

Bathynectes superba is thus shown to have a range apparently coextensive with the North Atlantic.

* See note on this station, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 456.

2. *Bathynectes longipes* (Risso).

1816. *Portunus longipes*, Risso, Crust. de Nice, p. 30, pl. i. fig. 5.
 1828. *Portunus longipes*, Roux, Crust. de la Médit. pl. iv. figs. 1, 2.
 1829. *Portunus infractus*, Otto, Nov. Act. Phys.-Med. Acad. C. L.-C. Nat. Cur. vol. xiv. p. 331, pl. xx. fig. 1.
 1851. *Portunus Dalyelli*, Spence Bate, Ann. & Mag. Nat. Hist. vol. vii. p. 320, pl. vi. fig. 9.
 1853. *Portunus longipes*, Bell, Brit. Stalk-eyed Crust. p. 361.
 1885. *Bathynectes longipes*, Carus, Prod. Faunæ Medit. p. 518.

Frontal margin slightly four-lobed or merely waved, waves four (representing the usual lobes), outer lobes or waves the wider. First four antero-lateral teeth almost as in *B. superba*, fifth not more than half as long again as the fourth. Transverse ridge of carapace as in the typical species. Chelipeds having the meros unarmed; carpus simply scabrous and only distally produced on the inner margin into a strongly developed triangular process, terminating acutely, but this process unarmed with lateral teeth; hand having one distal tooth at the extremity of the inner margin, but otherwise unarmed.

British Localities. Polperro, Cornwall; and Falmouth (*Mus. Norm.*); Oxwich Bay, near Swansea (*Bate*); Banff (? *T. Edward*, included in list of Crustacea at the end of his 'Life'; but that list has many errors).

Distribution. Naples, Zool. Stat. (*Mus. Norm.*), Nice (*Targioni-Tozzetti*), Genoa (*Verany*), Sicily (*Vienna Museum*), Adriatic (*Grube, Heller, &c.*), Black Sea (*Rathke*).

XXIX.—*Lepton squamosum* (*Montagu*), a *Commensal*. By the Rev. Canon A. M. NORMAN, M.A., D.C.L., F.R.S., &c.

LEPTON SQUAMOSUM has always been regarded as a rare shell. Although single valves are frequently dredged on various parts of our coasts few cabinets can boast of a series of perfect specimens.

In 1858 I procured a fine series of perfect though dead specimens among heaps of Nullipore and sand which had been dredged for manure and were lying on the shore at Glengariff, in Bantry Bay. I had never, however, seen it alive until I went to Salcombe, Devonshire, in 1875, for the special purpose of looking for certain Invertebrata which Montagu had procured there. There I found *Lepton squa-*

mosum, and the circumstances under which it occurred were remarkable. I was digging on the eastern side of the harbour in the hope of finding *Callianassa subterranea*, the parasite of which, *Ione thoracica*, I was especially anxious to procure. I did not succeed in finding the *Callianassa*, but came across large numbers of the long passages formed by *Gebia stellata*, the mouths of which passages opened into the sides of little pools in the muddy sand at about half-tide. In every case where the burrow was still occupied by the living *Gebia* I found in the burrow and at a short distance from the mouth one, or in some cases two, living *Lepton squamosum*. The burrows of the *Gebia* are lined with an ochreous-coloured slimy deposit, and upon this it seems probable that the *Lepton* feeds. Here, then, would seem to be a case of commensalism. These observations of course require verification, and I trust any naturalists who have the opportunity of examining the homes of *Gebia* will search within them for the *Lepton*. It is worth remarking that the geographical range of the crustacean and of the mollusk are, as far as is known, the same; both occur in the Mediterranean, for the *Gebia litoralis* of Risso is synonymous with *G. stellata*, Montagu, and both reach Scandinavia, in which country the *Lepton* has long been known and recently the crustacean also has been found.

The only malacologists who have observed the animal of *Lepton* in Britain are Alder and Clark, the first of whom procured his specimen at Salcombe and the latter near Exmouth, where, from the nature of the shore, we may pretty safely predicate that *Gebia* also lives.

A striking confirmation of the view here put forward of the commensalism of *Lepton squamosum* is to be found in a passage in Jeffreys's 'British Conchology,' vol. ii. p. 194. He writes:—"A species (*Lepton loripes*), half an inch long, found on the coast of Florida has a singular habitat. According to Mr. Stimpson, the discoverer, 'it lives in sand or mud, on the flats, near low-water mark, at the depth of a foot below the surface, and generally occupies the holes of marine worms and fossorial crustacea.' This might warrant a supposition that the animal of *Lepton* is predaceous." To this remarkable confirmation of the habits of the species observed by me at Salcombe I may add that the very same genera of fossorial crustacea which live at the latter place are those which occur also on the Floridan coast, where they are represented by *Callianassa major*, Say, and *Gebia affinis*, Say.

Of course I cannot acquiesce in Dr. Jeffreys's concluding supposition that "the animal of *Lepton* is predaceous," if, indeed, by that expression he meant that it would attack the

crustacean. Imagine a little and most tender bivalve like this attacking a *Gebia*! with what organ might it be supposed to enter on the contest? But the surprising thing is the opposite to this. Why does not the crustacean make a meal of the mollusk? Its abstention in this matter can only be accounted for by the supposition that there exists, as in so many other cases among animals, an hereditary friendship which induces the stronger to be amicably disposed towards the weaker, and to allow it to take up its lodging in the winding passages of its own house. The presence of *Lepton* is, I take it, clearly no case of parasitism, as that of *Montacuta substriata* (Montagu) on the test of *Spatangus purpureus*, or of the genus *Stylifer* on *Echini* and other Echinodermata, in which cases the parasite would seem to feed upon the exudations of the body direct from the body itself; still less does it find its counterpart in *Modiolaria marmorata*, Forbes, imbedded in the tunic of Ascidians. It appears to me to be perhaps paralleled in the case of a "greenish gelatinous annelid," which, according to Mr. D. Robertson's observations, is almost invariably associated with *Lima hians* in the marvellously woven Nullipore nest of that mollusk; and it would seem that the annelid lives in the Lima's nest, and the *Lepton* in the *Gebia*'s burrow with similar objects, namely to feed on the secretions from the body of the owner of the house, with which the walls of the dwelling are charged, and that the owners return kindness for the work of the little scavengers who keep their houses clean. Before I knew anything of all this I had often wondered at the extraordinary compression of the shell of *Lepton squamosum*. Now it is evident, taking into consideration the habits of the animal, the great advantage of such a shell. It lies perfectly flat on the floor of the passage, presenting no obtruding portion; and thus, as Mr. *Gebia* scuttles in and out of his dwelling, which he does at a great rate, there is no fear of the *Lepton* being swept, intentionally or unintentionally, by feet or tail from its position. Moreover, however friendly disposed Mr. *Gebia* may be to his guest, and even if it had the sense and wish if the guest were extruded to take it up in its chelipeds and replace it—after the manner of *Pagurus Prideauxii*'s dealings with its bosom friend *Adamsia palliata*—the shell is so delicate that the attempt to replace it would almost assuredly result in its destruction. It is most necessary therefore that the chances of removal should be reduced to a minimum. Hence an admirable adaptation of means to an end.

XXX.—*Descriptions of new Oriental Reptiles and Batrachians.* By G. A. BOULENGER.*Draco Walkeri.*

Head small; snout hardly as long as the diameter of the orbit; nostrils lateral, directed outwards; tympanum more or less distinct, much smaller than the eye-opening. Upper head-scales unequal, strongly keeled; six to eight upper labials. The male's gular appendage small, about half the length of the head; the appendage merely indicated in the female. Male with a very low nuchal crest. Dorsal scales much larger than ventrals, subequal, mostly with a short, feeble keel. The fore limb stretched forwards extends beyond the tip of the snout; the hind limb reaches the axil. Grey-brown above; a dark spot between the eyes and another in the posterior part of the supraocular region; upper surface of wings spotted with black in the females, brown, blackish in front, in the male; lower surface of wings with a pair of large black spots in front; belly unspotted.

	millim.
Total length.....	185
Head.....	15
Width of head.....	10
Body.....	57
Fore limb.....	32
Hind limb	41
Tail	113

Four specimens (one male, two females, and one young) were obtained at Koepang, Timor, by Mr. J. J. Walker, and presented by him to the British Museum.

Calamaria javanica.

Rostral nearly as deep as broad, visible from above; frontal a little longer than broad, shorter than the parietals, thrice as broad as the supraocular; no præocular; one postocular; diameter of the eye nearly equal to its distance from the mouth; four upper labials, second and fourth largest, second and third entering the eye; mental in contact with the anterior chin-shields; posterior chin-shields separated from each other. Scales in thirteen rows. Ventrals 181; anal entire; subcaudals 17. End of tail obtuse. Dark brown above, each scale with a lighter dot; a yellowish collar, inter-

rupted in the middle, some distance behind the head; upper lip and lower parts uniform yellowish.

Total length 185 millim.; tail 13.

Java. A single male specimen, collected by Dr. Ploem.

Coluber phyllophis.

Snout projecting; eye rather large. Rostral much broader than deep, visible from above; nasal sometimes entire or semi-divided; internasals as long as broad or a little longer, at least as long as the præfrontals; frontal once and one third to once and two thirds as long as broad, as long as its distance from the rostral or the end of the snout, a little shorter than the parietals; loreal considerably longer than deep; one præocular, with a subocular below; two postoculars; temporals 2+3 or 3+3; eight (rarely nine) upper labials, fourth and fifth (or fifth and sixth) entering the eye; four or five lower labials in contact with the anterior chin-shields, which are nearly as long as or longer than the anterior. Scales in twenty-three rows, very strongly keeled, outer row smooth. Ventrals obtusely angulate laterally, 209-220; anal entire or divided; subcaudals 80-96. Young pale olive above, with traces of a few black transverse bands on the anterior part of the body and a brown lateral line on the posterior part of the body and along the tail; labials yellowish, with brown sutures; belly yellowish, with a series of black dots on each side. The adult of a darker coloration, most of the scales and shields having black borders; anterior part of back usually with more or less distinct black cross bands; belly more or less dotted or spotted with black, the posterior ventrals and the subcaudals usually edged with black.

Total length 1800 millim.; tail 380.

China. Several specimens were obtained at Kiu Kiang by Mr. Pratt, and a specimen in the British Museum is stated to be from near Ningpo.

The adult specimens have been referred by Günther to *Elaphis sauromates*, Pall., and the young to a special genus, *Phyllophis carinata*, Gthr. I regard the true *Elaphis sauromates* as a variety of *Coluber quadrilineatus*, Bonnat. (*quater-radiatus*, Gmel.), distinguished by the retention in the adult of the dorsal spots, which in the western form disappear and are replaced by four black stripes. I can find no structural difference between the two forms, and I do not think that young specimens could be surely distinguished. But, as hinted by Strauch and Bedriaga, the present species is quite distinct, differing in the more prominent snout, larger eye,

longer internasals, longer loreal, and very strongly keeled scales, as well as in coloration.

I am compelled to propose a new specific name for this snake, the name *Coluber carinatus* being preoccupied.

Tropidonotus nuchalis.

Head as in *T. natrix*. Eye moderate. Rostral broader than deep, just visible from above; internasals as long as broad or a little broader, as long as the præfrontals; frontal once and one third to once and a half as long as broad, as long as or longer than its distance from the end of the snout, a little shorter than the parietals; loreal as long as deep or deeper than long; one præ- and two or three postoculars; temporals 1 + 1 or 1 + 2; six upper labials, third and fourth entering the eye, fifth very long; four lower labials in contact with the anterior chin-shields, which are shorter than the posterior. Scales feebly keeled, of outer row smooth, in fifteen rows. A very distinct groove along the middle of the nape. Ventrals 154-165; anal divided; subcaudals 46-50. Olive above, uniform or with small black spots; an oblique black line below the eye and another between the last two labials; lower parts uniform black, or black in the middle and olive on the sides.

Total length 640 millim.; tail 120.

China. Four specimens were obtained at Ichang by Mr. Pratt.

This snake is closely allied to *T. Swinhonis*, Gthr., from Formosa, of which it has been regarded as a variety by Günther. It differs in the shorter head, the nuchal groove, and the feebly keeled scales.

Tropidonotus asperrimus.

This name is proposed for a very common Ceylonese snake which has hitherto been regarded as a variety of *T. piscator*, Schn. (*quincunciatus*, Schleg.). It differs constantly from its Indian and Malay ally in having the scales much more strongly keeled, the keels forming sharp, strongly raised lines along the hinder part of the body and on the tail; only the outer row of scales is smooth. Ventrals 131-146; subcaudals 64-90. Anterior half of body pale olive or reddish, with two series of alternating large roundish or rhomboidal, dark olive or brown, black-edged spots, which are partly confluent on the vertebral line, and sometimes form a sinuous band; posterior part of body uniform dark olive or olive with blackish

spots arranged quincuncially; two oblique black lines, one below, the other behind the eye; lower parts uniform yellowish.

Total length 820 millim.; tail 210.

Rhacophorus macrotis.

Vomerine teeth in two oblique groups on a level with the front of the choanæ, which are very large. Head nearly as long as broad; skin adherent to the frontoparietals, which are rugose, studded with granules; snout triangular, a little longer than the diameter of the orbit; canthus rostralis angular; loreal region concave; nostril near the tip of the snout; interorbital space (in the middle) not wider than the upper eyelid, the frontoparietal bones narrowing posteriorly; tympanum very distinct, as large as the eye. Fingers long, with a distinct rudiment of web; toes nearly entirely webbed; disks of fingers about half the diameter of the eye, of toes smaller; subarticular tubercles moderate; a very small inner metatarsal tubercle. Tibio-tarsal articulation reaching the tip of the snout; tibia half as long as head and body. Skin smooth, granular on the belly and under the thighs. Grey-brown above, with a few small dark brown spots; loreal region greyish white; a dark brown band from the end of the snout through the nostril, the eye, and the tympanum to the side of the body; on the tympanum this band expands into a large temporal blotch; limbs with ill-defined dark cross bands; hinder side of thighs brown, dotted with white; lower parts whitish speckled with brown.

From snout to vent 78 millim.

A single female specimen, obtained by Mr. Hose at Baram, Borneo.

This *Rhacophorus* belongs to the group of *R. maculatus*. It differs from all the species of that group in the larger tympanum, from *R. maculatus* and *R. cruciger* in the absence of a parieto-squamosal arch and in the larger choanæ, from *R. leucomystax* in the narrower interorbital space and the larger choanæ, and from *R. Colletti* in the shorter hind limbs.

Bufo surdus.

Crown without bony ridges; snout very short, rounded; interorbital space a little narrower than the upper eyelid; no trace of a tympanum; eustachian tubes extremely minute. First finger considerably longer than second; toes one third

webbed, with single subarticular tubercles; a tarsal fold. The tibio-tarsal articulation reaches the angle of the mouth. Upper parts crowded with small warts, tipped with black asperities. Parotoids short, subquadrangular, as long as broad, close to the eye. Uniform pale olive above, white inferiorly. Male with a subgular vocal sac and black nuptial excrescences on the two inner fingers.

From snout to vent 67 millim.

Allied to *B. viridis*, but distinguished from it by the absence of tympanum, the very short parotoids, and the shorter web between the toes.

A single male specimen from Baluchistan; purchased.

XXXI.—On the Occurrence of *Pelochelys* in China.

By G. A. BOULENGER.

DR. A. STRAUCH'S recently published account of the Chelonians in the St. Petersburg Museum * contains, among other interesting information, the description of a Trionychoid of the genus *Pelochelys* obtained at Foo Choo by the late I. Poliakow in 1884.

The history of the two specimens now described is curious. Dr. Strauch tells us that out of a number of Trionychoids obtained by Poliakow at Foo Choo and Shanghai, and referred on first examination to the common *Trionyx chinensis*, Wiegman, two were selected, on account of their large size, to be made into skeletons. When the skeletons were prepared it was found that these specimens not only did not belong to *Trionyx chinensis*, but were not even referable to the genus *Trionyx*, the skull being of an entirely different type. Dr. Strauch, who is so hard on me for my efforts at basing classifications and arranging genera on osteological characters, will admit that in this case the method of study followed by me answers better the requirements of science than mere examination of the skin, as it is probable that were it not for the fact that the Trionychoids in question had been prepared as skeletons we should still be ignorant of the occurrence of *Pelochelys* in China. When dealing with osteological, and

* "Bemerkungen über die Schildkrötensammlung im Zoologischen Museum der kaiserlichen Akademie zu St. Petersburg," *Mém. Ac. St. Pétersb.* (7) xxxviii. no. 2 (1890).

especially cranial, characters it is, however, necessary to make allowance for variations due to age, and these changes Dr. Strauch has unfortunately neglected to consider in proposing for the Foo Choo specimens a new species, *Pelochelys Poliakowii*. He compares the skulls of nearly adult specimens with the figure given by Gray, and reproduced by me, of *P. Cantoris*, representing a small specimen. Now all young Chelonians have the orbits proportionally larger than the adult; hence the snout is shorter and the interorbital space narrower in proportion. It is just upon such a difference that *P. Cantoris* is supposed to be distinct from *P. Poliakowii*. But in my description I have explicitly stated that the interorbital space is broader than the diameter of the orbit, my remarks applying of course to the adult skull.

On comparison of the adult skull with the photographs given by Strauch I entertain no doubt as to the identity of the two species. Dr. Strauch appears to have been also misled by the figure in Günther's 'Reptiles of British India' which represents *P. Cantoris*; but Gray has drawn attention to the fact that "the form of the animal figured in 'Indian Reptiles' is from the Museum specimen of this species, with the markings and colour added from General Hardwicke's figure of the living *Chitra indica*. Dr. Günther believed they represented the same animal"*. As the true *Pelochelys Cantoris* very closely resembles *Trionyx chinensis* in colour, it is not surprising that Dr. Strauch was not struck by any peculiar markings in his specimens before the removal of the soft parts.

I therefore hold that *P. Poliakowii* is a synonym of *P. Cantoris*, the range of which embraces the mouth of the Ganges, Burma, the Malay Peninsula, Borneo, the Philippines, and China. There is nothing particularly surprising in the very wide distribution of this species, for it is known, from the observations of Cantor, to be estuarine and even marine; and most marine or semimarine reptiles have a wide distribution, for example *Crocodylus porosus*, the Hydrophids, and Homalopsids, not to mention the true marine Turtles. Dr. Strauch does not contest the soundness of the generic separation of *Pelochelys* from *Trionyx*; why then, I should like to know, does he not accept the separation of *Cycloderma* from *Cyclanorbis*, the cranial differences between the two being quite as great and of the same kind?

* Suppl. Cat. Sh. Rept. i. p. 91.

XXXII.—*Contributions towards a General History of the Marine Polyzoa.* By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Concluded from ser. 5, vol. xv. p. 257.]

[Plates VI. & VII.]

XV. SOUTH-AFRICAN AND OTHER POLYZOA.

THE present paper concludes the first series of the "Contributions" so far as the descriptive portion is concerned. A second may follow after a time if it should be found that there is a sufficient amount of interesting material on hand to make it desirable.

On referring to the first paper of the present series (which dates as far back as July 1880) I find that the programme proposed in it has only been partially realized. One important element of it has been almost entirely omitted—the record of the known species belonging to the various genera that have come under notice. It was soon evident that this portion of the plan would involve an expenditure of time and labour for which I was not prepared, and it was therefore abandoned*.

Of course the description of new forms (or forms supposed to be new) has occupied a large portion of the work. About a hundred species, previously undescribed, have been fully characterized and figured.

It may be interesting to contrast the style of diagnosis which is now generally adopted with that which satisfied the older writers and which survives in Busk's earlier works. In the latter brevity seems to have been the thing chiefly aimed at; two or three leading features were considered sufficient for identification, and there was no attempt at anything like a complete portraiture of the form. The present method is to make the diagnosis as full as possible (a very important point in the case of such a tribe as the Polyzoa), not merely to indicate two or three distinctive marks, but to present in detail the zoecial and colonial characters. There can be little doubt, I think, that this style of diagnosis is most in

* The want which I had hoped in some measure to supply, though in an imperfect and partial way, has been satisfactorily met in the valuable work lately published by Miss E. C. Jelly, 'A Synonymic Catalogue of the Recent Marine Bryozoa,' which contains a list of the names of all published species, combined with a full synonymy.

harmony with the altered views of the nature and origin of species which now prevail, whilst at the same time it makes identification both surer and easier. Science, in my judgment, would be the gainer if there were more rigour in dealing with meagre and insufficient descriptions of specific forms.

Another important change in systematic method is indicated by the increased attention which is paid to varietal modifications of the type-form and also to the lesser variations amongst the structural elements, in all of which "we see nature still at work," preparing for the introduction of new forms.

A considerable number of new varieties of recognized species are described in the present series of papers.

In addition to the merely descriptive matter, a record of the geographical range has been given as far as possible, and many systematic and morphological questions have been discussed.

In an Appendix I shall correct any errors or omissions that may have come to my knowledge and add a few notes on special points.

Suborder CHEILOSTOMATA.

Family Flustridæ.

FLUSTRA, Linnæus.

Flustra spinuligera, sp. n. (Pl. VI. figs. 1, 1 a, 1 b, 1 c.)

Zoarium of a light brown colour, divided into large segments, widening upwards and irregularly lobate*. *Zoæcia* alternate, disposed in lines, elongate, rounded at the top and slightly enlarged, narrowed towards the base; margin somewhat thick, bearing on each side a continuous line of rather short and stout spines; area closed in by a membranous wall, a little beneath the membrane, the sides of the cell traversed by a line of minute and pointed denticles. *Oœcium* immersed, rounded, surface smooth, a bar composed of two modified spines across the front. *Avicularia* distributed over the zoarium, occupying a distinct area, which ranges in a line with the cells, placed obliquely, rounded at the base, the beak much produced and carried up between the walls of the neighbouring cells above it; mandible broad and triangular below, running out above into a slender spinous process of considerable length.

* The habit is very similar to that of *F. foliacea*.

Locality. Port Elizabeth, South Africa (*Miss Jelly*).

In some respects the present species resembles *Flustra denticulata*, var. *inermis*, Busk, of which there is a figure both in the 'British Museum Catalogue'* and the 'Challenger' Report †. But the differences between the two are sufficiently important to warrant their separation. The habit of the zoarium, which in Busk's species is composed of simple "linear branches," is strikingly unlike that of the present form. The zoecia in the var. *inermis* are entirely destitute of spines, or are merely furnished with a single "small upturned spine" on each side of the mouth, while the avicularia of the two species differ markedly in shape (Pl. VI. figs. 1 c, d). The internal denticles are present in both.

It may be a question, I think, whether the variety *inermis* is not specifically distinct from *F. denticulata*.

Ortmann, in his interesting Report on 'Japanese Bryozoa' ‡, has described and figured a species (*Carbasea rhizophora*) belonging to the section of the genus in which the zoecia are disposed on one side only of the zoarium (*Carbasea* of authors), which in some points bears a notable resemblance to the present form. In shape and arrangement the cells of the two forms are identical, but there are no lateral spines nor is any mention made of internal denticles; the zoecia present the same characters, being in both cases furnished with the bar across the front; the same may be said of the avicularia—they offer, so far as I can see, no points of difference. The zoarium, however, besides having the cells on one side only, is decumbent and attached by tubular fibres given off from the dorsal surface. The resemblances are certainly remarkable, and the two forms must be regarded as very nearly related.

In the present species the side-walls of each zoecium are furnished with a number of circular pores (communication-pores) which form a line extending from one end of the cell to the other, a little below the internal denticles. A similar structure has been noticed by Busk in *F. denticulata*, var. *inermis*; but he states that it is only met with in the marginal zoecia.

Abnormal cells of peculiar form and destitute of orifice occur occasionally (Pl. VI. fig. 1 b).

* B. M. Cat. vol. i. p. 49, pl. xlix. figs. 3, 4.

† 'Challenger' Report, part i. p. 53, pl. xxxii. fig. 2.

‡ "Die Japanische Bryozoenfauna," von Dr. A. Ortmann, Archiv f. Naturgeschichte, Jahrg. 50, i. Bd., 1 Heft (1890).

Flustra nobilis, sp. n. (Pl. VI. figs. 5.)

Zoarium foliaceous, of a dark brown colour, margin slightly lobate, attached by a dense mass of delicate fibres, which originate on the lower series of zoecia, and are given off in pairs (one on each side) or singly from the oral extremity of the cell. *Zoecia* on one surface only, quincuncial, of large size, elongate, wide above, narrowing downwards (subpyriform), each one overlapping more or less the zoecium immediately above it; margin well raised, bearing a continuous line of bifid spines along the sides, at the summit four short spines, the two central ones usually larger than the rest, area occupying the whole front surface and closed in by a very stout, shining membrane; orifice ample, placed at the top of the area and extending from side to side, arched above, the lower margin straight, breadth much exceeding the height, operculum convex, with a thickened rim around the top and sides. *Avicularia* borne on the dorsal surface of the zoecia at the upper extremity (where it overlaps the neighbouring cell), placed one on each side, erect and free, membranaceous, tumid above, and tapering downwards to the point of attachment, on the summit a semicircular mandible (Pl. VI. fig. 5 b). *Oocium* (?).

Loc. Port Elizabeth, South Africa (*Miss Jelly*).

This is a handsome species and exhibits some interesting peculiarities. The zoecia are of unusual size, and, where furnished with the forked lateral spines, present a very picturesque appearance. The spine is composed of a short upright piece, from the base of which springs a tall slender fork, which bends inwards over the area; the latter is frequently broken off, and the margin of the cell is occupied by a line of denticles.

The membranous covering of the area is remarkable for its stoutness and its shining surface. The operculum marks an advance on the small membranous lid which usually closes the orifice in this family. It is of large size, filling in the upper portion of the area, and is strengthened by a well-marked rim round the top and sides. Below it is continuous with the membranous wall, and its limit is marked by a mere line. It is in some measure a transitional form between the simpler structure and the isolated and hinged operculum of the *Flustrine* genus *Euthyris* and the higher *Cheilostomata*. The avicularium of *Flustra nobilis* is of quite a different type from that which prevails in the genus to which it is referred. The ordinary *Flustrine* avicularium is very slightly specialized; the mandibular apparatus is commonly placed

on a zoëcial area of reduced size, in a line with the cells, and very clearly betrays its relationship to the ordinary orifice. But in the present case the structure has attained a very considerable degree of specialization; it is erect and free, attached by its base to the zoarium and bearing the mandible at the opposite pole. *Flustra nobilis* is clearly a species which has departed to some extent from the ordinary Flustrine type.

Family Membraniporidae.

MEMBRANIPORA, De Blainville.

Membranipora eburnea, sp. n. (Pl. VII. fig. 5.)

Zoarium incrusting. *Zoëcia* quincuncial, crowded, porcellaneous, with a white and glossy surface, pyriform, much produced below, the lower half of the area (which occupies the whole front and has a membranous covering) roofed in by an extension of the cell-wall, which slopes rather steeply upwards and is continuous above with the elevated margin surrounding the upper portion of the area, the margin furnished with stout, pointed, calcareous processes, which bend slightly inward; two or three are also commonly present on the wall which closes the cell below; orifice small, semi-circular, placed at the very top of the area. *Oëcium* (?).

Loc. ? Queensland (*Miss Jelly*).

Family Myrizoidae (part), Smitt.

SCHIZOPORELLA, Hincks.

Schizoporella concinna, sp. n. (Pl. VI. figs. 2.)

Zoarium erect, cup-shaped. *Zoëcia* on one surface only, quincuncial, of large size, subquadrangular or ovate, somewhat depressed, separated by thin raised lines, the sutures shallow, surface silvery, thickly covered with round perforations; orifice ample, much broader than high, arched above, the sides straightish, very slightly constricted below by the articular processes, lower margin straight, thin, with a rather shallow central sinus, rounded below, the opening, when perfect, contracted by a small denticular projection on each side; peristome slightly raised, operculum membranaceous; a ridge-like elevation of the zoëcial wall inclosing the orifice below; on each side of the latter, a little below the top, a small, slightly raised *avicularium* with rounded mandible (Pl. VI. fig. 2 a); occasionally a minute *avicularium* close to the sinus, placed transversely. *Oëcium* (?).

Loc. Port Denison, Queensland (*Miss Jelly*).

I have only had the opportunity of examining a single specimen of this fine species, and am therefore unable to give a complete account of the habit of growth, which may probably vary considerably.

The oral sinus is somewhat variable in shape and is often widely open above; but in what seems to be the perfect state it is as described. There is also some diversity in the form of the zoecia, those on the growing margin being often obovate or ovate, while those in the interior of the colony are more accurately characterized as quadrangular or subquadrangular.

Many of the cells also are narrow and greatly elongated.

Schizoporella bimunita, sp. n. (Pl. VI. figs. 3.)

Zoarium erect, bilaminate. *Zoecia* on both sides, lozenge-shaped, surrounded by raised lines, perforated round the margin*, the surface, when slightly calcified, rather depressed, covered with minute perforations, often nodulated; as calcification proceeds, irregular, raised, sometimes covered with low papillæ, sometimes smooth and dense, with scattered punctures; orifice elongate-oval, the sides curving outward very slightly, lower margin in great part occupied by a deep† sinus, widest above and narrowing gradually and slightly downwards, peristome not elevated; on each side of the cell (or sometimes on one side only) an elongate pointed avicularium, originating about the middle and stretching upwards alongside the orifice; scattered amongst the ordinary zoecia, and often forming small groups, cells (?oœcial) having the orifice sub-orbicular, with a shallow sinus, wide above, narrowing slightly and rounded below (Pl. VII. fig. 3 a); in other respects resembling the zoecia.

Hab. Stems of Hydroida.

Loc. Port Elizabeth, South Africa (*Miss Jelly*).

I am unable to give much account of the form of the zoarium and the mode of growth. The largest specimen which I have examined measures rather more than a quarter of an inch across and forms a compressed bilaminate expansion, which is attached to the stem of a Sertularian. The very regular shape of the zoecia, their division into two classes, each with its characteristic orifice, and the definite arrangement of the two large avicularia which, as it were,

* The marginal perforations are frequently obliterated by the calcification.

† Often more than half as long as the upper part of the orifice.

guard the cells on each side, are the stable and distinctive characters. There is much variability in the superficial aspect, dependent on the amount of calcification, and different portions of the same colony exhibit a striking diversity of appearance. There is a great tendency to the formation of nodules and papillary processes over the surface, and in some states the numerous perforations are a feature.

In the corner of the orifice below, a little behind the sinus, are two rather large and prominent calcareous processes on which the opercular hinge works.

Schizoporella inconspicua, sp. n. (Pl. VII. fig. 3.)

Zoarium incrusting. *Zoecia* ovate, quincuncial, perforated round the margin, gibbous, the front wall sloping up from the margin to the centre, on the highest point, immediately below the orifice, an umbo bearing a small *avicularium*, with rounded mandible, replaced in many of the cells by a broad spatulate *avicularium* with a large median aperture, the lower margin of which has a notch in the centre, whilst a prominent denticle projects from the middle of the upper margin; surface nodulated and thickly punctured, sometimes areolated; orifice orbicular or suborbicular*, with a wide, shallow, rounded or bluntly pointed sinus below, the articular denticles placed one on each side at the entrance of the sinus; the cell-wall elevated round the orifice. *Oecium* large, covering nearly half the cell above it, of considerable width, much broader than high, rounded above, the front surface flattened, shining, thickly covered with minute perforations, surrounded by a smooth border; oral arch low and wide.

Loc. Port Elizabeth, South Africa (*Miss Jelly*).

As calcification proceeds the gibbous character of the zoecia disappears; but it is very apparent in the normal cells towards the margin of the colony. In the central region the orifice is deeply sunk, the walls thicken, the oecia are sub-immersed, and much of the characteristic aspect of the species is lost. The structure of the avicularia offers some peculiarities which may be available as diagnostic characters. The orifice with the sinus is pyriform, but the portion above the sinus, which is covered by the movable lid or true operculum, is more or less orbicular. The hinge is placed at the bottom of it between the articular processes, which cause a slight constriction and mark the commencement of the sinus. It forms a well-marked boundary-line between the true operculum and the extension of it which closes in the sinus.

* Rather rudely orbicular, with many slight variations.

Schizoporella spectabilis, sp. n. (Pl. VII. figs. 1.)

Zoarium incrusting. *Zoecia* disposed in transverse rows, large, irregularly ovate, sometimes narrow, sometimes of considerable width, occasionally enlarged above, prolonged and narrowing downward and truncate at the base, convex, inclosed by strongly-marked boundary-lines, the front wall much elevated towards the orifice, and sloping rather abruptly downwards towards the bottom of the cell, of a light brownish colour, the surface smooth and shining and thickly covered with small white papillæ; orifice depressed, sloping towards the top of the cell, orbicular or suborbicular, with a somewhat lozenge-shaped sinus below, sharply pointed at the lower extremity, with a bend outward on each side, the opening slightly contracted by two denticular projections. Operculum of a dark horn-colour, terminating below in a short spike-like process, which passes within the sinus. Immediately below the orifice on each side of the sinus a large pyriform body, decumbent and adnate, attached by a short stem-like prolongation to the raised line which bounds the cell, near the upper end of one of them an avicularium facing towards the orifice, with pointed mandible. Other bodies of a similar character and in various stages of development occur on the cells, all of them originating at various points on the boundary-line. *Oeciium* of large size, elongate, obovate, wide above and narrowing towards the oral extremity, oral arch lofty, closed by a dark-coloured operculum, surface reticulate.

Loc. Stewart Island, New Zealand.

This very interesting species, so far as the character of the orifice is concerned, might probably be referred to the *Gemellipora* of Smitt*, as limited by Busk†, if that genus could be accepted as well founded. But the slight peculiarity in the shape of the sinus can hardly be accounted a sufficient basis for a generic group. We are hardly in a position at present to interpret fully the curious bodies which bud from the raised line by which the zoecia are surrounded. They are evidently not mere accretions of calcareous matter. Their constant form and position and the indications of definite structure which they present might naturally lead us to assign them zooidal rank; but we have no clue as yet to their morphological significance. All that we can say of them with certainty is that they are outgrowths from the zoecial wall; of their function we know nothing, but their number shows that they must be serviceable in some way to the colony. They are all of

* Smitt, 'Floridan Bryozoa,' p. 37.

† Busk, 'Challenger' Report, pt. i. p. 176.

much the same shape, pyriform, with (in most cases) a stem-like prolongation below, and are wholly adnate. A smooth and solid casing envelops the lower portion; but in the earlier stages it is wanting above, and a mass of calcareous matter is visible, filling the interior. In more advanced stages the external envelope involves the whole structure; but the form of the original opening is in most cases indicated by a tract of feeble calcification. Two of these bodies are usually present immediately below the sinus, and they commonly join so as to form a prominent ridge across the front wall. One of them involves in a greater or less degree and partially conceals the suboral avicularium.

Schizoporella scabra, sp. n. (Pl. VI. fig. 4.)

Zoarium incrusting. *Zoecia* quincuncially disposed, variable, commonly hexagonal, occasionally rhomboid or ovate, with raised boundary-lines inconspicuous in highly calcified states, young cells depressed, punctured, in mature cells the front wall much elevated towards the centre, highly calcified, the surface reticulate with nodular prominences, the punctures deeply sunk, a line of closely-set perforations round the margin, very conspicuous in the younger cells; orifice somewhat pyriform, the portion above the articular processes and hinge broad, the upper margin slightly arched, the sides tending somewhat inwards; below the hinge, where there is a slight constriction, a wide sinus, narrowing downwards and rounded below; hinge marked by a very distinct line, which curves upwards slightly, crossing the operculum almost immediately above the sinus; below the orifice a very prominent umbo, bearing on its inner surface a rather large *avicularium*, with broad, rounded mandible; peristome not raised. *Oecium* small, shallow, depressed, wide in proportion to its height, rounded above, surface smooth and glassy, oral opening extremely narrow.

Hab. Forms white masses on the stems of Hydroida.

Loc. Port Elizabeth, South Africa (*Miss Jelly*).

The appearance of the zoarium in this species is highly characteristic. In its mature condition the divisions between the zoecia are slightly marked; a thick calcareous covering overlies the primitive wall, the surface is reticulate, and covered by a multitude of small nodular processes. The avicularian umbo is hardly distinguishable, and both the orifice and the punctures are deeply sunk in the calcareous crust.

The form of the orifice can hardly be determined accurately

except by examining the younger cells. In few species is the line of separation between the two portions of the operculum, the movable lid and the fixed plate which closes the sinus more strongly marked. The latter is thick and prominent.

The oecium is remarkable for its small size and its very slight elevation. The surface is glassy and entire. In the one or two examples which I have seen there is an appearance of immaturity.

Schizoporella pectinata, Busk, sp., form *Africana*, nov.
(Pl. VI. fig. 6.)

Zoarium erect, bilaminate, compressed, divided into wedge-shaped segments, with lobate margin. *Zoecia* pyriform, small, convex, divided by distinct sutures, disposed obliquely in lines, front wall thickly covered with small punctures, in the older cells more or less obliterated; a line of rather larger perforations round the margin, frequently a smooth polished tubercle towards the lower part of the cell and an *avicularium* in the same region, the adult cells surrounded by a thickened border; primary orifice arched above, with a wide sinus below, tapering off to a rounded point, peristome raised; secondary orifice elliptical or semicircular, lower margin straight, within it a small pectinated ridge, at a short distance below it a roundish opening, formed by a bridge-like structure, which crosses the orifice (between the suboral avicularia) and shuts off the lower portion of it; on each side immediately below the orifice a raised *avicularium*, with pointed mandible; groups of larger cells (oecial) principally along the margin of the zoarium, very prominent and massive, with the orifice much elongated transversely and very narrow between the upper and lower margins; large avicularian cells (replacing zoecia) with pointed mandible, apex incurved, in lines along the outer edge of the zoarium.

Hab. Attached to the stems of Hydroida.

Loc. Port Elizabeth, South Africa (*Miss Jelly*); off Cape York, in 8 fathoms, coral-mud (*Busk*, 'Challenger' Rep.).

I refer the South-African form to Busk's species with some doubt. The figure of *Adeonella pectinata* in the 'Challenger' Report differs not a little from the present form. The "wide punctures" on the front wall which, as represented, are few in number, contrast strongly with the numerous minute punctures which cover it in the South-African species. The shape of the cells too differs, and the total absence of the suboral avicularia on the group of zoecia figured by Busk, marks a still wider departure from the

characteristic facies of the latter. In the specimens from Port Elizabeth which I have examined, these avicularia, which are elevated and very constant in position, are generally present; their absence is quite exceptional and rare. As, however, Busk mentions that they occur on some of the oöcial cells we must not attach too much weight to their absence from the zoöcia in the single specimen on which the 'Challenger' diagnosis is founded.

But there are other differences between the two forms which are more significant. In the oöcial cells of Busk's species the "pore" is said to be "reniform and placed low down on the front," and the latter character is again referred to as "an exceptional feature." Nothing of the kind is to be met with in the South-African form. The oöcial cells are distinguished by their size and more massive character and by the shape and size of the orifice; in all other particulars they agree with the zoöcia. The suboral opening occupies the same position as in the ordinary cells, immediately below the bridge, and it is roundish and not reniform. It is difficult at first sight to understand how the "pore" could be placed "low down on the front of the cell;" but supposing it to be so, we have an important difference between the 'Challenger' and the African forms*. There is no figure of the oöcial cell in the 'Challenger' Report, nor does it contain any reference to the primary aperture.

On the whole, and taking into account the general similarity of most of the leading characters and the presence in both of the minute peculiarity, the pectinate ridge or "denticle," it will be better to refer the present variety to Busk's species, of which it will rank as a form—*Africana*.

I have placed this species *provisionally* in the genus *Schizoporella*.

The genus *Adeonella*, as constituted by Busk, is indistinguishable from *Adeona*, as indeed he virtually admits†. The whole group requires further investigation.

The present species bears a close resemblance in many of the leading characters to the *Eschara Pallasii*, Heller, which I have referred to the genus *Schizoporella* on account of the marked sinus on the lower margin of the orifice‡. But oöcial

* In his interesting observations on *Adeonella*, in his 'Supplementary Report on the 'Challenger' Polyzoa,' Waters states that the "pore" "is placed so low down in *Adeonella Atlantica* that from an external examination it would be supposed that it opened into the zoöcial cavity" (p. 33).

† "As regards the general zoöcial characters there is no difference whatever between *Adeona* and *Adeonella*" (Busk, 'Challenger' Report, part i. p. 183).

‡ "Polyzoa of the Adriatic," 'Annals' for March 1886.

cells and the large marginal avicularium have not been detected in this form either by Heller or myself.

Family *Escharidæ* (part), Smitt.

LEPRALIA, Johnston (part).

Lepralia ocellata, sp. n. (Pl. VII. figs. 4.)

Zoarium incrusting, of a light brownish colour. *Zoæcia* quincuncial, disposed with great regularity, subquadrate (somewhat wider above than below), distinct, massive, of large size, depressed towards the base, rising towards the orifice, separated by a deep fissure, in which a delicate partition-line runs; surface thickly covered with large circular perforations; orifice ample, well arched above, constricted on each side, a little above the lower margin, which is straight, operculum apparently membranaceous, peristome not elevated; immediately below the orifice a tall central mucro with fluted surface, rising from an expanded base; behind it on the lower margin a small *avicularium* placed transversely, with pointed mandible; on one side of the orifice a very large avicularian cell (extending to the margin of the zoæcium) with punctured surface, a large semicircular mandible on the inner side looking towards the orifice; sometimes a second avicularian cell of similar structure but much smaller size on the other side of the orifice. *Oæcium* (?).

Loc. Malta (*Miss Jelly*).

There is a good deal of variability in the size of the lateral avicularia; but whenever two are present one is much larger than the other. Otherwise there is much constancy in the characters.

Lepralia lancifera, sp. n. (Pl. VII. figs. 6.)

Zoarium incrusting, sometimes of a very dark brown colour (almost black), sometimes lighter. *Zoæcia* disposed in lines, distinct, six-sided, surrounded by raised lines, front wall elevated, strongly calcified, covered with large perforations extending to the base of the suboral umbo, sometimes areolated, surface glossy; orifice rounded above (arch low), the lower margin straight, much wider than high, slightly contracted a short distance above the lower margin, peristome rising into a pointed elevation at the sides; immediately below the orifice a very prominent umbo carried out straight from the

cell-wall and projecting considerably, supporting an *avicularium* with a narrow lanceolate mandible, the beak slightly hooked at the extremity; on one side of the umbo a pointed and raised *avicularium*, directed obliquely downwards, sometimes a large number of such avicularia irregularly distributed. *Oœcium* large, prominent, subglobose, well rounded above, narrowing towards the orifice, frequently a penthouse-like projection above the oral arch, surface punctured, a profusion of avicularia of various sizes on and around the oœcium.

Hab. Incrusting a *Cellepora* and spreading over *Flustra armata*, Busk.

Loc. Port Elizabeth, South Africa (*Miss Jelly*).

This species is assigned somewhat doubtfully to *Lepralia*. The structure of the orifice does not conform very markedly to that which is characteristic of this genus; but, on the whole, it is perhaps more nearly allied to it than to any other group.

The front wall of the zoœcia may be described as reticulate, so completely is it occupied by large perforations, with a narrow line separating them. The avicularia are present in great numbers and are all of the same type and furnished with lanceolate mandibles. In some parts of the colony, and especially in the neighbourhood of the oœcia, they literally swarm. Under these circumstances there is no regularity of arrangement; they are of all sizes and turned in all directions. In the older zoœcia the surface is sometimes much roughened, and large areolæ extend from the margin towards the centre. The true character of the cells is best studied in the younger portions of the colony, in which the suboral avicularium and perhaps one or two others form the whole contingent.

MUCRONELLA, Hincks.

Mucronella aviculifera, sp. n. (Pl. VII. fig. 2.)

Zoarium incrusting. *Zoœcia* of large size, quincuncially disposed, broad-ovate, convex, separated by rather deep sutures, strongly calcified, the front wall thickly covered over its whole extent with round perforations, surface silvery white; orifice orbicular, the peristome slightly raised and forming a thick collar round it, a central bifid denticle within the lower margin and a small pointed denticle on each side, operculum membranaceous, finely furrowed from the top to the hinge-line, which crosses it just above the denticles; on the raised collar-like margin (immediately in front of the

bifid denticle) a central mucro, bearing on the top a minute *avicularium*, commonly two or three slender spinous processes below it on the cell-wall, also aviculiferous; at the top of the cell on each side a rather stout, calcareous, cylindrical process, with a minute avicularium on the summit; on one side of the orifice a very large raised avicularium, with spatulate mandible directed obliquely downwards. *Oœcium* wider than high, well rounded above, the sides slightly incurved and prolonged below alongside the oral arch, which is wide and shallow, the surface of a delicate silvery whiteness, covered with extremely minute risings, closely packed together.

Loc. Singapore or Philippines (*Miss Jelly*).

The most remarkable characteristic of this species is the profusion of the avicularia, and not only their profusion, but their peculiar character. With the exception of the large spatulate form, which occurs singly on a great proportion of the cells, they are all minute in size and mounted on the top of a calcareous column or erect spine-like process, and are present in extraordinary abundance.

EXPLANATION OF THE PLATES.

PLATE VI.

- Fig. 1.* *Flustra spinuligera*, sp. n. *a.* Segment of the zoarium, nat. size. *b.* Abnormal zoœcium. *c.* Avicularium. *d.* Avicularium of *Flustra denticulata*, var. *inermis*, Busk*.
Fig. 2. *Schizoporella concinna*, sp. n. *a.* Orifice and lateral avicularia.
Fig. 3. *Schizoporella bimunita*, sp. n. *a.* Oœcial cells.
Fig. 4. *Schizoporella scabra*, sp. n.
Fig. 5. *Flustra nobilis*, sp. n. *a.* Avicularia. *b.* Zoœcium, showing the origin of the radical fibres at *a.*
Fig. 6. *Schizoporella pectinata*, Busk, form *Africana*, nov.

PLATE VII.

- Fig. 1.* *Schizoporella spectabilis*, sp. n. *a.* Oœcium.
Fig. 2. *Mucronella aviculifera*, sp. n.
Fig. 3. *Schizoporella inconspicua*, sp. n.
Fig. 4. *Lepralia ocellata*, sp. n. *a.* Orifice.
Fig. 5. *Membranipora eburnea*, sp. n.
Fig. 6. *Lepralia lancifera*, sp. n. *a.* Group of zoœcia with oœcium. *b.* Oœcium, with penthouse-like projection in front.

* After the figure in the 'Challenger' Report, pl. xxxii. fig. 2 c.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

November 12, 1890.—Dr. A. Geikie, F.R.S.,
President, in the Chair.

The following communication was read:—

“On a new Species of *Trionyx* from the Miocene of Malta, and a Chelonian Scapula from the London Clay.” By R. Lydekker, Esq., B.A., F.G.S.

(i.) The anterior portion of a carapace from the Miocene of Malta exhibits a divided neural between the first pair of costals, as in the Indian species of *Trionyx*, and in *Chitra*. The Author describes this Maltese fossil, and discusses its relationship to *Trionyx* and *Chitra*, and names it *Trionyx melitensis*.

He notes the interest of finding another Oriental form in the Miocene of the Maltese Islands, which has already yielded a species of *Tomistoma*.

(ii.) A large scapula from the London Clay of Sheppey is referred to *Eosphargis gigas*, and is considered to support Dr. Baur's view as to the intimate affinity between the *Dermochelyidæ* and *Chelonidæ*.

December 10, 1890.—Dr. A. Geikie, F.R.S.,
President, in the Chair.

The following communication was read:—

“On certain Ornithosaurian and Dinosaurian Remains.” By R. Lydekker, Esq., B.A., F.G.S.

The Author is indebted to Prof. O. C. Marsh for the correct determination of the bones described in the paper.

1. *Ornithosaurian Quadrates*.—The reptilian bones in the British Museum, Nos. 43034, 44183, and 41179, are Ornithosaurian quadrates. The two latter belonged to the right side of the skull. The distal extremity of each forms a deeply grooved oblique trochlea, above which is a nearly quadrangular shaft. To the inner side of this shaft is attached, by suture, a flattened plate of bone, concave internally and convex externally, representing part of the pterygoid; so that the relation of the quadrate to the pterygoid in the *Ornithosauria* is the same as in the *Rhynchocephalia*.

The smaller quadrate would agree approximately in relative size with the so-called *Pterodactylus Manselii*, Owen, and the larger more nearly with the so-called *Pt. suprajurensis*, Sauvage, both of which may be provisionally referred to *Rhamphorhynchus*.

2. *Tibia of Cæluroid Dinosaur*.—The Author would provisionally

refer the right tibia of a small Dinosaur from the Wealden of the Isle of Wight, which had been incorrectly referred to *Hypsilophodon*, to the species originally described, from an examination of two vertebræ, as *Calamospondylus Foxi*, but which he would now name *Calamosaurus Foxi*. It presents striking avian affinities.

January 21, 1891.—Dr. A. Geikie, F.R.S.,
President, in the Chair.

The following communications were read:—

1. "On *Agrosaurus Macgillivrayi* (Seeley), a Saurischian Reptile from the N.E. coast of Australia." By Professor H. G. Seeley, F.R.S., F.G.S.

The complete left tibia, a less perfect proximal end of the corresponding right tibia, a fragment regarded by the Author as a fibula attached to matrix which contains two laterally compressed claw-phalanges, are preserved in the British Museum, and are labelled "Fly," 1844, J. Macgillivray, from the N.E. coast of Australia. These remains are described, and the distinctive characters which determine the fossil (the distal end of the tibia) noted. It shows an ordinal resemblance with *Poekilopleuron* and *Cetiosaurus*, but with *Dimodosaurus* from the top of the Keuper it is so close that the two must be regarded as nearly allied. The fossil is regarded as generically distinct from all known types. The remains indicate an animal about the size of a sheep, and it is considered as not improbable that the creature belongs to the Lower Oolites or Trias.

2. "On *Saurodesmus Robertsoni*, a Crocodilian Reptile from the Rhætic of Linkfield, in Elgin." By Professor H. G. Seeley, F.R.S., F.G.S.

The bone described in this paper was found in a mass which has been interpreted as a large boulder of Rhætic beds in Boulder-clay. The specimen has already been noticed by Sir Richard Owen and R. Lydekker, Esq. The Author maintains that the bone is a right humerus. He discusses its asserted Chelonian affinities, and concludes that it is not Chelonian but Crocodilian, but that, if grouped with the Crocodilia, it belongs to a suborder hitherto unknown, and defined by a combination of Crocodilian and Lacertilian characters which is not Saurischian.

MISCELLANEOUS.

HENRY BOWMAN BRADY, LL.D., F.R.S., &c.

DR. BRADY, the leading authority on the Foraminifera, died at Bournemouth on January 10. His family originally came from Swaledale, in Yorkshire; and his grandfather resided at Staindrop, in the county of Durham. His father, Mr. Henry Brady, had an extensive practice as a surgeon at Gateshead-on-Tyne. Here H. B. Brady was born, February 23, 1835. His father instilled into his children the love which he himself had for the study of nature, and especially of botany. His first schoolmaster was Mr. John Storey, where Belt, the naturalist, was a fellow pupil. He next was sent to Ackworth, in Cleveland, a well-known school connected with the Society of Friends, to which Mr. Brady's family belonged; and subsequently to Tulketh Hall, near Preston. After leaving school he was apprenticed to the late Thomas Harvey, a pharmaceutical chemist at Leeds. On the completion of his apprenticeship he studied under Dr. Thomas Richardson at Newcastle; and at this time Tuffen West, who was at Gateshead, did much to foster Brady's love of natural history. In 1855 he started business on his own account as a pharmaceutical chemist in Mosley Street, Newcastle-upon-Tyne. Here his energy, his close attention to business, and the first-class character of everything he supplied soon resulted in the development of an extensive connexion not only in dispensing but among the medical men of the north of England and elsewhere, and ultimately to a large export trade. In 1876 Brady had amassed a sufficient fortune to enable him to retire from business. He had never been strong in health, and attacks of emphysema had necessitated his often going abroad for the winter months. Subsequently to 1876 he spent a large portion of his life in travel. He twice went round the world. In 1878 he made a most interesting expedition in Marocco. In 1884, during a voyage round the world, much time was spent in the Fiji Islands. In 1886 he went to the Mediterranean, staying for longer periods in Africa, Italy, and Greece. In 1888 he stayed some time in Ceylon, and subsequently traversed the length of India. In 1889-90 he visited Egypt and ascended the Nile; on returning he was laid up at Cairo with œdema of the feet and legs, and from this he never entirely recovered. Last autumn, acting under advice, after spending the summer at Brighton, he resolved not to winter abroad, but to go to the mild climate of Bournemouth. The severity of the last two months was not anticipated. On the 3rd of January the writer of this notice received a letter from him in which he said "the cold weather has seriously affected me," and that he had not been out of the house more than two or three times during the previous month. On January 8 his brother, Professor G. S. Brady, received a telegram to say he was ill, and immediately left Sunderland for Bournemouth; on arriving he found Henry buoyed up by his usual cheerful spirits, but suffering from an attack

of pneumonia; the unfavourable symptoms rapidly developed, and he died on the 10th.

His character was in all respects a fine one—that of one of those sterling men whom the more you know the more you appreciate.

Dr. Brady was buried on January 14th in the old cemetery at Jesmond, Newcastle-upon-Tyne; the funeral was attended by numbers of the medical and scientific men of the neighbourhood.

Dr. Brady's numerous contributions to our knowledge of the Foraminifera need not be particularly referred to. Some of these were written in conjunction with his late friend Dr. Carpenter, others jointly with Parker and Jones. His great and magnificent work on the Foraminifera of the 'Challenger' must long remain the chief authority on the subject.

At the British Association meeting held in Newcastle in 1863 Brady was instrumental in founding the Pharmaceutical Conference, which has since that time held its meetings immediately before those of the British Association itself. Of that Conference he was himself President at Brighton in 1872, and again at Bradford in 1873.

In 1874 he was elected F.R.S., and in 1888 became a member of the Council. In 1886 the University of Aberdeen bestowed upon him an honorary LL.D.; and in the same year he had the honour of receiving a gold medal from the Emperor of Austria in recognition of services rendered to the National Museum.

His very extensive collection of Foraminifera was presented by him during his life to the University of Cambridge; and the great 'Challenger' collections, with many other types given by Brady, can be consulted in the British Museum.

The Genus Limacella.

On pp. 184–186 of the February number Mr. Pilsbry has some remarks on the genus *Tebennophorus* or *Limacella*, to which I may perhaps be permitted to reply, taking his several points in order.

- (1) That plate of Blainville's has certainly received bad treatment. The figures have been inaccurately copied; Férussac quoted it wrongly; and now, as Mr. Pilsbry has shown, I also have erred with regard to it! There are two figures iv., labelled respectively 1 and 2. Fig. 2 is obviously *Veronicella*, but fig. 1, for which alone my reference was intended, looks like *Limacella*, though from Blainville's text it is clearly intended for *Veronicella* also. I quite agree with Mr. Pilsbry that fig. iv. no. 1 might or might not from its appearance be of the genus under discussion; and as it is stated to be *Veronicella*, there apparently remains no doubt that my reference of it to *Limacella* was erroneous. I am still of the opinion, however, that fig. v. represents the genus American writers call *Tebennophorus*.

- (2) There is, I think, no doubt about the slugs I described being Blainville's types; nor are these the only British-Museum slugs described by Blainville. The Museum is mentioned in the original paper.
- (3) It is very difficult to say whether inaccuracy of description, when there is no doubt what was intended, ought to condemn a name. If so, there will have to be considerable slaughter of the genera described by early authors, or, for that matter, by some recent ones. *Philomyces*, which Mr. Pilsbry thinks might be adopted, was also inaccurately defined. So far as is known there is no slug in existence really agreeing with the original descriptions of *Limacella* or *Philomyces* taken literally.
- (4) *Limacella*, Brard, if it is anything, is *Limax* of modern authors, not *Agriolimax*. But a genus founded for the shells only of species of the Linnean *Limax* cannot be recognized as valid, and the only authors who have adopted it are Dr. Jousseau (1876) and Dr. Turton. The former writes *Limacella* for *Limax*, auctt., and *Limax* for *Arion*; while Dr. Turton (1831) kept the name for the shells of *Limax* and allied genera, though spelling it *Limacellus*. We are told, for instance, that *Limacellus parma*, Brard, is "found in the *Limax maximus*," as though it were a sort of parasite!
- (5) I think it nearly certain that my *Limacella nebulosa* is Rafinesque's species *E. nebulosus*; but if so, of course that author described it incorrectly. Mr. Pilsbry will observe that I have given the reference with a query.

While on the subject, it may be well to mention that there is a figure and description of *Limacella lactiformis* (as *Elfortiana*) in Knight's 'Pictorial Museum of Animated Nature,' vol. ii. and fig. 2598. The figure is very bad, being a rough copy of that in Man. de Mal.; but the generic description, so far as it goes, is accurate.

T. D. A. COCKERELL.

3 Fairfax Road, Bedford Park, Chiswick, W.,
February 3, 1891.

Preliminary Diagnoses of Four new Mammals from East Africa.
By OLDFIELD THOMAS.

Nyctinomus lobatus, sp. n.

Allied to and of the same size as *N. teniotis*, Raf. (*N. Cestoni*, Savi), but distinguished by its much larger ears, tragus, and anti-tragus, by the thinness of the ear-membranes and keel, and by its belly being pure white. Forearm 63 millim.

Hab. Turquel, Suk, inland British East Africa. Coll. F. J. Jackson, Esq.

5-1148

Otomys Jacksoni, sp. n.

Allied to *O. irroratus*, Bts., but with two deep grooves down each lower incisor instead of only one. Basal length of skull 31·4 millim.

Hab. Mount Elgon, 13,000 feet. Coll. F. J. Jackson, Esq.

Rhizomys annectens, sp. n.

Intermediate in size between *R. macrocephalus* and *R. splendens*; externally very similar to both. Basal length of skull 51 millim., as compared to 63 in the first, and 41 in the second of the allied species.

Hab. Either Masai-land or inland British East Africa. Coll. F. J. Jackson, Esq.

Cervicapra Clarkei, sp. n.

Smaller than *C. bohor*, Rüpp., but the horns longer, slenderer, and less curved. Skull light and delicate, flattened from above downwards; lacrymal fossæ present, although very shallow; lower jaw excessively weak and slender.

Length of skull (occiput to gnathion) 210 millim.; height (crown to angle of lower jaw) 94 millim.; length of horn, round curve, anteriorly, 245 millim.

Hab. Northern Somali-land. Coll. T. W. H. Clarke, Esq.

New Researches on the Spores of Myxosporidia (Structure and Development).* By M. P. THÉLOHAN.

At the present time we possess but very few definite notions as to the phenomena of sporulation in Myxosporidia. The observations made by Balbiani †, Bütschli ‡, and Gabriel § have, it is true, determined the general course of the development of the spores; but many details yet remain to be elucidated, especially with reference to the development of the polar capsules.

We know that the nuclei of Myxosporidia are localized in the endosarc, where they exist in very large numbers. The first stage of the formation of spores consists in the differentiation around one of these nuclei of a little sharply-defined sphere of plasma, which appears to be encased in a delicate envelope resulting from the condensation of the peripheral layer.

We next observe this nucleus divide by karyokinesis. I have seen, among other figures, a spindle with absolutely typical equatorial plate, so that not the slightest doubt could exist.

* Carried out at the laboratory of Prof. Balbiani, at the Collège de France.

† Balbiani, 'Leçons sur les Sporozoaires,' 1884.

‡ Bütschli, "Beiträge zur Kenntniss der Fischsporospermien," Zeitschrift für wiss. Zool. 1881; Bronn's Thier-Reich, Bd. i., Protozoa.

§ Gabriel, Berichte der schles. Gesellsch. f. d. J. 1879.

The little sphere of plasma then exhibits two nuclei; as these continue to divide, we soon have a sphere containing some ten of them. The sphere itself next segments into two secondary masses or sporoblasts, which remain united by the envelope of the primary sphere. Each of these incloses a certain number of nuclei; we shall see further on that my observations do not permit me to determine whether the number is in reality four or only three, as was found by Bütschli.

However this may be, the nuclei which do not enter into the constitution of the sporoblasts remain unemployed, and we subsequently find them in a little mass of plasma which persists at the side of the sporoblasts within the envelope of the primitive sphere.

We now have to consider the phenomena presented by the sporoblast up to the complete formation of the spore.

We first see the plasma (in the forms with two polar capsules) divide into three little unequal masses, two smaller and one larger, as has already been described by Balbiani and Bütschli. In the two former the polar capsules will take their origin; the third will become the plasmic mass of the spore. Each of the smaller masses contains a nucleus, and before long we see, usually in the neighbourhood of this nucleus, a little rounded vacuole arise, which appears like a clear space and is distinguished from the plasma by the absence of granulations. At some point of the wall of the vacuole there arises a kind of little bud of protoplasm, which grows out into the vacuole, driving back round its sides the substance with which the vacuole is filled; in this way after a certain time we get a little pyriform body surrounded by a clear stratum, formed by the contents of the vacuole, and united by a sort of pedicle with the remainder of the plasma, from which it does not differ in the least in appearance. The pedicle is gradually constricted, and the little pyriform body soon becomes free; meantime it has become surrounded by a membrane, and a filament has developed in its interior. The latter clearly arises from the protoplasm of the bud; but I have not been able to follow the process of its formation.

Around the polar capsule which has thus been formed we find the remains of the globule of protoplasm which gave it birth and the nucleus which the latter contained. The nucleus in most cases remains attached to the capsule; but sometimes it may separate from it and be included in the plasmic mass of the ripe spore. In a previous paper* I had considered these nuclei as belonging to the latter, and had assigned to them a different origin; the study of their evolution and especially the use of better methods now enable me to rectify my mistake and give to the facts their true significance.

The polar capsules during their formation have no fixed direction; it is not until later on that they orientate themselves and take up their definite position.

* Thélohan, "Sur la constitution des spores des Myxosporidies," *Comptes Rendus*, December 9, 1889; "Contributions à l'étude des Myxosporidies," *Annales de Micrographie*, February 1890.

As for the third mass which was formed within the sporoblast, it is destined to furnish the plasma of the spore; at a very early stage we find in it two nuclei generally close together, which persist until maturity. Now did these two nuclei preexist within the sporoblast, which in that case would primarily contain four of them, or do they result from the division of a single nucleus, as must be the case if we admit with Bütschli that the sporoblast contains three nuclei only? This is the point which my observations have not enabled me to determine.

Up to this point the spores are rounded or oblong; they lose no time in assuming their final shape by surrounding themselves with an envelope, the origin of which has unfortunately escaped me. In the tailed spores the tail is at first bent back on one side of the spore, and remains in this position until the rupture of the envelope of the primitive sphere, which persists for a tolerably long time.

It is not unusual, especially in the tench, to meet with spores with from three to eight capsules. I have always found a nucleus corresponding with each one of these; their formation therefore probably takes place in the usual way. In this case the sporoblast must without doubt have contained an abnormal number of nuclei; sometimes indeed it seems probable that a single spore is formed at the expense of the primitive sphere.

In conclusion, we may sum up the chief results of my investigations as follows:—

1. The nucleus of *Myxosporidia* divides by karyokinesis.
2. The polar capsules are formed at the expense of little masses of plasma, which are differentiated within the sporoblast and contain a nucleus; the process of their formation presents many points of analogy with that which has been observed by Bedot* in the nematoblasts of species of *Velella* and *Physalia*.
3. The plasmic mass of the spore is derived from another portion of the sporoblast; it contains two nuclei and a vacuole with contents stainable reddish brown by iodine, the existence of which I have already described, and the presence or absence of which is constant in the same form.—*Comptes Rendus*, cxi. (Nov. 1890), pp. 692–695.

On the Sense of Smell in Starfish. By M. HENRI PROUHO.

It is a legitimate conclusion from our knowledge of the anatomy of Starfish that the sense of sight is not sufficiently developed in these animals to enable them to distinguish and come up with their prey, and we are naturally led to admit that the sense of smell is their sole guide in the search for food. Nevertheless I have thought it worth while to render our knowledge of this subject more certain, by means of a few experiments directed towards the following points:—(1) observing how the behaviour of a Starfish is affected by the conditions under which prey is offered to it; (2) demonstrating the uselessness of the organ of vision in the search for food; (3) determining whether the sense of smell is diffused or

* Bedot, "Recherches sur les cellules urticantes," *Recueil zoologique Suisse*, 1888.

localized in certain organs. The whole of my observations have been made upon specimens of *Asterias glacialis* which have been kept for a year in the aquarium of the Arago laboratory.

(1) *a.* An *Asterias* having been isolated in a perfectly clean tub, we wait until it is quite motionless and its ambulacral tentacles, which are of no use for locomotion, near the oculiform spot, retracted; we shall designate these tentacles palps. When this condition of perfect immobility has lasted for some time we place a dead fish at about 50 centimetres from the *Asterias*. After a very short interval (thirty seconds to one minute) the palps nearest to the fish straighten out and the extremity of the arm carrying them is raised; this is the first indication that the Starfish has detected the presence of the bait. Precisely the same movements take place at the extremity of the other arms, and we then see the stimulus starting from the extremity, communicating itself by degrees to the ambulacral tentacles surrounding the mouth. The Starfish begins to move towards the fish. Some individuals go straight towards the bait, others hesitate a few moments. When the Starfish is on the point of seizing the fish I remove it and place it at a short distance from the arm which is posterior with reference to the direction in which the animal is travelling. Carried away by the motion which it has acquired, the Starfish then appears to avoid the bait; but its action soon changes, and we see it retracing its path towards the new centre of attraction. In this way, for a certain time, we can attract some individuals in all directions; but at length the animal becomes so much excited that it is incapable of directing itself with certainty.

b. Precisely the same phenomena are observed when we present a living fish to the *Asterias*; and if we suspend this fish at the distance of the length of the arms of the Starfish from the bottom of the vessel, the Starfish succeeds in seizing it: it rolls one of its arms round the fish, and, hauling on this, it raises itself and applies its mouth to its prey.

We are therefore led to conclude, from careful observation of an *Asterias* excited by a bait, that the sensations which it obeys are felt by the extremity of its arms, at which point a delicate sensibility was long ago declared to exist. Is the animal guided by sight when it advances towards its prey? The following experiments will furnish the answer.

(2) *c.* I removed the eye-spots from four of the arms of an *Asterias*, leaving the adjoining palps as far as possible untouched; and I saw this *Asterias* advance towards its prey with precision, but in such a way that its single intact arm pointed in the opposite direction to that in which the animal was moving.

d. A tub is divided into two compartments by means of a board placed at about 3 millimetres from the bottom. In one of the compartments I place an *Asterias*, and when it is perfectly motionless I place in the other division a dead fish. I then cause a gentle current of water to flow from the fish towards the division in which the Starfish is; the latter immediately manifests the peculiar excitement noticed in observation *a.* It extends its palps and commences

to move towards its invisible prey ; then, on arriving at the division which separates it from the bait, it attempts to thrust one of its arms beneath the obstacle. Thereupon I raise the board a little ; the Starfish at once takes advantage of this ; with much labour it stretches its arm beneath the board and seizes the fish placed on the other side.

It thus becomes evident that the very rudimentary organ of vision does not help the *Asterias* in seeking its food, and that the sense of smell alone serves as its guide.

e. Into a tub containing a stationary *Asterias* we let fall, without disturbing the water, a few drops of sea-water in which a fragment of fish has been crushed ; the *Asterias* manifests the same excitement and goes through the same movements as if the fish itself had been presented to it.

(3) *f.* I cut off the four distal ossicles of the five arms of an *Asterias*, so as to deprive the animal of all its palps. To-day more than a month has elapsed since the operation, and I have never been able to obtain from this *Asterias* the slightest show of excitement on presenting to it a bait either dead or alive, although before being operated upon the animal was very active in seeking its prey.

g. I removed all the palps of an *Asterias*, leaving the eye-spots. This animal, which in a trial experiment had been quick enough in seizing a linen bag containing a morsel of fish, no longer exhibits excitement on the approach of a bait ; and when food is placed in the tub in which it lives with other specimens of *Asterias glacialis*, it alone remains absolutely motionless.

These experiments prove that in Starfish the sense of smell is not diffused, but is localized in the ambulacral tentacles unfitted for locomotion, situated behind the eye-spot.

h. We divide the ambulacral nerves of the five arms of an *Asterias* at about 2 centimetres from the tip, so as to isolate in each arm a distal portion carrying not only the palps, but also a small number of ambulacral tentacles. When a bait is offered to this *Asterias* its palps are at once erected, and the stimulus is rapidly transmitted to the ambulacral tentacles of the distal extremities, but stops abruptly opposite the point where the nerve was divided. The result is that while the tips of the arms, which are powerfully excited, endeavour to set the *Asterias* in motion, the rest of the body, not receiving the sensations experienced by the tactile organs, remains absolutely impassive. This state of things had been foreseen, since we had severed the principal channel of nervous communication between the palps, alone capable of appreciating odours, and the great majority of the motile organs of the *Asterias*. I say the principal channel, for the superficial nerve-plexus has also to be reckoned with. We must conclude, however, that it plays a very subordinate part in the transmission of odours, since I only once saw the *Asterias* which had been operated upon set itself in motion after having been solicited by its extremities for a quarter of an hour ; and even then it did not travel towards the bait.—*Archives de Zoologie expérimentale et générale*, sér. 2, t. viii., Année 1890, no. 4, pp. xxxvi-xxxviii (*Comptes Rendus*, ex. (1890), pp. 1343-1346).

THE ANNALS

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[SIXTH SERIES.]

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XXXIII.—*On some new or imperfectly-known Species of Stromatoporoids.* By H. ALLEYNE NICHOLSON, M.D., D.Sc., Regius Professor of Natural History in the University of Aberdeen.—Part IV.

[Plates VIII.—X.]

IN the present paper I propose to give short descriptions of a number of Stromatoporoids from the Palæozoic rocks of North America, some of which are well known as occurring in deposits of the same age in the Old World, while others are new. Most of the forms in question have been collected by the officers of the Geological Survey of Canada, and have been entrusted to me by Mr. Whiteaves for examination and description. Among these is an interesting series of Stromatoporoids from the Devonian rocks of Manitoba. By the kindness of Mr. Whiteaves I have also been put in possession of examples of two of the species of Stromatoporoids described by Professors Hall and Whitfield from the Devonian rocks of Iowa ('Twenty-third Ann. Rep. of the State Cabinet,' 1873). One of these, viz. *Stromatopora expansa*, Hall and Whitf., proves to be a species of *Actinostroma*, and will be described and figured here; the other, viz. *Stromatopora (Cænostroma) incrustans*, Hall and Whitf., is a species of *Stromatoporella*,
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and I shall reserve its description for the present*. The remaining three species of *Stromatoporoids* described by the above-named observers from the Devonian rocks of Iowa have not come under my notice, and their microscopic structure has unfortunately not been described or figured. The same is true of various forms of *Stromatoporoids* described by Winchell and by Quenstedt from the Palæozoic rocks of North America. It is possible therefore that some of the forms which I shall here describe as new may have been previously named or figured. I have, however, elsewhere pointed out that descriptions and figures of the merely macroscopic characters of the *Stromatoporoids* are quite insufficient for the determination of *species*, and that, in point of fact, they only occasionally suffice for the determination of the *genus* to which a given specimen may belong.

In connexion with one of the Canadian *Stromatoporoids* I shall have occasion to describe a species of *Stromatopora* from the Silurian rocks of Oesel; but all the other forms dealt with are North American. As in previous papers, I shall confine myself principally to elucidating the microscopic characters of the forms described, such characters being the only ones upon which specific or generic distinctions among the *Stromatoporoids* can be safely based.

Stromatopora antiqua, Nich. & Murie.
(Pl. VIII. figs. 9–11.)

Pachystroma antiqua, Nicholson and Murie, Journ. Linn. Soc., Zool. vol. xiv. p. 223, pl. iv. figs. 2–5 (1878).

Stromatopora antiqua, Nicholson, Mon. Brit. Strom. p. 91, pl. v. figs. 8–11 (1886).

Cœnosteum of considerable size, spheroidal or hemispherical in form, with a limited basal attachment, and apparently without an epitheca. The mode of growth is distinctively latilaminar, the entire cœnosteum being made up of successively superimposed and perfectly definite strata, of which five or six occupy the space of 1 centim. measured vertically. The latilaminæ are often more or less extensively separated by minute intervals, and each consists of a single layer of zoöidal tubes.

* I had previously conjectured (Mon. Brit. Strom. p. 95) that the fossil which I had described from the Hamilton Formation of Ontario under the name of *Stromatopora nulliporoides* ('Report on the Palæontology of Ontario,' 1875, p. 78) might prove to be identical with the *Cœnostroma incrustans* of Hall and Whitfield. I may, therefore, here state that an examination of an authentic specimen of the latter has shown this conjecture to be correct, so that my name for the species must be abandoned.

The surface is undulating and is destitute of astrorhizal eminences or "mamelons;" but there are well-developed and much-branched astrorhizæ, the centres of which are placed 4-5 millim. apart. The astrorhizæ are not vertically superimposed in groups.

The skeleton-fibre is minutely porous and is incompletely reticulated, the radial pillars to a large extent preserving their distinctness. Hence in tangential sections (Pl. VIII. figs. 9 and 11) the cut ends of the radial pillars are more or less clearly recognizable as rounded or oval porous masses, united by irregular and exceedingly delicate connecting-processes. In vertical sections (Pl. VIII. fig. 10) the radial pillars are seen to be continuous from the top to the bottom of each latilamina—except when cut obliquely—and the spaces separating them are crossed by irregular transverse plates or "tabulæ," and represent the zoöidal tubes. About five or six pillars with their intervening tubes occupy the space of 2 millim. measured transversely. In tangential sections the zoöidal tubes appear as small rounded apertures in the skeletal network, and the branching astrorhizæ are well displayed.

Obs. Stromatopora antiqua presents us with a type in many respects intermediate between *Stromatopora*, Goldf. (as now defined), and *Syringostroma*, Nich. Though agreeing in general characters with the typical species of *Stromatopora*, the present form shows a strong relationship with *Syringostroma*, this being especially shown by the comparative distinctness of the radial pillars as definite structures. In the former genus, on the other hand, the vertical radial pillars are more or less undistinguishably merged with the horizontal connecting-processes, the skeleton thus becoming completely reticulate. None of my specimens of *S. antiqua* are in a state of thoroughly satisfactory preservation, and it is possible that the examination of more perfect specimens might show that the species is properly referable to *Syringostroma*, from the known species of which it could be readily differentiated. In the genus *Stromatopora* the present form presents most likeness to *S. typica*, Ros., from which it is separated by the more complete preservation of the radial pillars, the less perfect reticulation of the skeletal framework as seen in tangential sections, and the more markedly latilaminar mode of growth.

Formation and Locality. Niagara Limestone, Thorold, Ontario (coll. H. A. Nicholson). A poorly preserved specimen in dolomitic limestone of Niagara age from Durham, Ontario (coll. Geol. Survey of Canada), may also possibly belong to this species.

Stromatopora hudsonica, Dawson, sp.
(Pl. VIII. figs. 1-3.)

Caunopora hudsonica, Dawson, Quart. Journ. Geol. Soc. vol. xxxv. p. 52, pl. iv. figs. 9a and 9b, and pl. v. fig. 10 (1879).
Stromatopora hudsonica, Nicholson, Mon. Brit. Strom. p. 172 (1891).

Cœnosteum apparently massive, splitting easily into concentric strata, but not perfectly latilaminar in growth. The base and actual surface are unknown. Surfaces exposed by concentric fractures (Pl. VIII. fig. 3) show numerous minute and low protuberances or "mamelons," which are placed about 3 millim. apart, and each of which represents the centre of a small astrorhiza. The astrorhizæ are disposed in vertical systems, each of which is furnished with an axial wall-less tube, the aperture of which is placed at the summit of one of the small "mamelons" above mentioned. The intervals between these are occupied by innumerable small pores representing the mouths of the zoöidal tubes. Though the actual surface has not been observed, it may be taken as certain that its characters would be the same as those just described as distinctive of a concentric lamina within the mass of the cœnosteum.

The skeleton-fibre is minutely porous and about $\frac{1}{8}$ millim. in diameter, the skeletal tissue being completely reticulated and constituting a fine and close network. Tangential sections (Pl. VIII. fig. 1) exhibit the general skeletal network traversed by the branching horizontal canals of the astrorhizæ, and perforated by minute pores representing the transversely divided zoöidal tubes. Vertical sections (Pl. VIII. fig. 2) show recognizable radial pillars, about eight of which, with their intervening zoöidal tubes, occupy the space of 2 millim. measured transversely. The zoöidal tubes communicate freely by lateral apertures, and are furnished with few transverse partitions or tabulæ. Vertical sections also show very conspicuously the vertical wall-less axial canals of the astrorhizal systems.

Obs. This species, as I have elsewhere pointed out (Mon. Brit. Strom. p. 172), is very closely related to *S. typica*, Rosen, from which it is distinguished by the following more important characters:—

- a. The astrorhizæ are regularly arranged in vertical systems, each system having an axial wall-less canal of comparatively considerable size.
- b. As the result of the above, the surface shows nume-

rous minute pointed "mamelons," each of which is perforated at its summit by the aperture of the axial canal of one of the astrorhizal systems.

- c. The centres of the astrorhizæ are considerably closer together than in *S. typica*, in which species they are usually from 5-6 millim. apart.
- d. The zoöidal tubes are furnished with fewer tabulæ than those of *S. typica*, and also communicate more freely, giving to vertical sections a more lax and open aspect. The apparent scanty development of tabulæ may, however, be the result of poor preservation.
- e. The skeleton-fibre is a little coarser and the skeletal network is not quite so fine as in *S. typica*.

Upon the whole therefore, and in view of the above-mentioned distinctions, I am disposed to regard *S. hudsonica* as a good species. It is, however, obviously closely related to *S. typica*, Rosen, and may be considered as representing this common European species in the Silurian rocks of the New World.

Formation and Locality. Silurian formation, Albany River, Hudson's Bay, and Cape Churchill. The fragments upon which the above description has been drawn up were furnished to me by Mr. Whiteaves, and the specimens from which they were taken were collected in 1878 by Prof. R. Bell. The specimen from Albany River is the one upon which Sir W. Dawson originally founded his *Caunopora hudsonica*; but its preservation is not so good as that of the example from Cape Churchill.

Stromatopora, sp.

(Cf. *S. bücheliensis*, Bargatzky, sp.)

Two specimens in the collection of the Geological Survey of Canada, from the Devonian rocks of Lake Winnipegosis, have the general aspect of *Stromatopora bücheliensis*, Barg., sp., and are probably referable to this species. Unfortunately the specimens in question are dolomitized, and their internal structure is so far altered that this reference cannot be regarded as free from doubt.

S. bücheliensis is distinguished from *S. Hüpschii*, Barg., sp., its nearest ally, by its comparatively fine skeleton-fibre and correspondingly close texture, and by the smaller size and greater remoteness of the astrorhizæ. I have elsewhere fully

described and figured this species (Mon. Brit. Strom. p. 186, pl. x. figs. 5-7, and pl. xxiii. figs. 4-7); and the Canadian specimens, from their poor preservation, necessarily afford nothing further to add to our information regarding the species.

Formation and Locality. The specimens which I am disposed to refer here are from the Devonian rocks of Lake Winnipegosis (Islands 50 and 56, Dawson Bay). Another specimen, from Snake Island, may perhaps be also referable to this species.

Stromatopora, sp.

(Cf. *Stromatopora Hüpschii*, Barg., sp.)

Two of the specimens collected by the officers of the Geological Survey from the Devonian rocks of Lake Winnipegosis belong to a species of *Stromatopora* in many respects similar to *S. Hüpschii*, Barg. Structurally these specimens agree with the latter common European and British type, and differ from *S. bücheliensis*, Barg., in their coarse skeleton-fibre, the lax reticulation of the skeleton, and the loose spreading form of the astrorhizæ. The internal structure of these specimens is, however, very poorly preserved, and it would be rash to refer them unreservedly to *S. Hüpschii*.

Formation and Locality. Dolomitic limestones of Devonian age, Lake Winnipegosis.

Stromatopora Carteri, Nich. (Pl. IX. figs. 5 and 6.)

Stromatopora Carteri, Nicholson, Mon. Brit. Strom. p. 174, pl. i. figs. 6 and 7, and pl. xxiii. figs. 1 and 3 (1886 and 1891).

The cœnosteum in this species is massive and irregular in shape and is composed of gently curved latilaminæ, while the upper surface is without "mamelons," and does not exhibit clearly developed astrorhizæ. The skeleton-fibre is thick and coarsely porous. Vertical sections (Pl. IX. fig. 6) show that each latilamina is composed of stout radial pillars, somewhat flexuous, and running continuously from the bottom to the top of each latilamina, and united into an open network by a few irregular connecting-processes. The zoöidal tubes are furnished with "tabulæ," and are separated by the radial pillars, about seven of which, with their intervening tubes, occupy a space of 2 millim. measured transversely. Tangential sections (Pl. IX. fig. 5) show a loose reticulate skeleton, perforated by the transversely divided zoöidal tubes, which may be

distinct or may become laterally confluent, and thus give rise to sinuous loops.

Obs. This species was originally based upon specimens from the Wenlock Limestone of Britain, and it has not hitherto been certainly recognized elsewhere. The Silurian rocks of Oesel yield, however, a closely allied form, which I have provisionally named *Stromatopora borealis*, and which I may figure and briefly describe here. These two forms agree with one another in the main details of their minute structure, but they differ, amongst other points, in their mode of growth and in the relative development of the astrorhizæ. In the typical *S. Carteri*, Nich., the cœnosteum is massive and astrorhizæ are altogether wanting or are most imperfectly developed; whereas in *S. borealis*, Nich., the cœnosteum is laminar and astrorhizæ are extensively developed. The single Canadian specimen which I possess is a fragment only; but it appears to be a portion of a massive specimen, and it shows no definite astrorhizæ, and I therefore refer it to *S. Carteri*.

Formation and Locality. The only Canadian example I have seen is from a loose boulder of Silurian age, from Hayes River, Hudson's Bay (*coll. R. Bell, 1878*).

Stromatopora borealis, Nich. (Pl. IX. figs. 7 and 8.)

The cœnosteum in this species forms flat laminar expansions, attaining when mature a diameter of several inches, with a thickness of from a centimetre or less to more than 2 centimetres. The under surface was covered by an epitheca, and was attached by a limited point to some foreign body. The skeleton-fibre is thick and coarsely porous, and the skeletal tissue is of the completely reticulate type, while the mode of growth is not latilaminar.

The surface exhibits vermiculate ridges, which inosculate with one another so as to form a coarse network corresponding with the reticulated skeleton, the elongated or rounded meshes of the network corresponding with the apertures of the more or less confluent zooidal tubes. The surface also shows very well developed, ramified astrorhizæ, which do not open upon definite "mamelons," and which have their centres from 10 to 12 millim. apart.

Tangential sections (Pl. IX. fig. 7) show the vermiculate skeletal network, with sinuous and often elongated meshes representing rows of confluent zooidal tubes. Vertical sections (Pl. IX. fig. 8) show stout, flexuous, radial pillars, united by irregular, oblique, and equally stout connecting-processes, and separated by the zooidal tubes. About six pillars with their

intervening tubes occupy the space of 2 millim. measured transversely. The zooidal tubes are crossed by well-developed transverse partitions or "tabulæ," which are often placed at the same level as neighbouring tubes, and thus appear to be continuous.

Obs. In the general structure of its skeleton *S. borealis*, as I have elsewhere pointed out (Mon. Brit. Strom. p. 175), is very closely related to *S. Carteri*, Nich.; but it seems to be sufficiently separated from this as a distinct species by the following characters:—

- a. The cœnosteum is a thin laminar expansion, with a basal epitheca, and not composed of definite latilaminæ. On the other hand, *S. Carteri* is a massive form, with a marked latilaminar mode of growth.
- b. Astrorhizæ are numerous and well developed, whereas these structures are wanting altogether or are quite rudimentary in *S. Carteri*.
- c. The zooidal tubes have numerous tabulæ which are often placed at the same level in contiguous tubes, so as to give rise to the appearance of successive continuous concentric lines.

Formation and Locality. Silurian (Upper Oesel formation), Kattripank, Oesel (coll. H. A. Nicholson).

Actinostroma expansum, Hall and Whitf., sp.
(Pl. X. figs. 1 and 2.)

Stromatopora expansa, Hall and Whitfield, 23rd Ann. Rep. on the State Cabinet, p. 226, pl. ix. fig. 9 (1873).

The cœnosteum in this species forms "large expanded masses, sometimes of many feet in extent, with a slightly uneven or undulating surface, which is covered with broad low prominences, distant from centre to centre $\frac{3}{8}$ to $\frac{1}{2}$ inch" (Hall and Whitfield, *loc. cit.*). In spite of the presence of the prominences above spoken of, astrorhizæ are practically absent, being either quite unrecognizable or being represented merely by one or two pores of larger size than the zooidal apertures.

The skeleton-fibre is solid and of medium thickness. Tangential sections (Pl. X. fig. 1) show the typical "hexactinellid" structure of the genus *Actinostroma*—the radial pillars, as seen in cross-section, being rounded or subangular and being united by radially disposed connecting-processes or

“arms” of considerable thickness, thus enclosing subangular zoöidal meshes.

Vertical sections (Pl. X. fig. 2) show stout radial pillars, united at about their own width apart by tolerably regular “concentric laminae.” About six pillars, with their intervening spaces, occupy the space of 2 millim. measured transversely.

Obs. In the microscopic structure of the skeleton *A. expansum*, H. & W., closely approaches *A. clathratum*, Nich., the commonest species of *Actinostroma* in the European and British Devonian rocks; and it may be regarded as the American representative of this species. It differs, indeed, from typical examples of *A. clathratum* in no marked structural feature, except that the radial pillars are somewhat stouter and are more irregularly developed. On the other hand, *A. expansum* differs from *A. clathratum* in the apparently constant feature that the skeletal layers are thrown into slight but regular, circumscribed undulations, which give rise on each successive lamina to low and broad eminences, the centres of which are from 1 to 1½ centim. apart. The surface thus acquires a characteristic aspect, which has been well figured by Hall and Whitfield (*loc. cit. suprà*) and which is not observable in *A. clathratum*.

In the character just mentioned *A. expansum* presents a general superficial resemblance to the fossil which I described from the Corniferous Limestone of Ohio (Pal. of Ohio, vol. ii. p. 249, fig. 3, 1875) as *Stromatopora nodulata*. Even superficially, however, this resemblance is not complete; and I shall show later on in this paper that the latter form is proved by its possession of a porous skeleton-fibre to belong in reality to the genus *Syringostroma*, while its skeletal structure is much coarser than that of *A. expansum*.

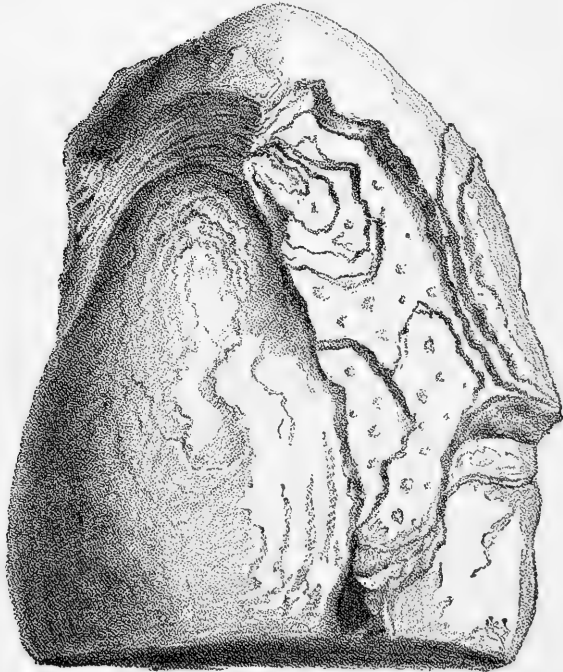
Formation and Locality. Devonian (Chemung beds), Rockford, Iowa. In the collection of the Geological Survey of Canada are two specimens from the Devonian rocks of Lake Winnipegosis (Island 52, Dawson Bay) which appear to agree in essential respects with the present species. As the internal structure, however, of these specimens is but imperfectly preserved, I have based the above description upon a specimen from Rockford, Iowa, kindly furnished to me by Mr. Whiteaves.

Actinostroma Tyrrellii, Nich.
(Pl. VIII. figs. 4 and 5.)

The cœnosteum of this species (woodcut, fig. 1) is massive,

conical, or hemispherical in form, sometimes of large size. Though the cœnosteum splits with great facility into thicker or thinner concentric strata, the mode of growth is not definitely latilaminar. The surface is covered with minute and close-set tubercles representing the upper ends of the radial pillars, and also exhibits numerous small, few-branched astrophorizæ, the centres of which are from 3 to 5 millim. apart. The astrophorizæ are superimposed in vertical systems and the axial canals of these commonly open on minute, slightly

Fig. 1.



Side view of an exfoliated specimen of *Actinostroma Tyrrellii*, Nich., of the natural size. The specimen is one in which "mamelons" are but incompletely developed, and the basal portion has been cut off. Devonian, Lake Winnipegosis, Canada. (Coll. Geol. Survey of Canada.)

elevated, conical prominences or "mamelons," the summits of which are also 3-5 millim. apart. In some specimens, however, these "mamelons" are very faintly marked, or, indeed, may not be recognizable at all.

The internal structure is that of a typical *Actinostroma*. Vertical sections (Pl. VIII. fig. 5) show that the cœnosteum is composed of close-set and comparatively slender radial pillars, which are united at short intervals by very closely arranged "concentric laminae," formed by the section of the horizontal connecting-processes. About twelve radial pillars and about eighteen or twenty "concentric laminae" occupy a space of 2 millim., measured respectively transversely and vertically.

Tangential sections (Pl. VIII. fig. 4) show a well-marked "hexactinellid" structure, the rounded and close-set ends of the transversely divided radial pillars being connected by well-developed whorls of connecting-processes or "arms," which enclose minute, angular, zoöidal meshes.

Obs. In its general form and superficial aspect, as well as in many of the details of its internal structure, *A. Tyrrellii* presents a very close resemblance to *A. stellulatum*, Nich. It may therefore be regarded as representing in the American continent the latter very common and characteristic species of the Devonian rocks of Europe and Britain. In fact there are no *external* or obvious features by which these two forms may be distinguished, except that in *A. Tyrrellii* the astrorhizæ are decidedly more closely set than in *A. stellulatum* (in which they are often 6-8 millim. apart), and that the centres of these structures are commonly placed on small and markedly pointed "mamelons," such eminences in *A. stellulatum* being, when present at all, low and flat. This distinction does not, however, amount to much, seeing that in both forms "mamelons" may not be developed at all.

On the other hand, *A. Tyrrellii* differs markedly from *A. stellulatum* in the following details of *internal* structure:—

- a. The horizontal connecting-processes or "arms," by which the radial pillars are united at definite levels, are very well developed in *A. Tyrrellii*, whereas they are incompletely so in *A. stellulatum*. Hence tangential sections of the former (Pl. VIII. fig. 4) show the "hexactinellid" structure characteristic of the typical *Actinostromæ*, while corresponding sections of the latter want this structure and more closely resemble similar sections in *Clathrodictyon*.
- b. The whorls of horizontal connecting-processes (which, as seen in vertical sections, give rise to the "concentric laminae") are developed at very short intervals, being from $\frac{1}{9}$ to $\frac{1}{10}$ millim. apart, and thus considerably nearer to one another than are the radial pillars.

Hence vertical sections (Pl. VIII. fig. 5) assume a characteristic latticed aspect. In *A. stellulatum*, on the other hand, the concentric laminæ are from $\frac{1}{8}$ to $\frac{1}{6}$ millim. apart.

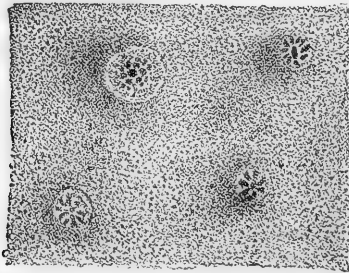
- c. The radiating astrorhizal canals are much less developed than they are in *A. stellulatum*. Hence vertical sections do not markedly exhibit the large rounded apertures produced by the cutting across of these tubes, such apertures forming a conspicuous feature in similar sections of *A. stellulatum*.

Formation and Locality. Apparently common in dolomitic limestones of Devonian age, Lake Winnipegosis, Canada (*coll. Geol. Survey of Canada*).

Actinostroma Whiteavesii, Nich. (Pl. IX. figs. 3 and 4.)

The cœnosteum in this species is massive and hemispherical in form, with an imperfect latilaminar structure. The skeletal laminæ are undulated in such a manner as to give rise to low and broad eminences, which are placed about 8 millim. apart. These eminences represent the points where the astrorhizæ open on the surface; but these structures are peculiar in so

Fig. 2.



Portion of the exfoliated surface of one of the laminæ of *A. Whiteavesii*, Nich., enlarged twice, showing the superficial eminences and the rosette-like openings of the astrorhizal canals. Devonian, Little Red River, Canada. (*Coll. Geol. Survey Canada*.)

far that they are entirely circumscribed and do not appear to send out any radiating horizontal branches. Each astrorhiza in fact consists simply of a group of short vertical canals, of larger calibre than the ordinary zooidal tubes, which open in a rosette-like cluster at the summit of the eminences above spoken of, the canal-apertures often having a distinctly radial arrangement (woodcut, fig. 2).

In microscopic structure *A. Whiteavesii* is a typical *Actinostroma*, the cœnosteum consisting of parallel radial pillars united at corresponding levels by whorls of horizontal connecting-processes or "arms." As seen in vertical sections (Pl. IX. fig. 4) the radial pillars are of moderate thickness, about ten occupying the space of 2 millim. measured transversely, while the whorls of connecting-processes (forming the "concentric laminae") are decidedly more distant, about seven only of these structures being present in the same space measured vertically.

In tangential sections (Pl. IX. fig. 3) the rounded ends of the transversely-divided radial pillars are seen to be united by very regularly developed whorls of connecting-processes, the thickness of which is very nearly equal to the diameter of the radial pillars themselves. The result of this is that tangential sections coinciding with the plane of the laminae show a characteristic areolated structure, which is not at all unlike that exhibited by corresponding sections of some Monticuliporoids.

Obs. In its general aspect and its surface-characters the present species resembles *A. expansum*, Hall and Whitfield, the most obvious difference being that the low and rounded eminences characterizing the surface of the laminae in both species are smaller and nearer together in *A. Whiteavesii* than in the case of the latter. *A. Whiteavesii* also more or less nearly resembles the Stromatoporoids which Quenstedt has figured from the Devonian rocks of North America under the names of *Stromatopora pustulifera* and *S. monticulifera* ('Petrefaktenkunde Deutschlands: Schwämme,' Taf. cxlii.). As I have, however, elsewhere pointed out, mere external features, taken by themselves, are as a rule wholly unreliable in determining the affinities of the Stromatoporoids, and only become of value when taken along with the characters derived from the internal structure of the skeleton. Quenstedt's figures and descriptions of the forms to which he has given the above names are, however, unfortunately of little use except to give an idea of external features, and leave us almost entirely ignorant of the real structure of the cœnosteum. It is therefore impossible to be certain as to even the generic position of the forms in question. Both forms, however, are stated to possess well-developed astrorhizæ of the ordinary type, and are figured with such; and it may therefore be taken as tolerably certain that neither *A. expansum*, Hall and Whitf., nor *A. Whiteavesii*, Nich., can be identical with either of Quenstedt's types.

Though, as just stated, *A. Whiteavesii* has a general resemblance to *A. expansum*, Hall and Whitf., it is at once distin-

guished from this by the much finer structure of the skeleton, as also by the exceptional relative thickness and the very regular development of the connecting-processes of the radial pillars. The areolated aspect of tangential sections, resulting from the characters last mentioned, is indeed the essential peculiarity of *A. Whiteavesii*. Another very characteristic feature, by which the species is distinguished from allied forms, is the reduction of the astrorhizæ to their vertical canals only and the arrangement of the apertures of these in more or less definite rosette-like groups.

Formation and Locality. Devonian, Little Red River, Canada (*coll. Geol. Survey Canada*).

Actinostroma matutinum, Nich.

(Pl. IX. figs. 1 and 2.)

Cœnosteum massive, the laminæ undulated in such a way as to give rise to rounded eminences. Astrorhizæ apparently wanting, or at any rate imperfectly developed.

Vertical sections (Pl. IX. fig. 2) show strong radial pillars united at short intervals by stout "concentric laminæ." About six or seven radial pillars occupy a space of 2 millim. measured transversely, while nine to twelve "concentric laminæ" occupy the same space measured vertically. Owing to the undulation of the laminæ tangential sections (Pl. IX. fig. 1) are more or less unsatisfactory, as they necessarily cut obliquely across several successive laminæ; but they show the large rounded ends of the transversely divided pillars, united in places by thick connecting-processes.

Obs. Having mislaid my original notes on this type, and having returned to Mr. Whiteaves the specimens upon which these were based, I am not at this moment able to characterize the present species otherwise than by its microscopic structure. So far as this is concerned the species seems to be intermediate in character between *A. clathratum*, Nich., and *A. fenestratum*, Nich., its distinctive features being the thick radial pillars and the strong, close-set, and regularly developed "concentric laminæ."

Formation and Locality. Chaleur Group, Div. 1, L'Anse au Gascon, Quebec (*coll. Geol. Survey Canada*).

Actinostroma fenestratum, Nich.

(Pl. X. figs. 3 and 4.)

Actinostroma fenestratum, Nicholson, Mon. Brit. Strom. p. 146, pl. xvii. figs. 8 and 9 (1889).

The cœnosteum in this species is massive and not definitely

latilaminar in growth, while the concentric skeletal layers are simply curved and not undulated. The surface is therefore devoid of prominences or "mamelons." As a rule there are well-developed astrorhizæ which possess numerous ramified branches and have their centres from 1 to 1½ centim. apart. The astrorhizæ do not appear to be superimposed in vertical rows and do not possess conspicuous axial canals.

The skeleton-fibre is coarse, but is not porous. Vertical sections (Pl. X. fig. 4) show exceptionally strong radial pillars, very regularly parallel, and running without a break for long distances. About five or six pillars occupy a space of 2 millim. measured transversely. The connecting-processes of the radial pillars are thick and irregular, about seven or eight "concentric laminae" occupying the space of 2 millim. measured vertically.

Tangential sections (Pl. X. fig. 3) show the large circular or oval ends of the transversely divided pillars, joined by thick and irregular connecting-processes and separated by rounded zoöidal pores or by branches of the astrorhizal canals.

Obs. This species was originally described by me from examples obtained from the pebbles of Devonian limestone in the Triassic conglomerates of South Devon, none of such specimens being more than fragmentary. The collections of the Geological Survey of Canada contain, however, some specimens from the Devonian limestones of Lake Manitoba which appear to be unquestionably referable to *A. fenestratum*, and which show that the cœnosteum was massive, not latilaminar, and without astrorhizal prominences.

A. fenestratum is readily distinguished from all the other species of *Actinostroma* by the very coarse character of the skeletal fibre. In this respect the Canadian specimens—perhaps owing to their mode of preservation in dolomitic limestones—somewhat surpass the English examples, the latter having five or six pillars in 2 millim., while four or five pillars occupy the same space in the former. [It may be noted that tangential sections are not unlike similar sections of badly preserved examples of *Stromatopora Beuthii*, Barg., but are at once distinguished by the fact that the skeleton-fibre is solid and not porous.]

Among the American species of *Actinostroma* the present species stands nearest to *A. expansum*, Hall and Whitf., from which it is distinguished by its coarser skeleton-fibre, the simply curved laminae, the absence of the flat and rounded "mamelons" of the latter, and the well-developed condition of the astrorhizæ. *A. fenestratum* also presents a resemblance to *Syringostroma ristigouchense*, Spencer; but these two forms

differ from one another in the fundamental character of the solid or porous condition of the skeleton-fibre, while the connecting-processes of the radial pillars are markedly different.

Formation and Locality. The typical Canadian specimens of *A. fenestratum* are from dolomitic limestones of Devonian age, "Pentamerus Point," Lake Manitoba. These are non-infiltrated examples; but the minute structure of the skeleton-fibre has been affected by crystallization, the axial canals of the radial pillars being thus more or less entirely obliterated. Less typical examples, in an infiltrated condition, occur in the Devonian rocks of Lake Winnipegosis. These have a finer structure and less highly developed astrorhizæ than the typical examples from Lake Manitoba; but their state of preservation does not admit of their being satisfactorily separated from the latter.

Syringostroma ristigouchense, Spencer.
(Pl. VIII. figs. 6-8.)

Cœnostroma ristigouchense, Spencer, Bull. Univ. of the State of Missouri, p. 49, pl. vi. figs. 12, 12 a (1884).

Syringostroma ristigouchense, Nicholson, Mon. Brit. Strom. p. 97, pl. xi. figs. 11 and 12 (1886).

The cœnosteum in this species is massive, more or less definitely latilaminar in growth, and readily splitting into thick strata concentric with the surface. The laminae are gently curved, and there are either no astrorhizal eminences ("mamelons") or but very inconspicuous ones. Astrorhizæ are as a rule very well developed, being of large size and much branched; they are arranged in vertically superimposed systems, and have their centres about 1 centim. apart.

Vertical sections (Pl. VIII. fig. 7) show the skeleton to be composed of thick, close-set, parallel, radial pillars, which are minutely porous in structure. The radial pillars are separated by narrow zooidal tubes, about five or six pillars occupying a space of 2 millim. measured transversely, while about seven "concentric laminae" occupy the same space measured vertically. Tangential sections (Pl. VIII. figs. 6 and 8) show the large rounded ends of the transversely-divided radial pillars, placed close together and united in a stellate manner by whorls of delicate radiating connecting-processes or "arms." The rounded or sinuous pores included within the "hexactinellid" network thus formed represent the zooidal tubes as seen in section.

Obs. In the fact that the cœnosteum consists of well-developed radial pillars, united at corresponding levels by whorls

of connecting-processes, *Syringostroma ristigouchense* resembles an *Actinostroma*, while in the minutely porous structure of the skeleton-fibre it entirely resembles a typical *Stromatopora*. The only closely allied form with which the present species could be confounded is *Syringostroma nodulatum*, Nich., from which it is distinguished by the more dense character of the skeletal network and the fact that the laminae are not so undulated as to give rise to astrorhizal eminences.

Formation and Locality. Silurian (Lower Helderberg formation?), Dalhousie, New Brunswick (coll. J. W. Spencer and Geol. Survey of Canada).

Syringostroma nodulatum, Nich.
(Pl. X. figs. 5-7.)

Stromatopora nodulata, Nicholson, Palæontology of Ohio, vol. ii. p. 249, pl. xxiv. figs. 3-3 b (1875).

The cœnosteum in this species is massive, splitting readily into thick concentric strata. The laminae are sharply undulated, so as to give rise to prominent conical astrorhizal eminences or "mamelons," the summits of which are rounded and are placed about 12 millim. apart (Pl. X. fig. 7). The astrorhizæ themselves are fairly developed, but their branches are small and rapidly become lost in the general skeletal network. They are disposed in vertical systems, each system being provided with a small wall-less axial canal, which opens at the summit of one of the "mamelons" just spoken of.

Vertical sections (Pl. X. fig. 6) show that the skeleton is composed of strong radial pillars, which have a minutely porous structure and are disposed at right angles to the undulated "concentric laminae." About six or seven pillars occupy the space of 2 millim. measured transversely. The concentric laminae are regularly undulated and are closer together where they bend upwards to form the mamelons than in the concavities between the latter.

Tangential sections (Pl. X. fig. 5) show the cut ends of the transversely divided pillars, often more or less angular in outline, united together by a comparatively small number of delicate connecting-processes. The spaces between the cut ends of the pillars are comparatively wide and irregular, and represent sections of the zooidal tubes.

Obs. This species agrees with the preceding in combining in its cœnosteum the general structure of an *Actinostroma* with the minutely porous skeleton-fibre of a *Stromatopora*. It is most obviously separated from *S. ristigouchense*, Spencer, *Ann. & Mag. N. Hist.* Ser. 6. Vol. vii. 23

by the possession of exceedingly well-marked conical or rounded astrorhizal prominences or "mamelons," due to the close and sharp undulations of the laminae. It is also separated from the latter by the smaller thickness of the radial pillars and the more open character of the skeletal network thence resulting, the comparatively small number of connecting-processes, the less perfectly circumscribed zoöidal pores, and the less completely developed astrorhizæ.

Formation and Locality. Devonian (Corniferous Limestone), Kelley's Island, Ohio. The above description is based on a fragment of the original specimen described (*coll. Geol. Survey of Ohio*).

Syringostroma densum, Nich. (Pl. X. figs. 8 and 9.)

Syringostroma densa, Nicholson, Palæontology of Ohio, vol. ii. p. 251, pl. xxiv. figs. 2-2b (1875).

Syringostroma densum, Nicholson, Mon. Brit. Strom. p. 97, pl. xi. figs. 13 and 14 (1886).

The cœnosteum in this species is probably massive; but fragments have the form of irregular laminae, with a dense and close texture. The concentric laminae of the skeleton are gently curved, but do not give rise to superficial eminences or "mamelons." The astrorhizæ are of large size, with ramified and inosculating horizontal branches.

Vertical sections (Pl. X. fig. 9) show numerous close-set and irregular radial pillars of small size having a minutely porous structure and united by irregular connecting-processes in a partially reticulate manner. The general tissue thus formed is traversed at intervals by radial pillars of much greater size than the normal. About ten to twelve small pillars are found in a space of 2 millim. measured transversely, while the large pillars are about 1 millim. apart. Vertical sections also show conspicuously the large rounded apertures representing the transversely divided horizontal canals of the astrorhizæ.

Tangential sections (Pl. X. fig. 8) show a general closely reticulated tissue of a minutely porous character, in which the cut ends of the smaller radial pillars are only with difficulty or not at all recognizable as distinct structures. This network exhibits at irregular intervals rounded dark masses of comparatively considerable size, representing the cut ends of the large radial pillars above spoken of. Tangential sections also show the inosculating astrorhizal canals and the minute and irregular sections of the zoöidal tubes.

Obs. My material of this remarkable Stromatoporoid being

unfortunately very limited, I am not able to give more than the above very imperfect account of its characters. Its minute structure, as revealed by microscopic sections, is so peculiar, that it could not well be confounded with any other Stromatoporoid known to me. Its true affinities, however, must remain doubtful until its structural features have been more fully worked out by an examination of well-preserved specimens.

Formation and Locality. Devonian (Corniferous Limestone), Kelley's Island, Ohio (*coll. Geol. Survey of Ohio*).

ADDENDUM.

In describing *Clathrodictyon variolare*, Ros., sp., in my 'Monograph of the British Stromatoporoids' (p. 151), I was not able to refer to the species as occurring in the Palæozoic rocks of North America. In the collections of the Geological Survey of Canada, however, I find at least two specimens which appear to belong to this widely distributed European type. One of these is a large hemispherical specimen from the Hudson-River formation of Cape Smyth, Lake Huron. The other example, also of large size, is from the Silurian rocks of the Jumpers, Anticosti, and is believed to be the specimen referred to by Mr. Billings in the 'Geology of Canada' (p. 304, 1863) under the name of *Stromatopora concentrica*.

EXPLANATION OF THE PLATES.

[All the figures of minute structure are based upon photographs, the general scale of enlargement being about ten times the natural size. Where the figures are enlarged further, or are of the natural size, this is specially stated.]

PLATE VIII.

- Fig. 1.* Tangential section of *Stromatopora hudsonica*, Dawson, sp. Silurian, Cape Churchill, Canada.
- Fig. 2.* Vertical section of the same.
- Fig. 3.* Portion of the surface of an exfoliated lamina of the same, of the natural size.
- Fig. 4.* Tangential section of *Actinostroma Tyrrellii*, Nich., from the Devonian Rocks of Lake Winnipegosis, Canada.
- Fig. 5.* Vertical section of the same.
- Fig. 6.* Tangential section of *Syringostroma ristigouchense*, Spencer, sp., from the Silurian Rocks of Dalhousie, New Brunswick.
- Fig. 7.* Vertical section of the same, similarly enlarged.
- Fig. 8.* Part of a tangential section of the same, enlarged about twenty times.

- Fig. 9.* Tangential section of *Stromatopora antiqua*, Nich. & Murie, from the Niagara Limestone of Thorold, Ontario.
Fig. 10. Vertical section of the same, similarly enlarged.
Fig. 11. Part of a tangential section of the same, enlarged about twenty times.

PLATE IX.

- Fig. 1.* Tangential section of *Actinostroma matutinum*, Nich. Chaleur Formation, L'Anse au Gascon, Quebec. The section cuts the laminæ obliquely.
Fig. 2. Vertical section of the same.
Fig. 3. Tangential section of *Actinostroma Whiteavesii*, Nich. Devonian Rocks, Little Red River, Canada.
Fig. 4. Vertical section of the same. The section is not strictly vertical, and the radial pillars appear therefore to be more broken and interrupted than they really are.
Fig. 5. Tangential section of *Stromatopora Carteri*, Nich., from a boulder of Silurian Limestone, Hayes River, Hudson's Bay.
Fig. 6. Vertical section of the same.
Fig. 7. Tangential section of *Stromatopora borealis*, Nich. Silurian (Upper Oesel Formation), Kattripank, Oesel.
Fig. 8. Vertical section of the same.

PLATE X.

- Fig. 1.* Tangential section of *Actinostroma expansum*, Hall and Whitfield, sp. Devonian Formation, Rockford, Iowa.
Fig. 2. Vertical section of the same.
Fig. 3. Tangential section of *Actinostroma fenestratum*, Nich. Devonian Rocks, "Pentamerus Point," Lake Manitoba.
Fig. 4. Vertical section of the same.
Fig. 5. Tangential section of *Syringostroma nodulatum*, Nich. Corniferous Limestone, Kelley's Island, Ohio.
Fig. 6. Vertical section of the same.
Fig. 7. Portion of the surface of an exfoliated lamina of the same, natural size.
Fig. 8. Tangential section of *Syringostroma densum*, Nich. Corniferous Limestone, Kelley's Island, Ohio.
Fig. 9. Vertical section of the same.

XXXIV.—*Notes on Slugs, chiefly in the Collection at the British Museum.* By T. D. A. COCKERELL.

[Continued from p. 107.]

VI. THE *PIRAINEA* SECTION OF *AMALIA*.

THAT section of *Amalia* which includes *A. gagates*, called by Lessona and Pollonera *Pirainea*, differs very much from *Tandonia* in its distribution. The latter is strictly confined to the European region, the occurrence of a species in

Ecuador being merely the result of an accidental importation, while *Pirainea* has species in the most distant parts of the globe, and is almost cosmopolitan in temperate regions, where the climate is damp and fairly uniform. Dryness and extremes of temperature seem unfavourable to it, so that we get no representatives in Eastern Europe, temperate Asia, or Eastern North America. In considering the species of *Pirainea*, it will be convenient to arrange them under the various regions in which they occur.

a. European Region.

Amalia gagates (Drap.).

A very polymorphic species, not very variable in any particular locality, but differing very much in the different regions which it inhabits. English specimens are smaller than those from the Mediterranean Region, and not so dark, being also much smoother and more pellucid. The forms found on the borders of the Mediterranean are often very large, intensely black, and quite rugose. Generally speaking, in warm climates the species seems to become darker, more opaque, and more rugose. If we compare an English example with one from Sicily it is hard to believe that they are even closely allied.

Limax gagates, as figured by Draparnaud (Hist. Nat. Moll. 1805, pl. ix. figs. 1, 2), looks like the English form, but is described as black, shiny, with the body striate-subrugose. This must be considered the type. It is the var. *typus* of Lessona and Pollonera, and is a phase of the species met with in many localities where *gagates* is found. It differs from the usual English race in being black and more rugose; but it is not so rugose as some of the Mediterranean forms, and is only of moderate size.

Férussac's figures of *L. gagates* (Hist. Nat. Moll. pl. vi. figs. 1, 2) resemble the English form more nearly as to colour and agree in size; but fig. 1 has the rugæ rather too strong. Moquin-Tandon's plate ii. fig. 1 is like the English race, but the mantle has small spots; these spots are not mentioned in the description.

It thus appears that *Amalia gagates* in France, although much like the English form of the species, tends to become more rugose and darker, thus approaching the southern varieties. But in the north of France at least the var. *plumbea* is found not at all different from those in England.

Amalia (gagates subsp.) plumbea (Moq.).

Smother than the type, but of about the same size. Colour plumbeous, usually darker on the back than at the sides. Found in many parts of England and also in France. The British Museum contains examples from Bath (*J. E. Daniel*) and South Shields (*R. Howse*).

Amalia plumbea, var. *olivacea* (Moq.).

Like the last, but olivaceous. England, France, and Italy. Whether the Italian form is like subsp. *plumbea* in structure and size I do not know; but *olivacea* as found in England falls under *plumbea*.

Amalia plumbea, var. *rava* (Wllms.).

A drab-coloured form found in the west of England. There is a specimen from Bath (*J. E. Daniel*) in the British Museum.

Amalia plumbea, forma nov.

Pale lavender-colour. Found in Cardiganshire (see *J. W. Taylor*, *Journ. of Conch.*, Oct. 1888, p. 360).

Amalia gagates, forma *typus*, Less. & Poll.

Of moderate size, rather rugose, black. Rare in England, frequent in Southern Europe. The British Museum has a specimen from Bath (*J. E. Daniel*) which may be referred to *typus*; but it has really the coloration of the American var. *Hewstoni*, being black or blackish, with the sides and sole pale.

Amalia gagates, forma *Benoiti*, Less. & Poll.

Black, with the keel whitish. Italian.

Amalia gagates, forma nov. *atlantica*.

This is based on a specimen found at Tangier, collected by Mr. J. H. Ponsonby. It may be described as follows:—

Length 28, breadth $4\frac{1}{2}$ millim. Head black; mantle jet-black, respiratory orifice a little posterior to the middle, hinder part of mantle considerably raised; body black, slightly translucent at sides, keel entire, rugæ not well marked; body

rather smooth; foot-fringe black; sole grey and slightly translucent. Jaw dark brown, with a well-formed median projection.

This is, I presume, the same as Hesse's "*Amalia* nov. sp.?" also from Tangier; only his example was immature.

Mr. Ponsonby gave me a dried slug from Gibraltar, no doubt referable to *A. gagates*, but whether to this particular form I am not able to say.

Amalia gagates, var. *Bedriagæ*, Less. & Poll.

This Italian variety, as I am informed by Mr. Pollonera, is entirely black, of the same size as the type, but distinguished by having the lateral zones of the sole entirely black or blackish.

Amalia (gagates var. or subsp.) *mediterranea*, nov.

I apply this name to a large black subspecies found in Algeria and Sicily, in which the lateral areas of the sole tend to become dark. *A. gagates*, var. *Bedriagæ*, Less. & Poll., is very similar in colour, but is a form more closely allied to *gagates* proper.

Amalia mediterranea.

Length (in alcohol) 56 millim.; mantle 18 millim. long and 9 broad. Respiratory orifice $10\frac{3}{4}$ millim. from the anterior border of mantle. Hind end of mantle to end of body $37\frac{1}{3}$ millim. Sole $6\frac{1}{4}$ millim. diameter, median area $2\frac{3}{4}$ millim. diameter. Colour: all visible parts (except sole) black, anterior part of mantle free and white beneath. Sole with the median area pale ochrey and the lateral areas black. Mantle with a diamond-shaped (four-sided) sulcus; mantle coarsely rugose or wrinkled, elongate-oval, rounded in front, bluntly rounded behind, slightly emarginate at the commencement of the keel. Body elongate-cylindrical, tapering somewhat, keel only *well* developed posteriorly. Reticulations (sulci) longitudinal or simple, with a finer interstitial network. Mouth strongly wrinkled, slightly olivaceous. Sulcate lines on the sole as in *gagates*. Rugæ on body flattened. Slug rather dull black, though somewhat shiny, quite opaque.

Described from a specimen in the British Museum from East Algeria, received from Dr. Heynemann. Dr. Kobelt collected a lot of *Amalia gagates* in North Africa, and it was the opinion of the German malacologists that they could not be distinguished specifically from true *gagates*. I have com-

pared the above form very carefully with *A. gagates*, and it certainly seems worthy of a subspecific name.

Amalia mediterranea, forma nov. *similis*.

Length (in alcohol) $36\frac{1}{2}$ millim.; strongly keeled, keel rather flexuose. Opaque, wrinkly-rugose, grooved lines on body well marked, and connected by a network of smaller ones. Colour black, except sole, mouth-parts, and parts covered by the mantle, which are pale ochrey. Mantle emarginate behind. Lateral areas of sole narrower together than median area and greyer, in fact quite greyish, the median area being ochrey. Sole 6 millim. broad, median area $3\frac{1}{2}$ millim. broad.

Described from a specimen kindly sent to me by Mr. Pollonera, found at Catania, Sicily. It is evidently very close to the Algerian form described above, but not identical. In Lessona and Pollonera's 'Monograph,' p. 59, there is a reference to this Catania variety under *A. gagates*. Mr. Pollonera tells me that the sides of this form are sometimes pale.

Amalia ichnusæ, Less. & Poll.

A Sardinian form, perhaps a variety of *gagates*, from which it differs only by its smaller size and somewhat in its genitalia. Mr. Pollonera thinks that this might better be considered a subspecies or variety of *gagates* than any of the three Sicilian species described by him which have been referred thereto.

Amalia Doderleini, Less. & Poll.

Found at Palermo, and recognized by the black band on the mantle, which Mr. Pollonera says is never seen in the pale varieties of *gagates*.

Amalia (Monterosati, var.?) sicula, Less. & Poll.

This Palermo species, Mr. Pollonera informs me, is larger than the Catania *gagates* (my *similis*), much less rugose, and the shell is quite different, being like that on which Bourguignat founded his genus *Palizzolia*.

Amalia (scaptobia var.?) insularis, Less. & Poll.

A third species found at Palermo. Mr. Pollonera tells me it externally resembles *carinata*, Risso, much more than

gagates, but it approaches the latter in its genitalia. The mantle is mottled. Dr. Simroth has considered *Doderleini*, *sicula*, and *insularis* to be synonyms of *gagates*; but Mr. Pollonera writes (*in litt.* Jan. 13, 1891) that to him a *specific* character of *gagates* is its *lack of spots or bands*, and for this reason he cannot accept the proposed synonymy. He also observes that *insularis*, *Doderleini*, and the Algerian *scaptobia* all have the summit of the keel pale, while in *gagates* this is of the same colour as the back, except in the var. *Benoiti* from Messina, which was founded on a single specimen, and may be an individual abnormality.

Amalia scaptobia (Bourg.).

Found in Algeria and referred by Heynemann to *gagates*.

Mr. Pollonera writes that it was evidently described from a juvenile, but it is a spotted species, and therefore cannot be *gagates*.

Probably *A. insularis* of Sardinia and Sicily will prove to be a form of *scaptobia*.

A. eremiophila (Bourg.) from Algeria and *A. atrata* (Mab.) from Portugal are species of this section only known to me from what is published concerning them. This completes the series of European forms if we include *A. nigricans* (Schultz), which has not been identified by modern authors, and *A. Monterosati* (Bourg.), which is described from the shell alone, and is perhaps *A. sicula*, over which it has priority.

b. Atlantic Islands.

This geographical division will be thought perhaps a rather peculiar one, the more frequent custom being to treat of the islands under the heads of the continents to which they are nearest. Thus the Bermudas, as regards their general fauna, are distinctly American, while Madeira presents affinities with the western Mediterranean region. But so far as regards the slugs now under consideration, it may be said that all the insular forms are very much alike, and as many of the insular occurrences are doubtless the result of accidental introduction by human means, this is not surprising.

It might well be supposed that the wide distribution of *Pirainea* in islands and elsewhere was simply the result of accidental importations, and the slight changes from the type observable in many localities are certainly not greater than those which are known to have taken place in the case of

certain imported Mammals in the Falkland Islands; but in New Zealand there are native species, found nowhere else, which can hardly have sprung from ancestors brought there by human means.

The existence of peculiar species in New Zealand (and others reported from Tasmania) thus throws some doubt on the otherwise natural supposition that the insular, South African, and Western American forms of *A. gagates* were imported from Europe; and when we consider the very out-of-the-way localities in which they have been found, the theory of human accidental interference seems still less universally applicable.

Where, however, we find islands with no peculiar species of slugs, but with such cosmopolitan forms as *Amalia gagates*, *Agriolimæx agrestis*, and *Limæx flavus*, the probability that these have been introduced becomes practically a certainty, and "new species" described in the faunæ of oceanic islands must be looked on with suspicion when they belong to *Limæx*, *Amalia*, or *Agriolimæx*.

i. Madeira.

Amalia (gagates subsp.) drymonia (Bourg.).

Bourguignat appears never to have seen the various slugs he named *drymonius*, *abrostolus*, *calendymus*, and *polyptyelus* in Amen. Mal. vol. ii. (1859), and their characters are probably for the most part imaginary. *Amalia drymonia*, founded on Albers's account of the Madeiran *A. gagates*, is allied to the form *Benoiti*, to judge from the description; but whether any white-keeled *Amalia* really exists in Madeira seems at least questionable. The figures of the Madeiran and Canarian slugs given by Albers and d'Orbigny are so evidently coloured without serious regard to truth that species founded upon them cannot possibly be accepted as valid unless specimens resembling the figures should be found.

Amalia gagates, var. nov. *maderensis*.

Length (in alcohol) 14 millim., uniform dark brown, including foot; mantle blackish. The colour suggests *A. fuliginosa*.

Very near *gagates*, from which it differs only in colour, so far as I can see. Middle zone of sole more than twice as broad as either lateral zone; sulcations on sole as in *gagates*. Sole dark brown, unicolorous. Mantle oval. Keel not strong.

Madeira (*Mr. Mason*); one specimen in the British Museum.

ii. Canary Islands.

Amalia gagates, var. *carinata* (d'Orb.).

The figure given by d'Orbigny of this Teneriffe slug suggests at first sight some *Parmacella*; but a careful examination of his account of the species leaves little doubt that it is a form of *A. gagates*. There is no occasion to keep the spelling of the text "*caremata*," as it is evidently a misprint, and is given correctly (*carinata*) on the plate. Bourguignat's *Limax polyptyelus* was founded on d'Orbigny's figure, the new name being proposed because *carinata* was preoccupied for a European species.

iii. The Azores.

Amalia gagates has been recorded from these islands.

iv. Bermuda.

In the British Museum are three examples of *Amalia gagates* from Bermuda ('Challenger' collection). These were recorded by Mr. E. A. Smith (P. Z. S. 1884, p. 276). They belong to form *typus*, Less. & Poll., but are rather more opaque and rugose than is usual, and the keel is flexuose.

v. Ascension.

Amalia gagates, var. *ascensionis* (Lesson).

The published figure of this is a bad one, but it is no doubt a variety of *gagates*. The subgeneric term *Clytropolta*, Heyn., proposed for it is therefore quite unnecessary.

It is very interesting to find that this variety, collected so many years ago, resembles in colour the forms found at St. Helena, Tristan d'Acunha, and Juan Fernandez. Whether the Ascension slug is not really a subspecies indigenous to that island is perhaps open to question; but it seems more likely that here, as on the other islands, we have simply the descendants of imported *A. gagates*, which have already begun to diverge from the type. It would be an interesting experiment to bring some of these slugs to Europe and breed them in captivity, and see whether they kept true or reverted to the coloration of the European type.

vi. St. Helena.

Amalia gagates (var. *ascensionis*), forma nov. *helenæ*.

Mantle 7 millim. long (in alcohol), 5 millim. broad; sole $3\frac{1}{2}$ millim. broad. Respiratory orifice 5 millim. from anterior border of mantle. Colour dull palish ochrey, back darkish purplish grey; mantle purplish grey, except sides below sulcus, which are pale ochrey, rather sharply defined from the dark part by the sulcus. Neck bluish grey above. Body keeled strongly its whole length. Median area of sole not quite twice as broad as either lateral area. Sole with strong, transverse, oblique grooves meeting in the middle line. Body simply reticulate-grooved, but the interstices themselves finely reticulate-grooved. Keel not obviously paler than the back. Sides of sole with transverse grooves and one longitudinal groove.

St. Helena (*J. C. Melliss*); one specimen in British Museum.

Compared with subsp. *plumbea* from South Shields it is evidently very closely allied; but the median area of the sole is narrower. Its rugosity may partly be due to strong alcohol having produced extreme contraction.

vii. Tristan d'Acunha.

Amalia gagates (var. *ascensionis*), forma nov. *tristensis*.

Sole and sides yellowish, back and mantle plumbeous; rugæ rather strong.

Tristan d'Acunha ('Challenger' coll.); one specimen in the British Museum.

This is very near to subsp. *plumbea* and still nearer to form *helenæ*. It is not confined to Tristan d'Acunha, being also found in Juan Fernandez. It is most instructive to find that an apparently introduced species has varied in the same way on two islands so far apart as these, but at approximately the same latitude and with probably very similar climates. The St. Helena form, from a warmer climate, is not identical, but still very closely allied. It is also to be noticed that the forms of the south temperate region come to resemble the *plumbea* of North-western Europe, while those from intermediate localities are different.

c. The Cape Region.

Amalia capensis (Krauss).

Limax capensis, Krauss, Südaf. Moll. 1848, p. 73.

Whether this is really a species of *Amalia* peculiar to the

Cape I cannot say. It does not agree with *A. gagates*, so far as one can judge from the description.

Amalia gagates, forma *typus*, Less. & Poll.

Port Elizabeth (*J. H. Ponsonby*), three specimens; and Cape of Good Hope, Nov. 1873, one specimen; all in the British Museum.

These are quite like European examples.

d. South America.

Heynemann has recorded *A. gagates* from Brazil.

e. North America.

In North America *Amalia* is confined to the Pacific region.

Amalia gagates, var. *Hewstoni* (J. G. Cooper).

Limax Hewstoni, J. G. Cooper, Proc. Ac. Nat. Sci. Philad. 1872, p. 147.

I received a living example of *L. Hewstoni*, collected at Haywards, California, from Dr. J. G. Cooper, and was able to make a drawing of it, which was published by Mr. W. G. Binney in his Third Suppl. to Terr. Moll. U. S. (1890), pl. viii. fig. 1. The figs. D on the same plate had been made from an alcoholic example previously, and are not so good. The living specimen from Haywards was about 50 millim. long; sole dull greyish ochreous, about 5 millim. broad. Body blackish above, lighter at sides. Mantle $13\frac{1}{2}$ millim. long. Eye-peduncles blackish, lower tentacles pale. Respiratory orifice scarcely posterior to the middle of the mantle. Keel inconspicuous in the living slug, but strong when contracted in alcohol.

When immersed in alcohol the median area of the sole appeared grey, conspicuously darker than the lateral areas. I dissected the specimen and found the genitalia to agree with *A. gagates* in all essential points. The penis-sac is thick at its extremity. The spermatheca is globular and rather large. The albumen-gland is large and yellowish.

I have also received var. *Hewstoni* from Cœur d'Alene, Idaho (*H. F. Wickham*), and Mr. W. G. Binney has sent me two examples from Oakland, California, where they were collected by Mr. Hemphill in 1890. Mrs. M. E. Cusack sent me a drawing of var. *Hewstoni*, made from a specimen found by Miss Mora Cusack at Santa Barbara, California.

There can be no doubt that *L. Hewstoni* is correctly referable to *A. gagates*, and it differs very little from the type.

Amalia gagates, var. *plumbea*.

A *plumbea* form occurs with var. *Hewstoni*, or at least in the same region. A specimen in alcohol sent to me by Mr. Binney was 18 millim. long, back very sharply keeled, sole pale orange-yellowish, posterior edge of mantle pale. Reticulations as in var. *Hewstoni*. General colour leaden grey. Liver ochreous. This specimen was found by Mr. Hemphill in North Idaho or Washington, the exact locality not being known.

A large specimen of var. *plumbea*, collected by Mr. Hemphill at Julian City, California, was sent to me by Mr. Binney more recently.

This var. *plumbea* is really a subvariety of *Hewstoni* which has the colour-character of the European subsp. *A. plumbea*, but is not sufficiently segregated to be considered a subspecies.

f. Pacific Islands.

In the British Museum is a specimen of *Amalia fuliginosa* (Gould) marked "Polynesian Islands" (*S. Stevens*). It is uniform sooty (black-brown), including sole; not very rugose; transverse grooves on back hardly noticeable, though the longitudinal ones are plain. The median area of the sole is narrower than in New-Zealand examples; but I think they cannot be separated even as varieties.

i. Juan Fernandez.

Amalia gagates, forma *tristensis*.

There are six specimens from Juan Fernandez ('Challenger' coll.) in the British Museum, which may be described as follows:—

Blackish or greyish above, sides and sole more or less yellowish. Region of respiratory orifice yellow. Interstices of the main rugæ on back inclined to be dark. Opaque slugs, with the rugæ rather strong.

ii. Sandwich Islands.

Amalia sandwichensis (Eydoux).

The figure of this species given in Tryon's work evidently represents an *Amalia*, and probably a form of *A. gagates*.

There appears to be some confusion about the species formerly called *Limax sandwichiensis*, and Heynemann ('Die nactk. Landp. des Erdbodens,' p. 70) records an *Agriolimax sandwichiensis* (Souleyet) from the Sandwich Islands, said to be almost identical with *A. lævis*, but makes no mention of the *Amalia*.

iii. New Caledonia.

Amalia mouensis (Gassies).

Limax mouensis, Gass. Act. Soc. Linn. Bordeaux, xxviii. (1871).

This supposed species was described from the shell only, which appears from the description to be that of an *Amalia*.

g. New Zealand.

Amalia fuliginosa (Gould).

Length (in alcohol) 22 millim.; sole broadish, very dark brown or blackish, marked as in *gagates*, but median area about twice as wide as either lateral area. Mantle oval, rugose, black, with the usual sulcus. Body black, but sides below mantle brownish. Reticulations apparently as in *A. gagates*. Keel distinct. The brown parts incline to a sort of olivaceous tint.

Another example is browner and has the median area of sole grey and lateral areas brownish. One large one contains dull yellow globular eggs, which have diam. $2\frac{2}{3}$ millim.

Described from specimens in the British Museum from New Zealand (*Mr. Macgillivray*).

I have no doubt that this is a good species, although closely allied to *A. gagates*. It is certainly the *Limax fuliginosus* of Gould, a species which I am glad to have the opportunity of redescribing, as it has not been recognized by recent authors. It is smoother than *A. antipodarum*, and differs from it in various ways.

Amalia antipodarum (Gray).

Milax antipodarum, Gray, Cat. Pulm. 1855.

Length (in alcohol) 16 millim., mantle 6 millim. long. Sole and ground-colour a sort of coffee-brown; back, mantle, and neck above becoming black. Mantle truncate behind; sulcus well marked; respiratory orifice rather posterior. Keel strong. Rugæ as in *A. gagates*, back rugose and opaque. Sole rather lively brown, the median area hardly

twice as wide as one lateral area; striæ on sole as in *A. gagates*.

Described from two specimens, doubtless Gray's types, in the British Museum. This species differs little from *A. gagates* except in colour.

Amalia antipodarum, var. nov. *pallida*.

Length (in alcohol) $21\frac{1}{2}$ millim.; sole pale ochrey, unicolorous, median area hardly twice as wide as either lateral area; sole-striæ as in *A. gagates*. Reticulation on body as in *A. gagates*. Mantle dark greyish, with the edges pale and the sulcus dark. Neck above dark grey. Body well keeled, whitish, greyish on each side of keel. Respiratory orifice rather posterior. Not a *rugose* slug.

Described from a specimen from Wellington (Otago University Museum).

Amalia antipodarum, var. *emarginata* (Hutton).

Limax emarginatus, Hutton, Man. N. Z. Moll. 1880, p. 26.

Length (in alcohol) 27 millim.; sole and sides whitish, back dark greyish. Keel more or less pale. Median area of sole narrower than both lateral areas together. Sulcus on mantle not darker than the rest of the mantle.

Described from a specimen found at Dunedin (Otago University Museum), in the British Museum. Closely allied to var. *pallida*, from which it differs noticeably in its concolorous mantle-sulcus. It does not appear to me that *antipodarum*, *pallida*, and *emarginata* are more than three varieties of a single species.

h. Australia.

Amalia maura (Quoy & Gaim.).

Limax maurus, Quoy et Gaimard. (*Hab.* Port Jackson.)

Limax olivaceus, Gould. (*Hab.* Paramatta.)

Limax pectinatus, Selenka, Mal. Blätt. 1865, p. 105. (*Hab.* Sydney.)

This Australian species is evidently very close to *A. gagates*, but is probably a valid species. The supposed species *A. maura* (Q. & G.), *A. olivacea* (Gld.), and *A. pectinata* (Sel.) are all from the same neighbourhood, and as the descriptions agree in all important points, there need be no question about uniting them. The oldest name, *A. maura*, has been quite overlooked, the *Limax maurus* of Quoy and Gaimard remaining unidentified by authors.

Tate has described two species, *A. nigricollus* and *A. tasmanica*, from Tasmania; I have not seen specimens of either of them.

3 Fairfax Road, Bedford Park, Chiswick, W.,
January 25, 1891.

XXXV.—*Remarks on the Herpetological Fauna of Mount Kina Baloo, North Borneo.* By G. A. BOULENGER.

THE first Reptiles and Batrachians obtained on Kina Baloo were described by me in 1887*, four new species being established. The specimens, which were the property of Mr. W. Whitehead, did not find their way to the British Museum; for on his return home Mr. Whitehead disposed of them, together with many others which he had collected in North Borneo and Palawan, in favour of the Paris Museum. I am glad to say that recently, through the kindness of Prof. Vaillant, duplicate specimens from that collection have been received by the British Museum. So that of the twelve valid new species discovered by Mr. Whitehead on Mount Kina Baloo as many as five are now represented by types or co-types in the National Collection. Mr. Whitehead's collection of Reptiles and Batrachians formed the subject of an extensive paper by Dr. F. Mocquard †, in which numerous species and two genera are described as new, and upon which I now beg to offer some remarks.

On receiving at the end of January of this year a copy of Dr. Mocquard's paper, I wrote to the author that, whilst regarding his *Gymnodactylus baluensis*, *Hemidactylus craspedotus*, *Ablabes præfrontalis*, *Culamaria lateralis*, *Helicopsoides typicus*, *Rhacophorus acutirostris*, *Bufo fuliginosus*, *B. spinulifer*, *Nectophryne misera*, and *N. maculata* as valid species, I entertained serious doubts respecting the others, which I felt inclined to identify as follows:—

Pelturagonia cephalum = *Japalura nigrilabris*, Ptrs.

Tropidonotus maculatus, var. *torquatus* = *T. chrysargus*,
Boie.

Rana decorata = *R. luctuosa*, Ptrs.

* Ann. & Mag. Nat. Hist. (5) xx. pp. 95-97.

† Nouv. Arch. du Mus. (3) ii. 1890, pp. 115-168, pls. vii.-xi. Preliminary diagnoses were published in 'Le Naturaliste' for 1890.

Rana obsoleta = *R. signata*, Gthr.

*Rana paradoxa** = *R. Kuhlii*, D. & B.

Ixalus nubilus = *R. natatrix*, Gthr.

I also informed him that I held his new genus *Helicopsoides* to be identical with *Lepidognathus*, established about the same time by Van Lidth de Jeude, and that the *Rhacophorus* referred by him to *R. cruciger*, Blyth, could not belong to that Ceylonese species, suggesting its possible identity with *R. leucomystax*, of which *R. maculatus* and *Rana longipes* of his list (p. 122) are synonyms. I have, however, since received a new *Rhacophorus* from Baram, described in the last number of these 'Annals' as *R. macrotis*, which may be the same as that noticed by him under the name of *R. cruciger*.

Dr. Mocquard replied that he agreed as to the identifications of *Trop. maculatus*, var. *torquatus*, *Helicopsoides*, as he had himself independently found out, *Rana decorata* and *R. obsoleta*, but reserved his opinion concerning the others.

I will now endeavour to discuss, and, if possible, clear up these questions, as well as one or two others which have turned up on perusal of Dr. Mocquard's contribution.

1. *Pelturagonia cephalum*, Mocq.

On comparison of the description and figures given by Mocquard and a female specimen received from the Paris Museum with the very short description given by Peters and the young male specimen described in the 'Catalogue of Lizards,' I am fully convinced of the identity of this supposed new Agamoid with *Japalura nigrilabris* of Peters. The young male from Labuan shows distinctly the enlarged lateral scales at the base of the tail, which are, however, very much less developed than in the adult; and the female from Kina Baloo has a trace of the gular fold, the presence of which is denied by Mocquard. The enlarged caudal scales in the male do not, in my opinion, afford a character of sufficient importance for separating generically *J. nigrilabris* from the other species of *Japalura*.

2. *Helicopsoides*, Mocq., and *Lepidognathus*, Jeude.

As I have mentioned above, Dr. Mocquard admits that the two genera are identical, although the Bornean species must be held distinct from the Sumatran. *Helicopsoides* was described in the 1st July 1890 number of 'Le Naturaliste,'

* Name preoccupied by Linnæus, Syst. Nat. 1766.

and both Dr. Mocquard and myself received Dr. de Jeude's separate copy containing the description of *Lepidognathus* towards the end of the same month. It is therefore impossible for me to decide which description has priority, although I incline to believe it is Dr. Mocquard's; on the other hand, the name *Helicopsoides* is so defectively constructed that I for one would not hesitate to employ the name *Lepidognathus* if the genus should stand. But it is my opinion that both genera, together with my *Calamohydrus*, should be united with Günther's *Opisthotropis*, founded upon a West-African species, and which may be defined as follows:—

OPISTHOTROPIS.

- Opisthotropis*, Günth. Ann. & Mag. Nat. Hist. (4) ix. 1872, p. 16.
Calamohydrus, Bouleng. Ann. & Mag. Nat. Hist. (6) ii. 1888, p. 43.
Helicopsoides, Mocq. Le Natur. xii. 1890, p. 154. -
Lepidognathus, Jeude, in M. Weber, Zool. Ergebn. ii. p. 186 (1890).

Maxillary teeth small, equal, 20 to 25; mandibular teeth small, equal. Head small, not distinct from neck; eye small, with round pupil; nostril directed upwards, in a divided or semidivided nasal. Body cylindrical; scales finely striated and keeled, without apical pits, in seventeen or nineteen rows. Tail moderate; subcaudals in two rows.

Four species are known, distinguished as follows:—

- A. Scales in 17 rows; nasals separated by the internasals.
- Præfrontal single; 8 upper labials, fifth entering the eye 1. *O. atra*, Gthr. (W. Africa).
 - Præfrontal single; 8 upper labials, none entering the eye 2. *O. Andersonii*, Blgr. (Hong Kong).
 - Two præfrontals; 12 upper labials, none entering the eye 3. *O. rugosa*, Jeude (Sumatra).
- B. Scales in 19 rows; nasals in contact behind the rostral 4. *O. typica*, Mocq. (Borneo).

3. *Ablabes periops*, var. *præfrontalis*, Mocq.

This form is undoubtedly specifically distinct from *A. periops*, Gthr.; the two species constitute in my opinion a new genus, which I propose to call

HYDRABLABES, gen. nov.

Maxillary teeth small, equal, about 18; mandibular teeth small, equal. Head small, not distinct from neck; eye

small, with round pupil; nostril valvular, an oblique slit between two nasals; three pairs of chin-shields. Body cylindrical, elongate; scales smooth, without apical pits, in fifteen or seventeen rows. Tail moderate; subcaudals in two rows.

The affinities of this genus are with *Opisthotropis*, not with *Ablabes*.

Two species from Borneo:—

Scales in 17 rows; ventrals 190-209; two præfrontals 1. *H. periops*, Gthr.

Scales in 15 rows; ventrals 178-180; a single præfrontal 2. *H. præfrontalis*, Mocq.

4. *Rana paradoxa*, Mocq.

Rana Kuhlii is a very variable species, and I have repeatedly drawn attention to the great development of the terminal disks of its toes, which would warrant its removal to a distinct genus if such a character were regarded as generic, as it used to be in former times. This character appears to have led Dr. Mocquard astray in describing specimens of this species as a new form, *R. paradoxa*, to which he assigns a position widely remote from *R. Kuhlii*. I have now before me one of the types of *R. paradoxa*, and can state that it is identical with *R. Kuhlii*, as I had suspected from the description. I have described male specimens from Burma with the same enormous head, in a paper * which has been overlooked by Dr. Mocquard when dealing with the adhesive ventral disk of certain tadpoles.

5. *Rana Whiteheadi*, Blgr.

Doubts having been expressed as to the distinctness of this species from *R. jerboa*, Gthr., I have compared two specimens, male and female, received from the Paris Museum, with the types of the latter species, and have no doubt as to the correctness of the course followed by me. In *R. jerboa* the choanæ are considerably larger, the lateral fold is as well marked as in *R. erythraea* and continuous throughout, and the hind limbs are much longer, the tibia measuring four fifths of the length of head and body, as against two thirds in *R. Whiteheadi*.

6. *Ixalus nubilus*, Mocq.

The fact that all specimens of *Rana natatrix* from the Philippines are devoid of vomerine teeth, as I am informed by

* Ann. Mus. Genova, (2) v. 1887, p. 482.

Dr. Boettger, who has lately examined a considerable number, shows that I was probably mistaken in uniting with it the Bornean *Ixalus guttatus*, Gthr., which has more or less distinct vomerine teeth. The so-called *Ixalus natator* is nevertheless no true *Ixalus*, having the digital structure of *Rana latopal-mata*, *livida*, *formosa*, and *guttata*, to which it stands in close relation. If the absence of vomerine teeth be considered in this case a valid ground for generic separation, then *Ixalus natator* must bear the name *Staurois natator*, which was proposed for it by Cope in 1865; and the name *Micrixalus*, proposed by me in 1888 for South Indian and Ceylonese species, will become a synonym of *Staurois*. Whatever the views on this matter may be, *Ixalus nubilus* of Mocquard is not an *Ixalus*, and, judging from the description and figure, I can see no reason for separating it from *Rana natatrix*.

XXXVI.—*On the Necessity for the Abandonment of the Generic Name Cyclostoma, with Suggestions regarding others involved in this Genus.* By R. BULLEN NEWTON, F.G.S., British Museum (Natural History).

MUCH confusion has existed since Lamarckian days regarding the Molluscan name of *Cyclostoma*. It was first established by Lamarck in 1799 (Mém. Soc. Hist. Nat. Paris, vol. i. p. 74), to include the Linnæan type of *Turbo scalaris*, this same type being afterwards used for his genus *Scalaria* in 1801 (Syst. Anim. sans Vert. p. 88).

Without a single reference to his genus of 1799 Lamarck again introduces *Cyclostoma* in his 1801 work, p. 87, this time attaching as its type the *Turbo delphinus*, Linnæus, which, curiously enough, was made to stand for his genus *Delphinula* in 1803 (Ann. Mus. Hist. Nat. Paris, vol. iv. p. 108).

We are thus confronted with the fact that two Linnæan types have been occupied by Lamarck for four of his genera. Priority of nomenclature appears to have been little understood in these early times; and it is one of the difficulties of the modern investigator to unravel this and numerous other inconsistencies perpetrated by past authors.

The next reference to *Cyclostoma* appears under the authorship of Draparnaud, 1801 (Tabl. Moll. Terr. Fluv. France, pp. 37, 38), who employed for his type the shell so familiar to all students of conchology, viz. the *Nerita elegans*

of Müller. No notice, however, is made by this author to the preoccupation of the generic name in 1799, and we can only infer that Draparnaud was ignorant of its existence.

We must go back now some considerable time, to 1789, when William Coxe published his 'Travels in Switzerland,' containing natural-history information grouped together under the subsidiary title of "Faunula Helvetica," in which is a section called "Vermes," written by Bernhard Studer (vol. iii. pp. 384-392). This has evidently been a rare work to consult, as so few authors have referred to it in their treatises. It may be useful to state that a fine copy exists in the General Library of the Natural-History Museum, and from this I now make a quotation which has an important bearing on our subject (*vide* p. 388):—

"POMATIAS, Studer, MS.

"*Vermis cochleatus, tentaculis duobus linearibus, oculis ad basin externe.*

"P. ELEGANS. *Nerita elegans.* Müll. 363. List. Ang. t. 2. fig. 5. *Syn.* t. 27. f. 25.

L'Elegante striée, *Fr.* Die Feingestrickte Deckel-schenke,
Ger. Nerite-Pomatias.

"*P. variegatus.* A new species."

Here, then, we have every legitimate reason for keeping in use Studer's *Pomatias*, 1789, the type of which is the same as that adopted by Draparnaud for his *Cyclostoma* in 1801.

In 1820 (*Syst. Verz. Schweizer-Conchylien*, p. 21) Bernard Studer thought fit to recall his *Pomatias* and to use *Cyclostoma* as understood by Draparnaud. This we cannot admit, as his genus of 1789 was accompanied by a perfectly good description for those days and a reference made to a properly recognized type. It is, I think, an understood rule that a genus once established cannot afterwards be withdrawn unless its preoccupation can be proved.

Hartmann, in 1821 ("Syst. Erd- u. Süßw.-Gasteropoden Europa," in Sturm's *Deutsch. Fauna*, vol. vi. part 5, pp. 34 and 49), apparently ignorant of Studer's work of 1789, describes another *Pomatias*, and uses *Cyclostoma patulum*, Draparnaud, for its type. It is quite obvious then that the use of Hartmann's genus must be discontinued and another substituted, for which I propose *Hartmannia*.

The type genus of the Cyclostomidæ, or Cyclostomatidæ of some authors, now being withdrawn, Pomatiidæ is suggested to take its place as the family signification for *Pomatias* and the allied genera.

Having recognized the fact that the type of *Cyclostoma*, 1799, was applied to *Scalaria* in 1801 by the same author, it is necessary to do away with the latter genus and apply the name *Cyclostoma*, or to adopt Klein's name of *Scala*, 1753 (*Ostracologica*, p. 52), which we find used in 1797 by George Humphrey in his 'Museum Calonnianum,' p. 23. This latter method out of the difficulty commends itself to me more favourably than the first, as since Humphrey's day Messrs. H. & A. Adams, in 1853 (*Genera Recent Mollusca*, vol. i. p. 220), have adopted the same course, and still later this has been followed by Dr. Ferd. Stoliczka in 1868 ("Cre-taceous Gasterop. India," *Mem. Geol. Surv. India*, p. 230). If this be acted upon, then H. & A. Adams's family name Scalidæ would take the place of Scaliariidæ, hitherto used by most authors.

In tabular form the genera involved in this discussion will stand thus:—

Genus POMATIAS, B. Studer, 1789.

Type = *Nerita elegans*, Müller.
(Non Hartmann, 1821, = *Hartmannia*.)

= *Cyclostoma*, Draparnaud, 1801.
} Non Lamarck, 1799, = *Scalaria*. }
} Non Lamarck, 1801, = *Delphinula*. }

= *Cyclostomus*, Montfort, 1810.

= *Cyclostoma*, B. Studer, 1820.

Genus DELPHINULA, Lamarck, 1803.

Type = *Turbo delphinus*, Linnæus.

= *Cyclostoma*, Lamarck, 1801.
(Non Lamarck, 1799.)

Genus HARTMANNIA, R. B. Newton, *nom. mut.*

Type = *Cyclostoma patulum*, Draparnaud.

= *Pomatias*, Hartmann, 1821.
(Non B. Studer, 1789.)

Genus SCALA (Klein, 1753), G. Humphrey, 1797.

Type = *Turbo scalaris*, Linnæus.

= *Cyclostoma*, Lamarek, 1799.

= *Scalaria*, Lamarek, 1801.

It is trusted that these observations may lead to greater accuracy in the future when dealing with the literature and the types connected with the history of these genera.

XXXVII.—*New Scarabæidæ in the British Museum: a Fourth Contribution.* By CHARLES O. WATERHOUSE.

[Plate XI.]

Uroxys brevis, sp. n.

Breviter oblongus, convexus, nitidus, nigro-piceus; capite lævi, fronte carina transversa instructa, clypeo apice bidentato; thorace transverso, convexo, fere lævi, lateribus leviter arcuatis, lævissime bisinuatis; elytris thorace perparum angustioribus, quam latitudine paullo brevioribus, tenuiter striatis, striis lævibus, interstitiis fere planis, lævibus; pygidio lævi; tibiis anticis obtuse tridentatis, ad apicem truncatis; mesosterno utrinque punctis nonnullis notato, a metasterno linea fortiter angulata diviso; femoribus piceis.

Long. $4\frac{1}{2}$, lat. $2\frac{3}{4}$ lin.

Hab. Brazil.

This species is closely allied to *U. Batesi*, Harold, but is still shorter. The clypeus has the teeth shorter and more triangular. The thorax has the sides less abruptly turned inwards at the anterior angles; the lateral impression is elongate, but does not run off into a line at each end. The elytra have the striæ finer and apparently impunctate. The line dividing the mesosternum from the metasternum is strongly angular, having an angle of about 110° , leaving the mesosternum very long; whereas in *U. Batesi* the line is bent at an angle of about 80° , reaches forward almost to the front of the mesosternum, and has the apex itself rounded.

Uroxys terminalis, sp. n.

Leviter convexus, nitidus, piceo-niger; capite fere lævi, inter oculos

transversim perparum elevato, clypeo subtilissime obscure punctulato, margine leviter reflexo, medio sat fortiter bidentato; thorace convexo, lævi, lateribus ante medium sat fortiter angulato-dilatatis; elytris latitudine perparum longioribus, apicem versus arcuatim angustatis, evidenter striatis, striis sat distincte punctatis ad apicem profundioribus, apice declivi, sat late truncato, lævissime bisinuato, angulis externis prominulis, supra breviter dentiformi; pedibus rufo-piceis, tibiis anticis longis, tridentatis, ad apicem truncatis.

Long. $3\frac{1}{3}$ lin.

Hab. Brazil, Spirito Sancto.

This species appears to be allied to *U. angulatus*, Harold. The clypeus has the middle teeth prominent, the margin having a small but distinct sinuosity on the outer side of each, and there is a small notch at the division between the clypeus and the cheek. The thorax is very broad in front of the middle, gradually narrowed to the base, very obliquely narrowed in front, the lateral angle thus formed very obtusely rounded. The elytra have the apex truncate, the outer angle slightly prominent laterally, with a small acute tooth directed obliquely outwards at the upper outer angle of the prominent part. The line dividing the mesosternum from the metasternum strongly and sharply angulated, the angle being about 105° .

Uroxys simplex, sp. n.

Oblongus, leviter convexus, nitidus, piceo-niger; capite plano, lævi, antice breviter bidentato; thorace leviter convexo, lævi, lateribus ante medium sat angulato-dilatatis; elytris longitudine et latitudine æqualibus, evidenter subtiliter striatis, striis subtiliter obscure punctatis, striis prima et secunda ad apicem profundioribus, interstitiis vix convexis, lævibus; pedibus rufo-piceis. ♂.

Long. $2\frac{1}{2}$ lin.

Hab. Venezuela.

This species somewhat resembles the preceding, but is smaller, the thorax has the sides rather less strongly angulated, and the apex of the elytra is simple. The head has no transverse raised swelling; the clypeus has the teeth shorter, and there is scarcely a trace of a notch at the juncture of the clypeus and the cheek. The thorax is very short and broad, broadest before the middle, gradually obliquely narrowed towards the base, very obliquely narrowed in front, the angle at the side thus formed obtuse, lightly impressed above. The elytra have the striæ moderately fine, but distinct, the dorsal ones obscurely punctured, the lateral ones more distinctly

punctured; the sides are gently arcuate, as wide at the apical callosity as at the base, the apex very obtusely arcuate. The line dividing the meso- and metasterna is gently arcuate, with scarcely any trace of angulation.

Scatonomus thalassinus, sp. n.

Elongato-oblongus, convexus, paullo nitidus, obscure viridis; capite sat crebre evidenter punctato, margine antico paullo deplanato, quadridentato, dentibus brevissimis æqualibus; thorace crebre sat fortiter punctato, linea mediana lævi; elytris distincte striatis, subtiliter creberrime punctulatis, punctis majoribus distinctis immixtis; pygidio sat fortiter punctato; corpore subtus femoribusque nigro-viridescens.

Long. $6\frac{1}{2}$ lin.

Hab. Brazil.

This species is closely allied to *S. insignis*, Harold, but is dark green. The anterior teeth of the epistome are very short. The punctuation of the head and thorax is rather strong. The elytra have the striæ more impressed than in *S. insignis*; the punctuation is close and very fine, with stronger, very distinct punctures interspersed. The pygidium is strongly punctured, the punctures not generally very near together. The metasternum is finely but distinctly punctured. The abdomen has the margins of the basal segments rugose.

Onthocharis brevipes, sp. n.

Elongato-oblonga, nitida; capite piceo-æneo, vertice virescenti, subtiliter punctulato, clypeo antice leviter emarginato, medio bidentato, dentibus brevibus; thorace sat magno, piceo-æneo, antice angustato, subtiliter punctulato, lateribus medio fere rectis, angulis posticis rotundatis prominulis, linea mediana brevi distincta; elytris piceo-cupreis, sat fortiter striatis, striis sat fortiter punctatis, interstitiis leviter convexis, subtiliter evidenter sat crebre punctulatis; pygidio piceo, subtiliter punctulato; corpore subtus obscure piceo; pedibus piceis, tibiis posticis brevibus latis, tarsorum articulo basali longitudine duplo latiori, profunde emarginato.

Long. 3 lin.

Hab. Amazons, Ega (*H. W. Bates*).

This species is peculiar for the form of the thorax, which is somewhat obliquely narrowed anteriorly, with the sides nearly rectilinear at their middle. The elytra have the striæ rather more deeply impressed than is usual, and the punctures are larger and somewhat triangular. The posterior tibiæ are

short and very broad, abruptly dilated from the very base ; this character can only be seen when the tibia is extended unnaturally, so as to be almost in a line with the femur (Pl. XI. fig. 1).

Onthocharis æqualis, sp. n.

Elongato-oblonga, picea paullo virescens, nitida ; capite vertice subtiliter crebre punctato, clypeo fortius punctato, piceo, antice sat profunde emarginato, medio dentibus duobus acutiusculis instructo ; thorace virescenti, crebre evidenter punctato, basi utrinque læviori, medio linea brevi impressa ; elytris striatis, striis punctatis, interstitiis fere planis, fere lævibus ; pygidio virescenti, subtiliter punctato ; pedibus piceis, tibiis posticis elongatis, apicem versus latioribus, tarsorum articulo basali longitudine latiori, basi angustato.

Long. $2\frac{2}{3}$ lin.

Hab. Santarem (*H. W. Bates*).

The clypeus has the anterior emargination a little deeper than in many of the allied species, and the angles of the emargination are rather acute and extend forwards almost to a level with the middle teeth ; the punctuation is very distinct, the punctures slightly separated from each other. The thorax has the punctuation fine but distinct, especially anteriorly ; the impressed median line is very distinct. The elytra are dark pitchy, with a green tint ; the striæ are distinct but not very deep, the dorsal striæ are very finely punctured, with some larger punctures at intervals, the lateral striæ only show the larger punctures ; the interstices are not visibly punctured, except the sutural one, which has a few very delicate punctures. The pygidium is green, with very distinct punctures, which are slightly separated. The posterior femora are broad ovate ; the tibiæ are smooth above, except the usual line of punctures, the outer apical angle is distinctly produced ; the basal joint of the tarsus is short, narrowed at the base, emarginate at the apex, with the outer angle much prolonged (Pl. XI. fig. 2).

Onthocharis læta, sp. n.

Elongato-oblonga, nigro-picea, nitida ; capite thoraceque cupreis, elytris fere nigris, vix virescentibus, pedibus piceis ; capite crebre subtiliter punctulato, clypeo subtilius punctulato, antice emarginato, medio dentibus duobus acutis instructo ; thorace subtiliter crebre punctulato, medio linea brevi bene impressa ; elytris evidenter striatis, striis punctatis, interstitiis fere planis, subtilissime parce punctulatis ; pygidio sat fortiter punctato ; femoribus pos-

ticis ovalis, tibiis sat brevibus, apicem versus multo latioribus, tarsorum articulo basali longitudine duplo latiori, ad apicem profunde emarginato.

Long. $2\frac{1}{2}$ lin.

Hab. Amazons, Ega (*H. W. Bates*).

This species has the anterior tibiæ rather more abruptly enlarged on the inner side at the base than in the other species I have been describing. The two examples before me differ considerably in the punctuation of the thorax, one having it extremely fine, the other much more distinct. The elytra have the striæ moderately deep, the punctures in them very distinct and somewhat separated from each other. The pygidium is pitchy, with a green tint. The posterior legs have the tibiæ short, suddenly enlarged at the base on the inner side, forming an obtuse angle, thence to the apex gradually widened, the outer apical angle not produced; the basal joint of the tarsi at least twice as broad as long, deeply triangularly emarginate at the apex, with the outer angles prolonged (Pl. XI. fig. 3).

Onthocharis oblonga, sp. n.

Convexa, nitida; capite thoraceque cupreis, elytris æneo-viridibus, corpore subtus piceo-nigro obscure æneo tincto, abdomine apice cupreo, pygidio virescenti; capite fere lævi, clypeo antice leviter emarginato, medio bidentato; thorace medio fere lævi, latera versus subtiliter punctulato, medio linea brevi impressa; elytris distincte striatis, striis obsolete punctulatis, interstitiis fere planis, obsolete punctulatis; pygidio subtiliter punctulato; tibiis posticis elongatis, apicem versus paullo latioribus, angulo externo paullo producto, tarsorum articulo basali longitudine vix latiori, ad apicem emarginato.

Long. $2\frac{1}{2}$ lin.

Hab. Brazil (*ex coll. Lacordaire*).

This species is allied to *O. equalis*, but has the elytra a little shorter and more rounded at the sides. The posterior tibiæ are elongate, sparingly punctured above (besides the line of punctures), with no trace of median external projection. The basal joint of the posterior tarsi is longer, slightly narrowed towards the base, not very deeply emarginate at the apex, the outer angle scarcely more prolonged than the inner angle (Pl. XI. fig. 4).

Onthocharis Westwoodii, sp. n.

Elongato-oblonga, nigro-picea, vix ænescens, nitida; capite vertice

crebre subtiliter punctulato, medio transversim leviter elevato, clypeo piceo, creberrime irregulariter subtiliter punctato, antice leviter emarginato, medio dentibus duobus sat porrectis obtusis; thorace convexo, antice modice angustato, sat crebre subtiliter punctulato, postice utrinque fere lævi, medio linea lævissime impressa; elytris evidenter striatis, striis punctatis, interstitiis lævissime convexis, lævibus; pygidio ænescenti, subtiliter sat crebre punctulato; pedibus piceis, tibiis posticis sat elongatis parallelis, tarsorum articulo basali longitudine paullo latiori, ad apicem angulatim emarginato.

Long. $3\frac{1}{2}$ lin.

Hab. Brazil, Minas Geraes.

The thorax has the punctures fine but distinct and moderately separated. The elytra have the striæ distinctly impressed except the second at the basal half, the punctures in the striæ are of different sizes. The pygidium has the punctures fine, irregular, and distinctly separated from each other. The posterior tarsi have the basal joint a little broader than long, emarginate at the apex (Pl. XI. fig. 5).

Onthocharis constricta, sp. n.

Elongato-oblonga, nitida; capite virescenti, subtiliter punctulato, clypeo antice piceo, leviter emarginato, medio bidentato; thorace bene convexo, subtiliter punctulato, nigro-piceo virescenti, linea mediana nulla; elytris basi apiceque sat angustatis, piceo-nigris, evidenter striatis, striis sat crebre punctatis, interstitiis vix convexis, subtilissime parce punctulatis, fere lævibus, lateribus arcuatis; pygidio cupreo, subtiliter punctulato; corpore subtus cuprescenti, abdominis segmento penultimo viridi-tincto; pedibus piceis, tibiis viridi-tinctis, posticis sat elongatis, apicem versus latioribus, angulo externo producto acuto; tarsorum articulo basali brevi triangulari, ad apicem emarginato.

Long. $2\frac{1}{4}$ lin.

Hab. Cayenne.

The head has a slightly raised angulated line dividing the clypeus from the forehead. The thorax has the sides very much deflexed, so that the lateral margins are not visible from above; the punctuation is extremely fine but distinct, the punctures slightly separated from each other. The elytra have the striæ very distinct, the punctures in them moderately distinct and rather close together. The posterior tarsi have the basal joint short, triangular (Pl. XI. fig. 6).

This species has the somewhat peculiar form of *O. picta*, Harold.

Onthocharis Batesii, sp. n.

Oblonga, nitida, testaceo-rufa, capite pectoreque nigris viridi-tinctis, elytris rufo-piceis basi nigro-picea vel toto nigro-piceis; capite subtiliter punctulato, clypeo subtilius punctulato, antice leviter emarginato, medio bidentato; thorace subtilissime punctulato, fere lævi, linea impressa nulla; elytris sat brevibus, evidenter striatis, obsolete punctatis, interstitiis vix convexis, sicut lævibus; pygidio subtiliter punctulato, testaceo-rufo vel nigro-virescenti; pedibus testaceo-rufis (genibus plus minusve nigro-virescentibus), tibiis posticis sat elongatis subparallelis, tarsorum articulo basali subquadrato, ad apicem angulatim emarginato. (Pl. XI. fig. 7.)

Long. $2\frac{2}{3}$ lin.

Hab. Amazons, Ega and Fonteboa (*H. W. Bates*).

This is a very distinct, short oblong species. The amount of dark colour on the elytra and legs varies considerably.

Onthocharis Lacordairei, sp. n.

Elongato-oblonga, rufo-picea, nitida; capite lævi, vertice subtilissime punctulato; thorace subtiliter punctulato; elytris distincte striatis, striis obsolete punctatis, fere lævibus, interstitiis lævissime convexis, parce obsolete punctulatis, fere lævibus; pygidio bene convexo, lævi; tibiis posticis angustis, dimidio apicali fere parallelis, tarsorum articulo basali latitudine duplo longiori. (Pl. XI. fig. 8.)

Long. $1\frac{7}{8}$ lin.

Hab. Cayenne (*Lacordaire*).

The above description is taken from Dejean's specimen of "*O. myrmidon*, Lacordaire," and is labelled "Cayennæ, Lacordaire." It is quite distinct from *O. myrmidon*, Westw. It is rather more depressed than most of its allies, the anterior tibiæ have all three teeth beyond the middle of the tibiæ acute, with the apical one very obliquely directed forwards.

Onthocharis intermedia, sp. n.

Elongato-oblonga, nitida; capite virescenti, fere lævi, clypeo subtilissime obsolete punctulato, antice piceo, medio emarginato bidentato; thorace obscure virescenti, subtilissime latera versus distinctius punctulato, linea mediana brevi leviter impressa; elytris basi apiceque sat angustatis, virescenti-nigris, evidenter striatis, striis sat crebre punctatis, interstitiis vix convexis, fere lævibus, lateribus arcuatis; pygidio virescenti, sat crebre evidenter punctato; corpore subtus nigro-piceo, pectore virescenti; pedibus piceis viridi-tinctis, tibiis posticis sat elongatis, basi angulatim sat

dilatatis, apicem versus paullo latioribus, angulo externo paullo producto, tarsorum articulo basali oblongo, ad apicem emarginato. Long. $2\frac{1}{2}$ lin.

Hab. Amazons, Tapajos (*H. W. Bates*).

This species has the form of the preceding species and closely resembles it in every way. The colour, however, is different, the head is smoother, and has no distinct line dividing the clypeus from the forehead. The anterior tibiæ are rather broad and somewhat angularly enlarged at the base, as in the preceding species, and the intermediate tibiæ are almost similarly enlarged at the base, which is not the case in *O. constricta*. The posterior tibiæ are angularly enlarged at the base; the basal joint of the posterior tarsi is slightly elongate, with its sides nearly parallel (Pl. XI. fig. 9).

Onthocharis simplex, sp. n.

Elongato-oblonga, picea, virescens, nitida; capite nigro-viridi, subtiliter evidenter punctulato, clypeo piceo, antice leviter emarginato, medio bidentato; thorace nigro cyaneo-virescenti, subtiliter punctulato, linea mediana fere nulla; elytris nigro-piceis, virescentibus, evidenter striatis, striis sat crebre evidenter punctatis, interstitiis subtilissime punctulatis; pygidio evidenter punctato; pedibus piceis, tibiis posticis elongatis apicem versus latioribus, tarsorum articulo basali subquadrato, ad apicem emarginato, angulo externo producto. Long. $2\frac{3}{5}$ lin.

Hab. Santarem and Tapajos (*H. W. Bates*).

Var. Supra obscure viridis.

Hab. Tapajos (*H. W. Bates*).

The head is very distinctly punctured, with the punctures slightly separated; the clypeus is much more finely and less distinctly punctured, the anterior emargination is wide and not very deep, its outer angles acute, the middle teeth project beyond the level of the angles of the emargination. The thorax has the punctuation very fine but distinct, the punctures moderately separated. The elytra have the striæ very distinct and evenly and rather strongly punctured, the punctures separated from each other by spaces scarcely larger than the punctures; the punctuation of the interstices is extremely fine and is not easily seen. The pygidium is very distinctly punctured, the punctures slightly separated from each other. The posterior tibiæ elongate, widened towards the apex, with the outer angle produced; smooth above, except the line of punctures; the basal joint of the tarsi parallel-sided, emar-

ginate at the apex, with the outer angle produced (Pl. XI. fig. 10).

Onthocharis bella, sp. n.

Elongato-oblonga, cyaneo-viridis, nitida; capite subtiliter punctulato, margine antico piceo; thorace subtiliter punctulato, postice medio impresso lævi; elytris distincte striatis, striis evidenter punctatis, interstitiis lævissime convexis, lævibus; pygidio sat fortiter punctato; tibiis posticis angustis, dimidio apicali fere parallelis, tarsorum articulo basali latitudine longiori. (Pl. XI. fig. 11.)

Long. 2 lin.

Hab. Cayenne.

The head has the punctuation very fine but distinct, the punctures moderately close together, the front margin nearly smooth. The thorax has the punctuation very fine and moderately close, the posterior part of the disk almost impunctate; in the middle of the base there is a well-marked impression. The elytra have the striæ very distinct, the punctures in them not very close together. The legs are pitchy red. The club of the antennæ pale rusty testaceous. The underside of the body is pitchy, tinted with green. The colour of the insect above is very bright bluish green, shading into pitchy or violet in some lights.

Ontherus thoracicus, sp. n.

Elongato-oblongus, subnitidus, convexus, rufo-piceus; capite vertice lævi, clypeo transversim ruguloso, antice lævissime emarginato; thorace disco fere lævi; elytris distincte striatis, striis dorsalibus obscure punctatis, lateralibus distinctius punctatis, interstitiis perparum convexis, fere lævibus.

♂. Capite cornu sat longo, curvato, acuminato; thorace antice fortiter declivi, parte elevata medio emarginata utrinque in processu brevi fere truncato ducta, margine anteriori pone oculos acute exciso, tibiis anticis tridentatis.

♀. Capite cornu brevi leviter bidentato; thorace antice minus declivi, quadrituberculato; tibiis anticis quadridentatis.

Long. 6–6½ lin.

Hab. New Granada.

This species closely resembles *Pinotus incisus*, Kirsch (Berl. ent. Zeitschr. 1870, p. 357), and the male has the same incision in the front margin behind the eyes. The armature of the thorax, however, is different; instead of four tubercles there are two slightly prominent processes (separated from each

other by a somewhat wide emargination), truncated at their apex, the angles of the truncature slightly and obtusely denticiform. The elytra have the striæ less deep.

I am making this comparison with a specimen in Mr. B. Nevinson's collection which I have determined to be *P. incisus*.

Ontherus Nevinsoni, sp. n.

Oblongus, convexus, sat nitidus, rufo-piceus; capite postice subtiliter punctulato, clypeo transversim ruguloso, antice lævissime emarginato; thorace subtiliter punctato, disco fere lævi; elytris evidenter crenato-striatis, interstitiis perparum convexis, subtilissime punctulatis, fere lævibus, in ♂ subsericeo-micantibus.

♂. Capite cornu sat elevato, leviter curvato acuminato; thorace antice subito declivi, parte elevata antice subquadrituberculata; tibiis anticis tridentatis.

♀. Capite cornu brevissimo, bituberculato; thorace minus convexo, antice minus declivi, parte elevata medio vix binodosa.

Long. $6\frac{1}{4}$ lin.

Hab. Bolivia, Yungos.

This species is very like the preceding, but is broader and of stouter build. The thorax is distinctly punctured in front and at the base, particularly in the middle. The male has no incision behind the eye in the front margin of the thorax. The declivous part is much nearer the front margin; the front margin of the raised part might almost be said to be quadrinodose, but the outer nodes are mere slight swellings; the middle nodes are very small but more distinct. The female has a slight indication of two nodes at the anterior part of the thorax.

Ontherus elongatus, sp. n.

Elongato-oblongus, paullo convexus, niger, nitidus; capite vertice utrinque subtiliter punctulato, tuberculo brevi acuminato instructo, clypeo transversim ruguloso, antice vix emarginato; thorace subtiliter sat crebre punctulato, latera versus distinctius punctato, disco obsolete longitudinaliter impresso, antice prope marginem oblique declivi; elytris sat parallelis, ad apicem arcuatim rotundatis, fortiter striatis, striis fere lævibus, interstitiis parum convexis, parce subtilissime punctulatis; femoribus posticis elongatis, supra ad apicem dente triangulari producto. ♂.

Long. $7\frac{3}{4}$, lat. $4\frac{1}{4}$ lin.

Hab. Venezuela.

This is more elongate and less convex than most of the

species known to me. The head behind the frontal tubercle is impunctate, but finely punctured on each side. The thorax has the punctuation very fine and not very close; owing to the slight discoidal impression and the common anterior declivity there is a very slight swelling near the front margin. The metasternum is somewhat flattened, very delicately punctured (almost smooth), except the anterior portion of the intercoxal process, where the punctures are much stronger and closer, and at the sides, where the punctures are very strong but moderately separated; there is a very lightly impressed median line. The pygidium is rather closely and very distinctly punctured. The anterior tibiæ have four teeth (including the apical porrect one). The intermediate femora are very delicately punctured beneath, but have some strong punctures at the apex. The posterior femora are elongate and subparallel, a little enlarged close to the base and then slightly narrowed, the *upper* apical angle produced into a strong triangular tooth.

Ontherus Bridgesi, sp. n.

Elongatus, sat depressus, niger, nitidus; capite vertice utrinque subtiliter punctulato, tuberculo brevi acuminato instructo; thorace ad latera tenuiter punctato, antice subito declivi; elytris fortiter punctatis, striis punctatis, interstitiis convexis lævibus; metasterno medio lævi, postice impressione sat magno, lateribus punctatis; pedibus longis, tibiis anticis quadridentatis, dentibus duobus apicalibus distantibus, femoribus posticis elongatis, apicem versus paullo latioribus, subtiliter punctulatis, angulo apicali superiori acute dentiformi, angulo inferiori angulatim dilatato, tibiis gracilibus. (Pl. XI. fig. 12.)

Long. $7\frac{1}{2}$, lat. 4 lin.

Hab. Bolivia (*Bridges*).

This species has the elongate form of the preceding, but it is still more depressed, the elytra are more deeply striated, moderately strongly punctured, and the interstices are more convex; the eighth or marginal stria as it approaches the shoulder emits a short branch, which stops abruptly at about one third from the base of the elytron. The pygidium is very delicately punctured. The mesosternum has in the middle at the line dividing it from the metasternum a minute tubercle. The metasternum has posteriorly a well-marked ovate impression; the intercoxal process is distinctly but not closely punctured, it is obtusely angulated anteriorly; the punctures at the sides are small but distinct and not very close together. The posterior femora have the upper apical angle acutely

dentiform, slightly curved; the lower angle is somewhat triangularly dilated; the tibiæ are unusually slender.

A female from Peru which appears to be referable to this species differs in having a much smaller tubercle on the head; the metasternum has only a small lightly impressed fovea behind, with a faint indication of a median line; the posterior femora are long and narrow but simple; the anterior tibiæ have the four teeth equidistant, and the anterior declivity of the thorax is less abrupt.

Pinotus Buckleyi, sp. n.

Sat elongatus, subparallelus, niger, nitidus; capite antice rotundato, transversim ruguloso, medio cornu perlongo, apicem versus angustato, postice subcanaliculato, apice ipso truncato instructo; thorace lævi, antice declivi, disco utrinque fortiter rugoso, medio in tumulo elevato, tumulo apice triangulariter exciso, sicut bifurcato; elytris sat fortiter obtuse striatis, striis fere lævibus, interstitiis modice convexis, fere lævibus. ♂.

Long. 9 lin.

Hab. Ecuador, Chiguinda (*Buckley*).

This species has more the appearance of a true *Copris* than any *Pinotus* known to me, with more oblong elytra almost truncate at their apex. The much raised discoidal prominence of the thorax is directed forwards and upwards, divided at its apex into two acuminate tubercles. The elytra are marked with obtusely impressed striæ, each stria terminating at the base in a fovea.

This species may be placed between *P. anaglypticus* and *P. torulosus*.

Pinotus Haroldi, sp. n.

Niger, subnitidus; capite elongato-triangulari, planato, crebre transversim ruguloso, apice paullo exciso, postice cornu laminiformi reclinato, apice angustato recurvo; thorace crebre fortiter punctato, antice concavo, medio canaliculato; elytris paullo sericeo-opacis, sutura margineque nitidis, leviter punctato-striatis, interstitiis vix convexis, evidenter sat crebre punctatis; pygidio nitido, subtiliter punctato. ♂.

Long. 10½ lin.

Hab. Argentine Republic, Cordova.

Very near *P. nutans*, Harold, but at once distinguished by the much less impressed striæ of the elytra and nearly flat interstices. The head is a little shorter, with a small wide emargination at the apex. The laminiform horn is broad at

the base, with a deep cavity at the lower part, on each side of which is a small triangular tooth emanating from the margin of the horn; the apex of the horn is suddenly narrowed and bent forward at a right angle. The thorax is more strongly punctured (especially above) than in *P. nutans*, even in the anterior cavity. The elytra have the striæ fine but distinct, not dilated at the apex, the surface on each side of the striæ dull, leaving the middle of the interstices more shining; these are rather strongly and moderately closely punctured.

Pinotus andicola, Harold.

Harold does not describe the female of this species. I think it is undoubtedly the insect described by Blanchard under the name of *Copris triangulariceps*.

Pinotus nitidissimus, sp. n.

Ovatus, rufo-piceus, convexus, nitidissimus; capite sat magno, planato, triangulari, antice crebre transversim ruguloso, margine anguste reflexo, vertice linea transversa parum elevata leviter curvata postice lævi instructo; thorace convexo, lævi, disco antice leviter flexuoso, angulis anticis sat crebre punctulatis, lateribus bene rotundatis; elytris thorace angustioribus, quam latitudine paullo brevioribus, omnino lævibus.

Long. $8\frac{1}{2}$ lin.

Hab. Bolivia (*Bridges*).

This species is so entirely unlike any other known to me that it is difficult to locate satisfactorily; but on account of the rather large triangular head must come early in the arrangement according to von Harold. I should place it near *P. andicola*. The specimen described is probably a female. The thorax has the extreme front part declivous, with a shallow impression on each side of the front of the disk. The elytra are not striate; but with a strong magnifying-glass some very fine punctures may be seen arranged in lines.

Pinotus adrastus, Harold.

Von Harold describes this species (*Deutsch. ent. Zeitschr.* xix. p. 212) from Peru (*Thamm*). In the British Museum there is a specimen from Peru, also collected by Thamm, which agrees well with von Harold's description, except that the discoidal tubercles would appear to be more developed (curved inwards at the apex) and with a deep transverse impression between these tubercles and the acute basal tubercle.

The female has a short conical tubercle on the vertex of the head, which is rather more triangular than in the male. The thorax is almost vertically declivous in front (with a round impression on each side of the declivous part), the ridge formed by the declivity produced forwards and quadrituberculate, the middle pair of tubercles in advance of the lateral ones and moderately widely separated.

Pinotus torulosus, Esch.

Mr. B. Nevinson has pointed out to me a series of specimens which he has separated from the ordinary form of *P. torulosus* on account of their smaller size and convex shining interstices to the elytra. In the British Museum collection there is a similar specimen from Mendoza.

P. torulosus is described from "Conception," and the length given is $7\frac{1}{2}$ lines; the interstices of the elytra are "erhaben, gewölbt, glatt, glänzend."

Von Harold states ('Abeille,' 1869, p. 133) that he has seen authentic specimens of *P. Valdivianus*, Philippi, and that they do not differ from *P. torulosus* type. It would be interesting to have this observation confirmed. I have not seen Philippi's description.

P. punctatissimus, Curtis, ♀, has the interstices of the elytra slightly convex and somewhat dull, which is the more common form. One specimen in the Museum collection has the interstices almost flat.

Pinotus bicornis, sp. n.

Oblongus, sat parallelus, ater, opacus; capite rugoso, antice rotundato ad apicem vix sinuato, genis antice prominulis, prope marginem anticum cornu erecto sat valido, parallelo, ad apicem truncato instructo; thorace haud punctato (angulo laterali punctato excepto), antice pone oculos exciso, lateribus antice obliquis, ante medium in lobo productis, ad medium sinuatis, disco in processu subhorizontali sat crasso producto, processu apicem versus parallelo, apice truncato; elytris striis subnitidis subtilissime punctulatis vix impressis; tibiaram posticarum calcari apicali ad apicem exciso.

Long. $9\frac{1}{2}$ lin.

Hab. Peru (*Thamm*).

This species, in its dull surface and curious lateral margins of the thorax, has so much in common with *P. diabolicus*, Harold (Deutsch. ent. Zeitschr. xix. p. 211), with which it was received, that at first I was inclined to think it might be

the female of that species ; it does not, however, agree with Harold's description of the female, and differs in the entire absence of sculpture on the thorax, except on the lateral lobe.

Pinotus speciosus, sp. n.

Oblongus, convexus, æneo-iridis, nitidus ; capite cupreo, parce punctulato, clypeo apice obtuse bidentato, nigro, lateribus obliquis fere rectis, vertice cornu lato brevi erecto, angulis dentiformibus ; thorace cupreo, subtiliter punctato, antice declivi, parte elevata antice utrinque sinuata, medio obtuse producta supra impressa, postice leviter canaliculato ; elytris viridibus, thorace perparum angustioribus, sat rotundatis, fortiter striatis, striis sat crebre fortiter punctatis, interstitiis sat convexis, fere lævibus, pedibus nigrescenti-æneis, hic et illic cupreo tinctis.

Long. 7 lin.

Hab. Brazil (*Lacordaire*).

This may be placed next to *P. subæneus*, Casteln.

Pinotus agesilaus, sp. n.

Oblongus, crassus, piceo-niger, nitidus ; capite sat elongato, fortiter rugoso, utrinque prope oculos tuberculo minuto et ante medium cornu brevi erecto sat lato ad apicem subtruncato, genis dilatatis acute angulatis, clypeo subtilius rugoso, antice arcuato, apice incisura parva ; thorace brevi, ante medium subverticali, parte elevata nitida, ad basin parce punctata, antice quadrisinuata, in medio lobo sat lato paullo producta, parte declivi fortiter crebre punctata et subrugosa, utrinque carina obtusa obliqua instructa, margine anteriori pone oculos sat profunde emarginato ; elytris sat fortiter striatis, striis fere lævibus, interstitiis parum convexis, subtilissime vix punctulatis ; tibiæ posticarum calcari apicali apice emarginato. ♂.

Long. 15, lat. 9 lin.

Hab. Brazil, "St. Paul."

This species may be placed just before *P. boreus* in Harold's arrangement. The front margin of the thorax is rather deeply emarginate behind the eyes, somewhat as in *P. diabolicus* and *P. bicornis* ; this is an uncommon character, but may probably only exist in the male.

Pinotus nobilis, sp. n.

Oblongus, crassus, nigro-piceus, nitidus ; capite fortiter crebre punctato, antice angustato, clypeo fortiter bidentato et utrinque iterum lobato ; thorace fortiter crebre punctato, linea longitudinali vix

impressa, antice abrupte declivi, parte elevata antice flexuosa, parte declivi crebre fortiter granulosa, angulis anticis acutis, extrorsum sinuatis, lateribus sat longe brunneo fimbriatis; elytris sat fortiter striatis, striis vix punctatis, interstitiis paullo convexis, sublævibus; pygidio basi subtiliter punctulato.

♂. Capite pone medium cornu erecto brevi punctato ad apicem bidentato.

♀. Capite pone medium carina brevi obtusa leviter bidentata.

Long. 9-10½ lin.

Hab. Uruguay; Bolivia.

This species is somewhat intermediate between *P. crinicornis* and *P. fimbriata*. From *crinicornis* it differs in being more convex, with less long ciliæ at the sides of the thorax and with the front of the clypeus almost quadridentate; from *fimbriata* it differs in having the disk of the thorax strongly punctured. The larger male from Uruguay has the cephalic horn a little dilated at the apex and triangularly emarginate; the front margin of the raised part of the thorax quadrisinuate or quinque-lobate, the middle lobe slightly advanced, with its angles incrassate. The smaller male from Bogota has the cephalic horn narrower at the apex, and the thorax has the front margin of the raised part less strongly quadrisinuate, the middle lobe broad. A specimen marked "Cordova," which appears to be the female of this species, has the cephalic horn reduced to an obtuse ridge with its angles slightly dentiform. The thorax has the disk less raised, the front margin of the raised part forming one broad arcuate lobe with a sinuosity on each side.

EXPLANATION OF PLATE XI.

Fig. 1.	Hind leg of	<i>Onthocharis brevipēs.</i>
Fig. 2.	"	" <i>æqualis.</i>
Fig. 3.	"	" <i>læta.</i>
Fig. 4.	"	" <i>oblonga.</i>
Fig. 5.	"	" <i>Westwoodii.</i>
Fig. 6.	"	" <i>constricta.</i>
Fig. 7.	"	" <i>Batesii.</i>
Fig. 8.	"	" <i>Lacordairei.</i>
Fig. 9.	"	" <i>intermedia.</i>
Fig. 10.	"	" <i>simplex.</i>
Fig. 11.	"	" <i>bella.</i>
Fig. 12.	"	<i>Ontherus Bridgesi.</i>

XXXVIII.—*Descriptions of some new Genera and Species of West-African Lycænidæ.* By HAMILTON H. DRUCE, F.E.S.

AMONGST a large collection of butterflies lately obtained I find the two following apparently undescribed species of Lycænidæ; and as they do not seem to me to be properly referable to any known genera, I venture to describe them. The collection contains a good series of both. I also include descriptions of two genera for two well-known West-African Lycænidæ which cannot now be referred to their original genera, viz. *Myrina* and *Hypolycæna*.

HYPOMYRINA, gen. nov.

Allied to *Hypolycæna*; costa more arched and outer margin more rounded, and with an additional subcostal nervule, which is emitted rather beyond the middle of the third. Hind wing with the lobe distinct and more produced, and with one short linear tail on the lower median nervule. Palpi with the terminal joint long, slender, and pointed, almost as long as second; legs normal.

There are no secondary sexual characters.

Type *Myrina nomenia*, Hewitson.

We have specimens of this species as noted by Mr. Kirby (Hew. Ill. Diurn. Lep., Lycæn., Supp. p. 26) from Sierra Leone and Lagos, together with the typical form; and I find that a good series shows very slight variation and they will probably prove to belong to a distinct species.

HYPOKOPELATES, gen. nov.

Allied to *Hypomyrina*, having the venation much the same, but with the terminal joint of the palpi much shorter and with secondary sexual characters. The lobe very small and one short linear tail on the lower median nervule.

Type *Hypolycæna mera*, Hewitson.

KOPELATES, gen. nov.

Allied to *Hypokopelates*, but with the first subcostal nervule bent towards the costal nervure and distinctly touching it for some considerable distance. Palpi: second joint long and robust, terminal joint very small. Head very large; antennæ rather long, very slender, with rather lengthened abrupt club.

Type *Kopelates virgata*, mihi.

Kopelates virgata, sp. n.

♂. Upperside jet-black, with all the veins and inner and outer margins of fore wing and outer margin of hind wing very narrowly bordered on both sides with bright greenish ultramarine-blue, the costal margin of fore wing being black at the base and of hind wing rather broadly black from the base to the apex. The space between the lower median nervule and the submedian nervule on hind wing blue, as above. Cilia of fore wing black, of hind wing silvery grey outwardly bordered with black. Lobe very small, black, with a minute dark red spot and some lighter blue scales over (in some specimens this red spot is entirely replaced by black). Tail black, with white tip. The brand near base on hind wing is very small, creamy white, with yellowish centre and above the cell.

Underside greyish emerald-green, shiny, with a rather narrow, irregular, slightly darker band, bordered on both sides with whitish, rather beyond the middle, common to both wings, very faint on the costa, and gradually becoming more distinct where it is much angulated on the anal margin of hind wings, where also its whitish borders are more distinct. Lobe with a large black spot with some orange scales over; a silvery-blue patch between the lower median nervule and the submedian nervule, and a black spot between the two lower median nervules. A narrow black marginal line from the lobe nearly to the apex, bordered inwardly with white. A rather broad, indistinct, whitish line between the band and spots at the anal angle reaching about as far up as the black marginal line. Cilia of fore wing green, of hind wing green at apex, but silvery grey bordered with black towards anal angle. A short band at end of cell in both wings.

♀. Upperside uniform dull greyish brown with the lobe bright orange.

Underside as in male, but much paler, and with the band yellowish near the anal margin, and the black spot between the lower median nervules much larger and strongly bordered inwardly with yellow.

Head and thorax blackish. Abdomen of male covered with blue scales, of female brown above, whitish below. Palpi white, with black tips. Legs black and white.

Expanse, ♂ ♀ $1\frac{1}{4}$ inch.

Hab. Sierra Leone. *Mus.* Druce.

This species is not nearly allied to anything with which I am acquainted. The beautiful shining green on the underside appears only in perfect specimens, as several which are somewhat worn have nearly lost it and are almost greyish brown.

PILODEUDORIX, gen. nov.

Allied to *Rapala*, Moore, from which it differs in the much more triangular fore wings (the apex being more pointed and the interior margin shorter), by the anal fold being much more enlarged, and by having a long pencil of hairs attached to the hind wing between the lower median nervule and the submedian nervure near the base. The terminal joint of the palpi is longer and stouter, and the antennæ also are longer and more gradually clavate.

Type *Pilodeudorix barbatus*, mihi.

The patch of hairs on the inner margin of fore wing and the scaly patch on hind wing are both small.

Pilodeudorix barbatus, sp. n.

♂. Upperside: fore wing jet-black, partially covered with large ultramarine-blue scales, viz. from the base between the costal and median nervure nearly to the apex, and from the base beneath the lower median nervule to the interior angle, leaving the outer half of the inner margin black; a few blue scales close to the outer margin between the median nervules.

Hind wing jet-black, paler on the costal margin; blue scales in the cell; a distinct, rather lighter blue streak from the base to the outer margin, sharply bordered by the lower median nervule and the submedian nervures. The anal fold pure white from the base, merging into greyish above the lobe, which is very small and contains a dull red spot. A very narrow black marginal line from the apex to the lobe. The pencil of hairs which is attached to the wing near the base being jet-black, about the length of the body, and falling over the white anal fold. Cilia of fore wing black, of hind wing silvery grey, more especially towards the anal angle; a short black linear tail, tipped with white, on the lower median nervule.

Underside rather dark greyish brown, with slightly darker bands inwardly and outwardly edged with greyish white. Fore wing: a short broad band at the end of the cell, and beyond the middle, commencing below the costal margin, a rather broader band, gradually tapering off towards the inner margin, the lower half being placed closer to the base; a rather large black oblong band near the base just below the median nervure, and below that a shining whitish space and a small tuft of black hairs attached to the inner margin. Hind wing with a short band about the middle of the cell, and beyond that, commencing about the centre of the costal

margin and ending about the middle of the inner margin, a much broken irregular band; beyond this from the apex to the anal angle a faint greyish line bent inwards on account of a rather large black spot inwardly bordered with orange between the two lower median nervules; a faint submarginal line and a narrow black marginal line inwardly bordered with pure white. The lobe black, with a few bluish scales and an orange patch above.

Head white between the eyes; thorax and abdomen blackish above, with blue scales. Abdomen creamy white below; legs black, with white spots. Antennæ black, annulated with white. Palpi white, with black tips.

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

Hab. Sierra Leone. Mus. Druce.

Although the collection contains about forty specimens there are no females amongst them.

The spot between the nervules on underside of hind wing is frequently annulated with orange, and several specimens have a distinct white ringed spot in the cell of fore wing below, but on one wing only.

XXXIX.—*The History of a Long-forgotten British Lithobius.* By R. I. POCKOCK.

IN many, if not most, zoological groups there is an unfortunately large category of species which are tacitly ignored by more modern authors and consigned to oblivion by their common consent. For this neglect there is generally ample excuse, the excuse being often traceable to absence of locality for the typical specimen, or more often to some errors or omissions committed by the writer who first described the species. To rescue such a species from its fate is always gratifying, and the task is rendered still more so when it incidentally adds fresh and interesting facts to the history of the species by shedding unexpected light upon its synonymy, distribution, or structural variability.

Such species are *Lithobius pilicornis* and *L. Sloanei* of Newport. The first-named was originally described on p. 96 vol. xiii. of this Magazine, but subsequently and more fully on p. 369 of vol. xix. of the Trans. Linn. Soc., this last description being repeated in the 'Catalogue of the Myriopoda in the British Museum.' Immediately following the first description of the species is the description of the second, *L.*

Sloanei. This description is also repeated and amplified in the Linnean 'Transactions' and in the 'Catalogue.' In the Linnean 'Transactions' Newport refers to the resemblance between these two species and points out the characters by which they may be separated. Curiously enough, however, he nowhere gives the number of antennal segments of *pilicornis*, whereas he asserts that *Sloanei* possesses forty. And since, in his comparison of the two species, there is no statement that any structural difference is found in these appendages, the obvious inference is that *pilicornis* also possesses forty segments. Add to this that *pilicornis* is said to be English, while there is no locality for *Sloanei*, and we have sufficient information, one would think, to lead to the identification of at least *pilicornis*. No mention, however, of either has been made for more than thirty years, and but for what may be termed a lucky chance both might for many a year have still remained amongst the category of long-forgotten species.

* * * * *

During a trip to Cornwall in the autumn of 1890 my friend Mr. Oldfield Thomas was fortunate enough to capture upon St. Michael's Mount a magnificent specimen of the genus *Lithobius*.

It is manifest at a glance that this specimen is markedly different from the common British members of the family; for it far exceeds in size the largest examples of *L. forficatus* and *L. variegatus*, the two species which have hitherto shared the distinction of being generally considered the giants of the race—so far at least as Britain is concerned. Moreover, a closer inspection shows that, apart from its size, this new comer may be distinguished by sundry well-marked structural features from all its near relatives that are commonly met with in England. From a systematic point of view, in fact, its specific characters are at least as important as those which distinguish *forficatus* from *variegatus* or *crassipes* from *microps*.

Taking this into account, and not at the time recollecting that any similar or even remotely allied species had been described on the continent from the countries of which the Myriopod fauna is known, I had reasonable grounds for expecting that this one would prove to be new to science, and that we should have the satisfaction of recording a second species of the genus as peculiar to the British Isles. Reference, however, to literature, accompanied by a careful reexamination of the specimens of this genus that are contained in

the British Museum, soon dispelled this illusion. For three points speedily came to light:—Firstly, that the specimen is specifically identical with the type of *L. pilicornis*; secondly, that *L. Sloanei* is synonymous with *L. pilicornis*; and thirdly, that the species has been redescribed by von Porath and has received the appropriate name *longipes* as a secondary title.

The types of *longipes* were from the Azores, and the species was established in 1870. Two years later Dr. Meinert obtained a *Lithobius* from Madeira which he questionably identified as *longipes*. But to afford others an opportunity of testing the correctness of his conclusion, he recharacterized the species from the Madeiran example. If this description be compared with that given by von Porath certain differences between the two may be noticed—differences which, although slight in themselves, are perhaps in the aggregate of sufficient importance to justify the caution Dr. Meinert displayed in qualifying his synonymy with a mark of interrogation. I confess, however, to having come to the conclusion that these differences might easily be accounted for on the grounds of individual variation. I was consequently somewhat surprised to find upon consulting Dr. Meinert's last work on the Chilopoda that he subsequently comes to an opinion exactly the opposite of my own. For in this instance he identifies a specimen from Marocco as *longipes* of Porath, and, deciding that it is specifically distinct from his previously described Madeiran specimen, he assigns to this last the new name *galatheæ*. Fortunately, however, by drawing up a diagnosis of the Moorish example he again furnishes us with a means of keeping a check upon his determination and of testing the validity of his views. But here again it is hard quite to agree with Dr. Meinert. It seems to me that this third description by no means serves to emphasize the distinction between the so-called *galatheæ* and *longipes*. On the contrary, it confirms me in the belief that the Madeiran and Azorean specimens are co-specific; and there is no doubt whatever that Dr. Meinert has correctly identified the specimen from Marocco. Hence the three descriptions have been drawn up from specimens which are specifically identical. Clearly, however, such an expression of personal conviction will carry but little weight if unsupported by facts; and it is desirable to be somewhat more explicit, since this view is opposed to that of Dr. Meinert, whose opinion on such a point is worthy of most careful consideration—and this quite apart from the circumstance that his conclusion is so much the more valuable inasmuch as it was formed from a comparison of specimens.

In the first place, if we compare the description of the Azorean with that of the Madeiran specimen, we find that they resemble each other in colour, number of antennal segments, hairiness of sternites, number and shape of coxal pores, armature of anal legs and of the female generative appendage, while they differ a little in the number of ocelli and of teeth on the maxillary sternite and in that the Madeiran specimen is said to be posteriorly granular. Again, the example from Marocco agrees with both in colour, in the number of its antennal segments, in the shape of its coxal pores, and in the armature of its anal legs and of the generative appendage. But while it resembles the specimens from the Azores and differs from that from Madeira in the number of its maxillary teeth, it resembles that from Madeira and differs from those from the Azores in the number of its ocelli and in being posteriorly roughened. It further differs from the Madeiran specimen in the spine-armature of the first pair of legs; and it differs from both in the number of its coxal pores. Thus we see that Dr. Meinert's *galathea* differs from his *longipes*, which is doubtless too the *longipes* of Porath, in the number of its maxillary teeth and of its coxal pores, and in the spine-armature of its first pair of legs. But what is the value of these characters? Are they of specific importance? Clearly in the absence of series of examples these questions can only be answered by analogy, that is by seeing what value they have in other species of the genus. If now we turn to Dr. Latzel's description of *L. forficatus*, we find that the number of maxillary teeth varies from 10 to 14, that the coxal pores are either transversal, oval, or more or less round, and vary from 6, 6, 6, 5 to 12, 11, 11, 10, and that the spine-armature of the first pair of legs is not constant. Thus it is clear that the differential characters of *galathea* as described are of very little value. It is clear, moreover, if other characters of *forficatus* be examined, that the Moorish, Madeiran, and Azorean specimens differ far less from each other than do individuals of *forficatus*. But when a number of specimens agree precisely in most of their characters, and differ only in characters which are known to be still more variable in an allied species of the genus, it is surely illogical to consider such differences as worthy of specific consideration. To put it more clearly, suppose A, B, C, and D be four specimens, of which A and B are beyond all question members of the same species. If, then, it be found that A resembles and differs from B precisely as C resembles and differs from D, surely there are no grounds for concluding that C is a different species from D? The conclusion is rendered still more untenable if the differences

between A and B are greater than the differences between C and D. Thus by analogy we may fairly safely argue that *galatheæ* is synonymous with *longipes*. The same line of argument has convinced me, moreover, that the specimen from St. Michael's Mount is specifically identical with the type of *pilicornis*, and that *Sloanei* and *longipes* are synonyms of *pilicornis*.

It is not hard to find reasons why Porath and Meinert failed to identify *pilicornis*. The fact of the type being British* furnished strong grounds for the belief that Azorean and North-African specimens would be distinct from it. Moreover it will be remembered that Dr. Newport inadvertently implied that the specimen has forty antennal segments. As a matter of fact it has thirty-two and thirty-three; and why Newport should have assigned forty to the type of *Sloanei* is unintelligible, since the only entire antenna which the specimen possesses has but thirty-four. But for this error the species might have been identified; under the circumstances, however, no one can be blamed for failing to do so.

Again, the differences which Newport has pointed out for distinguishing *pilicornis* from *Sloanei* will not stand the test of criticism. Thus in counting the labial teeth of *pilicornis* Newport again fell into error; for he asserts that there are ten, whereas in reality there are the same number as in *Sloanei*, namely eight. The difference in the shape of the head in *pilicornis* is due to the fact that the sides of the sclerite have become curled downwards during the process of drying; and the greater apparent hairiness of *pilicornis* is no doubt to be attributed partly to the removal of the hairs in the type of *Sloanei* and partly to the fact that they have become matted to the various parts of the body; for this specimen, Newport informs us, was taken from a bottle forming part of the original collection of Sir Hans Sloane.

At the present time this type is a bleached and shrivelled example, bearing a ticket numbered 4167, which is presumably a copy of an original number affixed by Sir Hans Sloane; for a reference to the MS. catalogue of the Sloane collection shows that this number refers to "a middling good-sized brown *Scolopendra*."

To show still further the variability of this species and to follow Dr. Meinert's excellent example of furnishing others with a check upon the synonymy here given, I publish the

* Apart from Dr. Newport's statement to that effect there is no evidence that the specimen is British, there being no ticket affixed to it with the information.

following description of the specimen from St. Michael's Mount :—

Lithobius pilicornis, Newport.

Lithobius pilicornis, Newport, Ann. & Mag. Nat. Hist. xiii. p. 96. no. 5 (1844); Trans. Linn. Soc. xix. p. 369. no. 13 (1845); Cat. Myriopoda Mus. Brit. p. 20 (1856).

Lithobius Sloanei, Newport, Ann. & Mag. Nat. Hist. xiii. p. 96. no. 6 (1844); Trans. Linn. Soc. xix. p. 369. no. 12 (1845); Cat. Myriopoda Mus. Brit. p. 19 (1856).

Lithobius longipes, von Porath, Öf. Vet.-Akad. Förh. xxvii. p. 816 (1870); Meinert, Nat. Tidsskr. (3) viii. p. 323 (1872); id. Vid. Medd. Foren. 1884-86, p. 109.

Lithobius galathea, id. *ibid.*

Colour (in alcohol *) deep castaneous above and below, the arthro-dial membranes greyish blue; shining.

Head-plate pentagonal, sparsely punctured and hairy.

Antennæ hirsute, composed of thirty-two or thirty-three long cylindrical segments, of which the second is the longest; apical segment only very slightly longer than the penultimate.

Eyes composed of about twenty-six ocelli, arranged in five or six rows.

Maxillary sternite sparsely punctured and hairy; prosternal plates well developed, separated by a deep excavation, each armed with five long sharp teeth, of which (counting from the inside) the first, second, and third are close-set, while the fourth is separated from the third, and the fifth from the fourth by a wider space.

Tergites mostly smooth, those at the posterior end of the body being, however, roughened and granular; most of them with rounded angles; the eleventh, however, has its angles slightly produced and the thirteenth has them more strongly produced.

Sternites sparsely punctured and hairy; longitudinally depressed in the middle and lightly depressed at the sides.

Legs long and hairy, the tarso-metatarsus being especially hirsute; the posterior four coxæ furnished with 8, 9, 9, 7 long slit-like pores; *anal legs* long, coxæ armed with one lateral and one inferior spine, the other segments armed beneath as follows:—1, 3, 2, 1, 0; claw unarmed.

Generative forceps in female furnished with two spurs on each side; the claw obsoletely trifold.

* Mr. Thomas informs me that when living the specimen was of a deep dull green tint. This green has changed to a deep red from the action of the methylated spirit.

Measurements.—Total length of body 35 millim., of antennæ 15 millim., of anal leg 16·5 millim.

This specimen is the largest known example of the species. Porath gives 24 millim. as the greatest length of his typical examples and Dr. Meinert assigns 21 millim. to his specimen from Madeira and 18 to the one from Marocco. In addition to the individual just described and the types of *Sloanei* and *pilicornis*, the British Museum possesses a fourth from Madeira, which was sent by Mr. J. Y. Johnstone. This measures 26 millim. The type of *Sloanei* has the body very much shrunken; but, judging from the size of the head and from the length of the anal leg, it was at least as large as this example from St. Michael's Mount.

The types of *pilicornis* and *Sloanei*, as above stated, possess eight maxillary teeth; the specimen from St. Michael's Mount has ten, whereas the example from Madeira has but seven, the external tooth on the left side being absent. All of them agree in presenting 2, 2, 1 spines on the under surface of the first pair of legs.

The coxal pores vary a little in number, being either 8, 10, 10, 8 or 8, 9, 9, 7. The shape varies also. In the type of *Sloanei* and in the example from St. Michael's Mount, the two largest of the specimens, they are considerably more elongate than in the others.

The antennal segments vary in number from thirty-two to thirty-four*.

Distribution.—As may be inferred from what has been said above, the only definitely known localities for this species are Marocco, Madeira, the Azores, and St. Michael's Mount, off the south-west coast of Cornwall. But we may safely con-

* Since sending the above to press I have discovered other specimens of this species in the Museum collection. One of these was collected by Mr. Oldfield Thomas at Falmouth, and had been mistaken for *forficatus* until critically examined; the others, four in number, were obtained by the officers of H.M.S. 'Challenger' at Teneriffe, and, being badly preserved and damaged, had been provisionally set aside as unidentifiable. Of these Teneriffe specimens only one has a perfect antenna, which proves to be composed of thirty-three segments. In the largest specimen the maxillary teeth are large, sharp, and eight in number; in the others, however, these teeth are very blunt and more or less fused. The example from Falmouth has thirty antennal segments on one side and thirty-five on the other, and the maxillary teeth are conspicuous and four on each side.

No doubt the species has been introduced into Teneriffe from the mainland, just as it has into Madeira and the Azores; and what has been said above with regard to the distribution of the specimen from St. Michael's Mount will apply equally well to the one from Falmouth.

clude that it does not occur in Scandinavia, Denmark, Germany, and Austro-Hungary; for the Myriopoda of these countries have been so thoroughly investigated, that such a conspicuous species could not easily have been overlooked. Unfortunately nothing or next to nothing is known of the Myriopod fauna of Portugal and France, and in the absence of this information any attempt to account for the existence of this species in Britain must clearly be regarded as purely provisional.

No one will probably dispute that the species has been introduced from the mainland into Madeira. Moreover, it is quite likely that from Madeira it has made its way into the Azores. But its existence in England may be due to at least one or more than one of three causes—either the species inhabited England and France before the separation of the former tract of land, or it has been introduced from the continent since the separation, or it has been carried over to us from the Azores. In support of this last hypothesis we may urge the great rarity of the species in England and its apparent confinement to our south-western counties. For, coming from so warm a locality, we should expect that it would only be able to maintain itself in the extreme south-west, where the climate is moist and relaxing and frosts are of rare occurrence. The introduction of the species into England from the Azores might have been effected, one would think, by means of a floating tree-trunk driven before a south-westerly gale.

We can never, however, satisfy ourselves on these points until collectors have filled up the gaps in our knowledge with respect to the Myriopod fauna of Portugal and France.

XL.—*Descriptions of new Species of Upupæ and Trochili in the Collection of the British Museum.* By OSBERT SALVIN, M.A., F.R.S.

UPUPÆ.

Upupa somalensis.

Upupa epops senegalensis, Shelley, Ibis, 1885, p. 397.

Adult male. Similar to that of *U. epops*, and with the primaries and tail similarly banded with white; the upper back,

neck, head, and under surface are deeper rufous, almost as in *U. africana*, and the secondaries are marked as in that species, the basal two thirds being white and the apical black third crossed by a white transverse band. Total length about 10·5 inches, wing 5·4, tail 3·7, bill 2·2, tarsus 0·8.

Hab. Somali-Land.

There can be little doubt that the bird here described belongs to a species distinct both from *U. epops* and *U. africana*, having the primaries banded as in the former bird and the secondaries like those of the latter as well as its rich colour.

Scoptelus notatus.

Adult. Similar to that of *S. aterrimus*, but the upper surface bluer where *S. aterrimus* is purple and greener where that bird is steel-blue; the outermost rectrix on either side always has a subterminal white band, which varies somewhat in width and is sometimes divided into two spots by the dark shaft.

Young. Differs from the young of *S. aterrimus* in the same way as the adults from one another.

Hab. North-east Africa, perhaps extending into the Congo region.

The adult males of this species have a dark greyish sub-terminal patch on the inner webs of the primaries. In the females this is much larger, paler, and more distinct.

This bird of N.E. Africa has usually been united with the West-African *S. aterrimus*; but from the specimens before me I have no difficulty in distinguishing the two birds.

TROCHILI.

Panychlora micans.

Adult male. Similar to that of *P. aliciaæ*, and of about the same size. The whole plumage is of a rich reddish golden hue, brighter and redder on the crown. The tail is very dark and of more bronzy tint than in the allied species, but the outer rectrices are distinctly green, and not coppery bronze, as in *P. russata*; moreover the tail is slightly forked.

Hab. — ?

A single male specimen in the Gould Collection is the only one I have seen of this bird. It is very richly coloured, and, though differing obviously from *P. aliciaæ*, may possibly prove to be a variety of that species.

Heliangelus laticlavus.

Adult male. Very similar to that of *H. clarissæ*, and with the upper surface and tail coloured in the same way; on the under surface the white pectoral band is much wider, more than double the width of that of the allied form; there is no band of glittering green feathers below the white, and the middle of the abdomen is more distinctly buff; the under tail-coverts are white, with wider dusky shaft-stripes.

Female unknown.

Hab. Ecuador.

Heliangelus violicollis.

Adult male. Similar to that of *H. strophianus*, but the upper surface of a darker, more rufescent brown, especially in the middle of the back; the abdomen too has a more bronzy hue; the most obvious difference is in the colour of the throat, which is glittering violet-blue, without any red or rosy tint.

Young male. Has the feathers of throat black, with white edges; amongst these the glittering violet feathers of the adult appear.

Hab. Ecuador.

Heliotrypha speciosa.

Adult male. Very similar to that of *H. Barrali*, but with a longer bill and the throat of a more glittering olive-green, without the leaden or silvery hue of the allied species; the feathers of the breast are rather more conspicuously white at the base, but this character is also seen in *H. Barrali*. Total length about 5 inches, wing 2·5; tail, central rectrices 1·45, lateral 1·6; bill 1.

Hab. Colombia?

Amazilia Sumichrasti.

Adult male. Upper surface shining grass-green, darker on the head, more golden-bronze on the rump and upper tail-coverts; throat and breast glittering grass-green, the white bases of the feathers hardly showing anywhere; abdomen and flanks shining grass-green; under tail-coverts rufous; tail rich lustrous coppery bronze; bases of the inner primaries

and secondaries chestnut; maxilla black; mandible flesh-colour, the tip black. Total length about 3·8 inches, wing 2·1, tail 1·2, bill 0·9.

Hab. Tehuantepec, South Mexico (*Sumichrast*).

In some respects this species resembles *A. ocai*, but the richer, more coppery colour of the tail, the dull-coloured crown, and uniform green throat readily distinguish it. I am indebted to M. Boucard for the specimen now described.

Polyerata decora.

Damophila amabilis, Salv. P. Z. S. 1870, p. 211.

Adult male. Similar to that of *P. amabilis*, but the bill longer, the glittering feathers of the crown extending to the nape, and the upper tail-coverts and central rectrices dark shining green, without reddish or purple shade. Length of bill 1·1 inch.

Adult female has also a long bill and the upper tail-coverts and central rectrices dark green without purple shade.

Hab. Chiriqui.

I have long hesitated to separate this bird from *P. amabilis*, but am now convinced of its distinctness. Its range is probably very restricted and confined to the western slopes of the Volcano of Chiriqui. On the eastern side the range of *P. amabilis* is probably continuous from Costa Rica to Panama.

Oreopyra pectoralis.

Adult male. Similar to that of *O. calolema* in all respects except that the breast, when viewed from in front, is nearly black, and not glittering green.

The female is probably undistinguishable from that of *O. calolema*.

Hab. Costa Rica.

Phæolæma cervinigularis.

Similar to *P. rubinoides* as to the colour of the crown, which has a central glittering green stripe. In size it equals *P. æquatorialis*, but differs from that species in the colour of the crown and from both in having the chin pale chestnut, like the sides of the throat, with hardly a trace of green. Total length about 5 inches, wing 2·9; tail, central rectrices 1·4, lateral 2; bill 1·3.

Hab. Ecuador?

Of the two skins in the Museum one was in Gould's Collection and one in our own, the latter having been obtained from Mr. Whitely. Both are males. The exact locality where this bird is found remains to be discovered; at present I can only say that the types are made up in the manner usual in collections of humming-birds from Ecuador.

Eriocnemis ventralis.

Adult male. Upper surface shining grass-green, becoming bronzy black on the hind neck and crown, and glittering olive-green on the rump and upper tail-coverts; under surface with the throat bronzy black, a glittering blue gular patch; breast glittering green, shading into glittering amethyst on the abdomen; under tail-coverts glittering purplish blue; tail steel-blue; tibial tufts pure white; bill black. Total length about 3·9 inches, wing 2·25; tail, central rectrices 1·05, lateral 1·65; bill 0·85.

Hab. Colombia.

BIBLIOGRAPHICAL NOTICES.

Aids in Practical Geology. By GRENVILLE A. COLE, F.G.S., Professor of Geology in the Royal College of Science for Ireland. 8vo. Pp. i-xiv & 1-402; with 136 illustrative cuts. C. Griffin & Co.: London, 1891.

CHAPTER I. treats of Geological observations to be made in the field, from lowland to upland and into the mountains, with the utensils required and the methods recommended. For the construction of maps and sections, Geikie's and Penning's books are referred to. Mr. Dalton's geometric process of determining the true dip between two uncertain dips in the sides of a quarry is given at page 6. For labels, mentioned at page 10, good pencil-writing will surely resist moisture better than ink. Chapter II. is short, but important; treating of the collecting and packing of specimens.

As the chief aim of this excellent manual is to teach the student, whether indoors or abroad, to recognize the various kinds of Rocks—sedimentary, igneous, and metamorphic—that constitute the solid portions of the Earth's surface, the knowledge of how to find out and discriminate their constituent minerals is of primary importance. Hence Chapters III.-IX. (pp. 13-83) treat of the physical characters

of minerals; tests with water and acids, and examination with the blowpipe; pleochroism is also treated of. Under each group of subjects numerous trustworthy authorities are plainly referred to, so that the latest discoveries and newest forms of apparatus are brought under the student's notice.

The examination of Rocks themselves occupies Chapters X.–XX. (pp. 84–265). First are briefly noticed “coarsely fragmental rocks;” then “ordinary stratified rocks,” and “cleaved and foliated rocks,” “Igneous rocks,” or those “that have consolidated from a state of fusion,” are more fully treated, under the headings (1) “glassy rocks,” (2) “lithoidal rocks,” and (3) “distinctly holocrystalline rocks.” “Some physical characters of rocks” is the title of Chapter XII.; and “the chemical examination of rocks” that of Chapter XIII. In the next chapter “the isolation of the constituents of rocks” is carefully elaborated after the experiences of Cordier, de Bellevue, Thoulet, Fouqué, Harada, Delesse, Evans, and Smecth. The microscope and its use in petrological examination, with references to Sorby, Wallich, Judd, Lévy, Lacroix, and others, and a list of the more important works treating of microscopic petrography, occupy Chapters XV. and XVI. A careful description of “the characters of the chief rock-forming minerals [as seen] in the rock mass and in thin sections” follows (pp. 139–169). In Chapter XVIII. the practical examination of the rocks themselves is entered upon. Firstly, the sedimentary strata (pp. 170–196), such as i. Sands, sandstones, grit-stones, gravels, pebble-gravels, conglomerates, and quartzites: ii. Volcanic agglomerates, tuffs, ashes, and brecciated lavas: iii. Clays and shales: iv. Shell-limestone, coral-limestone, nullipore-limestone, oolitic limestone, dolomite, and brecciated limestone: v. Bone-beds and phosphatic deposits: vi. Stalactites, stalagmites, travertine, siliceous sinter, gypsum, rock-salt: vii. Concretionary limestone, ironstone, also flint and chert: viii. Coal and anthracite. Secondly, the petrology of the igneous rocks, as to external (macroscopic) and internal (microscopic) appearances, is treated (like the foregoing division) *con amore*, and with references to other workers, in a full chapter (pp. 196–250). These rocks are here grouped as A. Holocrystalline:—granites and eurites; syenites; quartz-diorites and quartz-aphanites; diorites and aphanites; olivine-gabbros and olivine-dolerites; peridotites. B. Hemicrystalline: “Lithoidal rocks containing some glassy matter:”—rhyolites; trachytes and phonolites; andesites; basalts; limburgites; nephelinites and leucitites. C. “Highly glassy igneous rocks:”—obsidians; tachylytes. A synoptical table, at p. 250, is intended to give the above-mentioned grouping at a glance.

Chapter XX. (pp. 251–265) is shorter, but carefully constructed to treat of “Metamorphic rocks,” both those “affected by contact-metamorphism,” and those “affected by regional metamorphism.” Among the latter are—“crystalline limestones,” “cleaved rocks,” and “foliated rocks.”

The palæontological relations of strata occupy the rest of this

useful work (Chapters XXI.–XXVIII., pp. 266–390). This Part iv., entitled “the examination of fossils,” is a condensed and matter-of-fact treatment of the subject, and probably, as far as it goes, the best of its kind yet published. The relationship of palæontology to zoology, and the extent to which either need be studied by students working for a good pass-examination, or by amateurs earnestly desirous of getting some mastery of the subject, are kept well in view. How fossils are found preserved in the strata, and how they may be preserved when they have been found in quarries and other sections, form a brief introduction to the study of fossils. The chief genera, or generic types, of Invertebrata are then concisely treated of in the order of their natural groups, from the Protozoa to the Crustacea, with notes on their distribution in the Geological series. Chapter XXVIII. is the last (pp. 379–390), and consists of a condensed “list of characteristic invertebrate fossils” for each of the geological formations from the “Harlech series” of the Cambrian upwards to the “Chillesford Beds” of the Pliocene.

To those who are especially desirous of working out the history of the Earth by such elucidation as petrology can give, this manual will be a very great help. An acquaintance with strata in their orderly arrangements and in their disturbed conditions is supposed either to have been attained, or to be looked for in other handbooks. So also the history of the formation of the strata in successive ages. Fossil remains of the vertebrate animals and of plants are also left to other teachers. With these intentional omissions, for reasons intimated or given in full, the book is very good for its purpose, being full of well-digested information, for the most part from the newest sources of information, and often from the author's personal research.

Of the 136 woodcut illustrations, 17 are concerned with apparatus necessary to the mineralogist and petrologist; 28 illustrate microscopic sections of rocks; and 91 are given to the fossils. A careful Index completes the work.

The Honey-Bee: its Natural History, Anatomy, and Physiology.

By T. W. COWAN, F.L.S., F.G.S., &c. Houlston & Sons: London, 1890.

THERE is probably no other insect which can boast of so voluminous a literature as this; and for precisely this reason the present little volume, the latest addition, will be heartily welcomed. In the short space of some 190 small octavo pages the author gives a concise account of the chief facts in the anatomy and physiology of the Hive-Bee, as now established after the discoveries of older workers have been tried by the ordeal of modern methods of investigation. Except in the case of facts long ago accepted, the names of authorities for statements in the text are in all cases given, and

references are furnished to a bibliography at the end of the volume, containing the titles of the principal memoirs &c. which have been consulted. We are sorry to find that the author has not thought fit even to mention Cheshire's treatise on 'Bees and Bee-Keeping' in his bibliography, although it is certainly entitled to rank as the modern English classical work on the subject. The book is illustrated with a number of figures, most of which Mr. Cowan states in his preface have been drawn for the purpose, while his indebtedness for others is duly acknowledged. Mr. Cowan's terminology is at times a little shaky: it is unfortunate that his definition of the word "inoscultation" (p. 58) should allow the reader to infer that a muscle is a "vessel;" and until we read this book we had never heard of *vasa differentia*, nor did we know that "Samenlister" was the German equivalent. The book is certain to be of much use to the comparative entomologist as well as to the intelligent bee-keeper.

E. E. A.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

February 25, 1891.—Dr. A. Geikie, F.R.S.,
President, in the Chair.

The following communication was read:—

"On a Labyrinthodont Skull from the Kilkenny Coal-Measures."
By R. Lydekker, Esq., B.A., F.G.S.

The Author describes a skull from Jarrow Colliery, which he refers to *Ichthyerpetum*, and names *I. hibernicum*, giving reasons for its specific distinctness from *I. (Erpetocephalus) rugosum*, Huxley. He compares it with allied forms, and believes that it is a member of the group *Brachyopina* of Miall, and if so that we have a number of forms belonging to a type which is unknown above the base of the Permian in Europe, but which survived to later times in the Indian, Australian, and Ethiopian regions.

March 11, 1891.—Dr. A. Geikie, F.R.S.,
President, in the Chair.

The following communication was read:—

"The Tudor Specimen of *Eozoon*." By J. W. Gregory, Esq.,
F.G.S., F.Z.S.

After careful examination of all the slides and figures, and after consideration of Sir W. Dawson's interpretation, the Author is

absolutely unable to recognize in the specimen any trace of the "proper wall," "canals," or "stolon passages" which are claimed to occur in *Eozoon*, or any reasons for regarding the calcite bands as the "intermediate skeleton" of a foraminifer. There are points in Sir W. Dawson's figure which might pass as "stolon passages," but they appear very different in a photograph, and the specimen agrees with the latter.

The Author, however, gives reasons for concluding that the case against the organic origin of the Tudor specimen does not rest on negative evidence alone; for though the rock is much contorted, the twin lamellæ and cleavage-planes of the calcite are not bent; and the fact that the crystalline bands cut across the bedding-planes further shows their secondary origin.

The rock in which the specimen was found is not "Lower Laurentian," and is included by Messrs. Selwyn and Vennor in the Huronian.

MISCELLANEOUS.

On Professor Jeffrey Bell's "Notes on Nomenclature of British Starfishes," with remarks on some Recent Crinoidea. By the Rev. Canon A. M. NORMAN.

The critical revision of names suggested by Prof. Jeffrey Bell (*Ann. & Mag. Nat. Hist.* for Dec. and Feb. last) seems intended for friendly criticism, as he himself assures me it was; and I therefore send the following items for the consideration of himself and others.

These notes, moreover, are partly corrective of my own use, as well as of that of others. Unfortunately in the preparation of my list, 'Museum Normanianum, I. Echinodermata,' I made the mistake of employing certain names as used by recent authors, instead of going into the matter again and seeing whether there were just grounds for changing nomenclature I had previously after mature consideration adopted.

Cribrella versus Henckia.

When Sladen wrote "Genus *Cribrella* (Agassiz), Forbes," he thereby intended, I take it, to express a truth, namely that *Agassiz* first used the name, that Forbes more accurately defined the genus, and that he employs it in Forbes's sense.

Professor Bell says that Forbes in using *Cribrella* (or *Cribella*) "perpetrated a robbery, which is now only (after half a century!) revealed to the world, which has been taught to revere his name. . . . He thought perhaps that he was justified, when he had placed the species in Nardo's genus *Linckia* (*Mem. Wern. Soc.* viii. p. 120) in 1839, and discovered his error and the fact that *Cribrella* was a synonym for that name a little later." The implication is

that Forbes found he had made a mistake in placing the species in *Linckia*, and therefore stole *Cribrella*. But Forbes distinctly gave the reasons for the change. "The name *Linkia* given it by Nardo must be rejected on account of a genus of plants having been so named previously; therefore I have adopted Professor Agassiz's proposed appellation"* . Moreover, Agassiz was probably cognizant at the time of what Forbes was doing, and most certainly approved, for he wrote shortly afterwards of Forbes's work, "Il circonscrit d'une manière plus rigoureuse mes genres *Uraster* et *Cribrella*" †. So much in defence of one whose "name" I still "revere."

But should *Cribrella*, as redefined by Forbes, or *Henricia*, Gray, be used? *Henricia* was published Nov. 1, 1840, *Cribrella*, Forbes, Dec. 1, 1840. The part of Forbes which contains the description of *Cribrella* contained pages 97-144, and considering the many woodcuts and the way in which that work was brought out must have been printed many months before Gray's paper. Under these circumstances I retain the opinion I held in 1865 that *Cribrella* should be used; but if others adopt a different course, they cannot be gainsaid. If there is a doubt in law, there can be none in justice, in using *Cribrella*, and is it not better "quieta non moveri."

1. Date of Dr. Gray's 'Synopsis.'

I cannot understand how it happened that in my 1865 paper I quoted this as 1841 instead of 1840. Others have no doubt copied the wrong date from me.

2. *Hippasteria phrygiana* or *Goniaster phrygianus*.

In establishing the genus *Goniaster* Agassiz placed four species in it:—1. *Asterias reticulata*, Linn.; 2. *A. equestris*, Linn.‡; 3. *A. nodosa*, Linn.; 4. *A. tessellata*, Lamarck.

Gray took all these species out of *Goniaster* and placed them in genera as follows:—1. *Pentaceros reticulatus*; 2. *Hippasteria equestris*; 3. *Pentaceros nodosa* (sic); 4. *Anthenia tessellata* (the type of Lamarck).

What then became of *Goniaster*? Gray placed in it the forms which Lamarck had erroneously considered to be varieties of *A. tessellata*, but left out the type, which of course Agassiz had in mind. Still more extraordinary, he made his *Goniaster* exactly conterminous with the genus *Pentagonaster* of Linck, which name he does not here employ; but his very next genus is *Pentagonaster*, Gray, and contains a single species, *P. pulchellus*, Gray, of which species Linck knew nothing.

* Forbes, 'British Starfishes,' p. 101. Vide also "*Linckia*" in Agassiz's 'Nomenclator Zoologicus' both under "Echinodermata" and in "Index universalis."

† Agassiz, Monog. d'Echinod. viv. et foss. liv. 2 (1844), p. 4.

‡ Agassiz undoubtedly by this name referred to the *Asterias phrygiana*, Parelius.

Thus the *Goniaster* of Gray is in no sense the *Goniaster* of Agassiz, and the species he put into it appear in Sladen's 'Challenger' Report under the names *Pentagonaster semilunatus*, Linck (an indefensible specific name), = *Goniaster cuspidatus*, Gray *; at p. 266 it is stated that *Pentagonaster* (*Goniaster*, Gray) *regularis* "should be" discarded; and *Goniaster Sebæ* is discarded, being nowhere referred to †.

And what has become of the unfortunate *Goniaster* in the most recent writers? It finds a place in Perrier thus:—

"XXVIII. Genre. GONIASTER, sens. nov.

"*Goniaster obtusangulus*, Lamarck. Océan Indien (?)."

Here is a new genus *Goniaster*, Perrier, and in no sense whatever is it *Goniaster*, Agassiz. Sladen follows Perrier.

By the laws of nomenclature *Goniaster* must be retained so as to include at least one of the species which Agassiz placed in it. Which, then, of Gray's three genera—for we must go back to that time—must be made a synonym of the earlier genus. Luckily there can be no doubt upon the question. On *the very same day*, Dec. 1, 1840, on which the second part of Gray's paper, which contained the genera in question, was published, appeared also *Goniaster* in pt. 3 of Forbes's work, containing one and one only of Agassiz's species in it; and the synonymy thus becomes *Goniaster*, Agassiz, = *Hippasteria*, Gray. The second species which Forbes had placed in the genus became removable that same day, to be put into the genus *Porania* established by Gray. My own description of *Goniaster* in 1865 was advisedly drawn up to restrict its application to this one species, *Goniaster phrygianus* (Parelius) = *Goniaster equestris*, Agassiz. I at that time carefully weighed all the circumstances connected with the nomenclature.

Agassiz would no doubt have preferred that his name should be used with his first species as the type, for in recording a list of Gray's genera ‡, without further observation, he gives them thus:—

"*Pentaceros*, Link, Gr. (*Goniaster*, Ag.); *Anthenia*, Gr.; *Hippasteria*, Gr.; *Goniaster*, Ag. (Gr.)."

This clearly indicated that he regarded *Pentaceros* as his *Goniaster*, that Gray might do what he liked about *Anthenia* and *Hippasteria*, but that *Goniaster*, Gr., was not his *Goniaster*. However, we must take facts as they are and as they rest on Forbes's action.

3. Use of the Generic Name *Palmipes*.

Professor Jeffrey Bell can scarcely have weighed the word *Anseropoda*, Nardo, or he could not have suggested that it should take the place of *Palmipes*. It is the very climax of barbarity, a monster

* Gray writes *cuspidatus*, and quotes Linck as using *cuspidatus*; but Linck's word was *cuspidalis*.

† The *Goniodiscus Sebæ*, M. & T., is another thing.

‡ Mon. d'Echin. liv. ii. p. 3.

with a head of Latin, a tail of Greek, and the whole a plural form! Agassiz knew well what he was about when he rejected it and applied *Palmipes* to the genus*. Professor Jeffrey Bell calls attention to the loose way in which *Palmipes* is employed by Linck; and of course authors can use their judgment in writing either *Palmipes*, Linck, *Palmipes* (Linck), Agass., or *Palmipes*, Agass.; for although Agassiz gave Linck the credit of the genus, the last of these is quite correct according to the direction in Brit. Assoc. Rules:—"Names used by previous [*i. e.* præ-Linnæan] authors may often be applied with propriety to modern genera, yet in such cases they acquire a new meaning, and should be quoted on the authority of the first person who used them in this secondary sense."

5. *Date of Cœlasterias.*

Sladen's reference is quite correct and intelligible to me—"Verrill, Trans. Conn. Acad. Arts and Sci. 1871 (1867)." I take it that Dr. Gray's copy in Brit. Mus. bearing date 1869 is only a part of the reissue. My own copy of "Notes on the Radiata in the Museum of Yale College &c." is paged 247 to 611, and has ten plates; the several sheets are all dated, the last being "March 1871," and the first page (247) contains the description of *Cœlasterias*, above which is "Read Jan. 16th, 1867," and at the bottom of the page "Trans. Connecticut Acad. vol. i. February 1867." I may add that the work as far as p. 502 bears date "March 1869," and this perhaps represents the portion in B. M. Library.

6. *Lophaster furcifer.*

Sladen's date, *Chætaster borealis*, 1844, seems quite correct; at least, he has the author's own statement of date, "May 1844," to rely upon; and Düben withdrew the specific MS. name "*borealis*" and substituted for it *Solaster furcifer* himself (*vide* Düb. & Kor. p. 245, note).

7. *Marginaster.*

Some naturalists of very high standing, *e. g.* G. O. Sars, when they meet with a species manifestly generically distinct from allies prefer to allow a full general description to stand for both genus and species for a time in hope that other allied forms may be found which will more accurately show what should be regarded as generic and what as specific characters. I do not defend, I only state the custom; but in such cases it is surely correct to refer to the description, which was intended to be both generic and specific.

8. *On the Presence of Rare Forms on the East Coast.*

I presume that Prof. Bell is satisfied Dr. Sutherland's specimen

* *Vide* Anseropoda in the Nomencl. Zool. of Agassiz both among Echinodermata and in General Index.

of *Porania pulvillus* sent to the B. M. as "from Ross-shire" came from the east coast of that county; the exact locality is desirable. There is every reason why *Porania pulvillus* might be expected on the east coast of our islands; and the remarkable thing is that up to the present time I am as ignorant of its living on that side of our islands as I was in 1865. On the west coast of Ross-shire I have taken the species myself, the specimens recorded Brit. Assoc. Rep. 1866, p. 196, having been dredged there.

Palmipes placenta has recently been procured again in the Moray Firth by Mr. Thomas Scott ('Eighth Annual Rep. Fishery Board of Scotland,' 1890, p. 332).

Notes on Nomenclature of some Crinoidea.

I take this opportunity of noticing certain points in connexion with the nomenclature of recent Crinoidea.

Antedonidæ versus Comatulidæ and Comatulæ.

I am at a loss to understand how it is that Dr. P. H. Carpenter in his 'Challenger' Report and his many valuable papers on Crinoidea, though he employs the genus *Antedon* (= *Comatula*), constantly uses the term *Comatulæ*. Lamarck wilfully gave the name *Comatula* to a genus which he was aware had previously been described by Fremenville. We do justice in restoring *Antedon*, and the sooner therefore the word *Comatula* is decently buried the better. I venture to express a hope that this may be at last done. This can never be the case while the word is so improperly, as I venture to think, used in titles of papers such as the following:— "Variations in the Forms of Cirri in certain Comatulæ;" "Preliminary Report 'Blake' Comatulæ;" "Classification of the Comatulæ;" "Descriptions of new and little-known Comatulæ;" "Comatulæ of the Leyden Museum;" and the important "Report on the 'Challenger' Crinoidea," which contains the description of *Antedon* and its allies, is called "Part II. Comatulæ," and the family designated "Comatulidæ." Now in each of the above cases the correct word to have used would have been Antedonidæ. When *Comatula* ceased to be used the family name fell with it according to the rule—"Families should be uniformly named by adding the termination *idæ* to the name of the earliest known or most typically characterized genus in them." In accordance with this rule, when in 1865 I substituted Fremenville's earlier name for that of Lamarck, I of course dropped the term Comatulidæ, and placed *Antedon* in a Fam. Antedonidæ.

Comaster versus Actinometra.

Agassiz in 1835 instituted a genus *Comaster* for forms allied to *Antedon* in which "the arms are ramified instead of being simply furcate," and he gave as its type *Comatula multiradiata*, Lamarck.

In 1841 J. Müller formed the genus *Actinometra*, with *Comatula solaris*, Lamarck, as the type; and having examined "a spirit specimen in the Paris Museum, which had been identified with the *Comatula multiradiata* of Lamarck," he placed it in his genus *Alecto* (= *Antedon*); on which Dr. Carpenter remarks "his reference of it to *Alecto* is difficult to understand." Dujardin and Hupé removed *Comatula multiradiata* into the genus *Actinometra*. The *Actinometra multiradiata* as defined by Carpenter is considered by him to contain only a part of the forms included by Lamarck and by J. Müller under the same specific name. Another part of their forms Carpenter has named *Actinometra Peronii* *; and in the paper in which this last species is described we read: "A remarkable specimen in the Bonn Museum was referred to the same type (i. e. *C. multiradiata*) by Goldfuss ('Petrefacta Germaniæ,' I., Dusseldorf, 1826-35, p. 202), who afterwards dissected it. This, however, may be left out of consideration altogether, as no example presenting such very remarkable peculiarities † as were described by Goldfuss has been met with during the last fifty years, and his type is now generally known by the name *Comaster*." But this *Comaster* of Goldfuss is not *Comaster*, Agassiz. *Comaster multiradiatus* (Lamarck) is Agassiz's type, and under his genus fall all such species as are congeneric with that species. In other words, *Comaster* is synonymous with *Actinometra*, J. Müller, and takes precedence of it ‡. I can see no way out of this. To use Dr. Carpenter's own words—"Comaster, Ag., is by no means the same as *Comaster*, Goldf." ("On the Genus *Solenocrinus*," Journ. Linn. Soc. vol. xv. 1880, p. 188). If there is such a form as was described by Goldfuss, which several authors have doubted, it will require the invention of a new generic name, which I would suggest might well be *Goldfussia*, while *Comaster* must undoubtedly supersede *Actinometra*.

Additional Notes on the Mollusk Lepton as a Commensal, and on the Crustacean Genus Bathynectes. By the Rev. Canon A. M. NORMAN.

Curiously enough, when consulting one of Stimpson's papers last night in reference to some North-Pacific Crustacea, I came across the following passage, which indicates a third instance of commensalism of the genera *Lepton* and *Gebia*.

* 'The Comatulæ of the Leyden Museum,' p. 214.

† Goldfuss's characters are given by Carpenter in his paper "On the Genus *Actinometra*," Journ. Linn. Soc. vol. xiii. 1877, p. 455.

‡ A reference to what Carpenter summarizes on the subject (Trans. Linn. Soc. ser. 2, Zool. vol. ii. 1879, p. 9) will show what a mess J. Müller made of the nomenclature. No doubt *Comaster* (or, as he calls it, *Actinometra*) as defined by Carpenter will be hereafter divided. When that division takes place, *Actinometra* would be resuscitated for his "Group 1. solaris," and *Comaster* retained for his "Group 3. typica;" each genus then would include its own type.

In his notes on *Gebia pugettensis*, Dana, Stimpson writes:—

“A curious parasitic bivalve, apparently new, both in genus and species, is frequently found adhering by its byssus to the inner surface of the abdomen of this crustacean. It approximates in character to the genus *Lepton*. *Gebia pugettensis* is found on the whole coast from Puget Sound to Monterey. It excavates its subterranean chambers in the sand and mud of beaches, near low-water mark, preferring that which is more or less indurated.” (Stimpson, “Crustacea and Echinodermata of the Pacific Shores of North America,” Journ. Boston Soc. Nat. Hist. vol. vi. (1857), p. 48 in separate copy.)

Professor A. Milne-Edwards, on seeing my paper on *Bathynectes* in the ‘Annals’ of this month, has kindly sent me a copy of some notes published by him in 1881, in which I find that he at that time synonymized the genus *Thranites** with *Bathynectes*. I was unaware of the publication of this paper, which has also escaped the notice of S. I. Smith and G. O. Sars, who have since written on the genera; nor is any reference to it to be found in the ‘Zoological Record.’

March 12, 1891.

Trochammina Bradyi, n. n.

Attention has been called in ‘The Naturalist’ of Cumbrae by Mr. Stebbing to the circumstance that the late Dr. Henry Brady, F.R.S., used the name *Trochammina Robertsoni* for two distinct species of Foraminifera. He first gave the name in 1876 to a delicate Carboniferous species with oblong test, bearing a remarkable though superficial resemblance to the Quinqueloculine *Miliolæ*. Eleven years later, in ‘A Synopsis of the British Recent Foraminifera,’ he applied the same name to a living species not uncommon in deepish water on the west of Scotland, and known also from the south-west of Ireland. His accurate description shows that he had no intention to unite the fossil and recent forms. The latter are rather circular than oval, with the peripheral edge lobulate, and having the outermost whorl composed of from four to six somewhat inflated segments. There is no resemblance to *Quinqueloculina*. Since, then, the name of the recent species must be changed, I would propose to call it *Trochammina Bradyi*, gladly availing myself of the opportunity to pay this slight tribute of respect to my valued friend so recently lost.

DAVID ROBERTSON.

Fern Bank, Cumbrae,
Feb. 25, 1891.

* A. Milne-Edwards, “Observations sur le genre *Thranistes* (Bov.)” (Bull. de la Soc. Philom. de Paris, Séance du 12 mars, 1881). Milne-Edwards throughout the paper *per lapsum* calls Bovallius’s genus *Thranistes* instead of *Thranites*.

THE ANNALS

AND

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[SIXTH SERIES.]

No. 41. MAY 1891.

XLI.—*British Fossil Crinoids*.—V. *Botryocrinus*, *Wenlock Limestone*. By F. A. BATHER, M.A., F.G.S.

[Plate XIII.]

HISTORY OF OPINION.

THE genus *Botryocrinus* was founded in 1878 by N. P. Angelin to include certain fossils from Follingbo in Gotland. The name, derived from *βοτρυς*, a bunch of grapes, appears to have been suggested by the peculiar branching of the arms in the specimens known to Angelin (see 'Annals,' ser. 6, vol. v. pl. xv. fig. 9, illustrating *Brit. Foss. Crin.*, II.).

On p. 24 of Angelin's 'Iconographia Crinoideorum' is the following diagnosis:—"Corpus elongatum, dendroideum, corymbosum. Calyx parvus, cyathoideus. Basalia quinque alta, pentaëdra. Parabasalia quinque hexaëdra. Radialia tria in unaquaque serie; primaria maxima, heptaëdra, lata. Anale singulum clypeiforme. Interradiale singulum, rhombeum, anale, radiale primarium et parabasalia duo tangens. Brachia bidigitifera; digiti ramusculos alternantes, multifidos emittunt. Tubus ventralis crassus, curvus, apice obtuso. Columna articulis tenuissimis, creberrimis."

This may be translated as follows into English and into modern terminology:—

Ann. & Mag. N. Hist. Ser. 6. Vol. vii. 27

Crown elongate, tree-like, clustered.

Dorsal cup small, bowl-shaped.

IB. 5, high, pentagonal.

B. 5, hexagonal.

R. wide, heptagonal.

C. 2 in each ray, smaller than R.

x shield-shaped*.

R' rhomboidal, touching R. and 2 BB.

Main arms 10, bearing alternating much branching armlets.

Ventral tube stout, curved, with blunt apex.

Stem-ossicles very fine and very numerous.

Of this genus Angelin described two species, *B. ramosissimus* and *B. corallum*, and these are the only ones hitherto described. But a recent examination of the type specimens and of others inclines me to believe that all these belong to the same species; that species will bear the name *B. ramosissimus*.

There was, however, another species described by Angelin and referred by him to another new genus under the name of *Sicyocrinus cucurbitaceus*. The diagnosis of this genus on p. 23 of the 'Iconographia' is as follows:—"Corpus corymbosum. Calyx cyathoides. Basalia quinque, subaequalia. Parabasalia quinque, hexaëdra, una cum interradiali parvo, rhomboideo. Radialia 4 × 5: primaria quinque majora lunulata. Anale secundum maximum. Analia superiora tubum ventralem efficiunt. Brachia quinque, articulis longiusculis, inaequaliter dichotoma. Columna quinquangularis ex articulis latoribus et angustioribus constat, foramine centrali." Which being interpreted is:—

Crown clustered.

Dorsal cup bowl-shaped.

IB. 5, subequal.

B. 5, hexagonal.

R. lunulate.

C. 3 in each ray, smaller than R.

x very large.

R' small, rhomboidal.

Main arms 5, with rather long ossicles, unequally dichotomous.

The upper-anals form a ventral tube.

Stem pentagonal; ossicles alternately wider and narrower, with an axial canal.

The points added to this in the specific diagnosis, p. 24, are

* The symbol *x* will, for its greater convenience, be used in future as equivalent to × of previous papers.

as follows:—R. broad and short; C. long and slender. *x* larger than R.; remaining anal plates united into a stout proboscoidiform tube curved at its apex.

Now a comparison of these diagnoses shows that the only point of any importance in which *Sicyocrinus* differs from *Botryocrinus* is the branching of the arms. A comparison of the figures shows one other point of difference, viz. the concrescence of the descending curved apex of the ventral tube with the ascending portion of the tube. That these were the only characters that could distinguish *Sicyocrinus* from *Botryocrinus* was recognized in 1879 by Messrs. Wachsmuth and Springer*, and they, rightly regarding them as of small moment, made *Sicyocrinus* a subgenus of *Botryocrinus*. It is unnecessary to allude further to the descriptions of these genera drawn up by Messrs. Wachsmuth and Springer, for, since they were founded on drawings not of the most reliable character, they could not fail to contain some mistakes. A recent examination of several specimens of *Sicyocrinus* in the State Museum at Stockholm, including the types, has convinced me that *S. cucurbitaceus* and *B. ramosissimus* must be considered as belonging to the same genus. This is not the place in which to discuss the matter fully; but it may be mentioned that the arms of *S. cucurbitaceus* are in fact essentially the same as those of *B. ramosissimus*, while the ventral tube is really far less different than would appear from Angelin's figures. I hope to prove these statements in another paper.

As the description of *Sicyocrinus* in the 'Iconographia' occurs a few lines before that of *Botryocrinus*, an advocate of strict priority might think that *Sicyocrinus* should stand as the genus. But Wachsmuth and Springer acted wisely in choosing the more normal *Botryocrinus* as the main genus, and, as events have shown, with perfect justice, for the characters formerly supposed to differentiate *Sicyocrinus* do not really exist.

The transference to the genus *Botryocrinus* of the species *B. cucurbitaceus*, and the reference to it of certain undescribed British species, one of which has long been known to collectors of Dudley Crinoids, as well as new facts acquired in a recent examination of the Swedish specimens; all these things necessitate the framing of a new diagnosis and the publication of a more complete and accurate description.

* W. & S. Rev. I. (99), Proc. 1879, p. 322.

GENERIC DIAGNOSIS.

Cup cyathiform, with plates of medium thickness. IB. 5, B. 5, R. 5. Arms with two main branches, bearing armlets or pinnules. R' small, oblong or rhomboid, between post. B. and r. post. B. below and x and r. post. R. above. x nearly same shape as radials. Ventral sac $\frac{1}{2}$ to $\frac{2}{3}$ length of arms, composed of primitively hexagonal plates. Stem round or sub-pentagonal, with small pentagonal axial canal and with radial sutures occasionally obscured.

DESCRIPTION OF THE GENUS.

The species vary greatly in general appearance.

Dorsal cup cyathiform.

Infrabasals 5; pentagonal; forming a very slight angle with stem; sometimes a little rounded.

Basals 5; 3 hexagonal, posterior and right posterior heptagonal; sometimes slightly protuberant.

Radials 5; of normal outline, articular facet occupies from $\frac{1}{2}$ to $\frac{2}{3}$ width; the axial canal may or may not be separated from the ventral groove by stereom*. The radials are more or less rounded and project from the cup, which thus acquires a roughly quinquelobate section.

Arms vary much in length and appearance, but are never very cumbrous. The armlets or pinnules of the various species, though superficially very different from one another, are closely connected in structure and arrangement. Axial canal for the most part distinct. Covering-plates small, and often irregular and extending over a large part of the ventral surface of the arm.

Costals from 1 to 6 in each ray, the extreme numbers being exceptional.

Anal structures:—Radianal (R') a small oblong or rhomboid, rests on sloping sides of the posterior and right posterior basals, with its upper margins abutting on the right posterior radial and the anal x .

Anal x or Brachial an irregular heptagon; its base, which is more or less horizontal, truncates the upper angle of the posterior basal; the left side is bounded by the left posterior radial, the right by the radianal and right posterior radial; above it supports in the middle, on a slightly curved surface, a wide plate, and on either side smaller plates.

* *Stereom*, any hard calcareous tissue forming skeletal structures in Metazoa Invertebrata and in Protozoa. 'Nature,' xliii. p. 345, Feb. 12, 1891.

The arrangement of the lower plates of the ventral sac varies in species and slightly even in individuals. The Ventral Sac consists of an unascertained number of longitudinal rows of plates, the lateral edges of which plates are folded as in *Thenarocrinus*; there is, however, a median posterior region in which the plates are much less or not at all folded; at the distal end of the sac also the folding lessens or disappears, and this end is often bent round on itself in a posterior direction. In some cases the foldings are broad, in others fine and deep; in the latter case the appearance of slits is produced, but slits do not exist.

The Tegmen apparently consists of a large number of small plates continuous with the covering-plates of the arms; but the actual arrangement of the ventral surface is yet unknown.

The Stem, rarely long, is sometimes almost stumpy. Distally it may be round, but proximally a pentagonal shape is usually discernible. The lumen is pentagonal. Radial sutures were probably present in the young at least of all species, but they cannot always be traced in the fossils.

The ossicles are low and have radiating striæ on the articular surface.

There were radicular cirri, but no cirri on the stem itself.

SPECIES OF THE GENUS.

The species hitherto known are:—

Botryocrinus ramosissimus, Angelin; 1878, *Iconographia*, p. 24. Syn. *B. corallum*, Ang. *ibid.* *Op. cit.* tab. xv. ff. 9, 9 a, tab. xx. f. 8, tab. xxiii. ff. 14, 15, 16, 16 a, tab. xxiv. f. 4. Silurian, *f* (=Aymestry?), Gotland.

Botryocrinus cucurbitaceus, Ang., sp., 1878, *olim Sicyocrinus*. *Iconographia*, pp. 23, 24, tab. iv. f. 9, tab. xvi. f. 5. S. Lovén, in H. Trautschold, "Ueber Crinoideen, Zusätze und Berichtigungen," *Bull. Soc. Imp. Nat. Mosc.* lvii. pp. 140-145, Moscow, 1882. Silurian, *c* (=Wenlock shale), Gotland.

Neither of these have yet been found in England; in their stead are three species not yet described, for which I propose the names *Botryocrinus ramosus*, *B. decadactylus*, and *B. pinnulatus*.

Botryocrinus ramosus, sp. n.
(Pl. XIII. figs. 1-4.)

This species is founded on a single specimen in the British Museum [57217], formerly in the collection of the late Mr. John Gray of Hagley, which comes from the Upper Wenlock Limestone of Dudley. The specimen is a crown lying in matrix and unfortunately imperfect at either end. Hitherto I have referred it by turns to *B. ramosissimus* and *B. corallum*, but examination of the Swedish specimens has brought to light differences that appear to warrant its distinction as a separate species.

SPECIFIC DIAGNOSIS.

Cup rather broad at base; plates slightly rounded. Articular facet occupies greater part of width of radial. Costals 3 or 4 to a ray. Arms about six times length of cup; give off small armllets at irregular intervals; axillaries rather nodose; arm-ossicles with rounded backs, slightly moniliform, height: width :: 5:8. Proximal median plate of sac almost full width of α , large and high. Ventral sac and stem unknown.

The epithet *ramosus*, branched, while it suggests the resemblance of this species to *B. ramosissimus*, indicates that the branching of the armllets is not quite so pronounced.

DESCRIPTION OF SPECIMEN.

Dorsal cup.—Since this is broken in the lower part, especially on the posterior side, its exact proportions cannot be accurately determined. It must, however, have closely resembled that of *B. ramosissimus*, and we may estimate the measurements as:—Breadth at base 6 millim.; breadth at summit 11·5 millim.; height 10 millim.

Infrabasals presumably 5 and pentagonal; only the upper parts of the anterior and left anterior are seen.

Basals 5: only the left anterior is completely preserved; hexagonal, height 5 millim., width 4 millim., with almost parallel sides; it is rounded or, in other words, very slightly depressed at the angles.

Radials 5; articular facet shallow and broad, occupying about $\frac{9}{10}$ width of plate; height, measured to lowest point on facet, 4 millim.; width below, 5·1 millim., width above, 5·4 millim.

The Arms are of rough appearance, swaying from node to node; their distal ends being lost, one can only estimate their

length as about 6 centim. Ossicles, both of main arms and armlets, slightly moniliform.

Costals 4 to a ray, except in left anterior radius, where are only 3. Lower edge of first costal slightly curved to fit facet of radial; the remaining sutures are horizontal. The first 3 costals are of about the same height, viz. 2·3 millim., and are 4·5 millim. in greatest, 3·75 millim. in least width. The fourth costal is axillary and pentagonal, 4 millim. high and 5 millim. in greatest width.

The armlets are given off from the main arms, on alternate sides, either on successive ossicles, or usually on every second, occasionally on the third ossicle. The ossicles from which they are given off differ little from the axillaries of a dichotomous arm. The armlets are of very varying size; they have primary and sometimes secondary branches, but do not appear to branch quite as much as in *B. ramosissimus* (Pl. XIII. fig. 3).

The ventral side of the arms is unknown.

Anal structures:—Radial is broken, but was apparently normal.

Anal x or Brachial 4·5 millim. high and 3·75 millim. wide.

The ventral sac itself is not seen. The proximal median plate of the sac is apparently an irregular hexagon; it occupies nearly the entire width of the anal x , so that, on its right side at all events (in this specimen), no smaller lateral plate rests on the anal x . Its height is 3 millim., its width below, 3·75 millim. Above it is seen to support 3 small plates, and these are followed by others apparently alternating with them.

This species is at once distinguished from *B. decadactylus* and *B. pinnulatus* by the presence of armlets, the irregular character of the arms, and the shape of the cup. It differs from *B. cucurbitaceus* in the thick low arm-ossicles. From *B. ramosissimus*, which it otherwise closely resembles, it differs in the beaded shape of the arm-ossicles, for those of the Swedish species have as a rule concave sides, and in the presence of 3 or 4 costals instead of 1 or 2. From all species it differs in the high proximal median plate of the sac.

Botryocrinus decadactylus, sp. n.

(Pl. XIII. figs. 5–15.)

Cyathocrinus (sp. 2) *decadactylus*, Salter, Catalogue of Cambrian and Silurian Fossils &c., p. 123 (Cambridge, 1873).

Cyathocrinus (sp. 3) *quindecimalis*, Salter, *op. cit.* p. 124.

This species is founded on a large number of specimens, of which the most important are as follows:—

In the British Museum :

- E 5611, young individual with stem ; formerly in the collection of the late Mr. John Gray of Hagley. (Pl. XIII. fig. 5.)
- E 1328, crown, seen from posterior, arms dissected away to expose ventral sac. (Pl. XIII. fig. 6.)
- E 1419, crown and part of stem, seen from posterior ; formerly in the collection of the late Mr. J. Johnson of Dudley. (Pl. XIII. fig. 15.)
- 57225, three fragmentary specimens on a slab with *Marsupio-crinus caelatus* and *Gissocrinus goniodactylus* ; formerly in the collection of Mr. J. Gray. (Pl. XIII. fig. 8.)
- E 5130, a small part of crown and of stem, showing surfaces of costals. (Pl. XIII. figs. 10 and 11.)
- 48191, a crown with extended arms, seen from anterior ; formerly in the collection of the late Mr. C. Ketley of Smethwick. (Pl. XIII. fig. 7.)
- E 1412, a complete specimen from root to crown, seen from anterior ; on a slab with *Desmidocrinus* ; formerly in the collection of Mr. J. Johnson. (Figs. 5 and 6, p. 408.)

In the Woodwardian Museum, Cambridge :

- a/494, a specimen labelled by Salter *Cyathocrinus deca-dactylus*. (Pl. XIII. fig. 14.)
- a/495, a specimen labelled by Salter *Cyathocrinus quin-decimalis*. (Pl. XIII. fig. 13.)

In Mason College Museum, Birmingham :

- 149, a rather broken crown ; left posterior view.

In the Museum of the Yorkshire Philosophical Society, York :

- A worn specimen with 43 millim. of stem.

In the collection of Charles Holcroft, Esq. :

- 136, a beautiful specimen ; anterior view. (Pl. XIII. fig. 9.)
- 349, also a good specimen ; anterior view. (Pl. XIII. fig. 12.)

Again it is my pleasurable duty to thank Messrs. Holcroft and Platnauer and Prof. Lapworth for the loan of specimens, while I must also thank Dr. Henry Woodward, F.R.S., and Prof. T. McKenny Hughes for allowing me to figure the fossils in the British and Woodwardian Museums respectively.

The above specimens as well as the rest that I have seen are all said to come from Dudley, and their horizon appears to be the Upper Wenlock Limestone.

The proposed name of this species is one of those printed by Salter: although not a good name, and although no adequate description was given by Salter, yet I have adopted it simply so as not to burden nomenclature with a synonym. Salter did not profess to describe species in his Catalogue, and all he said of *Cyathocrinus decadactylus* was "Ten single arms, unbranched, and with very large thick tentacles." This applies to not a single *Cyathocrinus* it is true, but it applies to nearly every species of every genus of the Decadocrinidæ. *Cyathocrinus quindecimalis* was said to have "Fifteen arms, like those of the last species, but with even thicker tentacles." The specimen alluded to (Pl. XIII. fig. 13) shows, however, that this number of arms was a misapprehension. The original specimens of both *C. decadactylus* and *C. quindecimalis* belong to the species of *Botryocrinus* that I now proceed to diagnose.

SPECIFIC DIAGNOSIS.

Cup elegant, rapidly widening above. R. projecting, with rather narrow facet. Arms about six times length of cup, two-branched, with rather stout pinnules; sutures alternate in direction. Proximal median plate of sac wider than high. Ventral sac ridged, with plates, except at distal end, laterally folded; the distal end is almost straight. Stem slender; round or subpentagonal.

DESCRIPTION OF SPECIES.

Dorsal cup of graceful appearance, owing to the concavo-convex curve of its sides. Average measurements, based on seven specimens, are:—Breadth at base 3·33 millim.; breadth at summit 8·36 millim.; height 6·5 millim.

Infrabasals 5, pentagonal, forming a very slight angle with the column; sometimes smooth, sometimes slightly rounded or protuberant, and sometimes with a slight ridge along their proximal margin. Average measurements, based on seven specimens, are:—Height 1·91 millim.; greatest width 2·17 millim.

Basals; 3 hexagonal and 2 heptagonal; occasionally show slight traces of axial folding*. Average measurements,

* A very large number of Crinoids have the plates of the dorsal cup folded or ridged along certain definite lines at right angles to the edges of the plates. Such folding is well seen in the genus *Vasocrinus*, in *Gissocrinus goniodactylus*, and in the ornate individuals of *Marsupites testudinarius* where it is often accompanied by smaller parallel ridges. Whether it be of any morphological importance we need not now inquire;

based on seven specimens:—Height 3·36 millim.; greatest width 3·7 millim.

Radials, 5, of normal shape; project slightly from the cup, so that the articular facet, lying at right angles to the outer surface of the plate, is directed outwards; sometimes show traces of axial folding. Measurements, based on seven specimens:—Height to bottom of facet 2·9 millim.; greatest width 4·21 millim. The facet occupies from less than $\frac{1}{2}$ to $\frac{6}{7}$ of the width of the radial; its average width as deduced from the same seven specimens is 2·26 millim. The articular surface is rarely exposed, and when visible is usually so worn that no drawing of it can be given: it appears, however, that the axial canal was not separated from the ventral groove by stereom, that a transverse ridge running at the level of the axial canal served as fulcrum, that outside this ridge there was a bevelled surface marked with slightly radiating rugosities, and that inside the ridge on either side of the groove was a depression for a muscle-attachment. Compare with articular surface of first costal (Pl. XIII. fig. 10). On either side the facet the distal portions of the radial curve round it and bend inwards to meet the tegmen.

Arms, about six times as long as the cup: each splits into two main branches, which bear pinnules, one on each ossicle on alternate sides; of elegant appearance. The younger the individual the more marked is the axillary character of the ossicles of the main arm, which thus has an irregular zigzag appearance (Pl. XIII. fig. 5); in older specimens the main arm is more straight and regular, but the sutures between its ossicles alternate markedly in direction. These differences of character may also to some extent be traced within a single arm, where the distal end corresponds to the younger, the proximal to the older stage.

Costals usually 3 or 4 to a ray; rarely more, 136 Holcroft has 6 in one ray, very rarely less; usually all are of the same width as the radial facet, but sometimes, as in 349 Holcroft, they taper distalwards. The axillary of course always broadens out. The height of each costal is $\frac{2}{3}$ its width, except in the axillary, where the two are equal.

The pinnules do not begin their regular arrangement immediately after the bifurcation of the arms. The first distichal never appears to bear a pinnule, but the first pinnule arises on

in any case it seems advisable to have a definite term to express it. Since the main ridges or folds appear to follow the lines of the axial nerve-cords, I venture to speak of them as "axial" in direction, and to call the phenomenon generally "axial folding."

the outer side of the second distichal. This first pinnule is usually stouter than the preceding ones, and is not seldom branched, in which case it should strictly be called an armlet, *e. g.* *a/495* Cambridge (Pl. XIII. fig. 13) and 136 Holcroft. The ossicle next this axillary distichal, *i. e.* the third ossicle of the main branch, does not as a rule bear a pinnule, and then the second pinnule arises on the inner side of the fourth ossicle. After this the pinnules follow regularly on the alternate sides of each successive ossicle. Variations from this normal plan may occur; thus in E 1419 B. M. the first pinnule of the left-hand branch of the right posterior arm springs from the outer side of the third distichal.

The pinnules in ordinary specimens are about 9 millim. long, but usually appear shorter owing to loss of the distal ossicles. They have rounded backs, with a width of about $\cdot 9$ millim., gradually tapering. They are somewhat compressed laterally, so that the depth is greater than the width. Their ossicles are half again as long as wide. Considerable variations, however, occur; thus pinnules of ordinary thickness may attain a length of 14 millim.; others, more thick, are from 17 to 20 millim. long (*e. g.* 149 Mason Coll.). In some specimens where the pinnules lie rather closely together they are flattened on the side and have almost the square look of an *Encrinus* pinnule (Pl. XIII. fig. 14). The pinnule ossicles have sometimes a slight ridge at either end (*e. g.* 349 Holcroft).

The covering-plates of both arms and pinnules are very small; they appear to have been shield-shaped, from three to four on each side of an ossicle, alternating in the middle with those of the other side (Pl. XIII. figs. 8 and 9).

Anal structures:—Radial small, four-sided, and often rectangular; does not differ from that of other species of the genus. The following are some measurements:—in E 1328 from *x* to *r. post.* B. 1.75 millim. and from *r. post.* R. to *post.* B. 1.4 millim.; in E 5130 the corresponding measurements are 2.1 millim. and 1.9 millim.; in E 1419 they are both 1.2 millim.

The Anal *x* (or Brachial) has an average height and width of 3 millim., being rather smaller every way than a radial. It is somewhat rounded. On its upper margin it supports three plates, a large middle plate and a smaller one on either side partly resting on the adjacent radials (fig. 1, p. 408).

This middle plate, which corresponds with that spoken of as the second brachial in Paper III. on *Thenarocrinus*, is shaped like the anal *x*, but is half again as wide as high.

Like *x*, it supports three smaller plates, and from them spring three longitudinal series of plates.

The ventral sac is rarely exposed, but has been laid bare by dissecting away part of the arms in E 1328 B. M. (Pl. XIII. fig. 6). It is straight and its length in this specimen is 29 millim., *i. e.* about $\frac{3}{4}$ length of arms. It is composed of an unknown number of longitudinal rows of ossicles, of which rows five can be traced down to the anal *x*. The ossicles are primitively of hexagonal shape, but for the most part are folded on the lateral margins; in the median dorsal region this lateral folding is as a rule slight, but in the other rows it is strongly marked, and the appearance produced is exactly that of *Thenarocrinus*, but on a much smaller scale. This minuteness renders it very hard to see that the folds are not slits; the appearance is most deceptive (Pl. XIII. fig. 7). The height of these folded plates is about .8 millim., their width about 2 millim. Distally the sac tapers gradually to a rounded point, the plates lose their folding and resume the regular hexagonal outline. The exact position of the anal aperture is not shown by any of the specimens examined; certainly no trace of it can be seen in the proximal region of the sac.

The Stem is longer and more slender than in other known species of the genus. In E 1412, where it is completely preserved, the measurements are:—Length 113 millim., diameter about 2.5 millim.; the length of the crown is 39 millim. In the young specimen E 5611 (Pl. XIII. fig. 5) 57 millim. are preserved, and the length of the crown is 23 millim. The usual diameter in mature specimens is 3 millim. The section is round, or, in the proximal region, obscurely pentagonal. In the proximal part of the stem the ossicles alternate in diameter, and close to the crown the wider ossicles are also slightly higher than the others; lower down both are of the same height; in the distal region all the ossicles are of equal diameter and equal height, and the height is rather less than in the proximal region. The height of the ossicles in the proximal half of the stem is usually a little less than .5 millim. In E 5611 (Pl. XIII. fig. 5) the stem has been bent sharply into three unequal portions; in the proximal portion 17 ossicles go to 5 millim., in the middle portion 13 ossicles, in the distal portion 16. The sutures are finely crenelate, indicating the presence of radiating striæ on the articular surfaces. The lumen is pentagonal, with angles radial in position; in the stem-section of E 5130, which is 2.5 millim. in diameter, it has a diameter of .7 millim. (Pl. XIII. fig. 11).

There are five radial longitudinal sutures passing out from

the angles of the lumen. In the proximal region of the stem these sutures do not reach to the exterior and are not always easy to distinguish in section. They are always very obvious in the distal region, and are for example clearly seen on the exterior in E 1412 and E 5611. In E 1412 the sutures can be traced externally to a distance of 70·5 millim. from the distal end, *i. e.* for about $\frac{5}{8}$ the length of the stem. In the middle region of the stem the radial sutures are straight, and cut the horizontal sutures at right angles, thus dividing each ossicle into five equal and symmetrical pentameres. But distalwards a change gradually takes place: the radial sutures are no longer straight but zigzag; the pentameres are bent upwards on one side, downwards on the other; thus the pentameres of each ossicle do not exactly register, but partly overlap so as to abut laterally against pentameres of the adjacent ossicles. This semi-alternating disposition of the ossicles is clearly seen both in E 5611 (Pl. XIII. fig. 5) and in E 1412 (fig. 5, p. 408).

The Root is preserved in E 1412 (fig. 6, p. 408). It there occupies about 6 millim. of the distal end of the stem; three cirri are seen issuing from one of the radial sutures, and one of them bifurcates once. The longest cirrus is 9·5 millim. long, has a diameter of ·9 millim., and is composed of 12 ossicles.

This species resembles *B. pinnulatus* in the shape of its cup and in its pinnulate arms, and in these points it differs from *B. ramosus*, *B. ramosissimus*, and *B. cucurbitaceus*. From *B. pinnulatus* it differs in the lesser length of the arms, the alternation of the sutures between the main arm-ossicles, the greater stoutness of the pinnules, and the more strongly marked ridges of the ventral sac.

Before leaving this species it is necessary to justify the rejection of Salter's supposed species, *Cyathocrinus quindecim-alis*. The specimen a/495 in the Woodwardian Museum, to which this name was attached, is figured on Pl. XIII. fig. 13. A mere inspection of this figure will show that it has not "fifteen arms," while a comparison of it with fig. 14, which represents one of the specimens labelled by Salter *Cyathocrinus decadactylus*, will show that it has not "thicker tentacles." The orientation of this specimen is uncertain; the cup is much broken and its plates indistinct; portions of four rays are visible. So far as can be seen these rays bifurcate on the third or fourth costal, and give off pinnules just as described above. But taking the second ray from the left of the specimen, and directing attention to its right branch, a peculiar pinnule is seen to arise on the outer side of the second brachial. The peculiarity of this pinnule is that it bifurcates

after its first ossicle, and this is absolutely the only character that could give rise to the idea that this specimen had fifteen arms. But this is not so rare nor even so peculiar a structure as to warrant the separation of those specimens in which it is found. In 136 Holcroft, for instance, an extremely normal specimen of *B. decadactylus*, the lowest pinnule of the left branch of the arm on the right is seen to bifurcate on the second ossicle. This pinnule is, not only in this species of *Botryocrinus*, but in very many pinnulate crinoids, stouter than the succeeding pinnules; its bifurcation is merely an instance of reversion to the armllet stage, and is a very natural occurrence in the earliest known pinnulate form among the *Fistulata*. A far stronger case of irregular branching is seen in the specimen which, in default of a better, must be taken as the type of our next species; and yet I have little doubt that even this is but an individual abnormality of no specific value.

Botryocrinus pinnulatus, sp. n.
(Pl. XIII. fig. 16.)

This species is founded on a single specimen in the Dudley Museum. It is a crown seen from the posterior; with the extreme distal ends of the arms broken off, and with five stem-ossicles attached.

For the loan of this specimen I am indebted to Mr. William Madeley, the Secretary of the Dudley and Midland Geological Society. No locality is recorded, but from the character of the matrix, which is a soft yellowish shale, Mr. Madeley thinks that it probably came from the shale between the two Wenlock limestones at the Wren's Nest, Dudley.

This individual shows in the branching of its arms certain abnormalities that might conceivably be regarded by some as specific characters. I prefer, however, to regard them as unessential, and to distinguish the species by characters less obvious but of more permanent value.

SPECIFIC DIAGNOSIS.

Dorsal cup shows slight axial folding; R. project. Arms between seven and eight times length of cup; sutures between brachials almost parallel; pinnules long and fine. Ventral sac very slightly ridged; its proximal median plate wider than high.

The trivial name *pinnulatus* is given because the pinnules are more completely differentiated than in any other species of the genus.

DESCRIPTION OF THE SPECIMEN.

Dorsal cup.—Similar to that of *B. decadactylus*, but with the projection of the radials and the axial folding slightly exaggerated. Breadth at base 3·6 millim.; breadth at summit 8·5 millim.; height 11 millim.

Infrabasals 5, pentagonal; greatest height 2·2 millim.; greatest width 3 millim.

Basals 5; 3 hexagonal, 2 heptagonal; show slight axial folding; greatest height 3·5 millim.; greatest width 3·5 millim.

Radials 5; of normal shape, project outwards rather more than in *B. decadactylus*, show slight axial folding; height to bottom of facet 3·25 millim., greatest width 5·4 millim., width of facet 2·25 millim. The articular surface is not clearly seen, but appears to be the same as in *B. decadactylus*. The axial canal is not separated from the ventral groove. The surface of the radials, where well preserved, is very slightly shagreened, with the rugosities arranged concentrically.

The Arms are preserved to a length of 71 millim., but must have been at least 80 millim. long when perfect, *i. e.* more than seven times length of cup. Apart from the abnormalities in their branching, the essential characters are as follows. The sutures between the ossicles are parallel, except in quite the distal part of the arm, where they alternate at a very slight angle; the arms consequently have a more rigid appearance; their sides are almost straight, the backs of the ossicles being regularly rounded and only very slightly moniliform. Height of ossicles $\frac{4}{5}$ of width.

Costals 4 in each of the two rays visible; width and height both 2·5 millim.; the axillary expands to 3·9 millim.

Pinnules very long and thin; one measured about halfway up an arm is 16 millim. long, with a mean width of ·5 millim., and is composed of ossicles ·75 millim. long. They are more square and flattened than is usually the case with *B. decadactylus*.

The axial canal appears, in the distal part of the arms at all events, to have been separated by stereom from the ventral groove.

The covering-plates, so far as any indications are given by this specimen, appear to have been much the same as in *B. decadactylus*, but on the pinnules at least were proportionately smaller.

Anal structures:—Radial measures 2 millim. from anal *x* to right posterior basal, and 1·4 millim. in the transverse direction.

Anal α or Brachial somewhat rounded and protuberant; height 3.5 millim., greatest width 4 millim. It supports three plates, of which the middle one is 2.1 millim. high and 3.1 millim. wide.

Of the Ventral Sac only the 11 proximal millimetres are exposed; the width here is 7 millim. The plates are flat, not ridged, and wide, with well-marked lateral folds.

The Stem:—only 5 proximal ossicles are preserved; these make together a length of 1.5 millim., and have a diameter of 3 millim. The ossicles alternate in size; the section of the larger ones is pentagonal, that of the smaller ones quinquelobate. The sutures are crenelated, but the striæ seem restricted to the edge, the inner part of the lobes being smooth, somewhat as in *Pentacrinus*. The stem is not clearly represented in the figure.

The radial sutures are very clearly seen in section, though not externally. The lumen is pentagonal, with a diameter of .75 millim.

The abnormalities in the branching of the arms are as follows:—The left posterior ray has the fourth costal axillary: following first the left branch, we see clearly two distichals, of which the second appears to be axillary; the outer branch from this distichal must, however, have been small, probably merely an armlet, possibly only a rather stout pinnule; the inner branch from this distichal is a normal main arm with pinnules: now taking the right branch we notice one distichal, and this is axillary giving rise to two main arms with pinnules; in each of these main arms the first pinnule is given off on the outer side of the second ossicle, and in the right of these two main arms the first pinnule seems to have been stouter than those succeeding. The right posterior ray has unfortunately lost all its costals and some of the succeeding ossicles; we shall, however, probably be right in referring to this ray the two main arms that lie in the middle of the specimen: the left main arm, however, appears to bifurcate on an early ossicle, the first preserved, and the outer branch, at first hidden, emerges from under the other arms about halfway up the specimen; such at least is my interpretation; the other branch of the left main arm continues regularly up to the ninth ossicle of those preserved; this ossicle is shaped like an axillary and probably gave rise to a fairly stout armlet or pinnule, which, however, is hidden from view; the eleventh ossicle likewise gives off a stout pinnule, on the other side, after which the arm is normal. It seems possible that there was some accident to the arm at the ninth and eleventh ossicles just mentioned, and

that the abnormalities are due to recuperation. The right anterior ray has four costals, of which the fourth is axillary: this ray splits into three main branches, of which the two on the left, *i. e.* adanal, side spring from an axillary distichal no longer preserved, while that on the right or outer side springs from the axillary costal and is at first sight perfectly normal; it too, however, gave off, apparently from its most proximal ossicle, a very small arm. Of the anterior and left anterior rays only a very small portion has been exposed; it is hardly likely that they were perfectly normal, at the same time there is nothing to prove the contrary, and from the broken distal end of the specimen we learn that each sent only two main arms as far as that point. The small arm that is seen issuing from among the branches of the left posterior ray and running up the left side of the specimen may proceed either from the right posterior ray or from one of the anterior rays. Now there are certain features in this specimen that are quite clearly simple individual abnormalities, possibly even due to accident. As regards other aberrant features the irregularity of their occurrence and variations in their structure should convince everyone that they cannot be of specific value. Similar instances of abnormal repetition of the arms are rare: A. von Strombeck* has, however, described and figured some for *Encrinus fossilis*, Blum., while Mr. W. Bateson † has recently published a careful figure by Mr. Edwin Wilson and a description by Dr. P. H. Carpenter of much the same structure in *Antedon bifida*, Pennant, sp. (= *A. rosacea*, Linck, sp.). It is more to the point that in various American species of *Baryocrinus* the arms "sometimes branch once on the third or fourth plate in some of the rays—but never in the anterior one—and only in one arm to a ray, the other arm always remaining simple" ‡. As in none of these cases are the essential characters of the species destroyed, I feel justified in supposing that the present specimen is abnormal only as regards the secondary arm-branching, and that its other characters are those of a species.

This species resembles *B. decadactylus* in the presence of pinnules and therein differs from all other known species of *Botryocrinus*. In the shape of its stem, of its cup, and its ventral sac it also resembles *B. decadactylus* more nearly than other species. From *B. decadactylus* it differs in the more

* "Ueber Missbildungen von *Encrinus liliiformis*, Lam.," *Palæontographica*, iv. 169–178, pl. xxi., Cassel, 1855. See especially fig. 12.

† "On some cases of Abnormal Repetition of Parts in Animals," *Proc. Zool. Soc.* 1890, pp. 579–588, London, Oct. 1890. See fig. 4.

‡ W. & S. Rev. I. (101), *Proc.* 1879, p. 324.

pronounced axial folding of the cup, in the longer and straighter arms, in the greater parallelism of the sutures between the arm-ossicles, in the greater length and fineness of the pinnules, in the less ridged nature of the ventral sac, and apparently in the more pronouncedly pentagonal stem.

GENERAL REMARKS ON THE GENUS.

In the investigation of the various species of this genus at home and abroad certain points of morphological interest have turned up, to which attention may now be directed.

The covering-plates of the arms.—It has already been remarked (p. 393) that the tegmental plates appear continuous with the covering-plates of the arm, and this is partly seen in Pl. XIII. fig. 8. The specimen there shown would, however, not prove much by itself; it is suggestive rather than convincing: but in a large specimen of *B. ramosissimus* in the Riksmuseum at Stockholm the ventral surface of the arm is completely exposed, and here is seen a remarkable structure (fig. 4, p. 408). The ventral groove, instead of being covered by a double row of regularly alternating shield-shaped plates, is entirely overlaid by a large number of small irregular plates which appear to extend beyond the limits of the groove itself over the adjacent portions of the arm-ossicles. Ordinary covering-plates open along the median line, and that this was the case in *Botryocrinus* is proved by many specimens; but in the present specimen there is neither visible opening nor suggestion of opening, at least in the proximal part of the arms. The appearance, though on a larger scale, is not unlike that of the small plates that cover the ventral surface of a pinnule swollen with genital products; since, however, the structure occurs not in the pinnules or armlets but in the main arm it is improbable that the similarity is more than superficial. On the other hand, the apparently swollen state of the lower pinnule in Pl. XIII. fig. 9 may be due to the presence of gonads.

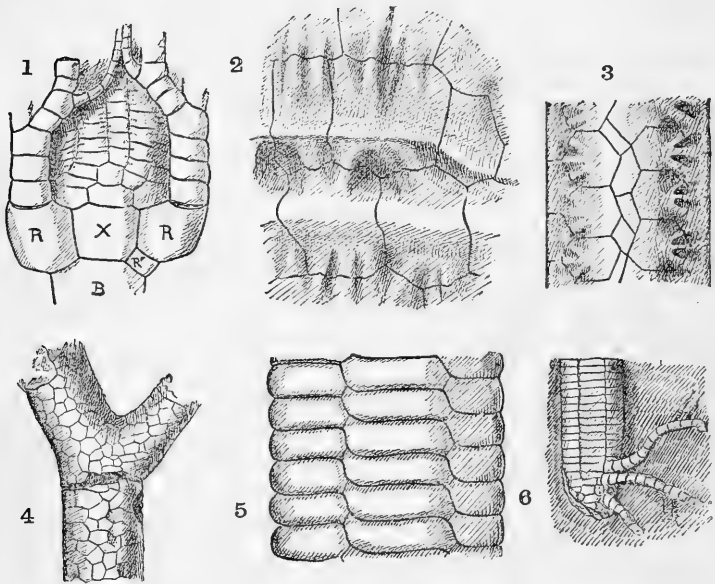
The Ventral Sac.—I have previously alluded to the opinion that "slit-like fissures" are present in the ventral sac of certain *Fistulata* (Paper II., *Annals*, ser. 6, v. p. 311); and I have shown that in *Thenarocrinus* slits do not exist, although the appearance of such is produced by simple folding of the plates (Paper III., *Annals*, ser. 6, vi. p. 229). Now in this connexion the genus *Botryocrinus* (including *Sicyocrinus*) is of particular interest. For, in the first place, the slit-like appearance is, in many specimens of all species, very strongly marked; and, in the second place, a description of the ventral

sac of *B. cucurbitaceus*, written by no less eminent an observer than Prof. Svén Lovén, has been published by Prof. H. Trautschold in support of his view that the ventral sac of the "Angulosi" is fissured for the exit of generative products*. Whether Prof. Lovén's words bear all the meaning that Prof. Trautschold attributed to them I will not venture to say; neither can I say whether Prof. Lovén himself meant all that his words naturally imply, for when he was kind enough to discuss the matter with me last year he had forgotten the details of his observation. After describing the plates of the sac as being prolonged laterally into "Beine," he says, "Die von den Beinen der Platten umschlossenen Räume sind vertieft," and "die Vertiefungen [sind] von Kalk frei." Now I have very carefully examined not only the specimen figured by Professors Angelin (Iconogr. pl. iv. fig. 9) and Lovén (*loc. cit.*), but other even more instructive specimens from Bursvik, Gotland, now in the Riksmuseum at Stockholm; and I have not only been absolutely unable to demonstrate spaces free from stereom—"von Kalk frei"—but whenever I have been able to clear away the matrix, a task which though difficult is not impossible, I have invariably been able to trace the sutures between the plates across the synclinal folds, in which position they have precisely the same appearance as they have when traversing the anticlinal folds (fig. 2, p. 408). I therefore affirm that there are neither slits, nor holes, nor pores visible in the ventral sac of *B. cucurbitaceus*. I have also examined with the utmost care all the specimens of *B. ramosissimus* in the Stockholm Museum, and, while I have been equally unable to demonstrate openings in any, I have been able in one specimen, figured by Angelin, Iconogr. pl. xxiii. f. 14, to trace the sutures across the depressions (fig. 3, p. 408). In *B. decadactylus* and *B. pinnulatus* the folds are much narrower, and it is a very difficult matter either to clean them or to see to the bottom of them; but I have discovered nothing that would lead one to suppose that the structure differs in any essential point from that of the Swedish species. I therefore conclude that slits, pores, and openings of every description are absent from the ventral sac of *Botryocrinus*.

As to the Anal opening itself, it seems to have been figured by Angelin (Iconogr. pl. xv. ff. 9, 9a) at the base of the sac on its anterior side. But I do not quite understand the figure; the specimen is no longer to be found, and in no other specimen have I been able to discover any trace of a similar structure, in that, or indeed in any other position.

* H. Trautschold, "Ueber Crinoideen, Zusätze und Berichtigungen," Bull. Soc. Imp. Nat. Mosc. lvii. pp. 140-145, Moscow, 1882.

The Stem.—The presence of Radial Sutures has not, so far as I am aware, hitherto been noticed in this genus; thus one more is added to the gradually increasing number of early forms in which the stem is so divided. These sutures are, as a rule, more observable in the young, and they are more marked in the distal region of the stem. These two facts



STRUCTURE IN *BOTRYOCRINUS*.

- Fig. 1. The anal area of *B. decadactylus*; mainly from evidence of E 1419, B. M. ($\times 3$.)
- Fig. 2. From the proximal part of the Ventral Sac of a large specimen of *B. cucurbitaceus*, from Bursvik, Gotland, in Riksmuseum, Stockholm. To show the folding, without perforation, of the plates. The distal end of the sac is beyond the left of the drawing. ($\times 6$.)
- Fig. 3. Part of the ventral sac, as seen from the back, of a specimen of *B. ramosissimus* in Riksmuseum, Stockholm, which was figured in Angelin's 'Iconographia,' Tab. xxiii. fig. 14. ($\times 3$.)
- Fig. 4. Ventral surface of arm of a large specimen of *B. ramosissimus*, from Föllingbo, Gotland, in Riksmuseum, Stockholm. To show small, irregular, covering-plates. ($\times \frac{3}{4}$.)
- Fig. 5. Distal part of stem of *B. decadactylus*, E 1412, B. M. To show irregularity of pentamerous. ($\times 12$.)
- Fig. 6. Root of *B. decadactylus*, E 1412, B. M. ($\times 3$.)

imply that the sutures are, so far as the present stage of evolution is concerned, primitive structures. The same, it

will be remembered, was the case with *Thenarocrinus*. The pentagonal outline of the stem-lumen, even when radial sutures are no longer visible externally, seems, in other genera no less than in *Botryocrinus*, to bear witness, often in a marked manner, to the former pentamerous structure of the stem-ossicles. Whether this pentamerous structure is really more primitive or ancestral than a simple undivided ossicle, especially an ossicle with a round lumen, we are not at present in a position to decide. There are, however, two facts, a consideration of which may eventually aid us in solving the problem. First the fact that the radicular cirri in this genus, and indeed all cirri in every genus where longitudinal sutures or their traces are present, arise along the suture-line. The morphological importance of this fact, as denoting the radial or interradial position of the original sutures, has already been noticed by Messrs. Wachsmuth and Springer in connexion with the presence or absence of infrabasals. Secondly the fact that towards the distal, *i. e.* the first-formed part of the stem, the pentameres of any one ossicle, instead of all lying in the same plane, abut against the pentameres of adjacent ossicles, and are only brought into line by the curvature of their articular surfaces. The outline of each pentamere has in fact six sides, and the pentameres have an essentially alternate arrangement just like the hexagonal plates of a ventral sac (fig. 5, p. 408).

Inter-relations of the Species.—There can be little doubt but that, in accordance with the main scheme of arm-evolution sketched in Paper II. ('Annals,' ser. 6, v. p. 374), the pinnulate forms are descended from those bearing armlets. Of the armlet-bearing forms there are three species, *B. ramosus* in England, *B. ramossimus* and *B. cucurbitaceus* in Gotland. Of these *B. ramosus* is very closely allied to *B. ramosissimus*. If Professor Lindström's correlation of the Gotland beds* be correct, *B. ramosissimus* appears at or above the horizon of the Lower Ludlow (*f*), and might therefore be directly descended from *B. ramosus* of the Upper Wenlock. *B. cucurbitaceus*, however, occurs in beds of the age of the Wenlock shale (*c*), and the intermediate links are not known, for no species of *Botryocrinus* are yet recorded from beds *d* and *e*. It may have been that *B. ramosus* and the other English forms were derived from some of these links. Taking the English forms, there seems little doubt but that the order in which we have studied them is the order in which they were evolved. We have traced the change of armlets into pinnules,

* Prof. G. Lindström, "Ueber die Schichtenfolge des Silur auf der Insel Gotland," Neues Jahrb. f. Min., Jahrg. 1888, Bd. i. pp. 147-164.

with relics of their ancestry still preserved by certain specimens of *B. decadaetylus* in the branched first pinnule. We have traced the gradual differentiation of these pinnules from coarse to fine, from rounded to square-sided. We have seen too the sutures between the arm-ossicles at first set at steep angles alternately to one another, then with the angle lessening, and lastly quite parallel. Concomitantly with these changes we have noticed how the plates of the cup, from being smooth or simply rounded, have become more and more folded along the axial lines, while the ventral sac has become less ridged, and the stem more pentagonal. These species afford us an excellent illustration of the gradual adoption by the adult of the characters of old age. The characters in which the species differ from one another may be useless, but they are not accidental; they represent different stages of growth. It is unfortunate that the horizon of *B. pinnulatus* is not quite certain; if the specimen really comes from a bed below that in which the other British species have hitherto been found, some doubt is cast on the truth of the above views. But the agile evolutionist has leapt over worse obstacles ere now, and it must be remembered that evidence from only one specimen (as is also the case with *B. ramosus*) is of slight value in such a question, while something may be explained by the change from shale to limestone. (See Note, p. 412.)

Relation to other Genera.—Of the other genera placed by me in the division Botryocrinites, there are two, *Vasocrinus* and *Barycrinus*, in which both arms and cup are constructed on the same essential plan as in *Botryocrinus*. When Messrs. Wachsmuth and Springer last discussed these three genera* they could point to more differences than would now be possible, yet even then the differences were not very great. We may proceed to discuss these differences in order.

The Dorsal Cup in *Botryocrinus* is cyathiform, in *Barycrinus* and *Vasocrinus* it is shallow: its plates in *Barycrinus* are massive and protuberant, in *Vasocrinus* thin, and in both these genera axial folding is well marked; in *Botryocrinus* there is some variety in the protuberance and solidity of the plates, while axial folding is seen in the course of development. So far the differences are unimportant.

The Arms in *Barycrinus* are robust, in *Vasocrinus* less robust; in *Botryocrinus* they are either massive or graceful. The costals in *Barycrinus* are stated to be invariably 2 (Revision, p. 100), while *Vasocrinus* appears to have had 3

* Revision, I. (96–100), Proc. 1879, pp. 319–323.

—there is a mistake somewhere in Wachsmuth and Springer's description, although this is a point on which they lay stress—in *Botryocrinus*, however, the number varies from 1 to 6. Here too then it is hard to see how any great distinction can be drawn; and the number of costals is rarely a point of much importance, even as a specific character, in the older Crinoids.

The Ventral Sac of *Barycrinus* is unknown, or was so in 1879; that of *Vasocrinus* is said to have a "series of large quadrangular plates at the base, the lower ones as wide, but much higher than the radials." It is very easy to see how this structure may have arisen, for, as previously stated, the median posterior region of the sac in *Botryocrinus* is usually more solid than the rest, and in *B. ramosus* the proximal median plate is just such a one as in *Vasocrinus*. Certainly this difference appears no greater than that which obtains in the various species of *Botryocrinus*. In both *Vasocrinus* and *Barycrinus* the radianal is occasionally absent; but as in all species where it occurs it is very small, and as the species in which it is absent have not hitherto been placed in separate genera, this fact can hardly affect the separation of the genera themselves.

The Stem in *Barycrinus* is subpentagonal, in *Vasocrinus* it is round, in *Botryocrinus* it is either. In *Barycrinus* radial sutures are well marked, in *Vasocrinus* they have only been seen in *V. dilatatus*; in *Botryocrinus* they vary in the extent to which they are visible. The lumen in *Barycrinus* is large and "highly organized," though in what the organization consists is doubtful; in *Vasocrinus* it is "comparatively small and simply constructed," in *Botryocrinus* it is small and pentagonal.

Now it must be confessed that these differences are of no great importance, and that some difficulty is experienced in drawing up a diagnosis of *Botryocrinus* that shall adequately distinguish it from the two other genera. Since, however, I have not had access to many specimens of either *Vasocrinus* or *Barycrinus*, I have thought it better simply to describe the long-known genus *Botryocrinus* as fully as possible, with the aid of new material, and to leave to the American palæontologists the task of comparing it afresh with these other more particularly American genera. The date of *Vasocrinus* is 1857, of *Barycrinus* 1868; *Botryocrinus* is ten years younger, and, should it prove identical with either of these, must yield its name. I commit it therefore to the tenderest mercies of my fellow-workers beyond the Ocean.

EXPLANATION OF PLATE XIII.

Botryocrinus ramosus, sp. n.

- Fig. 1.* 57217 B. M. Specimen seen from the posterior. (Nat. size.)
Fig. 2. The same from the right side. (Nat. size.)
Fig. 3. An armlet of the same. ($\times 2$.)
Fig. 4. The left side of the same, showing all exposed. (Nat. size.)

Botryocrinus decadactylus, sp. n.

- Fig. 5.* E 5611, B. M. A young individual, with almost complete stem. (Nat. size.)
Fig. 6. E 1328, B. M. Specimen seen from posterior, the arms dissected away and the ventral sac exposed. (Nat. size.)
Fig. 7. 48191, B. M. Plates of the ventral sac from the proximal anterior region. ($\times 7$.)
Fig. 8. 57225, B. M. Part of one specimen to show tegmental plates and covering-plates. ($\times 3$.)
Fig. 9. 136, Holcroft. Pinnules showing covering-plates. ($\times 9$.)
Fig. 10. E 5130. Distal surface of first costal. ($\times 5$.)
Fig. 11. The same. Articular surface of stem-ossicle. ($\times 5$.)
Fig. 12. 349, Holcroft. Proximal part of stem. ($\times 4$.)
Fig. 13. $\alpha/495$, Cambridge, Fletcher Collection. Specimen showing a branched proximal pinnule; labelled "*Cyathocrinus quindecimalis* (Salter, MS)." From a drawing by Mr. Edwin Wilson, artist of the Cambridge Engraving Co. (Nat. size.)
Fig. 14. $\alpha/494$, Cambridge, Fletcher Collection. Specimen with stout, square-sided pinnules. From a drawing by Mr. Edwin Wilson. (Nat. size.)
Fig. 15. E 1419, B. M. Specimen seen from posterior. (Nat. size.)

Botryocrinus pinnulatus, sp. n.

- Fig. 16.* Specimen in Dudley Museum; seen from posterior. (Nat. size.)

Note to p. 410. Relations of *B. pinnulatus*:—My friend Mr. Madeley thinks that "the Upper Limestone (Wenlock) of Dudley was a deep-water formation, deposited in deeper water than the underlying shale," and "that the *Lower* bed of limestone was not formed in water so deep as the *Upper* Limestone." Mr. Madeley, further, is "inclined to consider the blueish mudstone lying on the top of the Upper Limestone at Dudley as a deep-water formation (1) from the uniform fineness of the particles throughout a considerable thickness, (2) from the paucity of the concretionary pebbles of argillaceous limestone scattered therein, (3) from the limited *character* of the fossils from classes to species, and (4) from the paucity of the fossils themselves; in all of which conditions it is in marked contrast with the shale lying between the Upper and Lower Limestones." "The overlying shale is not dissimilar in texture &c. from those thin seams of shale intercalated in the Upper Limestone, from which so many

beautiful specimens of Crinoids and Cystidea have been collected.”

Now deep-water forms are, at the present day, usually more ancestral than contemporary shallow-water forms, and the same rule seems to have held good in past ages; we may therefore reasonably suppose that, while *B. pinnulatus* was living in shallow water at Dudley, other more ancestral forms were living in deeper seas, and that, as the Dudley sea-bottom sank, these latter forms came in. Even if this be not allowed, it must be remembered that the rarity of well-preserved Crinoids in all beds below the Upper Wenlock Limestone renders any objections based on negative evidence of very small moment.

XLII.—*On the Occurrence of Halistemma in British Waters.*

By the Rev. A. D. SLOAN, M.A., B.Sc. (Edinb.), St. Andrews.

[Plate XII.]

THE first Siphonophore recorded in St. Andrews Bay was obtained in the bottom tow-net some distance off the Castle on the 16th of May. When brought into the Marine Laboratory it was in a moribund condition, and was preserved in alcohol before it was given me for examination. Unfortunately the bracts had all fallen off and the tentacles were very much contracted.

The specimen evidently belongs to the genus *Agalmopsis* of Sars, under which, however, that observer appears to describe several genera; but, if we are to follow the new arrangement of Hæckel in his recent reconstruction of the Siphonophora, we must put it in the genus *Halistemma*, in which he includes the *Halistemma* of Huxley, the *Agalmopsis punctata* of Kölliker, and those forms of the *Agalmopsis* of Sars whose tentacle-branches end in simple terminal filaments.

The creature or colony of creatures, according as its various parts are regarded as organs or individuals, consists of a long flexible stem, along which the various structures (organs or individuals) are distributed in an irregular manner without definite nodes and internodes. The stem presents a division into an anterior shorter and a posterior longer portion, called respectively the nectosome and the siphosome. The nectosome is the locomotory part of the creature and is that portion of the trunk which bears the swimming-bells, and after being

carried forward in the form of a slender axis terminates in the float or pneumatophore. The siphosome constitutes the greater part of the creature and consists of an elongated flexible axis bearing at intervals the bracts, polypes with tentacles, mouthless polypes without tentacles, and various urn-like structures and clusters, which appear to represent the excretory and reproductive organs. The nectosome or portion of the axis which bears the swimming-apparatus terminates in a large oval float or pneumatophore, whose anterior wall contains a great deal of reddish pigment. In the Agalmidæ the float is described as being very small in comparison with the swimming-bells; but in this form it is proportionally large, being about three times larger than the largest swimming-bell. The comparatively large size of the float cannot altogether be attributed to contraction of the other parts during preservation, as it is noticeable in a rough sketch made by Mr. Holt when the creature was still alive.

Behind the float the nectosome presents the appearance of a narrow delicate cylinder, devoid of lateral structures, and extending about two and a half times the length of the long axis of the pneumatophore. It is quite straight throughout all its length, and in it Mr. Holt figures several little bubbles or globules, which are, however, not seen in the preserved specimen. The length of this stalk is comparatively great; but it is very contractile, and may have been fixed in its extended state.

This narrow stalk passes somewhat suddenly into a thicker portion of the axis, along which the swimming-bells (nectocalyces, nectophores) are distributed, and which exhibits a spiral twist. At the place where the narrower joins the thicker portion of the nectosome is a small cluster of buds, which represent young swimming-bells. In the specimen may be seen three or four very small buds and then two rows of four buds each, which are continuous with two rows of functional swimming-bells. The buds increase in size as we proceed distally along the axis, and so do the fully developed nectocalyces, the distal ones being the largest.

The functional swimming-bells consist of a large bell-shaped portion variously compressed and a short pedicle by which they are connected to the axis. They are six in number, arranged in two rows of three. Behind the nectocalyces is a portion of the nectosome devoid of structures, but presenting several little knobs, which may represent the stalks of nectocalyces whose bells have fallen off.

The nectosome passes into the siphosome or polyp-bearing part of the axis, along which the protective, nutritive, excre-

tory, and reproductive structures are distributed. It is long, very extensible and contractile, and flexible. In the specimen under consideration it ends abruptly, as if a portion of it were wanting. The structures which it bears are crowded together at the proximal end, but occur more sparsely as we proceed distally.

The anterior part of the siphosome is covered with buds, which are evidently young polypes or feeding individuals, and then follow more fully matured polypes as we pass along the axis. Of these polypes or feeding individuals there are two incipient and nine fully developed, the former following pretty closely on one another and the others at increased intervals. The first distinct polyp exhibits a large basal portion and a small oral portion, and at the base may be seen the contracted tentacle. The full-grown polypes, in their preserved condition, are all acorn-shaped, presenting a large basal part, corresponding to the cup of the acorn, and then a cone-shaped portion, somewhat elongated and terminating in a shallow cone, in which the mouth is situated. Round the basal portion the many-branched tentacle may be seen in a highly contracted state. The ninth or last polyp is represented only by its basal portion and coiled tentacle, the larger part of it having been torn off.

The tentacles unfortunately were all in a contracted condition, and this is to be regretted, as Hæckel, following Eschscholtz and Huxley, in his new arrangement of the Siphonophora, employs the characteristic appearance of the terminations of the branches of the tentacles for the distinction of genera. As far as I could make out, however, the tentacles of the specimen exhibit the simplest form of termination, and would therefore point to its belonging to the genus *Halistemma*.

Along the internodes or portions of the axis between the polypes numerous other structures are distributed. Some of them resemble closed polypes, some little urns, and others bunches of grapes, and these seemingly represent sensory, excretory, and reproductive organs.

The closed polypes, called palpons by Hæckel, are regarded by him to be sensory in function. The urns in which there is a mouth or opening he considers to be excretory. The cluster-like structures again are gonodendra, of which several occur in each internode.

Bracts are figured by Mr. Holt in his drawing, although very sparingly. In the preserved specimen I have not been able to alight on one. They are leaf-like structures, triangular in form.

The specimen evidently belongs to the genus *Halistemma*, but differs from all the forms of *Halistemma* and *Agalmopsis* I have seen figured in the proportionally larger size of the pneumatophore and the relatively greater length of the portion of the nectosome between the pneumatophore and the nectocalyces. The length of the specimen in its preserved condition is $1\frac{1}{8}$ inch.

Another specimen evidently belonging to the same species was obtained a few days later. It measured about $\frac{1}{2}$ inch in length and was in a very dilapidated condition. Indeed it consisted only of the nectosome with its pneumatophore, but stripped of the nectocalyces and a portion of the siphosome, from which all the structures had been removed. It, however, showed the same relatively large size of pneumatophore which characterized the other specimen.

Note by Prof. M'INTOSH.

The occurrence of *Halistemma* on the east coast of Britain is of great interest; indeed, the Siphonophores are there, as a rule, conspicuous by their absence. Of the other Siphonophores *Diphyes* has very rarely been seen in good condition in the inshore waters of Britain, perhaps the most striking instance being in Lochmaddy, North Uist, in 1865, where it occurred in great beauty amongst the hordes of *Salpæ*, swimming actively through the water and avoiding the bottles that were used in its capture. Amongst the Physophora again *Physalia* is seen occasionally on the west coast of England and the Outer Hebrides, very fine examples having been procured off Southport in 1874. *Verella* is common on the western shores of North Uist, and also is found in considerable numbers at various parts of the west coast of England from the extreme south northward to Scottish waters. The small size of the specimens described by Mr. Sloan would alone have rendered them apt to be overlooked amidst the varied contents of the tow-nets.

EXPLANATION OF PLATE XII.

The accompanying figure is the reduction of a drawing made from the preserved specimen with the aid of Abbe's camera lucida. The objective used was Zeiss's a_2 and the eyepiece Zeiss's no. 2.

- a. Pneumatophore.
- b. Young nectocalyces.
- c. Functional nectocalyces.
- d. Incipient siphons or feeding polyps, with coiled tentacle at base.
- e. Mature feeding polyps.
- f. Contracted branches of coiled tentacle.
- g. Palpons or sensory polypes and cystons or excretory polypes.
- h. Gonodendra.

XLIII.—Description of a new Lizard of the Genus *Zonurus* from the Transvaal. By G. A. BOULENGER.

Zonurus Jonesii.

Head once and one third as long as broad. Nasals scarcely swollen, in contact with each other, pierced in the middle; fronto-nasal pentagonal, longer than broad, separating the præfrontals, and forming a suture with the frontal; frontal heptagonal; interparietal enclosed between the four parietals; temporals in three longitudinal rows; no spines; four supracoculars; three supraciliaries; a loreal, a præocular, and two suboculars; six lower labials and five large chin-shields on each side; gular scales small, obtusely keeled, gradually increasing in size posteriorly. Dorsal scales large, quadrangular, rough, strongly keeled, in ten or twelve longitudinal and twenty-one transverse series (from occiput to base of tail); sides of neck with small keeled rhomboidal scales; lateral scales much smaller than dorsals, rhomboidal, strongly keeled, separated from one another by granules. Ventrals smooth, in twelve or fourteen longitudinal and twenty-six transverse series. Two enlarged posterior præanal scales. Upper surface of limbs with imbricate strongly keeled scales. Six femoral pores on each side. Tail with whorls of large, rugose, strongly keeled, spinose scales; the keels strong even on the subcaudal scales. Brown above, with a vertebral series of paired black spots and a black lateral band; brownish white inferiorly.

	millim.
Total length (end of tail injured)	118
Head	21
Width of head	16
Body	46
Fore limb	22
Hind limb	32

A single male specimen was obtained by Mr. C. R. Jones in the Murchison Range, Transvaal, and presented by him to the British Museum. Curiously another new species was discovered in the Transvaal only four years ago, and described by Dr. Reichenow as *Z. vittifer* *.

* Zool. Anz. 1887, p. 372.

XLIV.—On *Pherusa fucicola* (Leach).

By ALFRED O. WALKER.

THE confusion that has arisen about this species is so great that it appears worth while to make an effort towards clearing it up. It was first described by Leach in 1814 in the 'Edinburgh Encyclopædia,' vol. vii., art. Crustaceology, and in the Trans. Linn. Soc. vol. xi. part 2, 1815, p. 360. In the latter he describes the genus *Pherusa* as follows:—"Antennæ superiores setâ nullâ ad articuli quarti basin. Cauda superne haud fasciculato-spinosa. Manus filiformes." The only species, *P. fucicola*, is described as follows:—"P. testaceo-cinerea aut griseo-cinerea rubro-varia. Habitat inter fucos in Danmonia australis mari rarius." The definition of the genus only differs from that of *Amphithoë* (as pointed out by Stebbing in his invaluable 'Challenger' Bibliography) in the substitution of "manus filiformes" for "manus ovatae."

In the 'Encyclopædia Britannica,' 1816, Supp. pl. xxi. *Pherusa fucicola* is figured. The first gnathopods are very slender, while the second are much longer, the wrist and hand together forming an elongated oval, of which the wrist occupies more than one third the length. It cannot be said that this figure agrees with Leach's definition of the genus ("manus filiformes") or of the Subdivision II. in which he places it, the definition of which is "*Pedum paria duo antica in utroque sexu monoductyla conformia.*" Only one other Amphipod is figured, viz. *Melita palmata*, Montagu. This has no secondary appendage to the upper antennæ and no finger on the hand of the second gnathopod. These figures therefore are of little or no scientific value.

Desmarest ('*Considérations sur la Classe des Crustacées*,' p. 268, pl. xlv. fig. 10) translates Leach's description and gives a figure which appears to be an indifferent copy of that in the Encycl. Brit., the hand of the second gnathopod being again large and ovate.

Milne-Edwards (*Hist. Nat. des Crustacées*, 1840, vol. iii. p. 32) says that *Amphithoë fucicola*, Leach, is distinguished by the great inequality between the first two pair of feet, the first pair being filiform and the second, though much thicker ("plus grosses"), being still slender ("grêles") and elongated. This description seems to be founded on the figure in the Encycl. Brit. and not on Leach's description. Milne-Edwards does not appear to have seen the species.

In 1857 Costa ('*Amfipodi del Regno di Napoli*,' p. 209, pl. iii. fig. 2) described *Amphithoë micrura*, adding that it

seems "very near to *Pherusa fucicola*; but if the figure given by the authors"—he does not say what authors—"is exact, ours differs from it by the first two pair of feet being equally small." These had been previously described as "filiform." He also says of the abdominal segments, "furnished on the back with a short and delicate spine near the base of the fifth segment, and another on the posterior margin of the sixth observable when highly magnified."

In 1862 Spence Bate ('Catalogue of the Specimens of Amphipodous Crustacea in the British Museum,' p. 145, pl. xxvii. fig. 10 [not fig. 9, as stated both in text and plate]) describes *P. fucicola*, Leach. He had previously stated that the genus *Pherusa* differs from *Atylus* only in having an entire instead of a cleft telson. He refers to this species *Amphithoë Jurinii*, M.-Edw., and *A. fucicola*, Leach (Milne-Edwards, Ann. des Sci. Nat. 1830, vol. xx. pp. 376, 377), notwithstanding that this author makes these two species quite distinct. Spence Bate also refers *A. microura*, Costa (v. supra), to *A. fucicola*, from which, however, it differs in the antennæ, the peduncles of both pair in Costa's species being very much longer in proportion to the flagella than in *A. fucicola* as described by Spence Bate, and in the last three pleon-segments, which appear to be extremely short in *A. microura*, while they are figured as somewhat long in Bate's figure.

We have therefore apparently here three distinct species referred to *Pherusa fucicola*, Leach, of which only one, *A. Jurinii*, M.-Edw., seems at all to agree with Spence Bate's description and figure.

In 1862 Spence Bate and Westwood published part 6 of the 'British Sessile-eyed Crustacea.' At p. 252 they repeat Bate's statement that the "chief distinction between *Pherusa* and *Atylus*" is the "entire central caudal plate" in the former genus. At p. 255 they describe and figure *P. fucicola*, Leach, "from the typical specimen of Dr. Leach in the British Museum." They admit that it "differs from the figure given in the 'Catalogue of Amphipoda in the British Museum' in a few details, the most important of which are the length of the last pair of caudal appendages and the length of the inferior antennæ." They omit to mention that the telson, as figured by them, is *deeply cleft*, and that consequently the typical species of Leach's genus *Pherusa* cannot belong to that genus as defined by Spence Bate and themselves.

By the courtesy of the authorities of the British Museum I have been able to make as careful an examination of the

specimens in that collection which are labelled *Pherusa fucicola*, Leach, as it is possible to do without dissection. There are three specimens in spirit labelled *P. fucicola*, Leach, in Spence Bate's writing. These are evidently the species described in the Brit. Mus. Cat. p. 145, as above mentioned, and differ entirely from the same species as described by Bate and Westwood in the 'Brit. Sessile-eyed Crust.' In the only specimen in which the antennæ are perfect the lower are considerably longer than the upper, though described in the Catalogue as "scarcely as long as the upper." This is not, however, of much importance, as it depends on the length of the flagellum, which varies much with age and sex in many species.

There are also three dried specimens marked *Pherusa fucicola*, Leach. These are believed to be Leach's original type specimens. They are described in the 'Catalogue of the Crustacea in the British Museum' by Adam White (1847) as being from Col. Montagu's collection.

This, as will be seen, is a matter of great importance. An examination of these specimens (which are undoubtedly those from which Bate and Westwood described their *P. fucicola*) reveals the following facts:—

1. That Leach was in error when he stated that there was no secondary appendage to the upper antennæ ("setâ nullâ ad articuli quarti basin") and that the same mistake was made by Bate and Westwood.

There is such an appendage, but, being very slender and lying close along the flagellum, it is easily overlooked.

2. That Bate and Westwood were in error in describing the "posterior pair of pleopoda" (uropoda) as "having the rami equal." On the contrary, one of the rami is reduced to a mere scale on the upperside of the other branch. It is this that forms the distal portion of the apparent double telson figured by these authors.

3. That the same authors have transposed the gnathopods—the one marked "i" is the first and that marked "h" is the second.

The consequences of these errors are far-reaching, for, on comparison with the *Gammarella Normanni* of the same authors (Brit. Sessile-eyed Crust. p. 333), it becomes evident that this is the same species. But Stebbing has shown (Ann. & Mag. Nat. Hist., July 1874) that *G. Normanni* is the female of *G. brevicaudata*, M.-Edw., which has the second gnathopods furnished with a very large ovate hand! And here I may say that the Brit. Mus. type specimens agree with Bate and Westwood's and Stebbing's descriptions of *Gamma-*

rella brevicaudata ♀ to the smallest detail. The solitary species therefore on which Leach founded his genus *Pherusa* disagrees in almost every particular both with his definition of the genus and of the subdivision in which he placed it!

Under these circumstances, and in accordance with no. 11 of Strickland's Rules for Zoological Nomenclature, adopted by a strong committee of the British Association in 1865, it seems clear that *Pherusa fucicola*, Leach, should be discarded from our lists. In this rule it is laid down that "definition is necessary before a zoological term can acquire any authority," and that "Definition properly implies a distinct exposition of essential characters, and in all cases we conceive this to be indispensable." It is certain that Leach's description of *Pherusa* does not comply with the above conditions.

There appears, however, to be no reason why the genus *Pherusa* as defined by Spence Bate in the Brit. Mus. Cat., and which, as we have seen, is entirely distinct from *Pherusa* of Leach, should not retain its place under the name of the former author.

Dismissing *P. fucicola* of Milne-Edwards and the figure of Desmarest as of no value, being founded on the erroneous figure in the 'Encycl. Britannica,' the synonymy of this species will then stand as follows:—

Genus PHERUSA, Bate, 1862.

Pherusa Jurinii, M.-Edwards.

Amphithoë Jurinei, M.-Edwards, Ann. des Sciences Naturelles, 1830, vol. xx. p. 376.

Amphithoë Jurinii, M.-Edwards, Hist. Nat. des Crustacées, iii. p. 30, pl. i. fig. 2 (1840).

Amphithoë norvegica, Rathke, Acta Academia Nat. Cur. Leopold. Carol. 1843, vol. xx. p. 84, pl. iv.

Paramphithoë norvegica, Bruzelius, Skand. Amphip. Gamm. p. 77 (1859).

Pherusa fucicola, Bate, Brit. Mus. Cat. Amphipoda, p. 145, pl. xxvii. fig. 10 (1862).

Calliope norvegica, Bate, Brit. Mus. Cat. Amph. p. 150.

Calliopius norvegicus, Boeck, Skand. og Arkt. Amphipoder, p. 348, pl. xxii. fig. 6 (1876).

Pherusa fucicola, Carus, Prod. Faunæ Mediterr. vol. i. p. 404 (1835).

It may be asked why I have not displaced *Pherusa*, Bate, in favour of the older genus *Paramphithoë*, Bruzelius. I reply that *Pleustes*, Bate, 1858, is still older, and, as amended by

Boeck, would probably answer quite as well. But a complete revision of the Pleustidæ, Atylidæ, &c. is much wanted, and until this is done I prefer to disturb existing genera as little as possible.

I have very little doubt that *Calliopius norvegicus*, Boeck, should be referred to the above species. Meinert ('Naturhistorisk Tidsskrift,' 1877-8) and Zaddach ('Meeresfauna Preuss. Küste') consider that *C. norvegicus* cannot be distinguished from *C. leviusculus*, Krøyer. In this I cannot agree with them. The two species differ completely in the antennæ, the first and second gnathopods, and the form of the hinder margin of the third pleon-segment. The nodule or tooth on the third joint of the peduncle of the upper antennæ is only found in the male.

The type specimen in the British Museum now stands as follows:—

Genus GAMMARELLA, Bate, 1857.

Gammarella brevicaudata, M.-Edwards.

[*Pherusa fucicola*, Leach?]

Amphithoë micrura, Costa, l. c. (♀).

For other synonyms see Norman, Ann. & Mag. Nat. Hist. 1889, ser. 6, vol. iv. p. 128.

It will be seen that Costa fell into the same error as Leach and Bate and Westwood in overlooking the secondary appendage of the upper antennæ both in his *Amphithoë micrura* and *A. semicarinata*.

I have to thank Dr. A. M. Norman, F.R.S., and the Rev. T. R. R. Stebbing for valuable suggestions, and Mr. R. I. Pocock, of the British Museum, for his kind assistance in the examination of the type specimens.

Colwyn Bay,
March 20, 1891.

XLV.—*Descriptions of new Genera and Species of Pyralidæ contained in the British-Museum Collection.* By W. WARREN, M.A., F.E.S.

Subfamily *CHRYSAUGINÆ*.

CHRYSAUGE, Hüb.

Type *C. divida*, Hüb. Ex. Schm.

Chrysauge latifasciata.

Chrysauge bifasciata, Wlk. ii. p. 368, var. *b*.

Resembles *bifasciata*, Wlk., but all the black markings are twice as broad.

Chrysauge catenulata, sp. n.

Resembles *bifasciata*, Wlk., but the two dark transverse fasciæ of the fore wing are finer and the black border of the hind wing is traversed by a more or less distinct, fine, chain-like, yellow band, very conspicuous in the male, but restricted in the female.

Four examples from S. Paolo, another from British Guiana.

CHRYSOPHILA, Hüb.

Type *C. auriscutalis*, Hüb. Zutr. figs. 465, 466.

Chrysophila basilinealis, sp. n.

Resembles *C. auriscutalis*, Hüb.; distinguished by the straight black bar which runs obliquely from the base of the fore wings below the costa to the inner margin before the anal angle.

Two examples in the British-Museum collection, both from Espiritu Santo. The female is quite perfect; the male is smaller and much faded, the deep orange tints of the female being quite lost; fortunately the pectinated antennæ are left.

NACHABA, Wlk.

Type *N. congrualis*, Wlk. xix. p. 835.

Nachaba carbonalis, sp. n.

Fore wings bronzy brown-black, finely freckled with iridescent scales. Hind wings yellow, with all the margins blackish,

the apex broadly so, and a greyish shade running up base-wards from centre of hind margin; abdomen dark cinereous; head and thorax bronzy fuscous.

Expanse of wings, ♀ 20, ♂ 16 millim.

One female, two males, the former from Espiritu Santo, the latter from S. Paolo.

Easily distinguished by the black fore wings, which have the apex bluntly rounded off.

Nachaba flavisparsalis, sp. n.

Fore wings reddish purple, brighter than in *N. notata*, Wlk.; a narrow yellow subbasal fascia, not reaching costa and sloping slightly *outwards* from the inner margin; second line curved, indicated only by two yellow blotches, one above the inner margin near the anal angle, the other larger, subcostal. Hind wing as in *N. notata*, Wlk., bright yellow, with a blackish border, broadest at apex and thinning out before the anal angle, with an orange shade running up towards base from about the centre of the hind margin. Abdomen cinereous; head, palpi, antennæ, and thorax reddish purple.

Expanse of wings 16 millim.

One male, from Espiritu Santo.

Resembles *notata*, but smaller.

Nachaba cinerascens, sp. n.

Fore wings glossy, mouse-coloured, with the two curved cross lines faintly darker. Hind wing rather paler. Head, thorax, abdomen, and fringes all concolorous.

Expanse of wings 18 millim.

One male, Espiritu Santo.

DASTIRA, Walker.

Type *D. hippialis*, Wlk. xix. p. 917.

Dastira sublituralis, sp. n.

Fore wing dull purplish, slightly darker than *D. hippialis*; at the extreme base more reddish; bounding the reddish basal patch is a bright yellow vertical fascia, reaching from the inner margin as far as the base of the costal swelling, and edged outwardly with a fine dark brick-red line; second line very indistinct, running throughout parallel to the hind margin, as in *D. imitatrix*, its upper part being reflexed to near the middle of the costa instead of going straight to its

outer fourth as in *D. hippialis*. Hind wing like fore wing, without the yellow fascia, and paler, more fuscous, towards the base. Abdomen cinereous; head and thorax purplish.

Expanse of wings 16 millim.

Like *D. hippialis* in colour and *D. imitatrix* in markings.

One male from Espiritu Santo.

Dastira imitatrix, sp. n.

Wings coppery red, dusted thinly with coarse black scales. Fore wing with an oblique yellow blotch running from the inner margin nearly to the costa, before which the basal area is purplish; the blotch is bounded externally by the fine blackish first transverse line; costal margin of the basal area above the thickening blackish; second line blackish, starting at about two thirds of the costa, and running more or less parallel to the hind margin, so forming a blunt curve outwards; fringes with a black, somewhat interrupted, basal line, which is continued round the apex as far as the start of the second line. Hind wing with one curved line. Abdomen reddish ochreous; head and thorax purplish, like the basal area of the fore wings.

Expanse of wings 22 millim.

Two males, from Espiritu Santo.

Subfamily PYRALIDINÆ.

TYSPANODES, gen. nov.

Like *Tyspana*, Moore, except in the labial palpi, which are upcurved along the forehead, rising as high as the vertex, whereas in *Tyspana* they are quite short.

Type *T. nigrolinealis*, Moore (*Filodes*), Proc. Zool. Soc. Lond. 1867, p. 95.

Tyspanodes flaviventer, sp. n.

Fore wing white, with the extreme base yellowish; the intervals between the veins marked with thick black lines; in the cell are two subquadrate black spots and three more irregularly shaped towards the base; fringes chequered, black and white. Hind wing yellow, with broad black apex. Legs black and white; head and thorax ochreous; abdomen yellow, with black anal segment.

Expanse of wings 26 millim.

One male, Darjiling.

Tyspanodes hypsalis, sp. n.

Fore wing as in *T. flaviventer*; hind wing blackish, with centre only broadly whitish ochreous; abdomen whitish ochreous; fringes glossy cinereous.

Expanse of wings 26-28 millim.

Two examples from North China. One of these bears a label in Walker's handwriting, "*hypsalis*," but the description, as far as I have been able to ascertain, was never published.

OROMENA, Moore.

Type *Briarda relinquenda*, Wlk. xv. p. 1802.

Oromena commutanda, Warr.

In the Descr. Lep. Coll. Alk. ii. p. 160, Mr. Moore describes as *relinquenda*, Wlk., a species which is certainly not identical with Walker's type of that insect, and which must therefore be renamed. I propose for it the name *commutanda*.

SPECTROTROTA, gen. nov.

Fore wings short, stumpy; costa curved at base, slightly concave beyond middle; apex bluntly rectangular; hind margin nearly vertical. Hind wings rounded.

♂. Fore wings with the cell-space inflated, appearing at one third from the base as a small, oval, scaleless depression; near the base of the submedian is a large raised comb of hair-like scales that projects slightly over the inner margin. Hind wing also with a thick brush of scales rising from the base of the abdominal margin; labial palpi rising vertically in front of face; the basal joint hairy and swollen; terminal joint scarcely distinguishable from second, but ending in a loose pencil of hairs; maxillary palpi, tongue, and ocelli wanting; antennæ annulated, pubescent beneath; head hairy; patagia slightly raised; anal segment of abdomen in male with a hairy tuft.

Neuration peculiar; median vein of fore wing, not very far from the base, slightly deflected towards the inner margin; from the bend the first median nervule runs straight to the hind margin parallel to the submedian, the second and third and the lower radial starting at about equal distances from one another; no discocellular; subcostal vein running quite close to the costal, being curved upwards out of its usual

course; the four subcostal nervules rising out of it; the upper radial, which runs, as usual, straight between the hind margin and the place where the discocellular should be, is then thickened and becomes recurrent through the cell-space, curving first downwards, so as nearly to touch the median at its point of deflexion, then sharply upwards till it touches (or joins) the subcostal, just before the bladder hole. Hind wing likewise with cell open, but without any recurrent vein. The submedian in the fore wing and the centre branch of the three independent veins on the hind wing raised and thickened at the base, beneath the brush of hairs. Female with ordinary neurulation and without the tufts of scales.

Type *Spectrotrota fimbrialis*, Warr.

Spectrotrota fimbrialis, sp. n.

Fore wing ashy grey, dusted with darker grey and reddish fuscous; first line scarcely visible, crossing the wing before the cell-patch, and followed beneath it by a dull fulvous patch, beneath which arises the lappet of the inner margin, which is grey mixed with fulvous; second line pale, inwardly dark-edged, especially on the costa; starting from the costa just beyond the middle, running obliquely outward as far as the middle, then forming rather a strong indentation inwards above the inner margin; this line is followed by a distinctly darker, reddish-tinged, fuscous fascia, containing well-defined dark streaks between the veins; base of fringes preceded by a row of largish wedge-shaped blackish marks; fringes pinkish grey, with an interrupted darker dividing-line. Hind wing fuscous, paler, more ochreous towards base; tuft of scales yellowish ochreous. Head, thorax, and abdomen grey, mottled with darker; anal tuft ochreous; underside, both of wings and abdomen, and legs grey, mottled with darker; labial palpi darker; antennæ annulated black and white.

Expanse of wings 16 millim.

Several examples from Australia.

MIMAGLOSSA, gen. nov.

Fore wing elongate; costa curved; apex rounded; hind margin oblique, convex; labial palpi upcurved in front of face; the terminal joint remarkably *long, pointed*. Male without antennal processes; with a slight swelling, as in *Balanotis*, Meyr., on the costal margin of the fore wing, at two thirds; male smaller than female. Scaling smooth and glossy.

Type *M. habitalis*, Guen. (*Glossina*), Delt. et Pyr. p. 125.

Mimaglossa revulsa, sp. n.

Like a very large *habitalis*, but the ground-colour pale reddish ochreous, the usual lines, which are shaped exactly as in *habitalis*, indistinctly fuscous; hind wing pale ochreous, tinged with greyish only at apex and along the base of the fringes; head and thorax reddish grey; abdomen greyish ochreous.

Expanse of wings, ♀ 36 millim.

One female from Australia with the MS. name *revulsa*, Wlk., attached to it. The specimen is not in first-rate condition; perfect ones will probably show the lines and markings clearer.

PARASARAMA, Warr.

Parasarama, Warr. Ann. & Mag. Nat. Hist. 1890, vi. p. 474.

Fore wings elongated, narrow at base; costa straight, only curved slightly in the last third; apex blunt; hind margin curved. Hind wings rounded, twice as broad as fore wings. Antennæ with basal joint swollen, filiform in female, slightly pubescent in male; palpi upcurved in front of face, very long; the second joint rising as high as or higher than the vertex, in the female slender, in the male thickened; third joint erect, shorter, aculeate and slender in female, fringed with hair-like scales and thickened in male; tongue present; patagia long, partially raised; abdomen stout and short in both sexes; scaling coarse; fore wings in the male with raised tufts of scales in the cell; hind wings semitransparent.

Type *P. cuproviridalis*, Moore (*Locastra*), Proc. Zool. Soc. Lond. 1867, p. 67, ♀.

The genus resembles *Sarama*, Moore, but is without the antennal appendages in the male.

Parasarama (?) *nigrescens*, sp. n.

Fore wings ochreous, with a greenish tinge; first line indicated only by an obliquely-curved streak from the inner margin and a black dot on the median vein; some grey scales on the costa towards the middle, and two small tufts of raised black scales below them in the cell; exterior line black, indistinctly denticulated, two denticulations in the middle and one above the inner margin being particularly conspicuous; marginal area and fringes dark fuscous, leaving only a narrow pale shade beyond the exterior line. Hind wings fuscous, darker towards the hind margin, with indistinct traces of a

darker submarginal curved line. Head, face, palpi, and thorax concolorous with base of the fore wings; abdomen dark. Underside glossy ochreous, tinged with pink; space beyond second line in both wings dark fuscous.

Expanse of wings 26 millim.

One female from Yesso.

PSEUDOLOCASTRA, gen. nov.

Fore wings three times as long as broad, narrow at base, widening out towards hind margin; costa straight till shortly before apex, which is blunt; hind margin obliquely curved. Hind wing rounded. Antennæ filiform in male, slightly pubescent in female; palpi of female as in *Parasarama* ♂, with terminal joint thickened, of male thickly clothed with a mass of appressed scales, club-like, and recurved over the head; abdomen of female short, of male prolonged beyond the hind wings, the anal segments thickened; patagia prominent; fore wings of male without raised scales; hind wings of both sexes hairy towards inner margin.

Type *P. inimica*, Butler (*Locastra*), Ann. & Mag. Nat. Hist. 1879, ii. p. 448, ♀.

ORTHOTRICHOPHORA, gen. nov.

Resembles *Pseudolocastra*, but smaller, and with the palpi of the male in comparison greatly exaggerated, reaching as far as the middle of the thorax; distinguished at once by the cell in the fore wings of the male being occupied by an erect screen of dark hairs; middle tibiæ with a thick fringe of hairs; scaling finer and smoother, beneath glossy.

Type *Orthotrichophora syrictusalis*, Walk. (*Bertula*), xvi. p. 165.

PROBOSCIDOPHORA, gen. nov.

Fore wings with the costa in the female slightly, in the male decidedly, shouldered near the base, faintly concave in middle and a little curved before apex, which is blunt; hind margin obliquely curved. Hind wings rounded. Antennæ of female simple, of male strongly ciliated, especially along the basal half, and with a conspicuous distortion about the middle; palpi of female upcurved in front of face, with terminal joint aculeate, as in *Parasarama* ♀, in male with the second joint short, thickened, and slightly porrected upwards; the third joint very long, four times as long as second,

laterally flattened, and porrected forward and downwards, resembling a stork's beak: legs hairy; the tibiæ all with tufts of hair. Fore wings of male with some flattened tufts of hair in the disk. Underside with the costa thickened till towards the apex and with a large subcostal pad of flat scales near the base.

Type *P. tritonalis*, Walk. (*Pyralis*), xix. p. 906.

GONODISCUS, gen. nov.

Fore wings elongate; costa straight; apex blunt; hind margin obliquely curved. Hind wings rounded, very broad. Antennæ (female) filiform, basal joint swollen; labial palpi erect in front of face, terminal joint rising considerably above vertex; maxillary palpi distinct, erect, half as long as labial; tongue and ocelli present; scaling smooth and fine. Neuration: fore wing with the cell elongate; first median nervule rising at four fifths, second just before end, third and lower radial close together from the end; upper radial and last subcostal nervule near together from upper end of cell; without denuding, which is impossible in the case of the single specimen, I cannot make out the position of the rest to state them precisely. Hind wings with the discocellular much bent, the upper third short and perpendicular, the lower portion running obliquely outwards, three times as long as the upper; median nervules as in fore wing; costal concave in middle, with its upper nervule curved upwards towards the apex, the lower one straight.

Type *G. amplalis*, Warr.

In the absence of the male the proper place of this species and genus must remain uncertain.

Gonodiscus amplalis, sp. n.

Fore wings whitish grey, dusted with darker grey and some dull tawny patches; an indistinct blackish fascia close to the base; a distinct curved black fascia at one third, edged with paler internally, space between it and the basal fascia more or less suffused with dull tawny; exterior line black, dentated, curved outwards in its upper half, and followed by a paler space; an indistinct dark cell-spot; space between second and third lines palest, except on costa and inner margin, which are greyer; in the submarginal field at the anal angle is an ill-defined tawny blotch; fringes grey, like the fore wings. Hind wings dull whitish, with the costa and apex dull fuscous; an indistinct curved central fascia. Head,

thorax, and abdomen grey. Underside dull cinereous, the hind wings lighter.

Expanse of wings 40 millim.

One male from Coquimbo.

The following eight species belong to the group with antennal appendages in the male, sometimes considered as a distinct subfamily, *Epipaschiinæ*.

STERICTA, Led.

Type *Glossina divitalis*, Guen. Delt. et Pyr. p. 124, pl. vii. fig. 4.

Stericta cinerascens, sp. n.

Fore wings pinkish ochreous, almost wholly suffused with dark fuscous and blackish scales; first line very indistinct, only showing as a black patch on costa and inner margin; beyond and below the costal patch is a black spot of raised scales near the beginning of the cell; second line strongly serrated, the serratures more conspicuous by the pale ochreous serrated line that follows them; central area beyond and below the black patch of scales less suffused with dark; inner and hind margin fuscous, the latter paler just in the centre, with pale spots at the end of the veins; fringe cinereous, chequered light and dark. Hind wings ochreous, with a broad blackish border, which runs up irregularly along the inner margin; fringe dark, with pale basal line and apical half paler. Head, thorax, and abdomen reddish ochreous, irregularly dusted with fuscous, the head and thorax darkest; basal joint of abdomen with a spot of black scales. Underside pale ochreous, with a broad blackish border in both wings; a dark central spot and traces of the second line blackish in both; costa of the fore wing and first line on the costa blackish.

Expanse of wings 30 millim.

Two females, one from Parramatta, the other doubtful.

Stericta papuensis, sp. n.

Fore wing a mixture of whitish, pink, and olive-green scales; basal area paler, with a darker patch on the inner margin; first line diffusely dark, nearly vertical, broader on the costa, followed by a narrow paler space, which is again followed by a narrow dark shade, beyond which can be discerned a small dark spot in the cell and a larger dark

patch below it; second line strongly denticulate, followed by a whitish similar line, the costal half of which is most distinct; then comes an olive shade, interrupted in the middle by the white spots which follow the angle of the second line; subterminal shade pinky white; hind margin preceded by a series of blunt, wedge-shaped, olive-green blotches, between which the veins are pale; fringe shining white, chequered with olive and pink. Hind wings whitish, with the veins and broad border fuscous; below the border there are traces of a fuscous line. Head, thorax, and abdomen like the fore wing, the darker specklings being found on the head and thorax. Underside pinky fuscous, with the basal portion of the hind wing and costal spots on the fore wing whitish.

Expanse of wings 30 millim.

One female from New Guinea, bred.

Cocoon oval, flattish, hairy, pale reddish brown, containing evidently an inner, more closely woven, oval chamber.

Stericta marmorea, sp. n.

Fore wings a mixture of dull greenish and pink; basal one third rather darker green and grey along the costa, paler at the base of the inner margin, with a reddish patch on the same margin before the first transverse line; from centre of base a black horizontal line, not quite reaching the first transverse line, and interrupted halfway by some raised whitish scales; first line at one third vertical, black, preceded by a narrow and followed by a broader pale ochreous space, the latter containing a series of raised scales; the line itself is interrupted in the cell, the costal portion above it being formed of two black spots superimposed; a blackish linear cell-spot, preceded by raised pale scales; exterior line finer, denticulate, forming rather a prominent angular projection in the centre towards the hind margin, and followed throughout by a narrow pale space; the space between the two lines is whitish along the costa and beyond the first line, dusted with dark grey, but towards the second line broadly greenish, tinged with pink; hind margin likewise green and pink, with two darker dashes beyond the cell; fringes pinkish grey, narrowly darker at the end of each vein. Hind wings dull pinky grey, more fuscous towards hind margin, with a curved denticulate line towards the hind margin, edged with paler; a dark line before the base of the fringe, which is like that of the fore wing. Head, thorax, and abdomen mottled green and grey. Underside of fore wing cinereous, darker along the disk, of hind wing dull ochreous, with the apex and

margin pinkish ; cell-spots and exterior line dark and distinct in both wings.

One male from Hobart, expanding 40 millim.

HYPERBALANOTIS, gen. nov.

Fore wings with straight costa in the female, in the male with the basal two thirds rather convex, and at two thirds distorted in consequence of the neuration ; apex blunt ; hind margin obliquely curved. Hind wings rounded, not much broader than fore wings. Antennæ of female moniliform, of male slightly pubescent ; palpi in female erect in front of face, terminal joint aculeate, in the male thicker and applied to face ; antennal appendage of male large, club-like, reaching middle of thorax.

Type *H. uchatina*, Butler (*Glossina*), Ill. Lep. Het. ii. p. 56, pl. xxxviii. fig. 10.

Hyperbalanotis olivacea, sp. n.

Fore wings yellowish olive, more or less suffused with dark grey, and here and there with reddish tints ; first line blackish, sinuous, but only distinct on the inner margin, its course marked by a pale yellowish-olive band, unsuffused by grey ; the basal area with a broad, dark-grey, diffuse band through its centre ; second line black, distinctly denticulate, forming a distinct outward curve in the centre, and immediately followed by a narrow yellowish-olive space ; marginal space partially filled up with dark grey ; median area with a diffuse blackish band down the centre ; a black linear cell-spot along the inner margin, and in the neighbourhood of the anal angle are some scattered reddish scales ; fringes chequered olive and dark grey, preceded by a series of black patches. Hind wings dark fuscous ; fringes as in fore wings. Head, thorax, and abdomen dull olive, mottled with grey. Underside ochreous, much suffused with grey towards the costa and hind margin in both wings.

One male from Japan, expanding 26 millim.

DEUTEROLLYTA, Led.

Type *D. conspicalis*, Led. Wien. ent. Mon. vii. p. 359.

Deuterollyta variegata, sp. n.

Fore wings pale, variably suffused with a mixture of green and pinkish scales ; an indistinct dark transverse band at one

third internally pale bordered; an interrupted blackish streak runs from the centre of the base as far as this first line, immediately before which it forms a blackish patch; exterior line fine, blackish, curved outwards in the middle and neatly denticulate throughout; a small dark cell-dot; submarginal area suffused with pinkish, which generally intrudes into the outer half of the central area, where it is pretty definitely outlined and divided from that; a row of black dashes before the fringes, which are glossy and somewhat chequered; sometimes, instead of the central area being greenish and the marginal pink, the colours are reversed, and in other instances the two colours are mixed up; the distinction of shades is, however, greatest in the males. Hind wings glossy whitish, becoming fuscous towards the hind margin, where also the veins are fuscous; a faint darker submarginal line and central dot. Head, palpi, antennal appendages, and thorax variegated with pink and green, in correspondence to the prevailing tint of the fore wings; abdomen pale grey. Underside dull whitish, darker grey towards the costa and hind margin of both wings, the fore wings shaded with reddish.

Expanse of wings, ♀ 32 millim., ♂ 26 millim.

Five females, two males, from Rio Janeiro.

HOMURA, Led.

Type *H. nocturnalis*, Led. Wien. ent. Mon. vii. p. 340.

Homura trisulcata, sp. n.

Fore wing dull pale green, varied with grey; an indistinct blackish transverse line near base, consisting of small separate patches of slightly raised scales; exterior line nearer the hind margin than usual, dark, acutely denticulate, and followed by a paler shade; in the cell-space are two oblique linear marks of distinctly raised scales, and a third immediately below the inner one; fringe green, preceded by a row of fine black dashes; beyond the exterior line is an obscurely edged dark costal blotch. Hind wings dull whitish, a little darkened towards the apex and along the base of the fringe, with a very indistinct curved submarginal line, which is obsolete towards the inner margin. Head, thorax, and antennal appendages, which as well as the patagia are very large, all dull greenish; abdomen greenish ochreous. Underside pale ochreous, with the costa and apex of both wings tinged with pink, and the exterior line marked towards the costa.

Three males from Rio Janeiro, expanding about 34 millim.

RÆSELIODES, gen. nov.

Fore wings narrow, elongate; costa straight; hind margin obliquely curved; apex blunt; labial palpi (female) erect, the second joint with long erect hairs, partially hiding the terminal joint, which is aciculate and rises above the vertex; tongue and ocelli present; maxillary palpi invisible; antennæ in female annulated, filiform, in male coarsely pectinated, enlarged at the base, which also bears a dense erect tuft; near the base of the submedian between it and the internommedian is a bladderly protuberance, and the underside of the fore wing is beset with hairs; cell long, the end wedge-shaped; first median nervule from the angle at the base of the wedge; second, third, and lower radial from the point; between the median and submedian is a strongly developed independent surplus vein, which near the base stands out as prominently as a true vein, as in *Castnia*; this vein reappears in the hind wing.

Type *R. ochreosticta*.

Ræseliodes ochreosticta, sp. n.

Fore wing whitish grey, dusted and suffused with darker grey, especially throughout the basal and apical areas; first line very indistinct, blackish, running obliquely outward from the costa to middle of wing and then vanishing; the dull dark grey basal area contains a small bright yellow patch of scales shortly before its outer margin in the middle; second line denticulated, but only indicated by the darker points upon the veins; central area paler, containing an oblique dark dash over the discocellular; the second line is immediately followed by a similar pale line; submarginal area dark grey, showing a row of blackish dashes before the fringes, which are pale, with darker base. Hind wings dull whitish, with the veins and border fuscous. Head, thorax, and abdomen dark grey.

Expanse of wings 24 millim.

One male from Rio Janeiro.

Ræseliodes dissimilis, sp. n.

Fore wing pale pinkish grey, dusted with darker; the basal half ochreous or bone-colour, with the costa and veins dark brown; a linear black dash in the middle is conspicuous; first line nearly in centre of wing and irregularly vertical is indicated by dark partially erect scales and preceded on the costa by a blackish blotch; end of cell marked by fulvous

scales, and scales of the same colour are mixed with those of the first line towards the inner margin; second line black, runs obliquely outwards to the middle, then, more serrated, inwards, forming a slight angle externally before the anal angle; an indistinct fulvous submarginal shade in the dark grey subterminal area; fringes dark grey, with a bright pale basal line. Hind wings ochreous, tinged with fuscous, which increases towards the hind margin, where it forms a dark fuscous shade; fringe ochreous, chequered with darker spots. Head, face, palpi, thorax, and base of abdomen pure bone-coloured; abdomen dusted with cinereous, becoming entirely cinereous along the anal segments.

Expanse of wings 24 millim.

One female from Rio Janeiro.

SYNAPHE, Hüb.

(*Tretopteryx*, Rag.)

Synaphe pertusalis, Hüb., var. *vitrea*, Warr.

Differs from the type form (i.) in its much smaller size, 16 millim., and (ii.) in the greater breadth of the diaphanous fascia in both wings. In the fore wings half the cell before the dark cell-spot and the space immediately below it is also diaphanous, whereas in the type form the cell-spot shows as a dark projection from the outer edge of the dark basal two thirds. In the hind wings the dark basal patch is much reduced and the transparent fascia proportionally increased.

One male, one female, from Palestine, from Canon Tristram's collection.

LEPTOCTENISTA, gen. nov.

Fore wing with costa slightly convex throughout; apex rectangular, blunt; hind margin vertical for two thirds, then suddenly curved off: anal angle rounded. Hind wings ample; scaling coarse and dense; labial palpi obliquely ascending in front of face, laterally flattened; second joint large, wide, third short, from the middle of the top of second, rather porrected; maxillary palpi and ocelli invisible; tongue short; antennæ (male) bristly, thickened at the basal joint, pubescent beneath; each joint with a pair of fine pointed bristles. Head and face hairy.

Type *L. dubia*, Warr.

Leptoctenista dubia, sp. n.

Fore wings ochreous, mottled throughout with dark grey; first line blackish, obscurely dentate, followed on costa by a pale unsuffused oblique space, edged on the costa with darker; a large diffuse black cell-spot, the costa above it darker; second line obscurely dentate, followed by a dentate shade, which starts from the costa as a dark triangular patch; both the second line and this subterminal shade are finely edged with paler; a row of black wedge-shaped spots before the base of the fringes, which are brownish grey. Hind wings dirty fuscous, with the basal third greyish ochreous and a blackish cell-spot. Palpi, antennæ, collar, and basal segments of abdomen ochreous; head, thorax, and rest of abdomen mottled with dark grey. Underside pale ochreous, dusted with darker.

Expanse of wings 34 millim.

One male from Rio Janeiro.

STEMMATOPHORA, Guen.

Stemmatophora duplicata, sp. n.

Glæa duplicata, Walker, MS.

Fore wings dull reddish fuscous, dusted with fine black atoms; first line indistinctly darker, sinuous, at one third; second line at five sixths, nearly parallel to hind margin, denticulate, followed by a similarly dentate paler line; a faint dark central spot; costa dotted dark and light from centre to second line. Hind wings *pale ochreous*, dusted with reddish grey towards hind margin. Head, thorax, and antennæ reddish fuscous; abdomen ochreous. Underside pinkish, with the outer line paler in both wings; costa dotted along its whole length.

Expanse of wings 28 millim.

One female from Hindostan.

I can find no record of the publication of this species under Walker's manuscript name. It seems to be allied to *Stemmatophora denticulata*, Swinh., from Burmah.

Stemmatophora albilineata, sp. n.

Fore wings dun-coloured; the basal area brown-black, bounded by a vertical white line, which has a slight tooth externally below the median vein; second line also white, curved, approaching the first line opposite the tooth, and

there forming a corresponding white projection; the sinus filled internally with brown-black, which tint also prevails on the costa beyond it; a dark central spot; veins towards the hind margin paler, with black spots in the intervals; fringe concolorous. Hind wings whitish basewards, thickly dusted with fuscous along the inner margin, and with a denticulated, dark, pale-edged band at two thirds, beyond which the border is dark fuscous; fringe as in fore wing. Head, thorax, and abdomen ochreous, sprinkled with fuscous; palpi, anal segments of abdomen, and its sides brown-black; tufts of the legs in male the same; anal tuft of male reddish brown.

Expanse of wings 24 millim.

One male, one female, from Natal.

[To be continued.]

XLVI.—*On the Shoulder-girdle in Cretaceous Ornithosauria.*

By Professor H. G. SEELEY, F.R.S., &c., King's College, London.

IN 1882* Professor Marsh published the remarkable discovery that the American Cretaceous Ornithosaurs are characterized by the anchylosis of the anterior thoracic vertebræ into a structure resembling a sacrum, to which the scapulæ are said to articulate. No figure has been given of this singular condition of the shoulder-girdle. But it appears to me probable that the character is common to all the Cretaceous Ornithocheiroidea, and is a distinctive condition of that ordinal group.

Sir Richard Owen in 1859 published in the 'Transactions of the Palæontographical Society,' pl. iv. figs. 6, 7, 8, figures of a symmetrical bone from the Cambridge Greensand which was interpreted as probably frontal. The discovery of a more perfect specimen did not elucidate its nature; and in the 'Ornithosauria,' 8vo, 1870, p. 88, I placed over my account of it the twofold description "? Neural Arch of Sacral Vertebra, ? Vomer," remarking that there is no proof that it is a skull-bone, but that if from the skull it might have been the vomer. This specimen I drew in pl. xii. figs. 15, 16. I go on to remark that "A specimen collected by the Rev. T. G. Bonney is preserved on the sacral side of a left os innominatum with the keel downward. It appears to show a sutural

* "Wings of Pterodactyles," Am. Journ. Sci., April 1882, p. 254.

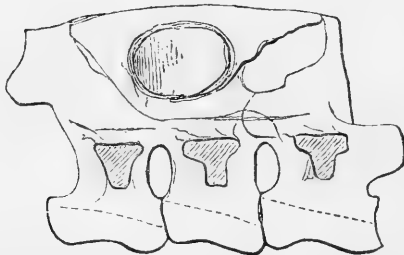
surface from which an anterior part has come away. And if this specimen is compared with the neural arch of the sacral vertebra (pl. x. figs. 8, 9) it will be found to correspond entirely." The vertebra referred to is singular in the circumstance that the transverse process has a higher position relatively to the neural canal than is usual, the infra-neural articulation preserves the concavo-convex articulations, while the neural spine shows a vertical suture with the arch next it. The neural spine of this vertebra is not absolutely the same in character with the bones already referred to. It is a remarkably thick wedge, forming more than half the height of the vertebra. Its sides are smooth, vertical, and flattened, with a defining ridge above the transverse neural platform. I believe this vertebra to be one of three which I suppose to have been ankylosed by their neural arches in *Ornithocheirus*, to form the articulation for what is usually the free extremity of the scapula. And it follows that the other specimens to which I have referred are portions of separated neural arches of this structure, in which three consecutive neural spines are blended together.

This difference of condition from an ordinary pelvic sacrum is exactly what might have been anticipated, for the ordinary transverse processes evidently carried costal ribs, though they are not shown in English specimens of dorsal vertebræ of *Ornithocheirus*, and therefore the mechanical stimulus to ossification was necessarily absent from the infra-neural parts of the vertebræ, which in the pelvic sacrum has blended the vertebræ together. All these bones are in the Woodwardian Museum of the University of Cambridge.

If the interpretation of them which I offer is legitimate, it is probable that the portion of the neural arch which is impressed with the vertical, parallel, transversely ovate facets, concave from front to back, for the scapular articulation, is a distinct ossification imbedded in the neurapophyses, comparable to the neural spines of lower Vertebrates, which have not usually a separate existence in the Ornithosaurian skeleton. It has every appearance of being a separate bone, but it is manifest that the evidence of its relation to the vertebræ is imperfect. I have published figures of all the materials, and offer a restoration of the scapular ossification on which I have drawn the outline of the most complete supra-neural bone which has been found separate (fig. 1). My reason for including three vertebræ is based upon a comparison of my figures in the 'Ornithosauria,' pl. x. figs. 8, 9, and pl. xii. fig. 17, with pl. xii. figs. 15, 16, and the figure of 1859 already quoted in Owen's

Palæontographical Monograph. This seems to indicate that two vertical sutures must have divided a mass like that outlined on the restoration. I have no knowledge whether

Fig. 1.

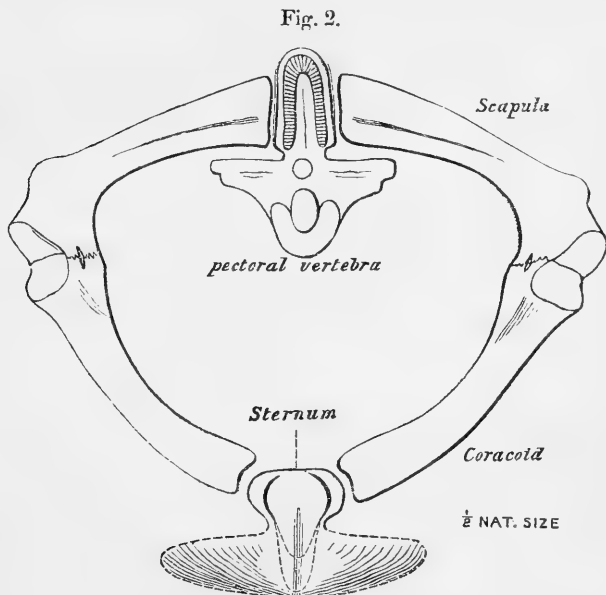


Restoration of Pectoral Vertebrae, showing Supra-neural Ossification with Ovate Articulation.

this condition is paralleled by American specimens, for Prof. Marsh (*Am. Journ. Sci.*, April 1882) only mentions the anchylosis of several vertebrae in the pectoral region. A similar condition is well known to characterize many birds, and Professor Owen instances (*'Anatomy of Vertebrates,'* vol. ii. p. 16) the Flamingo and the Sparrow-Hawk as having the second to the fifth dorsal vertebrae consolidated into one piece. But no bird has the scapula articulating with the neural arch.

I have figured the scapula in *Ornithocheirus* and some allied genera (*'Ornithosauria,'* pl. i. figs. 2-12, and *'Geological Magazine,'* Jan. 1881, pl. i. fig. 1). It is a short stout bone which widens and thickens to what is usually the free end, where it terminates in a broad, ovate, truncate, flattened surface, which is smooth, vertically flat, and a little convex in length. This extremity, which has every character of an articular surface, exactly corresponds in form and size with the impressions on the sides of the bone which I regard as part of the neural arches of pectoral vertebrae. The conclusion therefore seems to follow that the scapulae extended transversely outward, curving a little downward from the neural spine which divided their extremities from each other. Though this condition is dissimilar to anything seen among birds, the scapulae approximate dorsally in some mammals, as do the supra-scapulae among lizards and amphibians. Since the scapula and coracoid are anchylosed together in most species of *Ornithocheiroidea*, an arch is thus made between the vertebra and the sternum, which is almost as firm as the arch

of the pelvis, which no other fossil group of animals parallels. I accordingly make a restoration of this structure of the shoulder-girdle (fig. 2).



Restoration of the Shoulder-girdle in *Ornithocheirus*.
Posterior aspect.

The only hypothetical element is the posterior transverse expansion of the sternum, which is never preserved in Cambridge-Greensand specimens. I have also completed the transverse processes of the vertebra; but no specimen shows the form of the articulation for the rib or the length of the process. In some species the coracoids may have been relatively longer; but I believe this form of shoulder-girdle is substantially the same in all the Cretaceous group. It will be interesting if a similar structure is found in the American species.

I have long been aware of a very close affinity between these fossils from Cretaceous Rocks of England and America. The publication by Professor Marsh (*Am. Journ. Sci.*, May 1884) of figures of the skull of *Pteranodon* made that affinity more manifest. Sir Richard Owen figured in the '*Palæontographical Monograph of Cretaceous Pterosauria*,' pl. iv. figs. 4, 5, a fragment described as part of the proximal

end of the metacarpal of the fifth or wing-finger. I regarded this fossil as part of the premaxillary of a toothless Pterodactyle, and in the *Ann. & Mag. Nat. Hist.* for January 1871, p. 35, remarked:—"A new genus appears to be constituted by some (three) portions of jaws from the Cambridge Greensand. Unfortunately, the extremity is not preserved. They have the ordinary dagger-shaped snout, but appear to be entirely destitute of teeth. I provisionally name the genus *Ornithostoma*." It was only after this publication that anything was heard of Pterodactyls in America, and not till 1876 that the toothless character of their jaws was known and the name *Pteranodon* proposed.

Professor Marsh's material is evidently incomparably superior to that which was before me; but there is, so far as I can discern, no evidence of generic difference between *Ornithostoma* and *Pteranodon*. If any one will turn to the figure of my type (*Pal. Soc.* 1859, pl. iv. figs. 4, 5) already quoted, and compare either the lateral aspect, fig. 4, or the palate, fig. 5 (from which the matrix there shown is now removed), with Prof. Marsh's figures reproduced in the '*Geological Magazine*,' August 1884, p. 347, the only difference found will be that the American toothless Ornithosaur is twice the size of that from the Cambridge Greensand. There is perfect correspondence between them in the dagger-shaped form of the jaw, in the relation between the height of the jaw and the breadth of the palate, in the flattened sides of the snout and their convergence superiorly into a rounded ridge, in the thin rounded margin to the jaw which represents the alveolar border, and in the smooth palate formed by a single wide concave channel. No palæontologist will fail to appreciate the significance of these absolute coincidences of structure; and, so far as they go, they seem to me to indicate that *Pteranodon* is a synonym of *Ornithostoma*. I record the British species as *O. Sedgwicki*.

There is some other evidence which points towards the same conclusion. In the '*Ornithosauria*' I figured the quadrate bone and quadrato-jugal of *Ornithocheirus* (pl. xi. figs. 13, 14, &c.). The form of the quadrato-jugal was then unparalleled; but Prof. Marsh's figures show substantially the same type (*loc. cit.*) in the American toothless Ornithosaur.

Further, Professor Marsh figures an extraordinary development of the occipital crest in this type, and the *Ornithocheirus* of the Cambridge Greensand gives evidence of a crest having been worn away. Mr. J. F. Walker's specimen of natural mould of the Ornithosaurian brain

('Ornithosauria,' pl. xi. figs. 10-12, and Journ. Linn. Soc. vol. xiii. pl. xi.) was only laid bare after I had removed a great thickness of open cellular investing bony tissue from above it. The skull figured pl. xi. figs. 1, 2 of the 'Ornithosauria' shows traces of an eroded crest above the foramen magnum, and superiorly the external tissue of the parietal region is worn away; but there is nothing to show how much has been worn away. When, however, the form of the receding neural arches of the atlas and axis is compared with the back of the skull, the vertebræ slope backward as though an occipital crest extended backward from the skull; but it may not have been so much developed as the nuchal bone in the Cormorant.

In my theoretical restoration of the skull of *Ornithocheirus*, given in the Ann. & Mag. Nat. Hist., January 1871, pl. iii. fig. 3, there is no antorbital vacuity in the skull, and this condition was found to characterize the American toothless Ornithosaurs when Prof. Marsh figured the complete skull in 1884.

There is therefore, as it seems to me, a close correspondence between the skulls of the American edentulous Cretaceous Ornithosaurs from Kansas, and the dentigerous genera from the Upper Greensand and other Cretaceous rocks of Europe in all points which can be compared; and this I take as evidence that they are closely allied and belong to the same ordinal group. Mr. E. T. Newton (Proc. Geol. Assoc. vol. x. no. 8, p. 421) places *Pteranodon* and *Nyctodactylus* in Prof. Marsh's Pteranodontia, while *Ornithocheirus* and *Ornithostoma* are placed in a division of the Pterosauria. But if *Pteranodon* is *Ornithostoma*, and if the skull of *Ornithocheirus* is in essential points on the same plan as in the American genus, I fail to see how Mr. Newton's grouping can be sustained.

There is another point of identity between the American and English types in the structure of the carpus. It was no easy matter to determine the mutual relations of these bones in Cambridge specimens, for the structure was unlike anything previously known. They were described and figured in the 'Ornithosauria,' their relations to each other were first figured in the Ann. & Mag. Nat. Hist., August 1870, in "Remarks on *Dimorphodon*," and some further details were supplied in the Linnean Society's Journal, December 1876, pl. xi. The carpus consists of a proximal carpal, a distal carpal, and a lateral carpal, formed as in birds. It was this evidence of the structure of the hand which led me in 1869 to form the genus *Ornithocheirus* for animals which had previously been referred to the genus *Pterodactylus*. Professor Marsh finds

the carpus to have the same structure in the toothless Ornithosaurs from Kansas, and discussed it fully in April 1882 (*Am. Journ. Sci.*), though without mentioning memoirs in which the structure had been figured, and from which the interpretation appears to be taken.

If, then, the resemblances in the bones which led Professor Cope to refer the early discoveries of American Ornithosaurs to *Ornithocheirus* have to be transferred to *Ornithostoma*, it does not affect the organic identity of the type; and it is by means of the excellent contributions to knowledge made by Professor Marsh that I am able to establish the conclusion that the dentigerous and edentulous Ornithosaurs of the Cretaceous rocks of Europe and America belong to the same subordinal group. I long ago pointed out (*Ann. & Mag. Nat. Hist.*, August 1870) how small is the classificational importance to be attached to presence or absence of teeth in Ornithosaurs and in Birds; and while the discovery of *Ichthyornis* by Prof. Marsh demonstrated that generalization among birds, the discovery of these Ornithosaurs, which mainly differ in their teeth, while they agree in the typical parts of the skeleton, gives it a parallel justification among the Ornithosauria. Whether the name Pteranodontidæ can be retained for a family to include the genus *Ornithostoma* remains to be established; for it is not improbable that animals will be found in which there is a partial development of teeth, and that Ornithosauria will eventually parallel Cetacea in the development and suppression of dentition.

I have used the name Ornithocheiroidea for the order (*Journ. Linn. Soc.* vol. xiii. p. 96), and that name may be found convenient as indicative of characters of skull, shoulder-girdle, carpus, vertebræ, and other bones in which the Cretaceous modification of the group differs from the Pterodactylia, which is chiefly characteristic of the Middle Secondary rocks, though I believe not absolutely limited to them.

Professor Zittel ('*Handbuch der Palæontologie*') has referred to my early proposal to name the fossil flying animals Saurornia (*Rep. Brit. Assoc.*, Bath, October 1864, Sections, p. 69, and *Ann. & Mag. Nat. Hist.*, February 1865). The new facts then brought forward necessitated a new name for the subclass. When I afterwards found that Prince C. L. Bonaparte, adopting von Meyer's view that the group formed an order, proposed to name the order Ornithosaurii in 1838, I adopted the name Ornithosauria, though it seemed a less suitable name, and was originally given to only one division of the animals comprised in Saurornia.

De Blainville had suggested Pterodactylia and J. J.

Kaup had used *Pterosaurii* previously for the genus *Pterodactylus*, not for the group as now known*. The merit of recognizing that order clearly rests with von Meyer, and the suggestion of a name for it cannot be important unless the name is suitable. Recognition of avian affinities in the bones of *Pterodactyles* in 1864 proved the starting-point of work among fossil reptiles which ended in the recognition of similar avian characters in portions of skeletons of other orders previously regarded as entirely reptilian. And on that account the name *Ornithosauria* is convenient, as expressing a new and truer point of view.

The *Pterosauria* of Owen and Zittel is not the *Pterosaurii* of J. J. Kaup any more than the *Ornithosauria* of 1869 is the *Ornithosaurii* of Fitzinger and Bonaparte; but while the former name appears to me to perpetuate a fundamental error, the latter is based on important truths of organic and osteological structure, which are becoming generally recognized. I proposed (*Journ. Linn. Soc.*, Dec. 1876) to limit de Blainville's *Pterodactylia* to the Jurassic *Pterodactyles* as an order comparable to the *Ornithocheiroidea*. And if the name *Pterosauria* were retained, it could only be as a substitute for *Pterodactylia*, indicating the short-tailed animals with long hind limbs, of which *Pterodactylus* is the type. And in any case the name must be limited to the group for which it was originally proposed, as in the classification given in the *Ann. & Mag. Nat. Hist.* for March 1891.

XLVII.—Notes on the *Trionychian Genus Pelochelys*.

By G. BAUR.

DR. ALEXANDER STRAUCH † has lately described a new species of *Pelochelys* from Futschau (China) under the name *P. Poljakowii*. This species, which is doubtless distinct from the type of *Pelochelys Cantoris*, Gray, is characterized by its broad interorbital portion, which is equal to the postorbital arch.

According to Boulenger the forms of *Pelochelys* from the Philippines are identical with those of the continent (*P. Cantoris*). I have lately examined, through the kindness of

* *Ann. & Mag. Nat. Hist.*, August 1870.

† Strauch, Dr. Alexander, "Bemerkungen über die Schildkröten-sammlung im zoologischen Museum der kaiserl. Akad. d. Wiss. St. Petersburg," *St. Pétersbourg*, 1890, *Mém. Acad. Imp. Sc.* 7^e série, tome xxxviii. no. 2, pp. 118-120, pl. iv. ff. 1-3.

Prof. Angelo Heilprin, a skull of *Pelochelys* from the Philippines preserved in the Philadelphia Academy. This skull is totally different from the skull of *Pelochelys Cantoris*, Gray; it resembles more that of *P. Poljakowii*, but it is also different from this.

The skull in the Philadelphia Academy, no. 111 (W. W. Wood), has the interorbital space larger than the diameter of the orbit, the postorbital arch larger than the interorbital, and the proboscis elongated as in *P. Poljakowii*. In general shape it is nearest to the latter species, but it differs from it by its broader postorbital arch and its parietals, which are not so much expanded mesially.

The following table gives the measurements of the type of *Pelochelys Bibronii*, Owen, in the Royal College of Surgeons, London, kindly sent to me by Prof. Stewart, of *P. Poljakowii*, Strauch, taken from the figures, and of the Philadelphia specimen.

	<i>P. Bibronii</i> , Owen. millim.	<i>P. Poljakowii</i> , Strauch. millim.	<i>P. spec.</i> (Philippines). millim.
Preorbital arch (from nasal opening to orbit)	7.5	9	10.5
Interorbital arch	11	14.5	16
Postorbital arch	14	14.5	17.5
Horizontal diam. of orbit. .	?*	12	12.5

The locality of the type of *Pelochelys Bibronii*, Owen, is not known; the type of *Pelochelys Cantoris*, Gray, is from Penang. According to Boulenger *P. Bibronii* and *P. Cantoris* are identical; but according to him also the forms from the Philippines, which had been described as *P. Cumingii*, are not different. That the Philippines contain a species of *Pelochelys* different from the *P. Cantoris* there can be no doubt; the only question now is whether the specimens in the British Museum from the Philippines agree with the specimen in the Philadelphia Academy. In this case the name *P. Cumingii* has to be applied for this species. *Pelochelys* occurs also in Borneo; and it would be interesting to know whether this genus is represented by a peculiar species on this island, or with which of the other forms it is identical.

Clark Univ., Worcester, Mass.,
March 30, 1891.

* It appears from the figures published of *P. Cantoris* that the interorbital space is smaller than the horizontal diameter of the orbit.

XLVIII.—*The Genera Cyclostoma and Pomatias, and on a misapplied rule of Zoological Nomenclature.* By the Rev. Canon A. M. NORMAN.

ALARMED, on reading Mr. R. B. Newton's paper in last month's 'Annals,' at the prospect of having to give up the titles of the above genera, so long familiar to me, and at that of having to change the names of about one hundred and twenty "species" in my collection, I at once was led to look into the matter in order to discover how it was that conchologists for the last ninety years had been ignorant of what they were about.

The result is* that it seems clear that Mr. Newton has misapprehended the facts, and that no need exists for changing the names *Cyclostoma* and *Pomatias* as now in use.

The year 1799 is not the same as 1891, and our ideas of genera are very different from those then in vogue. In the last century genera were very few, now we are groaning under the weight of far too many. Has not Mr. Newton fallen into the mistake of supposing that Lamarck formed three genera named *Cyclostoma*, whereas he only formed one, but employed that name with different applications? Again, Draparnaud established no new genus; he simply excluded the marine shells which fell under the characters of Lamarck's *Cyclostoma* (which genus, as first defined by Lamarck, was designed to include every genus to which Mr. Newton refers in his paper), and restricted its use to the round and entire-mouthed land and freshwater species.

Lamarck himself and his editor Deshayes shall testify to facts out of the last edition of Lamarck, which I am led to suppose Mr. Newton did not consult. It must be borne in mind that in this and the previous edition species of *Cyclostoma*, Lamarck, 1799, are distributed in the three genera *Scalaria*, *Delphinula*, and *Cyclostoma*.

Under *Scalaria* Lamarck writes:—"Les Scalaires, qu'on nomme aussi vulgairement Scalata, sont des coquillages marins très distingués des Cyclostomes, non-seulement par la habitation, et leur forme subterrículée &c."

Under *Delphinula* he writes:—"Ces coquilles se rapprochent évidemment des Scalaires par leurs rapports. . . . Ces coquilles marines sont fort différentes, par leur épaisseur, leur solidité, l'état de leur surface externe, des coquilles terrestres que nous nommons Cyclostomes, quoique, de part

* Though I have not the opportunity of referring to the earlier, but only to the last two editions of Lamarck.

et d'autre, les bords de l'ouverture soient réunis circulairement."

Thus, though Lamarck had at this time separated these genera, he still saw fancied alliances, and therefore points out differences.

Upon the whole matter Deshayes, in his observations under *Delphinula*, writes:—"Lamarck rassemblait en un seul genre, sous le nom de Cyclostome, tous les coquilles à ouvertures ronde et entière. Depuis, Draparnaud réduisit aux seules espèces terrestres* le genre Cyclostome de Lamarck; et ce savant zoologiste dans ses mémoires sur les fossiles des environs de Paris, adoptant l'opinion de Draparnaud, proposa le genre Delphinule pour les espèces marines de son ancien genre Cyclostome."

Next we come to the history of *Pomatias*. Hartmann, wishing to divide the genus *Cyclostoma*—as understood in 1821—and at the same time not wishing to change that well-established name, very wisely employed the genus *Pomatias*, R. Studer, for the section which he desired to separate and to name. He was perfectly justified in doing this, because Studer had included in his *Pomatias* two species, "*P. elegans*" and "*P. variegatus*, a new species;" to this second species therefore and its allies Hartmann restricted the name *Pomatias* †; and the genus is by most authors properly referred to Studer and not to Hartmann.

But to pass from a particular to a general subject, I especially desire to call attention to a rule of nomenclature only too often altogether overlooked or most wrongly applied. Rule 10 of the British Association "Rules of Zoological Nomenclature" runs thus:—

"§. A name should be changed which has before been proposed for some other genus in zoology or botany, or for some other species in the same genus, *when still retained for such genus or species.*"

The part of the rule which I wish to emphasize is contained in the words which I have italicized. The object of the rule is that the same name should *not be in use* for two genera at the same time. It follows that if an earlier name is obsolete, say *Cyclostoma*, a subsequently described genus bearing the same name may be employed.

* By "terrestres" Deshayes means non-marine, for Draparnaud included the freshwater operculated univalves now referred to *Bythinia*, *Paludina*, &c. under his *Cyclostoma*.

† Westerlund, in his 'Fauna der in der paläarktischen Region lebenden Binnenconchylien,' makes *Pomatias variegatus*, Studer, a synonym of *Pomatias septemspiralis*, Razoumovsky (1789), as previous writers had done.

To apply this : granted, for the sake of argument, that all which Mr. Newton has written is correct, still *Cyclostoma* is the title of this very genus, because if the genus *Cyclostoma*, Lamarck, is inadmissible, his genus being blotted out, the next title given to the genus must be adopted, and that is *Cyclostoma*, Draparnaud; so that we should simply have *Cyclostoma*, Draparnaud, instead of *Cyclostoma*, Lamarck—and indeed most authors write *Cyclostoma*, Drap.

It is desirable to give another and fuller instance illustrative of the application of Rule 10, and I hope I may be excused if that taken has reference to the genera named after myself, inasmuch as these genera happen to furnish the fullest example of the right and wrong applications of the rule—three right and one wrong—which at this moment occurs to my mind.

There have been three genera, thus :—

1. *Normania*, G. S. Brady (Crustacea Ostracoda), 1865.
2. *Normania*, Bowerbank (Spongiada), 1868.
3. *Normania*, A. Boeck (Crustacea Amphipoda), 1870.

1. Brady's genus was obsolete at the time of its publication, Prof. G. O. Sars having just before given the same form another name.

2. When Bowerbank described his genus *Normania*—which dates from 1868 ("Last Report Shetland Dredging," Brit. Assoc. Rep. 1868, p. 328), and not from 1874, the date of Bowerbank's Brit. Spongiadæ, vol. iii. p. 258, as a reference to that work would lead the reader to suppose—he stated as follows :—"A genus *Normania* was established by Mr. G. S. Brady in 1866 for a section of *Crustacea Copepoda** (*vide* Trans. Zool. Soc. vol. v. p. 382), but that title cannot be adopted, as the *Normania* of Brady is identical with *Loxiconcha* of G. O. Sars, which was founded a few months previously (*vide* G. O. Sars, 'Oversigt af Norges Marine Ostracoder,' 1865, p. 61, and G. S. Brady, Trans. Linn. Soc. vol. xxvi. 1868, p. 432)." But Professor Sollas, in his "Report on the Tetractinellida of the 'Challenger,'" 1889, after expressing his regret at being obliged to reject the name *Normania*, Bowerbank, and substituting for it *Pæcillastra*, n. n., writes :—"True, Bowerbank remarks that Brady's genus *Normania*, which has precedence, cannot stand; but this makes no difference, since according to convention, a discarded name which has ceased to be used for one species,

* "*Crustacea Copepoda*" is a mistake for "*Crustacea Ostracoda*." There is a genus in the former, *Normanella*, G. S. Brady, but that is a different name and dates only from 1880.

or genus, cannot be applied to another, otherwise the door would be opened to confusion." Now here Prof. Sollas has laid down a rule of his own nowhere else to be found. Bowerbank affords a right and Sollas an erroneous interpretation of Rule 10; and I notice that Schulze and Lendenfeld, in a later paper, have recognized this and again restored Bowerbank's name*.

3. *Normania*, Boeck, is in use, having been just again employed by Prof. G. O. Sars in his beautiful new work on the Crustacea Amphipoda of Norway. That name must be changed. There is little doubt that Sars fell into the error of retaining it from referring to Bowerbank only or to "Scudder," who erroneously gives the date of *Normania*, Bow., as 1875 instead of 1868; and had the former date been correct, Boeck's genus would have had precedence of Bowerbank's, but not of Brady's. This last, however, Sars knew to be only a synonym of his own genus *Loxoconcha*.

Thus we see that Bowerbank, Schulze and Lendenfeld, and G. O. Sars rightly apply, and that Sollas wrongly applies the rule.

I will not cite the very many instances in which well-established generic names have been of late wrongly, for a time at least, supplanted, and useless generic names thus added to our nomenclature. The fact is that 'Scudder's Nomenclator,' instead of being of service to science, is in this way frequently used to its detriment. Authors consult it to see if a generic name has been previously used. If it has been, many of them at once proceed to coin for the second or later use a new generic title or supplant it by some other; whereas the later employment of the generic name ought to have been retained if the earlier is not in use.

Inquiry should always be made as to whether the name applied in previous instance or instances is *in use* before the later name is changed.

One word more. I have been surprised to find that many of the younger naturalists are totally ignorant of the very existence of the Association Rules. For the information of those who may need it I may therefore state that they are to be found in the British Association Reports of 1842, and as last revised in the Report of 1865 (1866); and separate copies of the Rules can be procured at the offices of the Association, 25 Albemarle Street. At least I believe that this is the case. At the Newcastle-upon-Tyne meeting in 1889, at the request of several young zoologists, as Vice-President of

* F. E. Schulze and R. von Lendenfeld, 'Ueber die Bezeichnung der Spongiennadeln,' 1889, p. 31.

Section D, I brought the question before the Committee, and it was thought desirable that the Rules should be reprinted, and a committee for the purpose was appointed; but I was subsequently informed that copies still remained for sale. If applicants should fail to obtain them, and in that case think it well to put themselves into communication with me, I will take care that the matter shall be again brought forward in Section D.

I have taken this opportunity as an addendum to my notes on Mr. Newton's communication to carry out an intention of some standing to direct the attention of zoologists to what is undoubtedly a common misapplication of a rule of nomenclature.

With respect to the word Botany in Rule 10 the attempt has long been given up to exclude the use of a botanical generic name from Zoology, or *vice versâ*, and the introductory notes of the revised edition of the Rules (1865) intimate this. This may be illustrated by a genus referred to in my notes in last month's (April) 'Annals.' The genus *Linckia*, Nardo, was rejected by Forbes because of previous use in botany. Under altered views in this matter it is now in use for another section of the original genus of Nardo than that to which Forbes applied the name *Cribrella*.

XLIX.—*Descriptions of three new Species of Helix from New Guinea.* By EDGAR A. SMITH.

1. *Helix (Papua) hero*.

Testa rimata, depresso trochiformis, tenuicula, in medio acute carinata, albida, superne lineis obliquis opacis lutescentibus subfulguratis, interdumque aliis fuscis ornata, infra zonis concentricis paucis fuscis et opaco-lutescentibus cineta: anfractus $4\frac{1}{2}$, supremi convexiusculi, strii spiralibus confertis, lineisque incrementi obliquis sculpti, ultimus minus convexus, similiter striatus, sed antice minute rugosus, breviter descendens, pone medium labri leviter depressus, ad peripheriam acute luteo carinatus, inferne radiatim et concentrice subrugose striatus; apertura perobliqua, subnasuta, intus colores externos aliquanto obscuros exhibens; peristoma album vel superne pallide lilaceum, margine superiore leviter reflexo, in medio depresso, inferiore latius expanso, albo, supra umbilicum dilatato, rimam fere obtegente.

Diam. maj. 28 millim., min. 22; alt. $16\frac{1}{2}$.

Var. Testa pallida, radiis zonisque fuscis haud ornata.

The apical whorls of this very pretty species and the region

around the umbilicus are opalescent white and devoid of the oblique markings and bands. In the type the upper terminations of the brownish, oblique, irregular stripes on the body-whorl are almost of a reddish tint, and form as it were a series of spots at the suture. The variety is of a uniform opalescent or greenish-white colour, variegated above with the radiating, somewhat zigzag, opaque, deep cream-coloured markings, which on the lower surface assume the form of zones and irregular spots or blotches. In form this species bears some resemblance to *H. Tayloriana* (Adams & Reeve).

2. *Helix (Papua) ianthe*.

Testa depresso trochiformis, anguste rimata, ad peripheriam acute carinata, omnino alba, striis incrementi obliquis tenuibus sculpta; anfractus 4, superiores convexiusculi, ultimus supra et infra carinam leviter concavus, antice haud descendens; apertura oblique subquadrata, ad carinam acuminata; peristoma superne leviter reflexum, inferne latius expansum, margine columellari late dilatato, umbilicum fere obtegente; spira breviter conica, ad apicem obtusa.

Diam. maj. $25\frac{1}{2}$ millim., min. 21; alt. $13\frac{1}{2}$.

In form this species is very like *H. hero*, but more obtuse at the apex, and the aperture is not quite so acuminate. It differs also from that species in the absence of colour-markings and spiral striæ. The last whorl also is a trifle narrower and does not descend in front.

3. *Helix (Papua) aerope*.

Testa sublata umbilicata, depresso trochiformis, ad peripheriam obtuse angulata, pallide vel albido-fuscescens, circa medium zona angusta rufa cincta; anfractus 5, convexiusculi, sublente accrescentes, lincis incrementi tenuibus oblique striati, ultimus postice carinatus, carina versus aperturam sensim evanescente, supra et infra æqualiter convexus, antice breviter descendens, circa medium minute rugosus; apertura transversa, lunata, intus albida vel dilute lilacea; peristoma album, dilatatum et reflexum, margine columellari late expanso.

Diam. maj. $23\frac{1}{2}$ millim., min. $19\frac{1}{2}$; alt. 15.

This species somewhat resembles *H. aurora*, Pfr. (Novitat. Conch. vol. ii. pl. liv. figs. 9-11), in form, but is a trifle higher in proportion to the diameter. It also differs in being a smaller form and in having a larger umbilicus. The young of this species is evidently sharply keeled at the middle, but in the adult shell the keel gradually disappears towards the aperture.

LI.—*Descriptions of new Species of the Coleopterous Genus Oïdes* (Galerucidæ). By C. J. GAHAN, M.A., British Museum (Natural History).

IN the course of arranging the species of *Oïdes* in the British Museum collection, some apparently new forms have come under my notice. These are described in the present paper. One of them (*O. assimilis*) is exceptional with regard to the characters of the epipleura of the elytra.

Chapuis, in his characterization of the genus, has not mentioned any sexual differences. I have noticed that in the male the last ventral abdominal segment is emarginate or notched on each side at the apex, and that the median lobe thus cut off is usually bent inwards (or upwards). In the female the apical margin of the last ventral segment is generally entire, but is sometimes feebly emarginate or sinuate in the middle.

Oïdes bivittata, sp. n.

Ovata, testaceo-flava; capite supra longitudinaliter lineatim impresso, inter oculos transversim impresso; prothorace quam longiori plus duplo latiori, sat dense punctulato, disco antice transversim depresso; elytris dense tenuiter punctulatis, singulis vitta lata submarginali piceo-nigra, basi et apice angustiore; antennis subgracilibus, articulis tribus vel quatuor basalibus flavis, ceteris fuscis, articulo tertio quarto æquali.

Long. 8–9½ mm.

Hab. Celebes? (*Baly Coll.*), Aru Islands (*Wallace*).

This species is nearly allied to *O. Clarkii*, Jac. It may be distinguished from the latter by the absence of a dark sutural band from the elytra and by its having a single vitta on each side. In those specimens of *Clarkii* that I have seen the third joint of the antennæ is rather shorter than the fourth; in the present species the third joint is quite equal in length to the fourth. The species has a superficial resemblance to *O. linteata*, Blanch., to which it was referred by Mr. Baly. It may be very easily distinguished from that species by its much slenderer antennæ.

Oïdes quadrivittata, sp. n.

Breviter ovata, flava; antennis (basi excepta) fuscis; elytris singulis vittis duabus nigris—una submarginali, altera prope suturam apicem non attingente; metasterno piceo; prothorace quam lon-

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giori plus duplo latiori, sparsim obsoleteque punctulato, antice leviter transversim depresso; elytris tenuiter punctulatis. Long. 7-7½ mm.

Hab. Malay Archipelago: Kaiva, Gilolo (*Wallace*).

Head with a fine longitudinal, median, impressed line above, with a transverse impression between the eyes. Antennæ rather slender, with the first three or four joints yellowish, the remaining joints dark brown. Prothorax more than twice as broad as long, obsolete punctulate, anterior part of disk slightly transversely depressed. Scutellum yellow. Elytra very finely and not very thickly punctulate, each with two longitudinal black bands, of which one, submarginal, extends from the base to the apex without quite reaching to the suture behind; the other, close to and parallel to the suture, stops short behind without joining the submarginal vitta. Legs and underside of body yellowish. Metasternum piceous.

This species may be placed near *O. Clarkii*, Jac., with which it agrees in the structure of its head, thorax, and antennæ. It differs from that species by its shorter form and by the position of the inner dark bands on the elytra, as well as by the absence of a dark sutural band.

Oïdes tarsalis, sp. n.

Capite prothoraceque atro-cyaneis, nitidis; illo supra longitudinaliter sulcato; hoc obsolete punctulato, quam longiori minus duplo latiori; scutello triangulari, nigro, nitido, postice acuto; elytris dense punctatis, opacis, viridibus, margine externa angustim violaceis, epipleuris brevibus, concavis, marginem externam approximatis; corpore subtus, pedibus antennisque nigris, his articulis a tertio ad decimum subæqualibus.

Long. 12 mm.

Hab. Mombas?

Head and prothorax bluish black, glossy, obsolete punctulate. Head with a longitudinal median impressed line or groove above. Pronotum less than twice as broad as its median length, its sides slightly diverging from the base to the anterior third, thence converging; the anterior angles projecting and somewhat obtuse. Elytra thickly but not strongly punctured, dull dark green, with the outer margins tinted with violet; epipleura short and concave, close to the outer edge of the elytra. Body underneath, legs, and antennæ black, the latter rather longer than half the body, with the joints from the third to the tenth subequal. First

joint of all the tarsi as long as the two succeeding joints taken together.

The single male specimen, from the late Mr. Baly's collection, is ticketed "Momeba." As there appears to be no such locality, I can only conjecture that Mombas is the place meant. I have little doubt that the species is an African one. It agrees with *O. costata*, Baly, in the rather elongated and dilated first joint of the tarsus, although in many other respects it is very distinct from that species.

Oïdes assimilis, sp. n.

Ferruginea vel lurido-testacea; antennis (articulis tribus basalibus exceptis), palpis pedibusque et corpore subtus fusco-nigris; prothorace opaco, sparsim punctulato, quam longiori duplo latiori; elytris subopacis, dense punctatis, epipleuris concavis, fere ad apicem extensis, ab margine externa haud distantibus.

Long. 13-17 mm.

Hab. Old Calabar.

Reddish brown or dull testaceous, with the antennæ (the first three joints excepted), the palpi, the legs, and the under-side of the body brownish black. Head with a very faint median longitudinal impressed line above, and with a transverse impression between the eyes. Antennæ about half as long as the body in the male, somewhat shorter in the female, with the fourth joint slightly longer than the third or any of the joints which succeed it. Pronotum dull, sparsely punctulate, about twice as broad as its length in the middle, its basal margin slightly convex, its anterior margin strongly enough concave, its sides somewhat rounded. Elytra thickly and rather feebly punctured, their epipleura concave, extending almost to the apex, placed close to the margin, scarcely perceptibly widened just opposite the middle of the metathoracic episterna.

This species is somewhat larger and more elongated than *O. ferruginea*, Fabr. It differs further from this species by the closer punctuation of its elytra, by the greater approximation of the external margin to the epipleura of the elytra, and by the greater relative length of the fourth joint of the antennæ. In *ferruginea* the third joint of the antennæ is perceptibly longer than the fourth or any of the succeeding joints, and the epipleura of the elytra, while being relatively almost as long as in the present species, are much further back from the external margin. In both species a very faint mark, darker than the ground-colour and resembling a broad **M**, may be noticed on the pronotum.

Oïdes humeralis, sp. n.

Rufo-ferruginea, antennis, palpis, pedibus, metasterno et medio abdominis nigris; prothorace quam longiori duplo latiori, sparsim et minute punctulato; elytris dense punctatis, humeris tuberculi-formis, epipleuris concavis, pone medium evanescentibus, ab margine externa haud distantibus.

Long. 14 mm.

Hab. West Africa, Cameroons.

Ferruginous red; with the antennæ, palpi, legs, metasternum, and all but the sides and apex of the abdomen black. Head with a lozenge-shaped depression between the eyes and with a very fine median, longitudinal, impressed line behind. Pronotum about twice as broad as its median length, feebly and sparsely punctulate, its anterior margin strongly concave, its posterior slightly convex; its sides somewhat rounded, gradually diverging from the base to about the anterior third, thence converging; its anterior angles somewhat acute. Scutellum smooth, glossy, rounded behind. Elytra thickly punctured, with an oblique groove or depression just above each shoulder, and giving to these the appearance of obtuse rounded humps or tubercles; epipleura concave, placed close to the margin of the elytra, very slightly expanded just opposite the middle of the metathoracic episterna, from thence gradually narrowed, and disappearing beyond the middle.

Antennæ (♂) rather longer than half the body, with the third and following joints subequal.

This species somewhat closely resembles *O. ferruginea*, Fabr., and the preceding species, but is easily to be distinguished by the prominent shoulders of the elytra and by the character of the elytral epipleura, as well as by minor differences in structure and colour.

Oïdes semipunctata, Duviv., var.

Adorium puncticollis, Baly, MS.

A typis differt postpectore pedibusque totis nigris.

Hab. Laos.

In typical North-Indian specimens of *O. semipunctata*, Duviv., the legs are testaceous yellow, with only the tarsi and the extremities of the tibiæ black; the metasternum is black, the sides of the hind breast testaceous yellow, slightly infusate. In the present variety the legs and the hind breast are entirely black. In other respects the variety agrees with M. Duvivier's description of the typical form.

Oïdes pectoralis, Clark.

This species appears to have a tolerably wide range. There are specimens in the British Museum from the following localities:—Sumatra, Malacca (*Wallace*), Tringano, Siam, Assam.

Oïdes nigripes, Jac. (nec Oliv.), described in the 'Entomologist,' 1891 (April), Supplement, p. 34, appears to me to be identical with the present species.

Oïdes maculosa, sp. n.

Ovata, flavo-testacea; scutello, maculis duabus prothoracis et maculis septem singuli elytri nigris; corpore subtus (maculis duabus metasterni et maculis decem abdominis nigris exceptis), pedibus et antennis, flavo-testaceis; prothorace quam longiori plus duplo latiori, minute sat sparsim punctulato; elytris minute punctulatis, epipleuris brevibus, concavis, ab margine externa haud distantibus.

Long. 12–17 mm.

Hab. North India, Silhet.

Head yellowish, with a transverse impression between the eyes. Antennæ yellowish, scarcely as long as half the body; third and fourth joints subequal. Pronotum more than twice as broad as long, very finely and rather sparsely punctulate, yellowish, with two black spots—one on each side—near the base; anterior margin strongly concave, posterior slightly convex, sides rounded. Scutellum polished, black, rounded behind. Elytra minutely and not very thickly punctured, yellowish, each with seven black spots, of which six are in the order 2, 2, 2, the seventh placed just in front of the interval between the two posterior spots; epipleura short and concave, slightly expanded just opposite the middle of the metathoracic episterna, and from thence abruptly cut away behind. A spot on each side of the metasternum and a row of five spots on each side of the abdomen black; the rest of the underside of the body and the legs yellowish testaceous.

Oïdes innocua, sp. n.

Adorium innocuum, Baly, MS.

Albo-testacea, late ovata; antennis articulis duobus vel tribus ultimis nigris; capite supra inter oculos subdepresso; prothorace quam longiori plus duplo latiori, impunctato, nitido, margine antica concava, lateribus rotundatis, angulis anticis subrotundatis; scutello triangulari, postice acuto; elytris minutissime

punctulatis, nitidis; humeris prominulis, nonnihil tuberculi-formis; epipleuris brevibus, concavis, ab margine externa modice distantibus; corpore subtus flavo, metasterno nigro.

Long. 10–11 mm.

Hab. India.

The characters of the shoulders and the epipleura of the elytra will separate this from the somewhat similarly shaped and coloured species, such as *O. tarsata*, Baly, *O. sordida*, Baly, and *O. indica*, Baly. In the present species there is a very slight oblique depression above each of the shoulders, so that the latter appear like tubercles. The epipleura of the elytra are moderately distant from the external margin, they are somewhat expanded just about opposite the middle of the metathoracic episterna, and are then abruptly cut away behind. The species may further be distinguished by its having the whole of the underside of the body, the metasternum excepted, testaceous yellow. The legs are similarly coloured, with the underside of the third joint of the tarsi black.

It is probable that in a large series of the species some of the specimens would be seen to have black spots on the abdomen. There are very slight indications of such in the two specimens before me.

Oïdes coccinelloides, sp. n.

Subhemisphærica, flavo-testacea, maculis duabus prothoracis et maculis duodecim elytrorum nigris; corpore subtus pedibusque flavis, postpectore et maculis decem abdominis nigris; elytris valde ampliatis, epipleuris ab margine externa distantibus; antennis brevibus, flavis, articulis tribus vel quatuor ultimis fuscis.

Long. 10–13 mm.

Hab. North India, Sikkim (*Dr. Hooker*).

Yellowish testaceous. Head with a transverse impression between the eyes. Pronotum a little more than twice as broad as its median length; anterior margin strongly concave, basal margin feebly convex, sides rounded, with the anterior angles acute; surface almost impunctate, with a longitudinally ovate spot on each side near the base. Elytra nitid, almost impunctate, each with six black spots in the order 2, 2, 2, with the outermost spot of each of the two anterior pairs considerably elongated in the transverse direction, so as to form a sort of band. Sides of the elytra extending downwards to a considerable extent beyond their epipleura, so that the latter are seen as two ridges—one on the inner side of each elytron at a long distance from the

external margin. The hind breast, part of the mid breast, and a row of five spots on each side of the abdomen black: the legs and the remainder of the underside yellowish.

This species varies as to the size of the spots on the elytra. In one of three specimens before me the innermost spot of the middle pair is almost entirely obliterated, while the outer elongated spot is broken up into two. The sides of the elytra in this species attain a greater lateral extension than in any species of the genus at present known to me. In this respect it is most nearly approached by *O. maculata*, Oliv.

Oïdes ovatipennis, sp. n.

Capite testaceo, supra (medio excepto) nigro, sparsim punctulato; prothorace quam longiori duplo latiori, sparsim punctulato, testaceo, maculis duabus nigris; scutello lato, nitido, vitreo-testaceo, postice rotundato; elytris subovatis, basi angustioribus, minute sat dense punctulatis, nigris, sutura et marginibus angustim testaceo-flavis, apicibus singulatim rotundatis; corpore subtus infuscato, prosterno, mesosterno et apice abdominis testaceis; femoribus et basibus tibiæ testaceis.

Long. 9, lat. ad hum. $3\frac{1}{2}$ mm.

Hab. New South Wales.

Head and prothorax testaceous, finely punctulate, the former black above, with a small testaceous spot on the middle of the occiput. The prothorax about twice as broad as long, sides diverging from the base to about the anterior third, thence slightly converging to the apex; anterior margin very feebly concave, almost directly transverse; upper surface with two irregular black spots, one on each side. Scutellum broad, triangular, rounded behind. Elytra very finely and rather thickly punctured; black, each almost completely surrounded by a narrow testaceous yellow border; epipleura slightly concave, closely approximated to the external margin, gradually cut away behind without reaching to the middle. Body underneath brownish black, with the pro- and mesosterna and the tip of the abdomen testaceous. Femora and bases of the tibiæ testaceous, rest of the legs brownish black. The first two joints of the antennæ testaceous (the remaining joints are wanting).

This species may be recognized by the form of the elytra, which is somewhat ovate, narrower at the base than towards the extremity. The apices are singly instead of conjointly rounded.

Oïdes maculata, Oliv.*Oïdes subhemisphærica*, Guér.*Oïdes indica*, Baly.

Judging from the description and figure given by Olivier and from the description given by Guérin, the two species indicated above are, I think, identical with Baly's *Oïdes indica*, the type of which is before me. I am unable to find any definite characters by which to separate specimens from Java from those coming from other localities, such as Tringano, Siam, Burmah, and Assam.

LI.—*Descriptions of two new Species of Sandwich-Island Birds.* By SCOTT B. WILSON, F.Z.S.

Himatione mana, sp. n.

Male. Head ashy olive, shading into dull olive-green on the back; beneath dull greenish buff, except the chin and throat, which are whitish; wings and tail brown, edged outwardly with olive-green.

Female. Duller on the upper parts, while beneath the chin and throat are nearly white, the rest of the underparts more buff than in the male.

Dimensions. Total length 4.45 inches, wing 2.50, culmen .45, tarsus .70, tail 1.40.

Hab. Hawaii.

Obs. The bill is nearly straight, being almost similar to that of *Oreomyza*, while the plumage of the underparts, especially of the female, bears some resemblance to that species. It has not, however, the rounded wing and very short tail of *Oreomyza*.

Phœornis lanaiensis, sp. n.

This species closely resembles *Ph. obscura* and *Ph. myiastina*, but is smaller in dimensions than either; while the bill is distinctly intermediate in size between those two species. The outer pair of tail-feathers only have very slight white markings at the tip, but the abdomen and under tail-coverts are nearly pure white.

The length of the wing from the carpal joint is only 3.65, as against 4 of *Ph. obscura*.

Hab. Lanai.

Obs. The species found on Molokai seems to be identical with the bird from Lanai here described.

LII.—Description of a new Genus for the reception of the North-American Moths hitherto referred to *Telesilla* of Herrich-Schäffer. By A. G. BUTLER, F.L.S., F.Z.S., &c.

PLACODES CINEREOLA of Guenée, the type of the proposed new genus, was associated by its describer with the European *P. amethystina*; but as the name *Placodes* had been previously used in Coleoptera, Herrich-Schäffer, in the Index to his 'Schmetterlinge von Europa,' proposed to substitute for it the generic name *Telesilla* (subsequently duplicated in the class Aves). The date of the publication of this name was 1856.

In 1857 Lederer, not having noticed Herrich-Schäffer's action, proposed for the same genus the new denomination of *Eucarta*; he, however, incorrectly stated that *Diastema*, Guen., was only distinguishable from it by the want of tufts on the abdomen, which was insufficient for generic separation: had this been the case the name *Diastema* would have necessarily superseded both *Telesilla* and *Eucarta*; but Herrich-Schäffer, who examined two males, states that *D. virgo* differs so much in character from *T. amethystina* that it cannot stand in the same genus. In addition to the absence of the tufted dorsal crest of the abdomen (which was the only difference discovered by Lederer) he says that the margin of the fore wings is strongly sinuous and quite straight-lined, which seems a somewhat contradictory statement, but the hind wings are deeply indented at vein 5. Antennæ extremely shortly ciliated, every joint with two somewhat longer bristles.

From this I should judge that the ciliation of the antennæ was much more marked than in *T. amethystina*, in which, excepting when seen through a lens and in a good light, they appear to be simple. I therefore retain both genera.

As *T. amethystina* does not appear to be found in North America, although common to Europe and Japan, it is not surprising that Mr. Grote and others should have followed M. Guenée in associating the *Placodes cinereola* of that author with *T. amethystina*; but when I had the two insects before me, in the course of my rearrangement of the *Noctuites*, I was so struck by their different appearance and the totally dissimilar character of their markings, that I felt convinced that they could not be congeneric; I therefore asked my colleague Mr. Waterhouse to prepare the wings of duplicates of the two forms for comparison by clearing them of their scales, and the result was that I proved them to belong to entirely distinct though allied genera. The most important differences nevertheless are not in the wings but in the legs.

OGDOCONTA, gen. nov.

Differs from *Telesilla* in its shorter primaries, with costal margin more decidedly arched towards apex, the subcostal furca, formed by the third and fourth branches, considerably longer; the rudiment of the discocellular veinlet of secondaries almost entirely obliterated; middle tibia decidedly shorter instead of longer than the femur, the interior spur longer, tarsus much more slender and longer; posterior legs longer and with longer tibial spurs; labial palpi with slightly longer terminal joint; abdomen less strongly tufted. Type *P. cinereola*.

The generic name is suggested by the markings on the primaries of *O. cinereola*.

The Japanese "*Miana*" *segregata*, Butler (Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 85, and Ill. Typ. Lep. Het. ii. p. 25, pl. xxix. fig. 5), is a *Telesilla*.

I have been unable to identify Bremer's *Placodes fuscomaculata* from North China; it may be not even allied to *Telesilla*.

LIII.—*Note on Lycodon atropurpureus, Cantor, and Bufo stomaticus, Lütken.* By G. A. BOULENGER.

PROFESSOR LÜTKEN has very kindly sent me for examination examples of a *Lycodon* and of a toad from India preserved in the Zoological Museum of Copenhagen, and which were obtained by the late Mr. G. Westermann, the discoverer of one of the most remarkable of Indian snakes, *Elachistodon Westermanni*, Reinh. The exact locality where these specimens were procured is not known, but they are believed to be from Assam; they are perhaps from Bengal, like the *Elachistodon*. The *Lycodon* had been provisionally named by Prof. Lütken many years ago *L. subfuscus*, Cantor; and it is indeed very probable, from the number of ventral and caudal shields, that this determination is correct. On the other hand, it is equally probable that it represents the *L. atropurpureus* of the same author, and I have described it below under that name. The toads were described by Prof. Lütken himself as *Bufo stomaticus* in 1862; but as the locality whence they were procured was not indicated in the original description, no mention of that species is made in my 'Reptiles of India.' *Bufo stomaticus* is, however, a distinct species, allied to *B. Andersonii*, from which it differs in the absence of a tarsal fold.

My best thanks are due to Professor Lütken for enabling me to examine and describe these interesting specimens.

Lycodon atropurpureus, Cantor.

Snout much depressed, with swollen lips, subspatulate; eye moderate. Rostral twice as broad as deep, scarcely visible from above; internasals as long as broad, half as long as the præfrontals; frontal once and two thirds as long as broad, as long as its distance from the end of the snout, shorter than the parietals; no loreal, præfrontal in contact with the second and third labials; one præocular, not in contact with the frontal; two postoculars; temporals small, scale-like, 3+4; nine upper labials, fourth and fifth entering the eye; five lower labials in contact with the anterior chin-shields, which are longer than the posterior. Scales smooth, in seventeen rows. Ventrals 235, strongly angulate laterally; anal entire; subcaudals 83, in two rows. Pale brown above and below (bleached?), each scale with a few yellowish dark-edged dots; upper lip brown, with yellowish dots; a band of yellowish vermiculations along each side of the head, from the nostril to the nape, passing through the eye; belly with yellowish dots and a few square blotches of yellowish, wide apart, and each involving five or six ventrals.

Total length 940 millim.; tail 170.

A single female specimen, in the Copenhagen Museum.

Bufo stomaticus, Lütken.

Crown without bony ridges; snout short, blunt, with strong canthus rostralis and concave loreal region; interorbital space flat or slightly concave, a little broader than the upper eyelid; tympanum very distinct, vertically oval, its greatest diameter about two thirds that of the eye. First finger longer than second; toes three-fourths webbed, with single subarticular tubercles; two rather strong metatarsal tubercles; no tarsal fold. The tarso-metatarsal articulation reaches the eye. Upper parts rough, with irregular warts; parotoids large and flat, nearly as long as their distance from the end of the snout, reniform. Brown above, spotted or marbled with darker, uniform dirty white below. Male with a subgular vocal sac and black nuptial asperities on the two inner fingers.

From snout to vent 63 millim.

Five specimens were submitted to me by Prof. Lütken:—Adult male and female (the types), believed to be from Assam; two young from Calcutta; and one young from the Hugly.

MISCELLANEOUS.

"Goldfussia," "Comaster," and "Comatulidæ."

CANON A. M. NORMAN ('Annals,' ser. 6, vol. vii. p. 387) has proposed the name *Goldfussia* for a crinoid described by Goldfuss under the title "*Comatula multiradiata*, Lam." It is a pity that even so eminent a naturalist as Canon Norman should propose a new generic name for a specimen that he has never seen (and never will see, for it appears to have been destroyed), of which the sole description is regarded by the best authorities as unreliable, and the very existence of which Canon Norman himself appears to doubt. This publication of names without diagnoses rarely advances science, and, apart from its inconvenience, is unfair to those on whom the real labour of description subsequently falls. And why do these name-givers that shirk sponsorial responsibility always bury their new names in miscellaneous and controversial writings, or even in footnotes to papers on alien subjects? Their reward is obloquy if not oblivion.

As to "*Goldfussia*," no more need be said, for it has fortunately come into the world stillborn. Recognizing a familiar sound, I applied to my colleague Mr. R. Bullen Newton, who informed me that this name was in 1843 proposed by F. de Castelnau for a Lamellibranch genus*.

It may be worth pointing out that Goldfuss did not use the name *Comaster* in the 'Petrifacta Germaniæ,' but employed it first in his "Beiträge zur Petrefactenkunde," Nova Acta Acad. Leop.-Carol. Nat. Cur. xix. pt. 1, p. 39, Breslau, 1839. The date of *Comaster*, Ag., is usually quoted as 1835; but the original cover of Mém. Soc. Sci. Nat. Neuchâtel, tome i., which contains the "Prodrôme," bears date 1836. The priority of the name *Comaster* to *Actinometra* is no new discovery; but the diagnosis given by Agassiz was worthless, while Canon Norman has not told us what we are to understand by "*Comatula multiradiata*, Lamarck."

When the time arrives for splitting up the assemblage of genera at present lumped together as Comatulidæ, the name Antedonidæ should certainly be applied to that family in which *Antedon* is placed. But while such different forms as *Thaumatocrinus*, *Atelecrinus*, and *Promachocrinus* swell the motley crowd, the name Comatulidæ seems, from its very want of meaning, the best adapted to embrace them.

F. A. BATHER.

April 5, 1891.

* 'Essai sur le Système silurien de l'Amérique septentrionale.' 4to, Paris and Strasbourg, 1843. *Goldfussia* proposed for *Cardium? nautiloïdes*, sp. n., p. 43, pl. xv. figs. 5, 6.

A Note on Canon Norman's Remarks. By F. JEFFREY BELL.

I am glad I have succeeded in "drawing" Canon Norman, as I have the highest respect for his views on questions of natural history.

If I did not make myself clear to his acute intelligence I fear I must be very generally misunderstood. I have, then, to say that my references to Forbes's robbery were intended to be sportive; I very deeply regret that they should have seemed to be offensive. I need not say that there was no intention to offend the living or reflect on the dead.

Although I have the honour of numbering Dr. Sutherland among my correspondents, his reputation as a collector is not as extensive as I hoped it was; at the same time I could hardly have implied more distinctly than I did that his collection of Echinoderms was made on the east coast of Ross-shire—as a matter of fact in Cromarty Firth.

It is a little cruel that I should be charged with an implication that I did not mean, and that one that seems clear enough should have been missed. But I know Canon Norman is a busy man, and I own that one should write—if one can—so that he who runs may read.

I am glad Dr. Norman has taken the fence of *Goniaster*; there was an ugly take-off, owing to the way in which Messrs. Perrier and Sladen had broken up the ground, and I feared a deepish ditch on the other side; and I congratulate myself that by doing other things first Dr. Norman has come up and shown me the way over a very nasty place.

Anseropoda having asserted its priority, I for one am quite willing to let it lie beneath the mud with which Canon Norman has bespattered it. Succeeding synonymists are requested to note its place and mode of burial.

Just to complete what may be said about the matter, I may, however, add that the students of Echinoderms have not been quite as sharp as the ornithologists, who found out in 1879 (see Mr. H. T. Wharton's paper in the 'Ibis' for that year, p. 456) that Merrem meant his genus to be called *Ortalis*, and not *Ortalida*. *Anseropoda* is clearly in the accusative singular; *Anseropus* modified to *Anseripes* would have made a passable name, but we need not displace *Palmipes* to make way for it.

As to the date of *Lophaster furcifer*, I will only remark that I am astonished at Dr. Norman citing the "author's own statement of date;" if there is one man who is not to be trusted as to the date of a name my experience tells me it is the author of it.

If Dr. Norman will, when he has a moment to spare—it won't take more—turn up M. Perrier's descriptions of the species of *Marginaster*, he will see that the plea he makes is not an answer to the charge. I need not trouble the readers of the 'Annals' with the details.

On the Heart of Dentalium. By Dr. L. PLATE, Marburg.

In "Bemerkungen zur Organisation der Dentalien" (Zool. Anz. 1888), published rather more than two years ago*, I adopted the view expressed by Lacaze-Duthiers in his classical treatise on the Scaphopods, that these peculiar Mollusks do not possess a heart, but that the blood is driven along in the lacunæ by the contractions of the musculature of the body-wall only. Subsequent investigations have shown me that this assertion does not correspond with facts, but that a heart, albeit a rudimentary one, is actually present, lying in a special pericardium. The possible existence of the latter has already been suggested by the above-mentioned French anatomist. It is well known that the largest of all the blood-spaces, the so-called *sinus abdominalis*, runs along the median line of the ventral side of the body. At the anterior end of this, a little behind the anal opening, there is a hemispherical projection of the body-wall into the pallial chamber. This protuberance, which is marked *p* by Lacaze-Duthiers in plate ii. fig. 2 of his paper ('Annales d. Sc. nat. Zoologie, sér. 4, t. vii. 1857'), is produced by the completely closed pericardial sac, the ventral wall of which unites intimately with the integument, while the dorsal wall is applied to the stomach and the two nephridial sacs. Since Lacaze-Duthiers naturally did not succeed in filling the pericardium with colouring-matter by injection from the abdominal sinus, he remarks with justice:—"It therefore seems to me reasonable to admit that this sac is closed, and that it perhaps represents a rudiment of a peritoneal, pericardial, or some sort of serous cavity." Now in this chamber there lies the heart, in the shape of a rounded thin-walled pouch, which is not further divided into auricle and ventricles. The degenerate condition of the heart is expressed in this simplicity of structure and in the entire absence of vessels provided with special walls and of reno-pericardial openings. The heart is nothing more than a sac-shaped invagination of a portion of the dorsal pericardial wall into the lumen of the pericardium. The blood-corpuscles find their way into it, since they pass from the abdominal sinus into narrow fissures which lie between the stomach and the dorsal wall of the pericardium, and which are due to the fact that the two latter are united together only in places. From these fissures they fall into the heart itself, when the invagination takes place. When the heart contracts they are driven into similar fissures which are situated between the dorsal wall of the pericardium and the nephridia, and so find their way into the perianal sinus. Into histological details I will not at present enter; I may only remark that the histological structure is the same in the pericardium as in the wall of the heart itself, and that there exist in both numerous muscular fibres lying parallel with one another and arranged in rings. Nevertheless the contractions appear only (or at

* The present paper was sent in Feb. 5, 1890.

least chiefly) to take place in the heart: on this point fresh observations on living animals, which I have not at the present moment at my disposal, are much to be desired.—*Zoologischer Anzeiger*, xiv. Jahrg., no. 357, Feb. 23, 1891, pp. 78–80.

The Function of the Gemmiform Pedicellariæ of Sea-Urchins.

By M. HENRI PROUHO.

Since the pedicellariæ of Sea-Urchins were described by O. F. Müller the nature and functions of these singular organs have been explained in very different ways. In a paper on certain Echinoids from our own coasts * I asked myself what the rôle of the pedicellariæ was; and not being able at the moment to make a statement based upon definite observation, I had to content myself with the only probable hypothesis, and consider the pedicellariæ to be organs of defence. To-day I have the honour of submitting to the Academy an observation made in the aquarium of the Arago laboratory, which may easily be repeated.

The pedicellariæ of the Echinidæ were long ago divided into three classes, viz. the opificephalic, the tridactyle, and the *gemmiform*. In the present notice we have to concern ourselves with the last of the three only, that is to say with those which exhibit jaws, each provided with a muscular and glandular pouch, the secretion of which issues at the tip, which is terminated by a sort of poison-claw. The head of the gemmiform pedicellariæ of *Strongylocentrotus lividus* is directly attached to a calcareous stalk articulated to the test; it is capable of movement on the extremity of this stalk, but it cannot bend down to its base, so that an animal of small size which could glide to the foot of the pedicellaria would be sheltered from its attacks. The gemmiform pedicellaria cannot stoop to seize its enemy, and is therefore at a disadvantage in protecting the test. Moreover these pedicellariæ, which in *Strongylocentrotus lividus* have a length of 1 centimetre, are scattered through a forest of spines, a very large number of which are as much as 3 to 4 centim. long. If, therefore, a large animal approach the Sea-Urchin to attack it, it would seem that this animal would be protected by the spines themselves against the bites of the pedicellariæ. In short the active zone of these organs, which lies above the test and below the tips of the spines, appears to us, *à priori*, badly placed, and the *ensemble* of the facts is well calculated to make us pause ere we consider the gemmiform pedicellariæ to be weapons of much effect, notwithstanding their glands and poison-claws. But the difficulty completely disappears when we observe the way in which the Sea-Urchin defends itself by the aid of its gemmiform pedicellariæ.

If in a tub containing one or several specimens of *Asterias glacialis*, previously kept without food for a considerable period, we place a *Strongylocentrotus lividus* †, we shall not have long to wait

* 'Archives de Zoologie expérimentale,' 1887.

† The experiment here described I have repeated with *Sphærechinus granularis*, with identically the same results.

before we see it attacked by the Starfishes. As soon as the Urchin feels the contact of the ambulacral tentacles of the Starfish attempting to seize it, it quickly lowers the spines of the region menaced. These spines take up a slanting radial position round the centre of the attack, and they are so completely inclined that the majority of them become almost tangents to the test. By thus lowering its spines the Urchin unmasks its gemmiform pedicellariæ, which we now observe extended towards the arm of the Starfish, and presenting to it their widely open jaws. The *Asterias* continues the attack; but as soon as one of its sucker-feet touches the head of a pedicellaria, it is immediately bitten, and we can but conclude that the pain occasioned by the bite is very keen, for the arm of the starfish is precipitately withdrawn. In retracting, the sucker-foot which has been bitten *always* carries away the pedicellaria fixed in the wound.

Sometimes the first bites suffice to repulse the *Asterias*; but on other occasions the latter continues the attack, and then it becomes a really interesting sight to watch the Urchin unmasking its pedicellariæ at all the points of attack, and, if I may be permitted to use the expression, thus following the movements of its enemy by showing its teeth. In a first encounter the advantage always rests with the Urchin, and the *Asterias* retires riddled with wounds; but since each pedicellaria only serves a single time in the defence of the Sea-Urchin, since it leaves its jaws in the wound, the Urchin by degrees exhausts its means of defence. If therefore we leave a Sea-Urchin in a tub with several Starfishes, and the latter continue the assault, the Urchin succumbs to its fate; but the issue of the combat is for us a matter of secondary moment. The manner in which the Urchin unmasks its weapons, which are ordinarily concealed and protected by the spines, appears to me, on the other hand, particularly worthy of attention.

As soon as the Urchin is apprised, by means of its peripheral nervous system, of the danger which menaces it, it communicates to its spines a movement which has nothing in common with the customary movements of these organs, and the sole object of which is to bring the jaws of its gemmiform pedicellariæ to bear on the enemy. It is interesting to note that this movement of the spines is precisely the opposite of that which takes place if we wound the surface of the test with the point of a needle for instance. In this case spines and pedicellariæ incline towards the wounded spot. On the contrary, when the Urchin assumes a defensive position it withdraws the spines from the point menaced, at the same time directing towards its enemy its pedicellariæ, which are thus unmasked and the jaws of which are ready to bite. In this case it is not a local pain, but a more complex sensation which we cannot analyze, which provokes a combination of movements undeniably interesting in a creature so low in the scale.—*Archives de Zoologie expérimentale et générale*, sér. 2, t. viii., Année 1890, no. 4, pp. xlii-xliv (*Comptes Rendus*, cxi. (1890), pp. 62-64).

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LIV.—*Asterias rubens and the British Species allied thereto.*
By Prof. F. JEFFREY BELL, M.A., Sec. R.M.S.

[Plates XIV. & XV.]

THE definition of Starfishes in terms which shall, on the one hand, be intelligible because brief, and on the other accurate because complete, is perhaps as difficult an undertaking as any in systematic zoology. In some cases the amount of variation is so extraordinary that it is necessary to preface any definitions which one may be so presumptuous as to offer with some words of explanation. *Asterias rubens* is a case in point; it is, indeed, a subject which has already been treated of by many writers, and I will therefore be as concise as I know how. The reader may be assured that what is here put before him, even if it appear to him prolix, is but a summary of facts slowly acquired and long looked at from various points of view.

I shall, I am afraid, be found to differ from the conclusions on different points to which Canon Norman on the one hand or Mr. Sladen on the other have or would have arrived; but the discrimination of species is after all a matter of individual judgment—or the lack of it.

It will be remembered that a number of naturalists have
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distinguished the "violet crossfish" from the "common crossfish;" some have asserted that they live together, others that they are found apart; some, more exact, have stated where they have found them living together and where they have found them apart; authors have varied in the extent to which they believed them to be allied, from Müller and Troschel, who on p. 11 of their famous 'System der Asteriden,' regarded them as distinct, and on p. 126 in the "Nachträge" to the same work regarded them as "eins und dasselbe," to the latest reformator systematis, who cannot bring himself to put them in the same subgeneric division of "*Asterias*."

The differences of opinion which have existed will be easily understood by one who will take either a named or an unnamed set of some dozen specimens from almost any locality, so great are the variations of spinulation that may be detected.

Forbes distinguished the two, and gave figures to show the differences in the form of their ambulacra (Brit. Starf. p. 99); and the just weight of his authority has caused students of the British fauna to keep the two forms apart.

Without entering into full historical details on this point, there are some more recent authorities whose views must be noticed and discussed.

In a very valuable paper published in this Journal in 1865 the Rev. Dr. Norman writes* :—"The species of *Asterias*, both British and foreign, allied to *A. rubens* are extremely difficult. We are unable to make up our minds whether we have only one very variable form or many species. We have described the two species distinguished by Forbes, *A. violacea* and *A. hispida*, but for the present feel compelled to reserve giving a positive opinion with respect to the value of their distinctive characters. . . . We have other closely allied forms in our seas, which scarcely fall under the description of any species here described."

Prof. Perrier in 1875 wrote † :—"Ainsi l'examen de tous ces échantillons témoigne simplement du polymorphisme et de la grande extension géographique de l'*Asterias rubens*; mais les types divers que l'on peut observer et qu'on serait d'abord tenté de separer sont unis par tant de formes intermédiaires, qu'il devient bientôt impossible, quand on a beaucoup d'individus sous la main, d'établir aucune division tranchée. Je ne saurais donc jusqu'ici admettre l'*Asterias violacea* comme espèce distincte."

* Ann. & Mag. Nat. Hist. xv. 1865, p. 129.

† Arch. Zool. gén. et expér. iv. p. 314.

Very careful attention was paid to this question by the late Mr. George Hodge, and by the kindness of the authorities of the Museum of the Natural History Society at Newcastle-upon-Tyne I have been enabled to inspect for myself the specimens on which he founded his conclusions. The most important point is that he and Canon Norman agree generally as to what they call *A. violacea*, as I am able to testify from specimens which Dr. Norman has kindly lent me.

Under the head of *Asterias rubens* Mr. Hodge (Trans. North. & Durham. iv. (1872) p. 137) writes:—

“This and the following species are united by some authors: I think, however, we have sufficient grounds for separating them, their habitat and the form and character of the spines being quite distinct. The genus is altogether a puzzling one, and one in which it is very difficult to set up distinctive characters by which readily to distinguish one species from another, excepting in those examples which there is no mistaking. *A. rubens* runs off into several variations; but whether they are really distinct species or mere varieties it is difficult to decide.

“I may, however, state I have three strongly marked varieties, in addition to what I take to be the typical form, viz. :—

“1. *Asterias rubens*, var. *hispida*.—A small, squat, neat form, of which I have specimens dredged in deep water off Northumberland and Durham. They appear mature individuals, although they are only about half an inch across.

“2. *A. rubens*, var. *attenuata*.—A slender smooth form, sparingly furnished with spines, very distinct in character, obtained by dredging in Berwick Bay, 30 to 45 fathoms.

“3. *A. rubens*, var. *gigantea*.—A very large coarse species, occasionally brought in by the fishing-lines from deep water. It sometimes attains the enormous size of 14 inches, Mr. G. S. Brady having a specimen of this size. Those that I have obtained are two to three inches smaller. It is thickly beset with spines; the pedicellariæ are very numerous. In substance it is rather ‘flabby,’ and unless care is used when handling it in a living state, its rays are liable to break off at their junction with the disc; at this part the rays are rather restricted.”

On this it may be remarked that a naturalist who has easy access to fresh specimens of what has been called *A. hispida* would be doing a service if he would determine whether these small squat forms do contain mature ova and spermatozoa. I have myself been constantly on the look out for larger specimens which might be supposed to be the adults of *A.*

hispida, and have only once seen a specimen which I felt inclined to regard as such.

Among the many interesting specimens of Asterida which the British Museum owes to Mr. John Murray's dredgings on the west coast of Scotland there is one remarkable form which justifies the acceptance of Mr. Hodge's variety *attenuata*, and I am inclined to think the abnormal 'Knight Errant' specimen referred to by Mr. Sladen on p. 573 of his 'Challenger' Report might be placed in the same category.

Starfishes grow to such considerable size that there does not appear to be any justification for the "var. *gigantea*."

With regard to *A. violacea* Mr. Hodge says:—

"A very common species with us, so far as I know. On the Durham coast it is only found between tide-marks, whilst the former species (*A. rubens*) is seldom if ever taken under similar conditions. It is readily distinguished from the preceding by the bluntness of its spines, especially on the dorsal aspect, where they are mostly rounded at their summits, or in some cases one would almost say 'truncate.' In *A. rubens* the spines are (I believe) invariably pointed. Other distinct characters are apparent on examining specimens of each side by side; the general appearance of each is quite distinct, as is their habitat. Here (Seaham) I have never to my knowledge taken this species at sea, neither have I obtained *A. rubens* living within tide-marks."

If you take a few selected specimens you may show the justice of Mr. Hodge's view, but if you take such a series as he himself got together for the Newcastle Museum you can show that his rules are not always true and that there are intermediate stages to be found.

A word of warning may be uttered as to the word "*violacea*;" some violet-coloured specimens from Kenmare River which Prof. Haddon was kind enough to send me to assist in this investigation are all forms (and a wonderful variety too) of *A. rubens*. Of specimens with a violet colour I shall have something more to say soon. Here it need only be remarked that Messrs. Koren and Danielssen* are not doing justice to the observations of English naturalists at any rate when they say of *A. rubens* that "it is met with in two varieties of colour, from which there has at different times and by different writers been formed two species, viz. *Asterias rubens* and *A. violacea*."

The next authors whom we need cite are Messrs. Leslie and Herdman, who in 1881 published † a very useful list

* 'Norske Nordhavs Exp., Asteroidea,' p. 24.

† Proc. Roy. Phys. Soc. vi. (1880-81), pp. 90 and 91.

of the Invertebrata of the Firth of Forth. They say of *A. violacea* that they "have often obtained this species or variety in the Firth, and have always been inclined to regard it as a mere variety of the widely distributed and polymorphic *Asterias rubens*. At present, however, we have followed Mr. Norman and Professor Perrier in giving it the rank of a separate species."

The only foreign writer who in recent years has discussed the characters of *A. violacea* with a good faunistic knowledge is, I think, M. Fischer*, who writes under *A. violacea*:—"Hab. Avec l'espèce précédente [i. e. *A. rubens*, which is found on "toutes les côtes de sud-ouest de la France"], dont elle n'est peut-être qu'une variété, ainsi que le supposent Müller et Troschel; néanmoins, sa coloration est constante, ses tubercules sont plus petits, ses bras plus étroits, sa consistance moins charnue," &c. But it cannot, I fear, be said that this is a very satisfactory statement of the specific points.

The very latest mention of *Asterias violacea* which I know is to be found in Mr. Hoyle's paper on the fauna of the Clyde, for which I am, I believe, responsible †. The specimens which I was led to suppose to be *A. violacea* belong, I am now inclined to think, to a distinct species, which I propose to describe immediately.

I was at first in considerable difficulties as to what various authors meant by *A. violacea*. The British Museum collection contains but few specimens of *A. violacea* determined to be such; there is one specimen, connected with which is a label in the handwriting of Prof. E. Forbes, which, if it be not *A. rubens*, is certainly one of the numberless varieties to which reference has just been made. The specimen from Plymouth Sound which, in his 'Catalogue of British Radiata,' Dr. Gray refers to *A. violacea*, is, if I may use the word, certainly *A. rubens* ‡. There is a specimen about which it is very difficult to speak certainly—Dr. Gray registered it as *A. violacea* and labelled it *A. rubens*. And, lastly, there is an example from the Faroe Islands determined probably by Dr. Lütken, which may be safely said to be *A. rubens*, though it is named *A. violacea*.

Not one of these specimens therefore would justify the student in asserting that *A. violacea* is to be distinguished

* Act. Soc. Linn. Bordeaux, xxvii. (1869), p. 365.

† I must beg, however, to add that I do not accept any responsibility for the "distribution" assigned to this "species" and to "*A. rubens*," though I am far from saying that it is not correct.

‡ I may confirm this by a saying of Prof. Stewart that *A. violacea* is not found at Plymouth.

from *A. rubens*. But these specimens of Mr. Murray's to which I refer were of a violet colour and had tapering ambulacra, and I determined them therefore to be *A. violacea*.

As the collection increased, and I may say that the British Museum collection of British *Asterias* is now very extensive, my suspicions were aroused by the fact that from no locality other than West Scotland did Mr. Murray's species appear, and many skilled naturalists to whom I showed it declared that they had never seen it before.

Certainty as to what could really be meant by others when they used the term *A. violacea* was only attained when I had the loan of Canon Norman's specimens and of those collected by Mr. Hodge and preserved in the Newcastle Museum*. When I did so I found that Mr. Hodge's rules do not stand when a large series is taken. Similarly I found that the examination of a large series of starfishes, kindly sent me from the classical Cullercoats by Mr. Richard Howse, revealed the fact that "*A. rubens*" and "*A. violacea*" might be brought up from one spot by one dredge.

It will be noticed that Mr. Hodge's "varieties" come from different localities; I propose to show that very different forms can be taken from one and the same spot. But first we must see what variations there are. Glibly as many of us talk about variation, the figures on Plate XIV. will probably be a revelation to some; these direct attention only to the differences in spinulation, and that appears to be not only the most instructive but also the most important character.

Firstly, and in a general way, it will be observed that there are clearly two types of spines, one flat-headed or blunt, the other sharp at the tip; so, again, the spines may be comparatively few or closely packed, or they may be coarse and strong or fine and delicate (Pl. XIV.).

These facts are so well brought out in the Plate drawn by Mr. Highley that it would be surplusage to dilate upon them.

Now as to the distribution of these various forms, we have the coarsely spined form shown in fig. 8 only from the Shetland Islands; but the spines may be stouter and less sharp than or not so rough and numerous as in the specimen figured in other specimens from the same place, and on the other hand there is a very rough and strongly spined form from 55 fathoms (south-west of Ireland). There is such a

* To the authorities of which I desire to express my thanks for their kindness.

noticeable reduction of the spines in the specimen from Plymouth (fig. 6) that one might be inclined to suppose that spinulation becomes less coarse and more scanty in more southern latitudes, were it not that specimens equally poor in spines can be taken off the west coast of Scotland; a specimen from Kenmare River is more like that figured from Plymouth than like that shown in fig. 3, which came from the south-west coast of Ireland. Forms with as blunt spines as those from the Seaham specimen (fig. 4) may be taken from the Shetland waters, and such spines may be loosely or closely packed. The specimen (fig. 5) from Cullercoats could be duplicated from St. Andrews. Enough perhaps has been said on the subject of spinulation.

The general appearance of a starfish is, of course, largely affected by the relations of the radius of the disk (r) to the length of the arm (R). Specimens from Kilbrennan Sound show $R=6.5 r$, $R=6 r$, $R=4.5 r$; from Cullercoats we get $R=5 r$ or $R=4 r$; two specimens from Plymouth give $R=5.5 r$ and $R=4 r$; so here again there is variation without any apparent relation to locality.

Yet, again, the breadth of the arms at the base affects the habit or general contour of the spines, and this too is liable to considerable variation.

Forbes laid particular stress on the form of the ambulacra; but it will be found that the pyriform lanceolate shape is often associated with a sharp spinulation, and not with the blunter form which is characteristic of "*A. violacea*."

Some noticeable variations in length and breadth may be seen in the table which follows:—

R.	r .	Greatest breadth of arms
		near base.
millim.	millim.	millim.
210	30	50
178	28	37.5
160	31	32
150	23	35
99	16	22
76	16	22
62	10	15
48	12	19
40	9	11
33	7	8.5

I am brought therefore to the conclusion that *Asterias rubens* and *A. violacea* are not to be distinguished, and I offer the following diagnosis:—

$$R=7 r \text{ to } 4 r.$$

Arms generally five, rather stout, rounded, tapering very gradually, but not very narrow even at tip*, sometimes quite broad there. Dorsal surface covered with spines, subequal, generally of moderate size, closely packed, moderately numerous or sparse, in form they are pointed or more or less or quite blunt at their tips; a single, often prominent, row, which is either nearly straight or slightly zigzag, and then appearing at times to be double, runs along the middle of the back of each arm. Ambulacra wide, bordered by one or two rows of spines, when the inner is the thinner. A rather well-marked groove separates the outer adambulacral row from the next, which with another forms a pretty regular series along either side of the lower surface of each arm; the outer of these has groups of two or three spines set a little obliquely to the long axis of the arm. Further out there is a wide groove, and at the infero-lateral edge of the arm there is an irregularly double row of spines, which are often the strongest and best-developed of any on the body; sometimes, however, the ventral spines are as strong or stronger. Madreporite rather coarsely striate. A circlet of minor pedicellariæ at the base of the spines; major pedicellariæ † scattered over the

* Except in *A. rubens*, var. *attenuata*.

† I greatly regret to find that, by using them in his 'Challenger' Report, Mr. Sladen has given to Dr. Herapath's names a vogue which they do not deserve. The distinction between "scissors" and "shears" drawn by Mr. Sladen (Journ. Linn. Soc. xiv. (1879) p. 433, footnote) is not recognized either by lexicographers or by less learned persons, as the accompanying citations from the 'Imperial Dictionary' will show. If the connotation could be reversed and the term forcipiform be applied to the "pedicellaires droits" of Perrier and the forcipiform to the "pedicellaires croisés" there would be a closer resemblance between the name and the thing named. But such a course is impossible now, and we must, I am afraid, be content with the much less expressive terms "major" and "minor."

"*Forceps*. A general name used for a two-bladed instrument on the principle of pincers or tongs, used for seizing and holding and for extracting objects which it would be impracticable thus to treat with the fingers.

"*Scissors*. A cutting instrument resembling shears, but smaller, consisting of two cutting blades movable on a pin in the centre, by which they are fastened, and which cut from opposite sides against an object placed between them.

"*Shears*. An instrument consisting of two movable blades with bevel edges, used for cutting cloth and other substances by interception between the two blades. Shears differ from scissors chiefly in being larger, and they vary in form according to the different operations they are called upon to perform. The shears used by farriers, sheep-shearers, weavers, &c. are made of a single piece of steel, bent round till the blades meet, which open by themselves by the elasticity of the metal."

arms, varying somewhat in the number to which they are developed.

Colour. Red, orange, or purple.

Distribution. Eastern side of North Atlantic (Senegal to Finmark); Japanese Seas. Presence in Arctic Ocean uncertain, in Mediterranean very doubtful.

A. rubens, var. *attenuata*.

A. rubens, var. *attenuata*, Hodge, Trans. Northumb. and Durham, iv. (1872), p. 137.

Varieties with very slender arms and rare spines are sometimes so well marked that, as I have already indicated, I am inclined to think we may mark the variation by a name. Mr. Murray dredged such a specimen off Tobermory, Mull (30 fath.), and one of the 'Knight Errant' forms dredged off North Rona and described by Mr. Sladen may be put in the same category.

R=105; 75: r=15; 13.

Breadth of arm at base 14; 15.

Müller and Troschel accepted the statements of Lamarck and Risso as to the presence of *A. rubens* in the Mediterranean; Prof. Perrier in 1875 spoke of it as "provenant de toutes les mers de l'Europe," and in 1884 Messrs. Koren and Danielssen practically say the same thing; but in 1878 Perrier wrote that it "ne paraît pas pénétrer dans notre grande mer intérieure;" it is not given by Professors Sars or Ludwig in their reports on the marine fauna of the Mediterranean, and Carus accepts Perrier's later view.

With regard to the presence of *A. rubens* in the Japanese Seas it is customary (*cf.* Perrier or Koren and Danielssen) to make Dr. v. Martens responsible for the statement that the species is found there; but v. Martens refers to specimens from Japan seen and recorded by Müller and Troschel. Perrier adds, "Jusqu'ici aucun autre fait n'est venu confirmer cette affirmation." Almost contemporaneously, however, Mr. Sladen recorded *A. rubens*, var. *migratum*, from the Korean Straits*.

The question arises therefore as to the circumpolar distribution of the species; Wagner and Jarzynsky report it from the White Sea, but it is not to be found in Levinsen's list of Echinoderms from the Kara Sea; Sabine reports it from Davis Strait, but Duncan and Sladen do not give it among the Greenland Echinoderms. On this point it seems to be

* I cannot find any reference to this form in Mr. Sladen's 'Challenger' Report.

necessary to reserve our judgment. It is, however, clear that on the Atlantic shores of Northern Palæogæa *A. rubens* is widely distributed.

On the western shores of Scotland there is a form present which, so far as I know, is confined to that area of the Clyde. Mr. Sladen is the only naturalist I know of who has specimens other than those collected by Mr. John Murray, and although Prof. Haddon thinks he has taken it off the south-west coast of Ireland, the specimens he has been so kind as to let me see appear to be merely *A. rubens*.

This form I propose to call *Asterias Murrayi*, as an indication of the sense of gratitude I feel to Dr. John Murray for the valuable collections made by him off the west coast of Scotland and presented to the British Museum.

Asterias Murrayi. (Pl. XV.)

R = 7 *r*.

Arms and disk flattened, the shallow sides nearly vertical, disk small. Arms slender, with somewhat constricted bases. Ambulacra wide, feebly constricted at base, but otherwise tapering regularly; the ordinary arrangement of the ambulacral spines is the alternate disposal of one and two on successive plates. On the outer side of the shallow groove that bounds the spines is an irregular set of spines, which, where most orderly, are arranged in two longitudinal rows; sometimes they are grouped in threes and the set is placed transversely to the long axis. The side of the arms is bare of spines; along its upper edge is a single row of spines; this never seems to be doubled. At first sight a large specimen may seem to have no other spines on its dorsal surface but a faintly indicated row along the middle line, and neither optical nor tactile examination will reveal many more, save just a few on and about the disk. The whole surface will, however, be found to be densely covered with pedicellariæ; on smaller specimens there are a larger number of small spines on the arms, but they are never numerous. Madreporite large, distinct, quite close to margin of disk.

Colour. Violet or greyish white, darker when dried, lighter when preserved in spirit.

Hab. West coast of Scotland (Upper Loch Fyne, 65 fath.; Loch Goil, 45 fath.; mouth of Kilbrennan Sound, 22 fath.).

R 173; 97: *r* = 24; 14.

It is very interesting to observe that in comparatively young specimens the general appearance is very much more that of *A. rubens* than is the case with the adult. The arms

are a little swollen and puffed near the base and the reduction of the dorsal spines is not so marked. It is very probable that this, if a "new species," is one not only in the corresponding French sense of "inédit," but even in the evolutionary sense of the word.

We appear to be justified in regarding this species as distinct on account of the constancy of its slate-grey or violet colour, its flat arms, more slender than in *A. rubens* (except the variety *attenuata*, in which the rounded arm-form of *A. rubens* is retained), its loss of dorsal spines, and its limited geographical range.

I am not acquainted with any additions that have been made to our knowledge of the characters of *A. hispida* since 1881, when I published (Proc. Zool. Soc. Lond.) what information and criticism I could get together on the species.

It was then found that \bar{R} may be no more than twice r , that the adambulacral spinulation is constantly monacanthid, and that the major pedicellariæ are absent. The combination of these three characters may well be regarded as diagnostic of a species, and such forms as present it may be called *A. hispida*.

EXPLANATION OF THE PLATES.

PLATE XIV.

Figures to illustrate some of the variations in spinulation seen on the back of *Asterias rubens*.

- Fig. 1.* Spines rather blunt, thickly scattered over the whole surface. From Aberdeen.
- Fig. 2.* Spines blunt, with flat or rounded, not sharp tips, not at all unlike *fig. 4.* From Tenby, low water.
- Fig. 3.* Blunt spines, more reduced than in *fig. 2.* South-west Ireland.
- Fig. 4.* A specimen sent by Dr. Norman as an example of *A. violacea*; compare with *fig. 2.* From Seaham.
- Fig. 5.* Spines more reduced than in *fig. 3,* but of the same type. From Cullercoats.
- Fig. 6.* Spines larger than in *fig. 5,* but rarer, sharp at their tips. From Plymouth.
- Fig. 7.* Spines much sharper, rather stronger and rather less numerous than in an ordinary *A. rubens.* From Aberdeen.
- Fig. 8.* Of the same character as *fig. 7,* but more pronounced; spines a good deal stronger than usual. From Shetland.
- Fig. 9.* A very finely developed specimen from Kilbrennan Sound.

All of the natural size.

PLATE XV.

- Fig. 1.* *Asterias Murrayi*, natural size. Figure to show the general habit of this starfish, its flat arms constricted at their base, and the rare scattered spines.
- Fig. 2.* Part of upper surface of arm, natural size.
- Fig. 3.* Part of lower surface of arm, natural size.

LV.—*Some Alleged Cases of Misrepresentation.*
By F. A. BATHER.

MESSRS. C. WACHSMUTH AND F. SPRINGER have recently published an important theoretical paper* in which they do me the honour to discuss at length certain arguments concerning the anal plates of the Fistulate Crinoids that I advanced in this Magazine † a year ago. In this new paper they put forward views so different to those which they appear to have hitherto held concerning the homologies of various plates in the Crinoid calyx, that to reconsider the anal plates alone would no longer be possible, while a scientific treatment of the question would involve one in a very lengthy and far-reaching discussion. This discussion, the inevitableness of which I foresaw when writing the paper referred to, though I hardly guessed the turn it would take, is better deferred until the description of the Swedish and British *Fistulata* has been accomplished with some attempt at accuracy. By that time it is quite possible that my American friends may have again changed their front, while I shall certainly be surprised if my own ideas have not undergone some modification. For the present I wish merely to defend myself against certain accusations which, though they have no connexion with the truth or falsity of any theory, could not fail, if left unanswered, to damage my scientific reputation in the eyes of those who have not time to go fully into the subject.

On p. 325 of my paper on the classification of the Inadunata *Fistulata*, after giving an abstract of the controversy regarding the anal plate, I said: "The history of this controversy is curiously full of misunderstandings and misrepresentations. I hope that I have made no such mistakes: I have done my best to avoid them." Knowing the great pains that I took in the matter, I the more deeply regret to learn that, in the opinion of Messrs. Wachsmuth and Springer, my references to their writings were "inaccurate" and my representations of their views "astonishing," "faulty," and "ridiculous." I am sorry, but not altogether surprised, and I console myself with

* "On the Perisomic Plates of the Crinoids," Proc. Acad. Nat. Sci. Philadelphia, vol. for 1890, Part III. pp. 345-392. Published Feb. 1891. This paper is reviewed in the May number of the 'Geological Magazine,' 1891.

† "British Fossil Crinoids.—II. The Classification of the Inadunata *Fistulata*," Ann. & Mag. Nat. Hist. [6] v. pp. 310-334 and 373-486, April and May, 1890.

the thought that I am not the only person who has failed to grasp the meaning of these learned rather than lucid writers.

At the same time, on carefully comparing my account with their writings in the light of their recent criticism, I must confess, at the risk of exposing my dulness, that I cannot see very much to alter. I quite understand that the present ideas of Messrs. Wachsmuth and Springer are by no means those which I have attributed to them; but the question is not what they think, or even what they thought (or think they thought), but what they said, and what could be logically inferred from their statements. Let us then take their objections in order.

On p. 322 of my paper I gave certain extracts from their paper "On *Hybocrinus*, *Hoplocrinus* and *Baerocrinus*"*, and I said, "In this paper then the authors consider the 'azygos' plate to be an independent morphological element of the dorsal cup, *not* a modified radial." On this Messrs. Wachsmuth and Springer remark (p. 389) "We know of no passage in that paper from which Bather would be entitled to draw any such inferences . . . he should have quoted the exact language, and give [*sic*] the page where it occurs." Let it be noted that my statement was introduced as an inference from various passages, and that I did quote the exact language of those passages so far as seemed necessary. Now, however, I will quote more fully from their paper on *Hybocrinus* &c., giving the page, and will, for the benefit of Messrs. Wachsmuth and Springer, indicate the various stages of my argument.

P. 376, footnote. "In Revision I, pp. 65-75, we considered the combined right posterior radial and the azygous plate in *Dendrocrinus*, which in their position and proportions resemble the right posterior radial in *Cyathocrinus*, to be a compound radial. At that time we thought that the second, the so-called azygous plate, in *Dendrocrinus*, *Homocrinus*, and in the *Cyathocrinidæ* generally, was a modified radial, and also that the anal tube, possibly, had been developed from an arm. Upon these points we were evidently in error."

Conclusion. Wachsmuth and Springer think that the "azygous" plate in the *Cyathocrinidæ* is neither a modified radial nor part of a compound radial.

What then is it?

P. 368, lines 8-12. ". . . we hope to prove further on that the plates which constitute the azygous side, both special

* Amer. Journ. Sci. [3] xxvi. pp. 365-377, Newhaven, Nov. 1883.

anal plates and adjoining radial, had a common origin in all these genera, and were gradually evolved from a simple azygos plate."

Conclusion. (a) Wachsmuth and Springer think that an azygos plate existed in the dorsal cup of the *Fistulata* (to which group the context shows they are referring) before either the special anal [x] or the right posterior radial.

(β) Wachsmuth and Springer think that from this azygos plate both the special anal [x] and the right posterior radial were derived.

But is this azygos plate homologous with the azygos plate of *Dendrocrinus* and the *Cyathocrinidæ* generally?

P. 375. Figures 1, 2, 3, 4, 5, 6, 8, 9, representing "the arrangement of the plates of the azygos side in" *Baerocrinus*, *Hoplocrinus*, *Hybocrinus*, *Iocrinus*, *Dendrocrinus*, *Homocrinus*, *Poteriocrinus*, and *Eupachycrinus*. In each of these occurs a plate marked *a*. "*a*, azygos plate."

Conclusion. Wachsmuth and Springer consider that the azygos plate of *Baerocrinus* is homologous with that of other *Fistulata*.

P. 374, last par., continued on p. 375. This paragraph, which is really too long to quote in full, explains how the "large undivided azygos plate" of *Baerocrinus* "was gradually absorbed by the radial," *i. e.* right posterior radial, which in *Baerocrinus* itself "is not developed." This produces *Hoplocrinus*. In *Hybocrinus* the radial "has absorbed a greater portion," and "the upper left corner of the azygos plate has become divided off into a special anal plate."

Conclusion. (a) The azygos plate of *Baerocrinus* is the "simple azygos plate" of p. 368, from which the special anal and the right posterior radial were gradually evolved.

(β) Wachsmuth and Springer take *Baerocrinus* as the ancestral form, primitive in regard to its posterior side.

Summary of Wachsmuth and Springer's views.—There is in the *Fistulata* a plate not radial in origin, azygos in position, more conspicuous in the earlier forms; a plate that exists when even the radials are not fully developed, and from which another anal plate and a radial are evolved. So far then as the *Fistulata* are concerned this "azygos" plate is a primitive, independent morphological element of the dorsal cup.

This is the *rational* conclusion of a perfectly *consistent* hypothesis. But it is a conclusion which, when pointed out, does more than anything else to show the worthlessness of the assumptions on which it is based. Messrs. Wachsmuth and Springer are now as much astonished at it as I was, and

I am fully prepared to admit that they meant nothing of the kind; but language, not thought-transference, is the only recognized medium of scientific communication.

To return to my paper. On p. 324, in summing up the position which Wachsmuth and Springer held in 1886, I said: "(1) Azygos plate (Az) a primitive element of dorsal cup." On this they say (p. 390) "A careful examination of both sections of Pt. III of the Revision, will show nothing to justify Bather in assuming that we regarded the Azygos as a 'primitive element.' We only stated on p. 11: 'the lower segments (of the compound radials) are probably embryonic plates, which were resorbed by the upper segments.'"

My meaning was quite clearly explained on p. 323. In their own words [Revision III. (p. 12), Proc. 1885, p. 234] "the azygos piece may represent the lower segment of the posterior radial;" but [Rev. III. (p. 11), Proc. 1885, p. 233] "the lower segments are probably embryonal plates." For the rest they repeat in 1885-6 what they said in 1883, adding [Pag. cit., footnote] "For further information on *Baerocrinus* and the gradual resorption of the azygos and anal plate in the Inadunata generally, we direct attention to our paper on *Hybocrinus*, *Hoplocrinus* and *Baerocrinus*."

Now a structure that is "embryonal" or (as they now prefer to quote) "embryonic" is usually regarded as primitive or ancestral. Certainly it is so regarded when there is nothing said to the contrary, and when it is more highly developed the earlier the form. It was therefore natural to suppose that Wachsmuth and Springer regarded the Azygos plate as an ancestral or primitive structure; and when I found that on the question of the evolution they still stood by their previous paper, I had no hesitation in stating this conclusion.

It really seems to me, now that I read Messrs. Wachsmuth and Springer's protest, that they must attach to the word "primitive" some sense with which I am not yet acquainted.

Next I said (p. 324):—" (2) Anal (x) and right posterior radial derived from azygos plate." This Messrs. Wachsmuth and Springer (p. 390) regard as "equally inaccurate." But if I had said "derived from the *undivided Azygos in Baerocrinus*" I should have expressed their views.

Since, however, the "azygos" of *Baerocrinus* is admittedly homologous with the azygos plate of other *Fistulata*, I fail to see where the difference comes in.

In 1886 Messrs. Wachsmuth and Springer wrote as follows

[Rev. III. (p. 196), Proc. 1886, p. 120]: "it is probable that one of the non-armbearing so-called radials [in *Baerocrinus*] represents an azygous plate, such as we find in most of the *Fistulata*, that the right posterior radial and the anal plate were as yet undeveloped, and that *Baerocrinus* had but four radials. This interpretation of the plates, it seems to us, is corroborated by the gradual disappearance of the azygous plate among allied forms in palæontological times, and by the contemporary increase in the dimensions of the right posterior radial and the anal plate. The two latter pieces were absorbed from the azygous plate: at first the posterior radial, which in *Hoplocrinus* took the right upper corner, the left side remaining intact; afterwards in *Hybocrinus* the anal piece, which absorbed the left corner of the plate also." This seems quite clear; the azygos plate is absorbed in *Hoplocrinus* and *Hybocrinus*.

But the footnote on the same page is even clearer. The anal of *Antedon* and the azygos of *Baerocrinus* "both agree . . . in being absorbed by other plates; the azygous plate palæontologically by the right posterior radial and anal plate, the other in the growing animal over the whole surface." Now this means that in the evolution of the *Fistulata* the plate in the successive genera homologous with the azygos of *Baerocrinus* was gradually absorbed by the radial and anal.

But why mention *Baerocrinus* at all?

On p. 40 of Revision III. (Proc. 1885, p. 262) Wachsmuth and Springer say "In our chapter on the radials we have already alluded to the azygous piece, and expressed our conviction that its gradual resorption gave origin, not only to the right posterior radial, but also to the anal plate." Why, let me ask Messrs. Wachsmuth and Springer, did they omit all reference to *Baerocrinus* in this passage? Presumably because this perpetual insertion of the name *Baerocrinus* would make nonsense; for they cannot mean to say that the anal of the Carboniferous *Scaphiocrinus iowensis* has absorbed part of the azygos of the Ordovician *Baerocrinus Ungerni*. When did it cross the Atlantic to collect fossils in the *Brand-schiefer* of Erras?

Again I said (p. 324): "(3) Anal of *Antedon* not homologous with any plate of the *Fistulata* but an embryonic inter-radial." This statement of their views is they say (p. 390) "more faulty yet. To agree with Pt. III of the Revision it should be amended as follows: Anal plate of *Antedon*

larva *homologous* with plate x of the *Fistulata*, and interradial in position."

I am willing to admit that their present statement is quite consistent with Part III. of the Revision, and had they chosen to say as much in that work I should not have been led astray by the following considerations.

In their paper on *Hybocrinus*, *Hoplocrinus* and *Baerocrinus*, p. 377, they said "the 'anal' plate of the young *Antedon* is evidently not the homologue of the plate in the *Cyathocrinidæ* which we have designated as the 'special' anal plate, but . . . it is the equivalent of the undivided azygous plate in *Baerocrinus* and *Hoplocrinus*." On this they subsequently remarked [Revision III. (p. 196), footnote; Proc. 1886, p. 120] "In making this statement we had overlooked the fact that the latter plate* is simply an interradial with special function, while the azygous plate in *Baerocrinus* is as much radial as interradial." If they had meant what now they say they meant, they should have taken this opportunity of stating that they then considered the anal plate of *Antedon* to be homologous with the special anal of the *Cyathocrinidæ*. That certainly was not what I inferred from the above-quoted footnote: for, I argued, if the azygos of *Baerocrinus* is as much radial as interradial, so also is the special anal plate that was once a part of it; but the anal of *Antedon* is *simply an interradial*, therefore it cannot be homologous with the special anal of the *Cyathocrinidæ*.

In an earlier part of Revision III. (p. 39) published in 1885 (Proc. p. 261) they had laid some emphasis on the distinction between "interradials" and "the one true anal plate," and, although it is quite true that they compared the various positions assumed during growth by the anal of *Antedon* with the positions occupied in the evolutionary series by the anal plate of the *Fistulata*, still they never definitely stated the homology.

Even the sentence which they now (p. 390) quote from Rev. III. p. 40, that "at last in *Cyathocrinus* the latter plate [Azygos] was entirely removed, and the anal plate took the position of that in the larva of *Antedon*," does not necessarily imply homology; had they said "the anal plate took the position that it occupies in the larva of *Antedon*," this would have shown that they considered the two plates homologous. I, reading the sentence in the light of their subsequent footnote, naturally supposed that the ambiguity of its wording was intentional.

* Anal of *Antedon* larva.

I have already alluded* to my omission on p. 323 of the words "in *Baerocrinus*" from their statement that the Azygos plate is as much radial as interrarial, but Messrs. Wachsmuth and Springer will not accept my explanation. They now say (p. 390), "We stated correctly that the 'Azygos of *Baerocrinus* is neither radial nor interrarial' for it rests between two radials and alternates with the basals; but to say the same thing of *Homocrinus*, *Dendrocrinus*, etc. would be ridiculous."

Whether correctly or no, Messrs. Wachsmuth and Springer never did use the words which they have here put between inverted commas, but they used the same words as I used, although I did not put them between commas. It is odd, by the way, that they should misquote themselves three times on one page.

They were (in 1886) contrasting the anal of *Antedon* with the azygos of *Baerocrinus*; the former they said was simply an interrarial, the latter as much radial as interrarial. Remembering that only three years before they had dropped the radial origin of this azygos plate, they now wished to correct themselves; consequently the important point in the 1886 statement seemed to be the partly radial position of the azygos plate in *Baerocrinus*. But they continued to speak about the palæontological history of that plate, calling it merely the azygos plate. In this latter half of the paragraph, as I have pointed out, they extended the term to all *Fistulata*. I naturally supposed that if there were any importance in this partly radial position of the azygos in *Baerocrinus*, it lay in the fact that the azygos as a morphological entity was partly radial in position. That I was right in my supposition is proved by various passages in the present paper, where they lay stress on the fact that the azygos plate invariably alternates with the basals.

As to the point that it would be ridiculous to say the same thing of *Homocrinus* and *Dendrocrinus*, I reply that it is ridiculous to say that this plate is interrarial in *Baerocrinus*; it is only interrarial in the same sense as that in which any radial may be said so to be. If, however, it could ever be correctly called interrarial, so could the azygos plates of *Hoplocrinus* and *Hybocrinus*, and where exactly the line should be drawn I do not see.

I therefore maintain that I was justified, when *summarizing*, in the omission of special reference to *Baerocrinus*.

* Ann. & Mag. Nat. Hist. [6] v. p. 486.

I hope that I have now successfully defended myself against the charges of misrepresentation, though I may not be acquitted of obtuseness. There still remain, however, a few points in the body of Messrs. Wachsmuth and Springer's paper to which I must regretfully take some exception.

On p. 377 they say of me "He agrees with us and Carpenter that the radial anal plate, the so-called azygous piece, constitutes primarily the lower portion of the right posterior radial, which in the earlier forms occupies a position immediately below the radial." This represents with perfect accuracy the view given in my paper; it represents I believe the view of Dr. Carpenter; it may, for all any one can tell, represent the present view of Messrs. Wachsmuth and Springer;—but I deny that it represents their views of 1883-5-6, which were the last that had appeared when I published. According to those views the earlier forms were *Baerocrinus*, *Hoplocrinus*, and *Hybocrinus*; but in *Baerocrinus* there was, they said, no right posterior radial at all; while in the other two the radianal is certainly not immediately below the radial. This difference was all-important from my point of view, and if Messrs. Wachsmuth and Springer *now agree with me* I am glad to hear it, but they have come to the opinion of Carpenter and myself, not I to theirs.

On p. 380 they say "Mr. Bather assumes, as before stated, that the anal plate, the plate *x*, is derived primitively from a brachial &c." I should not venture to *assume* anything so important; my *conclusion* was arrived at after eleven pages of discussion and argument. The essential part of my conclusion was that the plate *x* passed down into the dorsal cup from above; the idea that it was derived from a brachial and the name "Brachianal" followed as corollaries, but nothing depended on them in the subsequent discussion as to Phylogeny and Classification.

On p. 381 Messrs. Wachsmuth and Springer say "We must also protest against his statement on p. 324. There, in summarizing our position on the anal question, he says under *Iocrinus*: 'Radial growing larger at expense of Azygos, and here has *absorbed x*;' while the fact is we have always held, and have said so, that this plate *x* was *unrepresented* in *Iocrinus* and was as yet *undeveloped*"*. In reply to this I need only refer Messrs. Wachsmuth and Springer to their own paper on "*Hybocrinus, Hoplocrinus, &c.*," p. 370, second paragraph, line 15. Here, on the subject of *Iocrinus*, they

* The italics are Wachsmuth and Springer's, *not mine*.

write: "We admit that the so-called postero-lateral radial (fig. 4 a) is not articulated to the bifurcating plates [*sic*] but united with it by suture; we insist, however, that the latter cannot be an azygous plate, as suggested by Carpenter,—nor is it a brachial—but that it is the equivalent of the combined small radial, and small anal plate in *Hybocrinus*." Again, *op. cit.* p. 376, first paragraph, "In *Iocrinus* . . . we suggest that possibly the radial may embrace an undivided anal piece." Whether they suggested or whether they insisted is immaterial; but if they did not mean that the anal *x* was represented in the right posterior radial, what that can be expressed by language did they mean?

On p. 383 they say "We cannot understand how Bather on p. 330 of his paper could conclude from the structure of *Ectenocrinus*, which he has regarded as one of the most 'primitive forms,' that *x* 'originated as a plate morphologically corresponding to an ordinary brachial.'" Now *Ectenocrinus* is not mentioned on p. 330 of my paper; the genera adduced are *Iocrinus* and *Merocrinus* and, in a less degree, *Heterocrinus*. On p. 379 of the same paper it is argued that *Iocrinus* and *Merocrinus* are more ancestral than *Heterocrinus*, and *Heterocrinus* than *Ectenocrinus*. "Comment," says the critic, "is needless!"

On pp. 384–5 they criticise my expression "the shifting of the radianal," and I agree with their criticism; but they might have alluded to the fact that on p. 78 of Revision I. (Proc. 1879, p. 301) it is stated that in *Homocrinus* "the lower portion of the compound plate is pushed slightly to the rear," and that on p. 40 of Revision III. (Proc. 1885, p. 262) is written "In *Poteriocrinus*, *Eupachyrcinus* and *Zaacrinus* the azygous plate is . . . completely pushed out of the radial position which it had previously occupied." But no doubt they did not mean this when they wrote it.

On pp. 383 and 386 they ascribe to me some "theory" that "the ventral sac represented a modified arm." So far as I am aware, the only people that have ever held this theory have been Messrs. Wachsmuth and Springer themselves; and of it I said (p. 331) "this view is as unnecessary as it is untenable."

In conclusion, I trust that no readers of this defence will suppose that the theories of Messrs. Wachsmuth and Springer are in the smallest degree invalidated by it. It is just because human nature is so apt to substitute personality for abstract truth, and to be prejudiced by quite unessential but distracting details, that I have thought it advisable to treat these disturbing questions apart from the real discussion.

When time is ripe for that, I venture to hope that it will not be necessary for my very friendly antagonists to lay so much stress upon misrepresentation.

LVI.—*Insect-Larva* (*Cecidomyia*, *sp.*) *eating Rust on Wheat and Flax.* By N. A. COBB and A. SIDNEY OLLIFF*.

ON many specimens of rusted wheat received from various parts of New South Wales we have noticed an orange-coloured larva. Our attention was first called particularly to these larvæ by the fact that they were invariably more common on the rusted plants. The orange colour of the larger of these larvæ would naturally suggest at once some connexion between them and the rust, which is also orange-coloured. This, in fact, had already been the case, one farmer averring most positively that these larvæ were the cause of the rust. This conclusion, founded on colour resemblance alone, could have little, in fact almost no weight, and we were inclined to regard the colour as deceptive, like the red coloration on fence-rails, and felt ourselves fortified in that position by the knowledge that these larvæ were probably *Cecidomyia* larvæ and would very likely be found to live on the juices of the wheat-plant. Later, however, specimens of rusted linseed were received, and on these also the same orange-coloured larvæ were found. We say the same, because on placing them side by side with larvæ from rusted wheat we could detect no difference. If these larvæ fed on the juices of plants, it was somewhat remarkable that the same species should be found on such different plants as wheat and flax. On the other hand, both these plants, though widely different from each other, were attacked by a rust in its *Uredo*-stage, and the *Uredospores of the rust were very similar*. This fact led to the suspicion that the rust-spores might be the food of the larvæ and to the following experiment. A moist chamber was partly filled with water, and in the midst of the water a piece of lead was so arranged as to form a miniature island about one fourth of an inch across. A fresh cutting was then taken from a wheat-leaf in such a manner as to include on its surface a single *Uredo* sorus. This cutting, one eighth of an inch wide and one quarter of an inch long, was placed on the miniature island together with three larvæ of the *Cecidomyia*. The larvæ were taken from a rusted linseed plant, and pains

* From an advance proof, communicated by the Authors, from the 'Agricultural Gazette of New South Wales,' vol. ii. part 2. By authority. Sydney, 1891.

was taken to place them on the lead and not on the wheat-cutting. Finally a glass cover was laid over the chamber, to prevent evaporation, and thus keep the wheat-cutting from withering. The object of the experiment was to ascertain how these little larvæ would behave towards the wheat-cutting and the rust-pustule on it. After about an hour, during which time no note was taken of the movements of the larvæ, the chamber and contents were placed under the microscope, when all the larvæ were found at the rust-pustule, and one of them was unmistakably feeding. The larva took one spore after another, and made very short work of each. It remained uncertain whether other food was taken, but it seemed very improbable. The operations were distinctly seen.

These interesting facts give rise to the following deductions:—In the first place it could hardly have been accidental that all three of the larvæ after one hour had found their way to the single accessible rust-pustule, which could not have been above half a millimetre in diameter. Their arrangement (one on top of another) was exactly that common to greedily feeding animals. It is therefore probable that the two larvæ which were not observed to actively feed had already satisfied their hunger.

Secondly, it is established that these larvæ will, at least under some circumstances, feed on the rust-fungus, apparently in preference to perfectly fresh tissues of the wheat-leaf.

Again, it must be borne in mind that the larvæ experimented with were taken from a rusted linseed plant. This goes to show that it is the rust that is sought rather than the juices of any particular plant.

Of course these experiments should be repeated and extended; but no opportunity has occurred to us for this, and it is not likely that they can be repeated until next season.

We shall endeavour to breed these larvæ, so as to obtain the perfect insect. Observations will be made on its habits, with the object of ascertaining more exactly the relations of the insect to rust. If it is found to live exclusively on the rust-fungus, then, so far at least, it is beneficial to the wheat-grower. If, however, it should be found in its wanderings to carry the rust-spores about on the surface of its body, and thus distribute the fungus, it would in that respect be harmful. We have no evidence of this, their bodies having been in all cases found clean and free from adhering spores; however, not very much attention has yet been given to this latter matter.

An idea has occurred to us almost purely speculative, but

which we give for what it is worth. It is well known that the Hessian fly, which also belongs to the genus *Cecidomyia*, is the worst enemy to the wheat-crop in the United States, while rust does much less damage there than in Australia. In this country the reverse is true; rust is the great evil, while the Hessian fly is at present unknown*. Have these facts any relation to each other? Taken in the light of the above observations on a species of *Cecidomyia* feeding on rust, it may not seem too fine-spun a speculation if we suggest that there may be a connexion. Let us suppose the larvæ of the Hessian fly to prefer rust as food if available, but to fall back on the juices of the wheat-plant when the rust gives out. This might account for the comparative rarity of rust where the Hessian fly is abundant, which is the case in America. All this is from the mountain-top of speculation. If, however, it should lead to an excursion into the valley of observation and experiment, some good may come of it.

Not that we would suggest the introduction of the Hessian fly for the sake of getting rid of the rust, even if the above suggestion should turn out to be well founded. We would, however, call attention to the need of further observations on the relations between fungi on the one hand and insects and mites on the other. It has already often been noticed that certain fungi are commonly accompanied by certain insects and mites. What, if any, is the relationship in these cases?

It remains to describe these larvæ in such terms as to make them recognizable to other observers. In this we are aided by the four accompanying illustrations.

The larva undoubtedly belongs to the family Cecidomyidæ, and in many respects, if the published figures are to be trusted, it comes very close to the larva of the true Hessian fly (*Cecidomyia destructor*, Say). It is composed of twelve segments, exclusive of the head and the so-called "supplementary segment," and possesses the characteristic two-jointed antennæ as well as the curious thoracic appendage called the "breast-bone" or "anchor-process." The head is retractile and is capable of being withdrawn within the first thoracic segment; and in every other structural detail it coincides with what we know of the larvæ of the genus *Cecidomyia*. An examination of these specimens clearly shows that the "supplementary segment" pertains to the head and not to the thorax. No further proof of this assertion is required than the statement that the eye-spots are situated in this additional somite. In the illustration the eye-spots appear to be within the ante-

* The pest has, however, been recorded from the Wellington district, New Zealand, where it is said to have caused much damage.

rior margin of the first thoracic segment; but this is not really the case. The appearance is deceptive, and is merely due to the fact that the "supplementary segment," or, more correctly, the hinder division of the head, is partly withdrawn into the first thoracic segment. Our larva has the protrusile labium which is common to all the species of the family, and the anal segment of the body is provided with a retractile organ, which probably assists the larva in locomotion. We did not observe that this particular larva possessed the power of jumping, as some of its allies are said to do. When young the specimens were dull white in colour, but afterwards they turned to a bright orange-yellow. In the latter state they measured $1\frac{3}{4}$ millimetres; but perhaps they were scarcely full-grown.

In explaining, more particular reference is made to the side or profile view (fig. 1). This figure shows the head and part of the thorax of a young larva. The thoracic rings bear rows of bristles, so that the beginning of the thorax is readily made out. In the illustration the head is not fully extended; therefore the eyes, two collections of dark-coloured granules just in front of the brain, appear as if situated in the first segment of the thorax. The downward-pointing nozzle is seen in front, and on the forehead above it two finger-shaped feelers or antennæ. The jaw-muscles, situated inside the forehead

just behind the antennæ, are attached to the mouth-parts below and to the wall of the head above. The most conspicuous feature of the head, however, is a pair of dark-coloured three-pronged pieces of horn (of which only the nearer one is shown in the large profile view), so arranged as to form a supporting framework for the attachment of muscles, one prong extending forwards to near the mouth-parts, another extending backward and thinning out in the region of

Fig. 1.



Head and Prothorax of young *Cecidomyia* Larva (profile).

Above a single rust-spore proportionately enlarged.

the eyes, and a short third passing upward and inward and articulating with a long slender piece of horn whose front attachment is near that of the jaw-muscles on the forehead.

This framework, by its strength and elasticity, preserves the form of the head and serves at the same time for the attachment of muscles mostly retractive. Thus the free ends of the hindmost prongs serve for the attachment of at least three pairs of muscles:—(1) fan-shaped

muscles, passing downward and serving to lift the head; (2) narrow muscles, passing forward and serving to retract the front portion of the head; (3) narrow muscles, passing backward and aiding to retract the whole head, an operation in which they are assisted by muscles attached anteriorly to the short prongs of the framework and posteriorly to the upper part of the body-wall of the thorax.

The most striking feature in the thorax is the peculiar "breast-bone" (fig. 2) found on the lower part. Seen from the side this organ seems to be of nearly uniform size throughout and to be forked in front. Seen from below, however, it is found to be wider in front, where it ends in a distinct and somewhat heart-shaped head. This breast-bone stiffens the thorax, and very likely serves other purposes. Fig. 1 also shows the anterior thoracic stoma; the oval above and to the right shows the relative size of a rust-spore (*Puccinia rubigo-vera*).

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Note.—Since the above was written we have seen larvæ on plum-leaves feeding on the spores of *Puccinia pruni*, and others on the rusted leaves of *Bidens pilosus*, which appear upon careful microscopical examination to be identical with those here described.

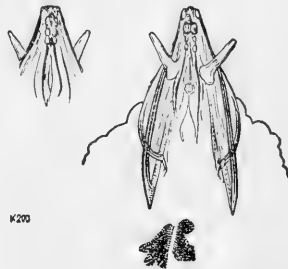
Fig. 2.



X200

Breast-bone or Anchor Process.

Fig. 3.



X200

Head, showing Mouth-parts.
(Dorsal and ventral views.)

LVII.—*Descriptions of new Genera and Species of Pyralidæ contained in the British-Museum Collection.* By W. WARREN, M.A., F.E.S.

[Continued from p. 438.]

UGRA, Wlk.

Type *U. parallela*, Wlk. xxvii. p. 188.

Ugra angustipennis, sp. n.

Fore wings very long and narrow, of nearly the same width throughout, sandy rufous, rather brownish along the costa, with two pale fasciæ, one curved near the base, the other starting from the costa at three fourths and bowed outwards, reaching the inner margin just before the anal angle; fringe slightly paler, with a darker middle line. Hind wings dull ochreous white, without markings, the base of the fringes alone darker. Head and thorax concolorous; abdomen absent; palpi long, dark reddish brown. Underside of fore wings dull reddish grey, of hind wings as above, but with the costa reddish.

Expanse of wings 20 millim.

One female in the Grote collection, from Colorado, unnamed.

BLEPHAROCERUS, Blanch.

Type *B. rosellus*, Blanch., Gay's Chili, vii. p. 102, pl. vii. fig. 12.

Blepharocerus (?) *cinerosus*, sp. n.

Fore wing ochreous grey, dusted with dark fuscous; first line dull ochreous, curved, second sinuous, forming a large outer and a small inward curve near the inner margin; the dark fuscous scales more thickly collected on either side of the lines, especially beyond the second line, where the lower part of the hind-marginal space is conspicuously darker; base of fringes also darker. Hind wing the same, but without the darker masses of shading, and with a very faint trace of a paler line. Head and thorax ochreous grey; abdomen and underside fuscous and grey.

Expanse of wings, ♀ 24 millim.

The costa at the base is rather abruptly bulged and slightly concave in middle.

One female from Chili.

Blepharocerus sabulosus, sp. n.

Fore wing sandy ochreous, dusted with darker, with the two transverse lines just visibly paler, curved and slightly angulated at one third from the inner margin, rather darker on the extreme costa; base of fringes, which are concolourous with ground-colour of wings, preceded by a row of dark indistinct dots. Hind wing like the fore wing, but dusted with fuscous; base of fringes more continuously darker. Head, thorax, and abdomen, underside and legs, all ochreous, dusted with darker, but fore tibiæ and tarsi darker, with segments only lighter.

Expanse of wings, ♀ 22 millim.

One female from Chili.

CONDYLOLOMIA, Grote.

Type *C. participialis*, Gr. Bull. Buff. Soc. N. Sc. i. p. 176, pl. v. fig. 45.

Condylolomia dubia, sp. n.

Closely allied to *C. participialis*, Gr., from North America, but with the front wings narrower, costa straighter, more pronounced apex, and obliquer and straighter hind margin: fore wings redder, only pale at the base of the inner margin, with two indistinct darker fasciæ, the first basal oblique, fading away in the middle of the wing, the second oblique, sinuous and recurved towards the costa; fringe reddish brown. Hind wings grey, paler than in *C. participialis*.

One female from Rio Janeiro, of the same size as *C. participialis*. In that species, of which only three males are in the British-Museum Collection, there is no trace of a basal fascia, and the second is represented by a *pale* upright curve, internally darker edged.

PYRALIS, Linn.

Type *P. farinalis*, Linn.

The species of Treitschke's genus *Asopia*, as given by Lederer, follow two type forms:—(1) those with the labial palpi simply upcurved in front of the forehead and concave to it, the terminal joint being pointed and continuing the curve; (2) those with the labial palpi at first ascending, but with the third joint thrown forwards, and so breaking the continuity of the curve. For the one I retain the Linnean term *Pyralis*, and for the other adopt Hübner's generic name *Hypsopygia*.

Pyralis albiguttata, sp. n.

Ground-colour purplish chestnut, rather glossy. Fore wing with the transverse lines white, the first narrow, vertical, nearly straight, at one third, very slightly swollen at the costa; the second rises as a white oval spot on the costa, is interrupted in midwing, and reappears towards the anal angle as a narrow, curving, white streak; costa between the two lines spotted light and dark. Hind wing with two curved whitish lines, which are nearer to each other on the inner margin than on the costa: fringes of both wings concolorous, with a broad dark basal line. Face, palpi, front of thorax, and base of antennæ pale ochreous; thorax and abdomen purplish. Underside purplish fuscous, with all the pale markings showing through.

Expanse of wings 16 millim.

One male from Wada-togá, Japan.

Akin to *P. lienigialis*, Zell.

Pyralis abilaotalis, sp. n.

Fore wing: ground-colour brownish grey, more or less sprinkled with white, especially towards the costa, between the two transverse lines, the basal and marginal areas being dark fuscous, untinged with white, the latter with a slight violet tint before the apex; the two transverse lines distinctly white, the first regularly curved outwardly, the second forming a deep sinus outwardly in the middle of the wing; a row of dark spots at the base of the fringes, which are *white*; a dark discal spot of varying intensity. Hind wing also brownish grey, but with less of the brown; a curved *dark* fuscous central band, bulging outwards in the middle, distinctly edged with two white lines; the space between the outer line and the hind margin more or less clear white, except at the apex and anal angle, which are darker fuscous; fringes white. Head and thorax cinereous; first two segments of abdomen dark, the rest reddish. Underside darker, reddish fuscous, with the second line only distinct.

A small species, about the same size or even less than *P. domesticalis* and *P. perversalis*, easily recognized by the white dusting. It may be akin to Zeller's *cæsalis*, also from South Africa, but in that species the transverse lines are said to resolve themselves into white spots.

Three specimens from Natal.

Pyralis oleagina, sp. n.

Fore wings glossy dull ochreous, suffused with greyish, darker along the costa, with two slightly paler ochreous transverse lines, the inner edged externally, the outer internally with darker; the first at one third is slightly bent outwards in the middle; the second from two thirds is nearly straight to the inner margin before the anal angle, with a slight unevenness near the middle; a round black discal spot; costa between the lines indistinctly dotted with fuscous and ochreous; a row of fine black lines before the base of the fringes, which are dull rosy. Hind wings like the fore wings. Head, thorax, and abdomen concolorous with wings. Underside brighter, not glossy; of the fore wing pinkish yellow, of the hind wing clear yellow, in both sprinkled with grey or blackish atoms, each with a central black dot and the outer line pinkish.

Expanse of wings 16 millim.

One female from Natal.

Distinguished by the dull greasy appearance and the roundedness of the costa, apex, and hind margin.

Pyralis tabidalis, sp. n.

Fore wing dark mouse-colour, in certain cases strongly flushed with reddish; the two lines paler, ochreous, first at about one third outwardly curved, the second at three fourths nearly straight, with only a slight flexion below the costa; centre of costa pale-spotted; central spot dark; central field slightly paler than basal and marginal; fringe pale, with a darker basal line. Hind wings like fore wings, but with the dark and lighter spaces reversed, the central band, which is much narrower, being the darker.

Expanse of wings, ♀ 24, ♂ 20 millim.

Three females and one male from Callao.

Pyralis monostæchalis, sp. n.

Fore wings dull blackish brown, the costa spotted with pale; a single central, slender, slightly undulating, whitish, transverse line, and traces of a fainter sinuous curved one before the hind margin. Hind wings without any markings. Thorax, abdomen, and underside of both wings concolorous; face and palpi dull yellowish.

Expanse of wings 16 millim.

Three examples, all females, from Dharmasala; from the Hocking collection.

EUTRICHODES, gen. nov.

Fore wings with costa slightly curved, apex blunt, hind margin obliquely curved. Hind wings long and narrowed, with round hind margin. Tongue developed; palpi upright in front of face, considerably above the head; terminal joint slender, pointed; antennæ (female) filiform. Hind wings with the inner margin armed with erect tufts of black scales; fringes very long, spatulate at their extremities.

Type *E. ravolalis*, Wlk. (*Pyralis*).

HYPANCHYLA, gen. nov.

Fore wings with costa shouldered at base and hollowed out along the middle third, between the origin of the two transverse lines; apex bluntly rounded; hind margin obliquely curved, with a slight elbow in the middle. Hind wings bluntly triangular, the hind margin nearly straight, the apical and inner angle somewhat produced. Antennæ in male finely ciliated, the basal joint enlarged; palpi rather thickly scaled, upcurved in front of face; second joint hairy beneath; terminal joint quite short; tongue well developed; neuration apparently normal, the costal vein running rather remote from the costa and being very slightly deflexed beneath the central hollow.

Type *H. maricalis*, Wlk. (*Pyralis*).

A development of *Pyralis*, Linn., and related to *Scenedra*, Meyr., and *Eutrichodes*, Warr.

ARTA, Grote.

Type *A. statalis*, Gr. Bull. Buff. Soc. N. Sc. ii. p. 230.

Arta rubricalis, sp. n.

Fore wings brick-red, with two pale transverse lines, the first basal, oblique, parallel to hind margin, externally edged with darker, especially on the inner margin; second line curved, with a slight indentation above the inner margin, twice as near the first line on the costa as on the inner margin, the space between them slightly darker than the rest of the wing; fringe reddish, with a basal row of small distinct black dashes. Hind wings and fringes glossy, whitish. Head and thorax reddish; abdomen greyer and paler. Underside pale ochreous, with the costa in both wings bright reddish dusted with yellow.

Two females from S. Paolo, the same size as the two North-American species *statalis* and *olivalis*, Grote.

HYPSOPYGIA, Hüb.

Type *Hypsopygia glaucinalis*, Linn. (*Pyralis*).

Hypsopygia sericea, sp. n.

Fore wing pale fuscous, glossy, rather transparent; the costa reddish brown to the apex, dotted between the two transverse lines with yellowish; these likewise are reddish brown, the first slightly curved outwards, the second straight, followed immediately by a paler space, which scarcely forms a pale line; a red-brown cellular dot; fringes unicolorous, with a very fine basal line. Hind wing paler, silky grey, with both lines reproduced, grey-brown, nearly meeting on the inner margin. Abdomen concolorous with hind wing, head and thorax with fore wing; antennæ with very fine long ciliations; tegulæ prolonged. Underside of body reddish fuscous: underside of wings darker than upper; with the outer line distinct in both, followed by a paler space.

One male, Darjiling.

Resembles *glaucinalis* in size, but smoother and more silky.

Hypsopygia japonica, sp. n.

Akin to *Hypsopygia placens*, Butler, also from Japan, but of quite a different colour; whereas that species is bright pale pink, with the markings and fringes bright yellow, the present species is dull pinkish cinereous, so much suffused with grey as almost to lose all the pink tinge; the two curved lines just paler, much nearer to one another on both wings, and with the intermediate space darker; fringes dull yellow, with the basal line and extreme hind margin dull reddish; head, thorax, and abdomen concolorous. Underside dull grey, with a reddish tint; the costal dots and base of the fasciæ showing paler. Hind wing with a single central curved dark line, edged externally with paler.

Expanse of wings 24 millim.

One male from Japan.

GALASA, Walker.

Type *G. rubidana*, Wlk. xxxv. p. 1802.

Galasa major, sp. n.

Resembles *G. rubidana*, Walk., but a third as large again, the costal concavity much slighter, the colour there not white, but grey; ground-colour not so deep a red; the two transverse lines not so distinctly marked, the space between them on the costa grey; a distinct black dot beyond the first line. Hind wings dull ochreous whitish, with the apical margin fuscous and fringes again paler; a small black dot near the base. Head and thorax reddish; abdomen dark grey. Under-side of fore wings and apex of hind wings reddish, hind wing whitish, with the costa grey; origin of both fasciæ plainly indicated on the costa of *both* wings.

Expanse of wings 24 millim.

One female from Columbia, in the Zeller collection.

HOLOPERAS, gen. nov.

Fore wings with costa very strongly curved from base to apex, which is blunt; hind margin obliquely curved. Hind wings rounded, broader than fore wings. Antennæ in female moniliform; labial palpi porrected; tongue present; middle and hind tibiæ fringed with tufts of hair.

Type *Holoperas innotata*, Warr.

The genus is akin to *Galasa*, Walk., but differs mainly in having the costa strongly convex, while in *Galasa* it is very visibly concave.

Holoperas innotata, sp. n.

Fore wings dull reddish grey, with darker dusting; faint traces of two transverse paler fasciæ at one third and two thirds. Hind wing dark grey. Head, thorax, and palpi reddish grey; abdomen simply dark grey, like the hind wings. Underside dull dark grey, the hind wings, except on costa, lighter; tufts of the tibiæ blackish.

Expanse of wings 26 millim.

One female from Columbia, in the Zeller collection.

ULIOSOMA, gen. nov.

Characterized at once by the abdomen of the male, which bears on each side a twisted tuft of yellowish hairs, rising from its base and extending beyond the tip of the abdomen itself. Fore wing short and broad, sharply convex close to the base and slightly concave in the middle; apex bluntly rounded; hind margin nearly vertical; labial palpi porrect,

drooping, comparatively large; tongue, ocelli, and maxillary palpi invisible; forehead with a projecting fringe of hairy scales; antennæ broken; hind tibiæ with a broad expanding tuft of hairs in the middle.

Type *Isopteryx discoloralis*, Wlk. xxxiv. p. 1315.

[To be continued.]

LVIII.—On the Galapagos Lizards of the Genus *Tropidurus*.
By G. A. BOULENGER.

I HAVE lately reexamined the specimens of *Tropidurus* brought home by Darwin and Commander Cookson, with the view of testing the value of the supposed new species from the Galapagos Islands recently described by Cope* and by Baur †. The specimens known from the Galapagos Islands were referred by Steindachner and myself to two species, *T. Grayi*, Bell, and *T. pacificus*, Sldr., the form with two light dorsal stripes described by Peters in 1871, from Chatham Island, as *Craniopeltis bivittata* being regarded as a variety of *T. Grayi*. It is this very form which has been redescribed, from the same island, by Cope under the name of *Tropidurus lemniscatus*, sp. n., without any reference whatever to Peters's description. What is almost worse is Baur's bold statement, "Ueber *Tropidurus (Craniopeltis) livittatus (sic)*, Peters, dessen Fundort unbekannt ist ‡, kann ich kein Urtheil abgeben." Is it too much to expect from herpetologists in America that they will look up the literature, and avoid quoting, as if seen by them, works to which they have not referred, as is evidently the case with Dr. Baur? I should also like to know where the latter gentleman has found *T. pacificus* quoted by me from Albemarle. I do not believe in most of the characters set forward by Baur to distinguish different species in the different islands; his statements are to a great extent contradicted by the typical specimens themselves, as when he says that the striped form, from Chatham Island, has 55–61 scales round the middle of the body, and that the specimens with 65 scales

* Proc. U. S. Nat. Mus. xii. p. 145 (1889).

† Biol. Centralbl. x. p. 475 (1890).

‡ Peters states in his original description, "Das einzige mir vorliegende Exemplar . . . stammt von der Galapagosinsel Chatham" (MB. Berl. Ac. 1871, p. 645.)

mentioned by me will prove to belong to the Charles-Island form, which has no stripes, whereas as a matter of fact it is precisely our unique adult striped individual (*T. bivittatus* = *lemniscatus*) which has the 65 scales. Here again we see that Baur has omitted to refer to Bell's original description in the 'Zoology of the 'Beagle,'' where *T. Grayi* is figured in a perfectly recognizable manner; otherwise he would not have been embarrassed to guess whether the name *Grayi* was made to apply to the striped form rather than to the spotted one. And finally, whilst I trust nobody will contest the accuracy of the localities given by Commander Cookson, accompanied by dated labels, the specimens from Abingdon Island agree perfectly with Bell's *T. Grayi* and Steindachner's *T. pacificus*, forms held by Dr. Baur to be restricted to Charles and Bindloe respectively.

As the striped form, *T. bivittatus* (*T. Grayi*, spec. *b*, of my 'Catalogue'), appears to be distinguished constantly, apart from the coloration, by its larger scales on the sides of the neck and by the upper head-scales being more broken up, I think it best to restore it to the rank of a species distinct from *T. Grayi*. But I feel justified in rejecting all Baur's new species as based on mere slight varieties of *T. Grayi* and *T. pacificus*, as will appear from the following synonymy; I also give the number of scales round the middle of the body in the various specimens preserved in the British Museum.

1. *Tropicidurus Grayi*.

Leiocephalus Grayi, part., Bell, Zool. 'Beagle.' Rept. p. 24, pl. xiii. fig. 1 (1842).

Tropicidurus Grayi, part., Steindachner, Festschr. zool.-bot. Ges. Wien, 1876, p. 310, pl. ii. fig. 1; Bouleng. Cat. Liz. ii. p. 172 (1885).

Tropicidurus albemarlensis, indefatigabilis, delanonis, duncanensis, Baur, Biol. Centralbl. x. 1890, p. 478.

1. Darwin's specimen, the type figured by Bell. No doubt from Charles Island. ♂. Sc. 63.
2. Darwin's specimen, probably from the same locality. ♂. Sc. 65.
3. Ditto. ♂. Sc. 61.
4. Ditto. ♂. Sc. 59.
5. Ditto. ♀. Sc. 61.
6. Albemarle, Commander Cookson. ♂. Sc. 57.
7. Abingdon, Commander Cookson. ♂. Sc. 59.

2. *Tropidurus bivittatus*.*Leiocephalus Grayi*, part., Bell, l. c.*Craniopeltis bivittata*, Peters, Mon. Berl. Ac. 1871, p. 645.*Tropidurus Grayi*, part., Steind. l. c.; Bouleng. l. c.*Tropidurus lemniscatus*, Cope, Proc. U. S. Nat. Mus. xii. p. 145 (1889); Baur, l. c.

1. Darwin's specimen, probably from Chatham Island. ♂. Sc. 65.
2. Ditto. Young. Sc. 57.

3. *Tropidurus pacificus*.*Tropidurus pacificus*, Steind. l. c. p. 313, pl. ii. figs. 2 and 3; Bouleng. l. c. p. 173.*Tropidurus abingdonii*, Baur, l. c.

1. Abingdon Island, Commander Cookson. ♂. Sc. 91.
2. Ditto. ♂. Sc. 95.

LIX.—On *Anabiosis*. By Prof. W. PREYER, of Berlin*.

THE fact of anabiosis, *i. e.* the revivification of perfectly lifeless organisms and their parts, the condition of which differs from ordinary apparent death in the total suspension of the whole of the vital processes, was experimentally established by me more than twenty-five years ago; and since that time I have substantiated it in my lectures and various papers, and have also drawn attention to its great theoretical importance †. I attach especial weight to the proof which I have furnished of the difference between the two antitheses of life, namely:—

- i. Lifeless and capable of living = anabiotic.
- ii. Lifeless and incapable of living = dead.

* Translated from the 'Biologisches Centralblatt,' Bd. xi. no. 1, Feb. 1, 1891, pp. 1-5.

† 'Der Kampf um das Dasein,' Bonn, 1869 (pp. 10, 39); 'Die Erforschung des Lebens,' Jena, 1873 (and 'Tageblatt der 45. Versammlung deutscher Naturforscher und Aertze,' Leipzig, 1872, p. 47); 'Naturwissenschaftliche Thatsachen u. Probleme,' Berlin, 1880; 'Der Hypnotismus,' Berlin, 1882 (p. 282); 'Elemente der allgemeinen Physiologie,' Leipzig, 1883. Cf. "Ueber den Lebensbegriff" in the journal 'Kosmos' (i. Jahrg. ii. Bd. p. 213, Leipzig, 1878), and "Die Wiederbelebung totenstarrer Muskeln" (Amtl. Bericht über die 39. Versammlung deutscher Naturforscher und Aertze in Giessen, 1864, and 'Recueil des travaux de la Société médicale allemande,' Paris, 1865).

Now, inasmuch as the facts on which this important difference is based have recently been called in question, not so much for spores and vegetable and animal ova as for adult organisms, I will adduce a few proofs of anabiosis in animals which are calculated to avert a possible relapse into the old heresy of the "eternal vortex of living matter" and of the so-called "vital force." They depend upon the acknowledged fact that animal life is impossible without water in the state of fluid drops.

I. *The Revivification of Hard-frozen Animals.*

I have often arranged and performed the following experiment. A number of similar frogs, which have adapted themselves in winter to a temperature slightly above freezing-point, are allowed to become frozen hard in snow or air at several degrees below zero C. We convince ourselves that the heart of one of the animals is frozen solid, and that the blood is no longer in a fluid state, and we then allow the rest of the frogs, which have been frozen under the same conditions as the creature we have examined, to thaw with the utmost slowness. We find that they completely recover, provided that the internal temperature has in no case sunk below $-2^{\circ}5$ C., notwithstanding the fact that during their apparent lifelessness, lasting for several hours, no metabolism, no circulation or breathing, no movement of the muscles, in short no vital process whatsoever, was able to take place. The frozen heart too, which we removed from the frog, commences to beat again by itself after thawing in the air, as was likewise observed by Horvath*. A single extremity of a frog after being frozen stiff will regain its functional power provided both the freezing and subsequent thawing are effected very gradually, as has been proved by my own experiments and those carried out by Heinzmann under my guidance †.

Sir John Franklin, the arctic voyager (1820), in writing of frogs, states that they were often found frozen hard, and were revived by warmth. Duméril (1852) achieved the same result by experiments. Richardson, the surgeon of Franklin's expedition, saw fish, on being taken out of the nets at Fort Enterprise in winter, become converted in a short time into solid lumps of ice, so that they were easily split up with a hatchet and the entrails could be removed in a lump. If,

* 'Centralblatt für die medizinischen Wissenschaften,' 1873, p. 34.

† Plüger's 'Archiv f. d. gesammte Physiologie' (Bonn, 1872), vi. Bd. p. 235.

however, "in this completely hard frozen condition they were thawed at the fire, they returned to life again," even after thirty-six hours.

Apart from all statements of others, my experiments alone prove the fact that a frog either deprived of its brain or uninjured, after the whole of its vital processes have been completely suspended owing to the formation of ice in its juices, can go on living after thawing as if nothing had happened. It has not yet been determined how long the total suspension of all vital processes at an internal temperature of, say, -1° C. may continue without the potential life being destroyed. With regard to plants, it was demonstrated by Julius Sachs (1865) that many can survive freezing, while Prillieux showed that water may solidify in the interior of plants without the destruction of tissues at a temperature of -2° to -3° C. On the other hand, we do not possess many observations on pelagic animals. The partial destruction of tissue by ice-crystals, observed by Romanes (1877) in a number of *Medusæ* which were frozen hard through and through did not prevent anabiosis on thawing; but precisely on account of this destruction of tissue the rhythm of the contractions was not the same as before. It is highly probable that in *Amphibia* also the structure of the contractile substance, of the protoplasm in the muscle-fibres, is permanently injured if the lowering of temperature is carried too far; it was doubtless in consequence of this that the subjects of my experiments, when the internal temperature had sunk below $-2^{\circ}5$ C., did not recover on being thawed, while this internal temperature itself was fatal to many. But already before this the continuity of all parts of the body was severed by the formation of ice, and consequently the possibility of metabolism was excluded as completely as if the animal had been petrified. This therefore is the crucial test, and not the attainment of the lowest possible temperature and the utmost degree of hardness, which entails the destruction of tissues. Thus much we learn from microscopical examination at the temperature which admits of the detection of ice between the plastic elements of the body.

II. *The Revivification of Desiccated Animals.*

If we allow *Tardigrades* (*Macrobiotus*, *Echiniscus*) or *Rotifers* to dry up in complete isolation on a slide (tracing a little ring round the body, which is now shrunken past recognition, to facilitate its speedy rediscovery in case the slide is not allowed to remain upon the stage of the micro-

scope), and keep the preparation over chloride of lime, we can revive the animals after a long interval either by sprinkling them with distilled water or by breathing upon them, notwithstanding the fact that no metabolism has taken place in the meantime. For we observe the same fragments of food in the transparent stomach on the resumption of motion as at its cessation *. Davaine allowed Rotifers to remain in a vacuum for five days, and still was able to revive them. Doyère allowed some dried specimens to remain in a "vacuum" for four weeks, and saw many revive on being moistened in the air. All the same the supposed vacuum must still have contained air, for I have found that dried Rotifers, in the perfect vacuum produced by Geissler's mercurial air-pump over sulphuric acid, resisted all attempts at resuscitation long before the expiration of the fourth week. They are no longer so shrivelled as they were when they were dried, clearly because, owing to the suspension of barometric pressure, the vestiges of air between the wrinkles expand, so that the surface becomes more or less smooth and brittle. The animals perish utterly. In the open they could adapt themselves to lack of food and water, to cold and heat, but lack of air was fatal.

On the other hand, the anabiosis of *Macrobieti* and *Rotifera*, and especially of certain *Amœbæ* and the lifeless *Anguillulinæ* united together by a viscid mass within a grain of wheat, has been proved by the fact that they have been kept for a long time in closed glasses in a dry state and at a low temperature without forfeiting their vitality. I have subjected dried Rotifers to a very low temperature and then raised them to 80°, Doyère to 153°, without destroying the whole of them.

Out of the large number of earlier observations which I have collected the following in particular, concerning the resuscitation of *Anguillulinæ*, Rotifers, and *Artiscoids* (bear-animalcules or *Macrobieti*), are of interest partly historic, partly actual.

Anguillulinæ remain cemented together in the dried grain of wheat, perfectly motionless yet capable of life, over two years (Needham, 1743), for days, months, years (Buffon, 1748), five years (Trembley, 1750), four years (H. Baker, 1754), half a year (Ginanni, 1759), twenty-seven years (H. Baker and Needham, 1771), for years (Koffredi, 1775), six years (F. Bauer, 1823), in the weaver's thistle eight months (J. Kühn, 1858).

* Greeff, in M. Schultze's 'Archiv für mikrosk. Anatomie,' i. p. 122 (1865), ii. pp. 122, 320 (1866).

Rotifers and Macrobioti, after being perfectly lifeless, have been revived after five months (Leeuwenhoek, 1719), two years and a half (Fontana, 1769), days (Spallanzani, 1777), several years (C. A. S. Schultze, 1834, and Creplin, 1837), six months (C. A. S. Schultze, 1838), three years (the same author, 1840), many years (the same, 1861), hours (Greeff, 1865), days, weeks, months, and years (Preyer, 1864-1889).

Whoever thoroughly examines the shrivelled Rotifers and Arctiscoids as they lie in the drying-oven, and notes how, on the evaporation of the water emitted by them at the moment of drying, after being completely isolated on a slip of glass they become motionless, and, exhibiting no change whatever for whole days and months, first swell up on being moistened and then begin to move, will arrive at the conviction that there is in this case no possibility of a *vita minima*, a minimum of physiological metabolism, since water is wanting. It is excluded as certainly as in the case of the frozen frog's heart. There remains only a potential life, which, through the emancipating process of anabiosis, is transformed into kinetic or actual life. The interruption of this latter through freezing and drying occurs in an enormous number of cases in nature, probably favoured in the case of many organisms (*e. g.* on the bark of trees) by a specific adaptation, and confirmed by heredity as being a highly advantageous property. The pause in the life of the individual comes to an end either through death in consequence of irreparable injury to the lifeless organism or through natural anabiosis, as, for instance, in the soil when it thaws in spring, or in the dust of the gutter of the roof when rain falls after a drought in summer, and so on. The organic machine therefore does not perish every time it stands quite still any more than the clock breaks down every time the pendulum ceases to swing.

The frozen and desiccated animals, destitute of all trace of circulation, are not dead, but merely do not live until enabled to do so by anabiosis.

Berlin,
Dec. 4, 1890.

LX.—*New Scarabæidæ in the British Museum: a Fifth Contribution.* By CHARLES O. WATERHOUSE.

SINCE my last contribution I have been determining the species of *Heliocopriss*, *Catharsius*, and *Copriss*. This is a difficult task at any time, and is rendered ten times more so by entomologists who have attempted to found species on

single female examples. As, however, I have exercised great care, I trust I shall not be found to have redescribed any characterized species among the following.

Heliocopris Hunteri, sp. n.

Nigro-piceus; capite ruguloso, cornubus tribus fere æqualibus erectis instructo; thorace brevi, sat fortiter reticulato-ruguloso, antice declivi, pone oculos profunde exciso, parte elevata disci in cornu longo horizontali acuminato producta, cornu ad apicem plus minusve exciso, angulis anticis acutis prominulis lævibus; elytris nitidis, leviter striatis, striis dorsalibus parce punctulatis, interstitiis planis, parce subtiliter punctulatis, basi quinque-tuberculatis.

Long. 17–20 lin.

Hab. E. Africa, Masai (*C. V. Hunter and F. J. Jackson, Esqrs.*).

Allied to *H. neptunus*, Bohem., but with the armature of the head and thorax quite different. The head is rather large, with three erect acuminate horns, one central and two lateral. A small-developed example has the middle horn shorter and more obtuse, and the lateral ones are only indicated by a slight swelling on the margin. The thorax with a single porrect discoidal horn, somewhat as in *H. hamifer*, Harold, but without the angular enlargement beneath, the apex nearly always notched. The space above the anterior angles is impressed and shining, and the margin behind each eye has a deep, almost circular emargination, leaving the projecting angle of the head behind the eye visible. The anterior angles are very acute and porrect, beset with reddish-brown hair. The elytra have five tubercles at the base, one on each of the second, fourth, and fifth interstices and two on the third; there is sometimes a trace of one on the sutural interstice.

Heliocopris operosus, sp. n.

Piceus

♂. Capite ruguloso, sat rotundato, medio cornubus duobus erectis acuminatis perparum divergentibus instructo, clypeo antice medio triangulariter paullo emarginato et utrinque leviter sinuato; thorace brevi, confertim granulato, antice verticali magis rugoso utrinque impresso, impressione lævi, parte elevata triangulari utrinque leviter bisinuata, medio obtuse producta, ad apicem vix emarginata, lateribus pone angulos anticos sinuatis; clytris nitidis, leviter striatis, striis parce obsolete punctulatis, interstitiis parce sat distincto punctulatis, basi trituberculatis.

♀. Capite paullo angustiori, vertice carina elevata (angulis dentiformibus) instructo; thorace antice carina leviter flexuosa, lateribus pone angulos anticos minus sinuatis crenulatis; elytris basi sine tuberculis.

Long. 17 lin.

Hab. Africa (*Burchell*).

Allied to *H. atropos*, Bohem. The head has a distinct but not very deep triangular emargination in the middle of the front margin. The male has the two erect horns placed at the middle, wide apart. The female has a strong carina more on the vertex. The male has the sides of the thorax rather strongly emarginate before the anterior angles, which are nearly right angles; the raised dorsal part is in outline nearly an equilateral triangle. The thorax of the female has the anterior carina slightly arched forwards in the middle and then gently sinuate on each side, the sinuosity about equal in extent to the part that is arched forwards. The male has three tubercles at the base of the elytra, two on the fourth interstice and one on the fifth; there is also a trace of another on the third interstice.

Catharsius Jacksoni, sp. n.

Niger, nitidissimus; capite lato, leviter ruguloso, vertice lævi, postice cornu longo, gracili, acuminato, recto, instructo, margine antico medio sat late triangulariter emarginato, utrinque lævissime sinuato; thorace confertim subtiliter granuloso, antice fere verticali subtiliter punctulato, medio lævi, cornubus quatuor crassis acuminatis, parte elevata subtilissime coriacea et subtiliter sat crebre punctulata, linea mediana leviter impressa; elytris leviter striatis, striis fere lævibus, interstitiis fere planis, subtilissime sat crebre punctulatis; pygidio sat crebre punctulato.

Long. 11 lin.

Hab. E. Africa, Masai (*F. J. Jackson, Esq.*).

Of all the species of *Catharsius* known to me this is the most like the true *Copris* of the *lunaris* group, and is particularly like the Japanese *C. pecuarius*, Lewis. Compared with *C. lunaris* the head is larger and the anterior emargination wider; the horn is erect and slender. The thorax has the four horns approximately equal, the lateral ones as in *C. lunaris*, the middle pair more conical, acute, separated from each other by a nearly equilateral-triangular space; the sides are arcuately rounded, the anterior angles a little greater than right angles. The elytra are short, the striæ very lightly impressed, the eighth with the usual carina only at the base for about two lines in length. The posterior tibiæ have the two carinæ well marked.

Catharsius Anderseni, sp. n.

Oblongus, convexus, nigro-piceus, sat nitidus; capite lato, semi-circulari, confertim rugoso, antice medio emarginatione parva, vertice tuberculo minuto nitido; thorace convexo, æquali, disco sat fortiter sat crebre punctato, lateribus granuloso-rugosis, puncto laterali vix conspicuo; clytris nitidis, fortiter striatis, interstitiis convexis sat crebre sat fortiter punctatis, carina laterali usque ad medium continuata; tibiis anticis tridentatis.

Long. $6\frac{1}{4}$ lin.

Hab. Lake Nyassa (*Andersen*).

Allied to *C. inermis*, F., or *C. latifrons*, Harold, but very different from both on account of its strongly sculptured head and thorax and convex, punctured interstices to the elytra. The thorax has no trace of impressed median line; the disk is shining, with rather strong punctures, which are slightly separated from each other at the posterior part, but have a tendency to unite transversely in the front part; at the extreme base and at the sides the surface is rather coarsely rugose; the sides are nearly parallel at their middle, very obliquely turned in in front, but forming a rather more distinct angle than in either of the above-mentioned species. The elytra have the striæ deeply impressed, with very faint indication of crenulation; the interstices are very convex, strongly punctured (compared with its allies), the punctures slightly separated from each other. The posterior tibiæ are rather more abruptly enlarged at their apex than in *C. inermis*, the upper carina is scarcely indicated.

Catharsius opacus, sp. n.

Rotundato-ovalis, convexus, niger, opacus; capite rugoso, antice triangulariter emarginato, et utrinque lævissime sinuato; thorace creberrime granulato-asperato, lateribus medio subrectis; elytris postice bene rotundatis, tenuiter nitido-striatis, striis parce punctulatis, interstitiis planis, subtilissime coriaceis opacis, subtilissime obsolete punctulatis, carina laterali sat valida, usque ad callum apicalem continuata; tibiis anticis tridentatis, posticis apicem versus gradatim latioribus; corpore subtus nitido.

♂. Capite vertice cornu brevi conico; thoracis disco paullo bigiboso, antice declivi.

♀. Capite tuberculo minuto; thorace æquali.

Long. $6-6\frac{3}{4}$ lin.

Hab. Lake Ngami (*Andersen*).

This species is very close to *C. peleus*, Ol., and represents that species in South-east Africa. The head has the anterior

emargination less deep, and consequently the two triangular teeth are less prominent. The elytra in *C. peleus* are dull, but when examined by a magnifying-glass numerous minute shining spots may be seen; and as these are absent in *C. opacus* the elytra are still more dull and are opaque even at the suture near the scutellum; the interstices are perfectly flat, which they scarcely are in *C. peleus*, especially at the sides.

Possibly the male I have described may not be fully developed, and in that case the cephalic horn might be more like that in *C. peleus*.

A small male has only a light impression in the front of the thorax. The female has no trace of impression.

Copris megaceratoides, sp. n.

Griseo-niger, parum nitidus; capite fortiter crebre punctato, antice late leviter emarginato, vertice cornu crasso, acuminato, curvato; thorace fortiter crebre punctato; elytris tenuiter striatis, striis distincte punctatis, interstitiis planis, sat nitidis, sat crebre sat fortiter punctatis; tibiis anticis quadridentatis, dente superiori parvo, tibiis posticis sat longe tridigitatis.

♂. Capitis cornu magno, compresso, fortiter punctato, pone medium subito recurvo, basi bidentulato, ad apicem subtus denticulato; thorace disco bene elevato, utrinque late leviter impresso, parte elevata in cornubus duobus acuminatis distantibus antice curvata partita, margine antico medio tuberculis duobus instructo, angulis anticis sat porrectis acutis.

Long. 10 lin.

♂, var. *minor*. Capitis cornu breviori, curvato, acuminato; thorace disco minus elevato, utrinque late impresso, parte elevata subplanata, subquadrata, antice emarginata, angulis obtusis, lateribus cariniformibus, antice declivi carinis duabus acutis instructa, prope angulos anticos dente triangulari elevato instructo.

Long. 9 lin.

Hab. Senegambia.

I have given the above name to this species on account of the resemblance in general form of the cephalic and thoracic horns to those of *Megaceras chorinæus* in the Dynastidæ. The thorax has an angle projecting forward rather beyond the posterior lateral angle of the head; the sides are somewhat straight anteriorly, and near the front angle there is an acute ridge, which in the smaller male is developed into a triangular tooth. In the large male there are two approximate acute tubercles close to the front margin; in the smaller male these are much reduced and are connected by two strong ridges with the elevated tubercles on the disk.

This species is nearly allied to *C. ochus*, Mots.

Copris globulipennis, sp. n.

Niger, convexus; capite rugoso, antice medio inciso; elytris bene convexis, rotundatis, subtilissime striatis, interstitiis planis vel fere planis, sat crebre punctatis.

♂. Capite antice incisura parva, vertice cornu longo ad apicem leviter curvato, antice sublævi, postice rugoso obtuse serrulato; thorace bene convexo, antice declivi fortiter granulato utrinque fossa magna sublævi, fossa externe dente magno triangulari limitata, disco postice elevato, convexo, obsolete punctato, basi lineaque mediana impressa fortiter punctatis, parte elevata antice obtuse quadridentata, dentibus duobus medianis magis approximatis; elytris subopacis obscure punctatis, striis 1-2 apice fortiter impressis.

♀. Omnino nitidus, minus convexus; capite antice fortiter anguste inciso, obtuse bidentato, vertice tuberculo parvo emarginato instructo, postice fere lævi; thorace minus convexo, antice et ad latera crebre asperato-punctato, disco postice sat crebre obsoletius punctato, linea mediana fortiter punctata, antice carina obtusa curvata; elytris paullo longioribus, nitidis, evidenter punctatis, sutura ad apicem rugosa striis 1^a-4^m apice fortiter impressis.

Long. 9 lin.

Hab. Cape of Good Hope.

This very distinct species may be placed near the preceding, but it is very unlike any known to me. I believe it is well known in collections under the name which I have retained for it.

Copris sodalis, Walker.

The type of this species is a small female from Ceylon. The only specimen in the Museum Collection agreeing with it is from Cachar. It is very near *C. sulcicollis*, Lansb., and has the same deeply impressed striae to the elytra and strongly punctured pygidium, but differs in having the whole of the disk of the thorax and the sides nearly to the middle almost impunctate. It differs from the female example of *C. sarpedon*, Har., in having the sides of the thorax rather more rounded anteriorly and in the punctuation.

Copris sinicus, Hope.

I think this can scarcely be separated from *C. sulcicollis*, Lansb. The typical specimen, however, has only the outer tubercles on the disk of the thorax, the middle pair being merely indicated by a slight swelling.

Copris capensis, sp. n.

Statura *C. lunaris*, niger, nitidus; capite crebre rugoso, postice lævi, margine antico sat profunde inciso; elytris tenuiter striatis, interstitiis parum convexis; pygidio fortiter sat crebre punctato.

♂. Capitis cornu longo acuminato fere recto, postice prope basin dentibus duobus parvis armato; thorace antice declivi, lobo mediano supra subtilissime parce punctulato, antice late triangulariter emarginato (vel recte truncato) angulis acutiusculis, parte declivi crebre fortiter punctata angulis solum lævibus, dente laterali valido compresso acuto.

♀. Capitis cornu brevi sat acuminato, apice in tuberculis parvis terminanti; thorace rugoso, disco postice lævi, antice abrupte declivi.

Long. $10\frac{1}{2}$ – $11\frac{1}{2}$ lin.

Hab. South Africa (*Dr. A. Smith*).

Apparently a common species and in many collections under the above name, but I am unable to find it described. It much resembles *C. lunaris*, but is larger; the head has a similar incision in front, the posterior projecting angles are a little less acute; the elytra have the striæ rather finer and the interstices generally less convex. The male has the horn on the head similar, perhaps a little more compressed laterally, the two small tubercles appear a little more removed from the base. The thorax is similar, except that the anterior lateral angles are less obtuse; the smooth cavity on each side of the disk is very deep and in the fully developed male reaches almost to the base; the median impressed line is almost obsolete; the lateral tooth is somewhat similar to that in *C. lunaris*, but is larger and more directed forwards and outwards, but not so much as in *C. anceus*; the sides are rather strongly punctured, the punctuation extending a little on to the raised disk; the largest male has the front angles smooth.

The female is rather less convex; the thorax is strongly rugose at the sides, with all the posterior part of the disk smooth, the anterior declivity (which is not separated by any distinct ridge) is transversely rugulose.

A small female ($7\frac{1}{4}$ lines long) apparently referable to this species has no declivity in front; this and one of the larger females have the elytra somewhat castaneous.

Copris lunarioides, sp. n.

Oblongus, minus convexus, sat parallelus, niger, nitidus; capite maximo, antice acute inciso, ruguloso, postice lævi; elytris leviter striatis, striis fere lævibus, interstitiis parum convexis; pygidio impunctato.

♂. Capitis cornu compresso, acuminato, leviter curvato, antice punctulato, postice rugoso; thorace antice truncato, parte mediana lævi antice paullo angustata, ad apicem emarginata quadrituberculata, antice lævi, utrinque late excavato, crebre asperato, dente laterali valido compresso, triangulari.

♂, *var. minor*? Thoracis lobo mediano antice crebre granulato.

♀. Capitis cornu sat elevato, transversim compresso, ad apicem paullo latiori et emarginato; thorace dimidio anteriori rugoso, basi lævi, lobo mediano obtuso antice a carina limitato, dente laterali minus elevato.

Long. 10–13 lin.

Hab. Abyssinia, Nyanza; Masai (*F. J. Jackson, Esq.*); S. Africa (*Dr. A. Smith*).

This is a common species, known, I believe, under the above name, and also confounded with *capensis*. It is a flatter insect than *C. lunaris* and more parallel, the parallel appearance being partly due to the great width of the head. The thorax is rather parallel-sided. The large male has the thorax almost without punctuation except the deep cavity on each side of the disk and in the lateral fovea; the median lobe is emarginate in front, with its angles obtusely dentiform and with a very small tooth slightly removed from the angle; the anterior surface of this lobe is smooth and shining, and it has on each side three or four minute tubercles.

In the smaller males the thorax has the median lobe truncate in front, with four small tubercles, the middle pair a little nearer to each other than to the lateral ones; the anterior upper margin is punctured, and the anterior declivity, as well as the cavities and anterior angles, are closely and rather coarsely rugose. The pygidium is smooth or almost so.

It is possible that the specimens which I have described as the large and smaller males may be referable to distinct species. The difference in the sculpture of the anterior declivity of the thorax may be a specific character.

Copris Morgani, sp. n.

Statura omnino *C. lunaris* at minor: niger, magis convexus, nitidus; elytris fortiter crenato-striatis, interstitiis bene convexus, lævibus, stria octava pone medium abbreviata.

Long. 8 lin.

Hab. Sierra Leone (*Rev. D. F. Morgan and James Foxcroft*).

This species may be placed near *C. orion* and *C. amyntor*. It is decidedly more convex than *C. lunaris*. The head is relatively narrower, more obliquely narrowed behind the

cheek, so that the projecting lateral angle is a right angle; in front there is a very slight triangular emargination, not an incision. Rather finely rugose, with the vertex smooth.

♂. Head with the horn as in *C. lunaris*, but smooth in front. Thorax as in *C. lunaris*, but more convex, obliquely narrowed in front before the anterior truncature, which is consequently narrower than in *lunaris*. The disk is smooth, with a strongly impressed punctured median line, with a few fine punctures by the middle pair of tubercles; the raised part has four tubercles in front and is relatively shorter and broader than in *lunaris*; the middle pair of tubercles are close together and in the smaller males entirely disappear, so that there is a simple truncate median lobe; the sublateral tubercles are relatively less developed than in *lunaris* and are a little less forward; the anterior declivity is smooth, or with a few punctures in the minor variety; the obtuse carinæ limiting the declivity converge below; the deep cavity on each side is moderately punctured, the anterior angles strongly punctured, the sides are moderately distinctly punctured, and in one specimen are rather strongly punctured.

♀. Head with a short trapezoidal horn, emarginate at its apex. Thorax strongly punctured in front and at the sides, the posterior part of the disk smooth; with an obtuse curved carina in front; the very transverse anterior declivity smooth.

The striæ of the elytra are not only unusually deep, but the oval punctures in them are rather strong, and crowded together so as to form a perfect chain.

Copris Harrisii, sp. n.

Oblongo-ovalis, convexus, nigro-piceus, nitidus; capite confertim punctato; elytris leviter crenato-striatis, interstitiis subtilissime punctulatis; pygidio evidenter punctato.

♂. Capite cornu longo sat acuminato parum curvato rugoso, basi postice bidenticulato armato; thorace antice utrinque profunde impresso, lobò mediano quadridenticulato, dente laterali compresso.

♀. Capite cornu brevi compresso ad apicem emarginato; thorace antice carina nitida vix elevata, parte declivi crebre sat fortiter punctata.

Long. 8-8½ lin.

Hab. Abyssinia, Shoa (*Sir W. C. Harris*).

This species has the form and appearance of *C. lunaris*. The head has a rather wide and not deep triangular emargination in front, with a slight sinuosity on each side. The elytra are as in *C. lunaris*, but the punctures in the striæ are perhaps a trifle more distinct, but not so strong as in *C. orion*.

The male has the horn on the head as in *C. lunaris*, but is more slender, and the apex itself is not so sharp. The thorax is as in *C. lunaris*, but the median dorsal line is less marked; the median lobe is truncate in front, with four nearly equal and equidistant tubercles; in the fully developed male this lobe is a trifle broader in front than posteriorly, its anterior vertical surface is densely and coarsely punctured, even slightly rugose; the deep impressions on each side of the lobe are rather strongly punctured; the sub-lateral tooth does not turn outwards so much as in *C. lunaris*, and in the fully developed males its upper edge is bisinuate, so that a second obtuse tooth is formed; the middle of the disk is almost smooth or with a few very fine punctures, but the sides of the middle lobe are distinctly punctured, and the front margin of the lobe and the base of the thorax (behind the impression) are still more distinctly punctured, the punctures being moderately close together; at the sides of the thorax the punctuation is rather strong and very close.

The female is like the female of *C. lunaris*, but the thorax is less convex, the median line is less impressed, and there is less anterior declivity. The horn on the head is similar. The thorax has the sculpture very similar, but not *quite* so strong, and is distinctly less rugose near the anterior ridge; there is little or no smooth space at the posterior part of the disk; the anterior declivity is very closely and rather strongly punctured, with a tendency to be rugose.

Copris orion, Kl., and *C. amyntor*, Kl.

There is some uncertainty in the identification of these species. In Erman's 'Reise,' Atlas, p. 34, *C. orion* is stated to be the insect known in Ecklon's list as *C. caffra* and *C. brevicornis*; it is distinguished from *C. lunaris* by its small size and "ferner ist das Halsschild, welches bei *C. lunaris* fast glatt zu sein pflegt, hier deutlich und grob punctirt. Die Streifen auf den Deckschilden sind tiefer eingegraben, und die Zwischenräume mehr oder weniger deutlich punctirt." In the Latin diagnosis the expression "interstitiis obsolete punctatis" is used.

C. orion of Boheman is certainly the insect known to me by that name, having the head almost entirely smooth, with the elytra so smooth that it is only with a strong magnifying-power that the punctures can be seen.

It is just possible therefore that *C. orion*, Bohem., from South Africa, may be distinct from *C. orion*, Klug, from Senegal.

C. amyntor, Kl. (Peters's 'Reise n. Mossambique,' p. 242), is from Sena:—"Am ähnlichsten ist diese der *C. caffra*, deren v. Winthem in einem Verzeichniss caffrischer Insecten erwähnt. Sie bildet den Uebergang zu der um eine Linie kleineren *C. orion*, Dej., von Senegal. Von beiden Arten ist sie unterschieden durch den oben nicht glatten, sonst durch Punkte und Runzeln uneben Kopf mit dem darauf sitzenden, an der hinteren Seite flachen, höckerigen, vor der Mitte deutlich zweigezahnten Horn und dem in beiden Geschlechtern starken und dichten fast überall punctirten Halsschild."

It appears to me from these extracts that *C. orion*, Kl., is more strongly punctured than *C. lunaris*, which is scarcely the case with *C. orion*, Boheman; and *C. amyntor*, Kl., is still more strongly punctured, and moreover has the head rugose. The species which I have identified as *C. amyntor* we have received from South Africa and Nyassa. From description I should think it possible that *C. obesa*, Bohem., is the female of this species.

The following notes may be of service in determining the species of this group:—

Elytra deeply striated.	Middle lobe of thorax emarginate.	Head smooth	<i>orion</i> , Bohem.
		Head coarsely punctured	<i>amyntor</i> , Kl.
	Middle lobe of thorax quadridenticulate.	Lateral tooth of thorax simple; clypeus widely triangularly emarginate	<i>Morgani</i> , sp. n.
		Lateral tooth of thorax double	sp.
Elytra moderately deeply striated.	Middle lobe of thorax quadridenticulate, but with the middle pair scarcely developed and appearing like one.	Lateral tooth of thorax simple; clypeus with narrow triangular emargination; anterior surface of median thoracic lobe finely punctured	<i>modesta</i> , B.
Elytra lightly striated.	Middle lobe of thorax quadridenticulate.	Middle lobe of thorax with anterior surface coarsely punctured; lateral tooth double.	<i>Harrisi</i> , sp. n.
		Middle lobe of thorax with anterior surface rather finely punctured; lateral tooth simple	<i>confusa</i> , B.

C. orphanus, Guérin, which is allied to these, is smaller and narrower and has the middle lobe of the thorax tridentate. We have received it from Kilima-njaro, and it seems to me very probable that *C. evanida*, Kl., from Sena, is referable to this species.

Copris gracilis, sp. n.

Convexus, piceus, parum nitidus; capite ruguloso, postice lævi; thorace creberrime evidenter punctulato; elytris obscure castaneis, nitidis, crenato-striatis, interstitiis leviter convexis, subtilissime parce punctulatis; pygidio evidenter sat crebre punctato.

♂. Capite cornu acuminato, sat longo, leviter curvato, basi bidenticulato armato; thorace antice abrupte declivi, parte declivi utrinque leviter impressa.

♀. Capite tuberculo parvo ad apicem impresso; thorace æquali.

Long. 5-5½ lin.

Hab. Caffraria.

Resembles *C. sinon*, F., but is less dull and differently sculptured. The head is similar, but is rather more rugulose in front. The thorax is moderately strongly punctured all over, the punctures being separated from each other by nearly the diameter of a puncture; the anterior declivous part is also punctured, but the punctures are a little finer and are very delicate at the upper part of the middle portion; the impressions on each side of the front part are less deep than in *C. sinon* and are punctured; the middle discoidal lobe is similar to that in *C. sinon*, but is much less prominent; there is a lightly impressed median line. The elytra are more shining than in *C. sinon*, with the striæ deeper and the interstices gently convex.

Copris puncticollis, Bohem. (according to a specimen kindly sent from Stockholm by Prof. Aurivillius for comparison), is very near *C. gracilis*, but is a little shorter and rather less parallel, and is at once distinguished by the coarser punctuation of the thorax, the punctures being crowded together.

Copris diversus, sp. n.

Convexus, piceus, nitidus; capite antice subtilissime punctulato, postice sat fortiter punctato, margine medio late leviter emarginato; thorace punctato, postice lævi, antice leviter declivi; elytris fortiter striatis, striis fortiter punctatis, interstitiis convexis, subtilissime parce punctulatis fere lævibus; pygidio fortiter crebre punctato.

♂. Capite cornu parvo acuminato.

♀. Capite lamina parva ad apicem subtruncata.

Long. 5 lin.

Hab. Madagascar, Nossi-Bee.

This species has very much the appearance of *C. minutus*, Drury, but the head has a very broad but not deep emargination.

The male has the head shining, almost imperceptibly punctured, the posterior margin and the side-pieces (behind the oblique line) strongly punctured. The horn is thick at its base, moderately acuminate, gently curved. The thorax is almost imperceptibly punctured, and appears smooth, except a space on each side of the fore part of the disk and the anterior angles, the punctures in these places being rather strong, those on the disk not very close together; there is a strongly impressed punctured median line, extending to the middle of the disk; the anterior declivity is very slight and has a few small punctures on its anterior surface. The elytra have the striæ deeply impressed and strongly and moderately closely punctured, but not nearly so much as in *C. minutus*; the interstices are moderately convex.

The female has the surface of the head a little less shining. The horn has the form of a subquadrate lamina, a little longer than broad, slightly curved, the lower part swollen in front. The thorax has the punctured spaces a little larger and more extended, meeting across the front part of the disk and coming nearer to the base.

Copris Nevinsoni, sp. n.

Oblongus, piceus, nitidus; capite lævi; elytris minus nitidis, leviter striatis, striis distincte punctatis, interstitiis perparum convexis, subtiliter laxe punctulatis; pygidio sat fortiter punctato.

♂. Capite antice late leviter emarginato, vertice cornu longo, curvato, acuminato, lævi; thorace disco excavato utrinque in cornu compresso lævi triangulari ad apicem acuminato incurvato, antice ad basin tuberculo minuto munito, ducto, excavatione sat crebre fortiter asperato-punctata, lateribus ante angulos anticos fortiter excisis.

♂, *var. minor*. Thorace disco crebrius fere ocellato-punctato, cornubus minus elevatis; lateribus ante angulos anticos leviter sinuatis.

♀. Capite antice haud sinuato, medio carina brevi obtusa vix elevata, vertice tuberculo vix elevato; thorace parum convexo, disco fere lævi, linea mediana impressa sat fortiter punctata, lateribus sat crebre punctulatis, marginibus ante angulos anticos leviter sinuatis; elytris fere impunctatis.

Long. $8\frac{1}{2}$ – $9\frac{1}{2}$ lin.

Hab. Siam (*J. C. Bowring, Esq.*), Cochin China.

This species is closely allied to *C. fidius*, but is shining and rather less convex. I have described the large male from Mr. B. Nevinson's collection. Some examples have the

elytra brown. I have seen this species bearing the name *C. malaccensis*, but believe it to be undescribed.

Copris signatus, Walker.

This appears to be a common Ceylonese species, easily recognized by the two erect horns on the margin of the head and by the T-formed horn on the vertex.

It is redescribed by Harold under the name of *Catharsius coronatus* (MT. München ent. Verein, i. p. 98). It is allied to *Copris punctulatus*, Wiedem.

Copris Davisoni, sp. n.

Statura *C. punctulati*, piceus, subopacus; capite laevi, vertice angulisque posticis punctulatis; thorace creberrime punctato; elytris striatis, striis sat fortiter punctatis, interstitiis modice convexis, distincte punctatis.

♂. Capite antice sicut truncato, margine medio cornu erecto, acuminato, ad apicem paullo curvato, fronte medio cornu erecto parallelo ad apicem binodoso.

♂, var. *minor*. Capitis cornu anteriori minori ad basin antice utrinque dente porrecto instructo.

♀. Capite antice obtuse bidentato, fronte medio tuberculo conico ad apicem subbinodoso.

Long. 6-6½ lin.

Hab. Malabar, Nilgiris (*W. Davison, Esq.*).

Very near to *C. signatus*, Walker, but a little narrower.

The male is at once distinguished by the singular armature of the head. The thorax is not quite so coarsely punctured as in *C. signatus*, and in the larger male the punctures have a tendency to run together in a longitudinal direction. In the large male there is a slight indication of a double swelling at the anterior part of the disk. The elytra have the striæ very distinct, the punctures moderately strong and somewhat separated; in the larger males they encroach more on the interstices and appear like pairs of punctures (one on each side of the stria) united on the stria; the interstices are moderately convex, very distinctly punctured, the punctures separated from each other by about two diameters of a puncture.

The female differs from the female of *C. signatus* in being a trifle narrower, with rather more finely punctured thorax; the head with the two anterior teeth a little narrower and separated by a narrower triangular space; the frontal tubercle having a tendency to be binodose at the apex.

I have seen this species bearing the manuscript name *C. rhinocerus*.

Copris excisus, sp. n.

Oblongus, parum convexus, sat nitidus, picous; capite antice lævi, postice subtiliter sat crebre punctulato, vertice transversim leviter impresso; thorace paullo convexo, sat crebre evidentem punctato, basi medio leviter impresso; clytris punctato-striatis, interstitiis sat convexis, subtiliter distincte punctatis; pygidio crebre punctato.

♂. Capite medio tuberculo parvo perparum elevato, clypeo utrinque profunde inciso, parte anteriori in medio recta, utrinque in cornu sat acuminato producta.

♀. Magis nitidus; capite medio transversim paullo elevato, tuberculo parvo conico ad apicem truncato, clypeo margine medio obtuse bidentato, dentibus sat distantibus.

Long. $5\frac{1}{2}$ lin.

Hab. N. India.

This is allied to *C. signatus*, Walker, but is more convex. The male has a deep incision on each side of the front part of the head, thus leaving a slightly acuminate horn-like process in front; these horns are slightly obliquely directed forwards, and are separated by a somewhat wide space. The thorax is more convex than in allied species; it is rather closely punctured, and the punctures are small, especially at the front part of the disk; there is a slight impression in the middle of the base, continued forwards by some larger punctures. The elytra has the striæ very distinct, with distinct transverse punctures, which are not crowded together; the interstices are slightly dull, gently convex, very finely punctured, the punctures not very close together.

The female is altogether more shining than the male. The head has the usual two obtuse teeth in front, but they are more correct than in the allied species and are separated by a more semicircular space. The thorax has the punctuation similar, but a trifle less fine. The elytra are shining and the punctures on the interstices are very distinct and less fine.

Copris Andrewesi, sp. n.

Statura omnino præcedenti, niger, opacus: capite crebre subtiliter punctulato, margine antico solum levi medio in lobo obtuso producto; thorace confertim sat fortiter punctato; clytris fortiter striatis, striis sat fortiter punctatis, interstitiis bene convexis, impunctatis vel obsoletissime parce punctulatis; pygidio fortiter punctato.

♂. Capite medio carina brevi, postico tuberculo minuto.

♀?. Capite medio convexo, postice tuberculo vix elevato.

Long. $6\frac{1}{4}$ lin.

Hab. India, Belgaum (*H. E. Andrewes, Esq.*).

This species is closely allied to the preceding, but is black and differently sculptured and with more convex interstices to the elytra. The head has a small projecting lobe in the middle of the front margin, with a slight sinuosity in the margin on each side of its base. The thorax is rather strongly punctured, the punctures separated from each other by about half the diameter of a puncture. The elytra have the striæ more impressed than in the foregoing species, the punctures encroaching considerably on the interstices; the interstices very convex, almost impunctate.

The male has on the middle of the head a very short transverse ridge, about twice as broad as high, the angles of which are slightly swollen; behind this there is a very slight scarcely raised tubercle.

The female (or undeveloped male?) has the middle of the head slightly convex, and posteriorly there is a very slight tubercle.

[To be continued.]

LXI.—*Reply to the Rev. Canon Norman's Views respecting the proposed rejection of Cyclostoma, with Remarks on No. 10 Rule of the "Stricklandian Code."* By R. BULLEN NEWTON, F.G.S., British Museum (Natural History).

THE abandonment of a familiar name like *Cyclostoma*, proposed by me in last April's number of the 'Annals,' is a matter for considerable regret, though I fear many others equally well known must soon share the same fate and be relegated to the regions of synonymy if we would attain to a proper degree of accuracy in our conchological nomenclature.

Certain objections have been raised in the May number of the 'Annals' to my proposals on this subject by the Rev. Canon Norman which, on being analyzed, betray an amount of prejudice that, emanating from so distinguished an observer, is indeed to be deplored. He charges me with having "misapprehended the facts, and that no need exists for changing the names *Cyclostoma* and *Pomatias* as now in use." To defend my position it will be necessary to recapitulate some of the details connected with the genera and types involved, and for this purpose I shall place them in chronological order, as follows:—

- (1) POMATIAS, B. Studer, 1789 (= *Nerita elegans*, Müller).
- (2) SCALA (Klein, 1753), G. Humphrey, 1797 (= *Turbo scalaris*, Linn.).
- (3) CYCLOSTOMA, Lamarck, 1799 (= *Turbo scalaris*, Linn.).
- (4) CYCLOSTOMA, Draparnaud, 1801 (= *Nerita elegans*, Müller).
- (5) CYCLOSTOMA, Lamarck, 1801 (= *Turbo delphinus*, Linn.).
- (6) SCALARIA, Lamarck, 1801 (= *Turbo scalaris*, Linn.).
- (7) DELPHINULA, Lamarck, 1804 (= *Turbo delphinus*, Linn.).
- (8) POMATIAS, Hartmann, 1821 (= *Cyclostoma patulum*, Drap.).

Every naturalist on viewing this list of eight genera and their types would readily admit the very urgent importance for their final revision. Beginning with Studer's *Pomatias* of 1789, we find that its type was transferred by Draparnaud to his *Cyclostoma* of 1801. There is, then, no alternative, in the exercise of the just law of priority, but to accept this Studerian name to the exclusion of the other. The next genus, *Scala*, truly a Kleinian name, and consequently pre-Linnean, but which was used by G. Humphrey in 1797, just two years before the establishment of Lamarck's first *Cyclostoma*, is recommended for adoption not only on the ground of priority, but as being a means of escaping from the difficulties connected with the genera *Scalaria* and *Cyclostoma*, the types of which are identical with that of *Scala*.

Prof. W. H. Dall, of Washington, has just favoured me with a reference to his valuable report on the 'Blake' Mollusca*, in which, after a full discussion on every aspect of this question, he had no hesitation in deciding in favour of the retention of *Scala*. It is to be hoped that before long we shall hear that M. de Boury, the chief authority on the Scalidæ, will see the necessity for adopting the same, more especially as he employs the family name of Scalidæ for his group, and not Sculariidæ.

Lamarck cancelled one of the mistakes of his previous work when, in 1804, he established his genus *Delphinula*

* "Report on the Mollusca dredged by the U. S. Coast-Survey Steamer 'Blake,'" Gasteropoda and Scaphopoda, Bull. Mus. Comp. Zool. Harvard Coll. 1889, vol. xviii. p. 299.

and attached as its type the *Turbo delphinus* of Linnæus, which had hitherto been identified with his *Cyclostoma* of 1801. In 1821 Hartmann introduced *Pomatias* in a totally different sense to that founded by Studer in 1789; hence it is apparent that a change in this name being necessary, and there being no available synonym to receive it, *Hartmannia*, recently proposed by me, must now be recognized.

Attention has lately been drawn to the fact in a contemporary journal* that this generic name had been utilized in botany, which, however, does not militate against its use in a zoological sense, as, according to the corrections made in 1865 in the British Association Rules, the subjects must be kept entirely distinct. Thus by the operation of the law of priority I have been enabled to reduce these eight genera to the number of four, which will henceforth stand as follows:—*Pomatias*, *Scala*, *Delphinula*, and *Hartmannia*. I am quite aware of the subsequent work done by Lamarck on his genera *Scalaria*, *Delphinula*, and *Cyclostoma*, as well as that of Deshayes on *Delphinula*, quotations from which are given in the Rev. Canon Norman's criticism; but we can only treat these genera from the dates on which they were separately founded, as no attempts were made in Lamarck's later researches to furnish a practical revision of the types of his earlier genera, except in the case of *Delphinula*, which he made perfectly definite for all time. Nothing could be clearer than the history of *Pomatias*, 1789; its distinct diagnosis and association with so well known a type leaves no loophole for hesitation as to what it included. The second species referred to under this genus was *P. variegatus*, a mere list or manuscript name without description of any kind. Not until 1820† do we hear of it again, when we find that Studer himself included it as a synonym of *Cyclostoma maculatum*, Drap., which species he and subsequent authors have shown to be the same as *Helix septemspiralis*‡ of Razoumowsky, 1789§. This species, then, belongs to *Pomatias* as diagnosed by Hartmann, but which, differing from Studer's of 1789, now becomes *Hartmannia*.

Canon Norman makes some critical observations on the tenth Nomenclature Rule of the British Association which deserve close attention. The rule stands thus:—"A name

* 'British Naturalist,' May 1891, p. 100.

† 'Verzeichniss,' 1820, p. 22.

‡ Quoted wrongly by Canon Norman in his footnote, p. 448, as *Pomatias septemspiralis*.

§ Hist. Nat. Jorat, 1789, vol. i. p. 278.

should be changed which has before been proposed for some other genus in zoology or botany, or for some other species in the same genus, when still retained for such genus or species." He advocates the application of the latter part of this rule to the genera under consideration. He argues that if the first *Cyclostoma* is inadmissible, we must accept the second, though I have distinctly proved it to be the equivalent of Studer's genus of 1789. I beg therefore to differ materially from the Rev. Canon when he intimates that I have misapplied a rule of nomenclature in rejecting *Cyclostoma*, as I hold that I have not violated it in any one particular.

He appears to be only anxious to demonstrate that we should follow the opinion most generally received by conchologists on this subject, instead of thinking it a matter for congratulation that the discovery of the Studerian genus now relieves us from the difficulties that have surrounded *Cyclostoma* for upwards of ninety years.

In considering the latter part of this tenth rule, however, I can imagine grave difficulties arising in its application, and I beg to enter a very strong protest against it.

There will always be a variety of opinions as to whether an earlier name is obsolete or not. Rather than have this hesitation in the matter let us erase this clause from our statute-book and adopt the law of priority, without the particular limit specified, as a "fundamental" maxim. If reference is made to the American * view on this subject we find no such restriction in force. *Canon xxxiii.* reads:—"A generic name is to be changed which has been previously used for some other genus in the same kingdom." Again, *Canon xiv.* contains, "The adoption of a 'Statute of Limitation' in modification of the *lex prioritatis* is impracticable and inadmissible." Turning to continental views, we find it stated in Dr. R. Blanchard's † report, *article xii.*, "Tout nom générique déjà employé dans le même Règne devra être rejeté." A number of other instances could be quoted where we fail to discover the irksome limit implied in our English rule in the exercise of this law of priority. Suppose for a moment we consider Rule 10 in its application to the example given us by Canon Norman, viz. the genus *Normania*. Thrice has this name been applied. The first is rendered a synonym, because

* 'The Code of Nomenclature and Check-List of North-American Birds, being the Report of the Committee of the Union of Classification and Nomenclature.' 8vo, New York, 1886.

† 'De la Nomenclature des Êtres Organisés. Rapport présenté au Congrès International de Zoologie.' 8vo, Paris, 1889.

Loxoconcha was previously used for the same organism. Bowerbank, a little later, applying Rule 10, introduces it again for another group. The third occasion cited of its use is not of course difficult to cope with, as it takes its place without any comment in synonymy. Now I ask, if the second *Normania* were allowed to stand, what would be the effect if some day the name of *Loxoconcha* should prove to be pre-occupied? For it must be remembered that our ordinary channels of information for ascertaining such a point are not yet complete. We have by no means exhausted the literature. Numerous works are gradually coming to light which have hitherto escaped such skilful compilers as Agassiz, Marshall, and Scudder. No doubt to guard against such a contingency as I have hinted at Professor Sollas wisely altered the second *Normania* to *Pœcillastra*. However grievous such an alteration as this must be to the great naturalist referred to in the name, and while we must admit that Canon Norman's deduction from the latter part of Rule 10 seems to have been neglected by Prof. Sollas in making this change, yet it was brought about in accordance with the views held almost universally in other countries, and should consequently be admitted. I therefore maintain that to prevent confusion in the future Prof. Sollas's genus should stand, and that *Normania* should be allowed to repose quietly in synonymy until the time comes when it may be called forth to take the place of *Loxoconcha*.

I venture to ask Canon Norman if, in the compilation of his "Revision of British Mollusca," published in the 'Annals' for 1890, where he places under review some seventy or eighty genera and subgenera, he is aware that about a dozen of them are preoccupied names, and whether they remain so in his desire to carry out strictly to the letter his interpretation of the latter portion of Rule 10?

There is a great work to be done in our conchological nomenclature; and although much has been effected by continental authors, there still remains a considerable field for action. But if we are to be limited in our adoption of the law of priority we shall have endless confusion and unsatisfactory results. I consider that the importance of this matter deserves attention from the British Association at their next meeting, to settle whether zoological science would not be considerably advanced by the rescinding of the latter part of Rule 10 of the Stricklandian Code, the words of which are "when still retained for such genus or species."

I am indebted to my colleagues Messrs. E. A. Smith and G. A. Boulenger for some useful suggestions in the prepara-

tion of this paper—the former for advice on the conchological aspect of the question, and the latter for having supplied me with references to the literature on the subject of the nomenclature laws.

LXII.—*Descriptions of Three new Bats in the British Museum Collection.* By OLDFIELD THOMAS.

Hipposiderus Pratti, sp. n.

Allied and but little inferior in size to *H. armiger*. Frontal sac present (in the female, therefore certainly large in the as yet unknown male); the fleshy prominences on each side of the sac still more developed than in that species, and forming a sort of supplementary nose-leaf more than 3 millim. high, running right across the muzzle, and only interrupted in the centre where the opening of the frontal gland is placed. (In the male there is no doubt a still further development of this remarkable structure.) Terminal erect part of the true nose-leaf high in the centre and sloping down rapidly on the sides, its upper edge therefore far more convex than in the other species of the genus; its outer edges not continuous with the horseshoe; its front surface with a single central vertical ridge. Front edge of horseshoe sharply and distinctly notched in the centre. Two supplementary leaflets present on each side of the muzzle.

Ears as in *H. armiger*. Wing-membrane attached to the ankles. Last caudal vertebra free of the interfemoral membrane.

Colour of the fur (in alcohol) apparently dull smoky grey above and below.

Dimensions of the type, an adult female in alcohol:—

Head and body 90 millim.; tail 56; head 33; ear, above crown, 24; forearm 83 (=3.25 inches); lower leg 35; hind foot, including claws, 21.

Hab. Kia-ting-fu*, Western Sze-chuen, China. Collected by A. E. Pratt, Esq.

* Found in the artificial caves made by the ancient inhabitants of the district. In the very same cave as this specimen Mr. Pratt obtained a male of what appears to be *H. armiger*, unless the male of *H. Pratti* is like *H. armiger* while the female is quite different. This, while possible, is very unlikely. Fortunately both sexes are known not only of the true *H. armiger* but also of the Chinese *H. Swinhoei*, Peters, ordinarily considered to be synonymous with it, and therefore there can be no question as to the specific distinctness of the new form.

This fine species is readily distinguished from its nearest allies, *H. armiger* and *H. leptophyllus*, by the very different shape of the terminal nose-leaf, by the great development of the prominences on each side of the frontal sac, and by its lesser number of supplementary leaflets. In size it is noteworthy as being only exceeded by three members of the large genus *Hipposiderus*, and it is in fact one of the largest insectivorous bats that have been described for many years.

Vesperugo (Vesperus) Moloneyi, sp. n.

Vesperus with the tragus extraordinarily short, with the outer upper incisors nearly as long as the inner, and with the anterior lower premolar minute.

Size of body medium, but the extremities so short that the forearm-length makes the species appear to be among the smallest of the genus. Head very broad and flat, much as in *Nycticejus** or in *V. pachypus*; facial glands swollen, but not raised vertically above the level of the centre of the muzzle. Ears very short, their edges evenly continuous, not emarginate externally either above or opposite the base of the tragus; the small keel usually present just behind the base of their inner margin nearly or quite obsolete. Tragus (see figure) extraordinarily small, quite unlike that of any other member of the group, *its height, measured along its inner edge, less than half its breadth*, its upper and its outer margins rounded; its outer base without any projection. Anterior extremities much reduced throughout, especially distally; the forearm but little more than half of the combined lengths of the head and body, the thumb very short, the two phalanges of the middle finger together only about half the length of the short forearm, and those of the fifth finger less than a fifth of it; finally the usual distal cartilaginous extension of the third finger is nearly obsolete. Hind legs unusually thick and muscular. Calcar feeble, post-calcareal lobule absent. Extreme tip of tail only free from membrane.



Fur short, uniformly very dark brown or black above and beneath.

Upper inner incisors long, their tips bicuspid; outer ones

* When showing (Ann. Mus. Genov. (2) ix. p. 88, 1890) that the American *Nycticejus humeralis* could not be separated generically from the Old-World *Scotophilus*, I did not notice that the name *Nycticejus* (1819) was anterior in date to *Scotophilus* (1822). Mr. Blanford has since pointed this out to me; and it is evident that the former name must be used for all the species hitherto called *Scotophilus*.

cylindrical, unicuspid, not reaching quite to the level of the outer cusps of the inner incisors. Upper premolars very close to and but little shorter than the canines. Lower incisors tricuspid, overlapping. Anterior lower premolar very small, scarcely exceeding in height the cingulum of the large posterior one.

Dimensions of the type, a male preserved in spirit:—

Head and body 50 millim.; head, length 16, breadth across muzzle 11; ear, length from base of inner edge 9, length from base of outer 11·5; tragus, length of inner margin 1·0, length of outer margin 3·8, breadth above 1·9, height of base 3·2. Forearm 29 (=1·15 inch); thumb, including claw, 5·5; third finger, metacarpal 29, first phalanx 8·5, second phalanx 7·8; lower leg 11; hind foot, including claws, 8·2; tail 30.

Hab. Lagos, West Africa. One specimen, collected and presented by Sir Alfred Moloney.

This most remarkable species is distinguished by its proportionally large body and head and the reduction in length of all its extremities, including in this term the ears, tragus, wings, legs, and tail. This reduction, combined with the markedly more muscular condition of the legs, no doubt indicates a less exclusively aerial manner of life; and we may be prepared to find when its habits are known that it seeks for its prey creeping about either the trunks and branches of trees or the rocks of cliffs and caves, rather than flying about in the open.

Stenoderma Nichollsi, sp. n.

Most closely allied to *Stenoderma rufum**, Geoff., with which it agrees in the number of its molars ($\frac{3}{3}$) and in the long parallel-sided palatal emargination. It differs, however, in the absence of the remarkable frontal ridges and concavity characteristic of that species and in the very dissimilar proportions of the upper molars.

Comparing the teeth with Peters's beautiful figures, the inner upper incisors are shorter and with more of a tendency to the bicuspidate form found in *S. achradophilum*, Gosse, and figured by Dobson †; the canines and premolars are similar, but the molars are again, while agreeing in number with those of *S. rufum*, more similar in shape to those of *S. achradophilum*; thus $\frac{m}{1}$ is far broader than in *S. rufum*, and extends inwards by nearly half its breadth beyond the level

* Skull and teeth figured by Peters, MB. Ak. Berl. 1876, p. 434, pl. i. figs. 1-7.

† Cat. Chir. B. M. pl. xxviii. fig. 2.

of the last premolar, and $m.2$ is equally broad. On the other hand, these two molars are not so compressed antero-posteriorly as in *S. achradophilum*, and the internal gap between them is broader. Finally, $m.3$ is far smaller than in *S. rufum*, not exceeding in transverse section one of the small outer incisors. Lower teeth as in *S. achradophilum*, except for their rather greater size.

Palatal emargination narrow, parallel-sided, extending forwards to the level of the middle of $m.1$.

External characters very much as in *S. achradophilum*, except that the colour is darker and more uniform, the head being dull brown, like the rest of the body.

Dimensions of the type, an adult female in spirit:—

Head and body 58 millim.; ear, above crown, 12; forearm 46 (= 1.8 inch); lower leg 18.

Teeth: distance from front of canine to back of $m.2$ 7.0 millim.; palatal breadth, outside $m.1$ 9.5, inside $m.1$ 3.9.

Hab. Island of Dominica, West Indies. Collected, under the auspices of the West-Indian Exploration Committee, by Dr. H. A. A. Nicholls, in whose honour I have much pleasure in naming the species.

S. Nichollsi is interesting as being the first of the rare genus *Stenoderma* found in the Lesser Antilles, *S. achradophyllum* being, so far as is yet known, a native only of Jamaica and Cuba, while *S. falcatum* is peculiar to the latter island. The habitat of *S. rufum* is unknown.

LXIII.—On *Pherusa fucicola*, Leach, and the Law of Priority. By R. I. POCOCK.

THERE are few zoological systematists who can say with Mr. Walker that they have destroyed more species than they have made. For this all carcinologists must be grateful; but most of them will, I think, feel regret at his decision in the case of *Pherusa fucicola*, as set forth in the last number of the 'Annals.' It seems to me that the position he has taken up is on any grounds absolutely untenable; and since he has courteously mentioned my name in connexion with his investigation (although the entire credit of the matter is due to him), it is possible that I may be suspected by some of agreeing with his views on the point. I consequently take this opportunity of repudiating once and for all on my own behalf such a system of nomenclature as that which he adopts, and of attempting briefly to show in what, to my mind, the faults of it mainly consist.

Omitting most of the synonyms, which for my present purpose are of no importance, the history of the genus and species may be briefly told as follows:—

It was first described in 1814* by Leach in the appendix to the article "Crustaceology" of the Edinb. Encycl., and subsequently, but not in the same terms, in the Trans. Linn. Soc. for the following year.

In 1830, in the Ann. Sci. Nat., Milne-Edwards described two species of Amphipoda—one named *Amphithoë Jurinei* and the other *Gammarus* (now *Gammarella*) *brevicaudatus* (a)—this last being, as Mr. Walker has shown, Leach's *Ph. fucicola*.

In 1862, in the Cat. Amphipoda of the Brit. Mus., Spence Bate wrongly described as *Ph. fucicola*, Leach, a species identical with *Amphithoë Jurinei*, M.-Edw., giving *Amphithoë Jurinei*, M.-Edw., as a synonym of it. In the same volume he also redescribed *Gammarella brevicaudata*, but of course without discovering that it was Leach's *Ph. fucicola*.

In 1863 †, in vol. i. of the Brit. Sessile-eyed Crust., Bate, in conjunction with Westwood, again describes *P. fucicola*; but on this occasion he characterizes, although not accurately, the right species, and gives a figure, although an inaccurate one, of Leach's type specimen. He does not discover, however, that his *Ph. fucicola* of 1863 is different from his *Ph. fucicola* of 1862.

To these errors committed by Spence Bate may be traced the synonymical labyrinth through which Mr. Walker has so skilfully and carefully brought us. But after trustfully following him so far, I sincerely regret that at this point we must part company. He prefers to follow a by-path which I am convinced will ultimately involve him and his followers in a maze, if possible, greater than that from which he has just escaped; while I am compelled to keep to the road along which the law of priority points—a law which is to me as a law of the Medes and Persians. Fortunately, owing to Mr. Walker's safe guidance, the road ahead is perfectly obvious, and leads inevitably to the following conclusions:—(1) That *Pherusa fucicola* of Leach, 1814 ‡, and of Bate, 1863, must

* Without going into the matter, I follow Mr. Stebbing in his opinion as to the date of this work.

† This is the date that the Museum copy of this work bears. I here use the dates to designate the different works, irrespective of the dates of publication of the separate parts of the 'Sessile-eyed Crustacea.'

‡ I am thus particular with the date because of the possibility of its ever being suggested that the *P. fucicola* of the Linn. Trans. (1815) may be different from the one described in the Encycl. of 1814. Such a suggestion, it seems to me, would not be altogether unreasonable, for the

stand as a genus and species of which *Gammarella brevicaudata*, *Normanni*, &c. are synonyms; (2) that *Amphithoë Jurinei* must be the name for the species which Bate in 1862 described as *P. fucicola*.

Having thus extricated ourselves, let us turn back for a moment and follow Mr. Walker along his path. His choice of it has evidently been taken in the hopes that it will enable him to circumvent the ruinous edifice of synonymy which blocks the way on the highroad; perhaps, too, he has been influenced by the thought that he will thus shift the responsibility of pulling it down upon some one with less regard for his own head than he has himself.

So much for his reasons: now for his excuse.

It sometimes happens that an author will, for the sake of peace and quietness, abstain from upsetting a recognized system of names, although he knows it to be rotten to the core, excusing himself on the trumpery plea that the correct name for an object is the name that has been most often used for it or that by which it is most commonly known*. But, to do Mr. Walker justice, he shelters himself under no such flimsy a covering as this. He boldly meets on their own ground those who attack him with the law of priority, brandishing in their faces another rule of the British Association. This rule, as he has told us, is in substance this:—No name can acquire authority until it be defined, definition being the distinct exposition of essential characters.

But what on earth does this mean? It is a thousand pities that the compilers of the rule did not give a distinct exposition of the meaning of the word *essential*. Essential for whom? and for what time? For Linnæus? for Mr. Walker? or for the zoologist of a hundred years hence? A knowledge of what is essential is purely a matter of experience. Therefore what is essential to-day may be absolutely inessential to-morrow; and consequently, in accordance with the rule, the names that are given in the nineteenth century may all have to be abolished in the twentieth, just as those who adopt and revere the rule (which I do not) must rechristen almost every species constituted by Linnæus. For it is scarcely an exaggeration to say that he who adopts a Linnæan name tacitly ignores the rule.

1814 description applies to the types and the 1815 one does not. At all events, I should be sorry for it to fall to my lot to refute such a belief.

* In that case a schoolboy should be designated in the roll-call by his nickname.

Clearly, then, in its literal sense the rule must mean that the description should be so exact as to differentiate the species from all others previously known and from all that will be brought to light in the future. But for all practical purposes this is impossible. All that those who hold to it can expect is that an author should point out such characters as are believed in his day to be essential. This I believe to be a legitimate, nay, the only possible practical rendering of the rule; and in accordance with this interpretation of it I maintain that Leach described *P. fucicola*.

This last assertion, however, requires justification because it is diametrically opposed to what Mr. Walker, who should know far better than I, says on the subject.

This author writes as follows (p. 421):—"The solitary species therefore on which Leach founded his genus *Pherusa* disagrees in almost every particular both with his definition of the genus and of the subdivision in which he placed it!" This statement is substantially true of the description published in the 'Linnean Transactions' for 1815; but it is not true of the *original* description which appeared a year earlier in the appendix to the article "Crustaceology" of the Edinb. Encycl.

If we turn to this description we find the genus and species characterized (allowing for the sake of brevity that the class and tribal names symbolize certain characters) as follows:—It is a *Gasterurous* (*Hedriophthalmatus*), *Malacostracous Crustacean* belonging to the tribe Gammarides and to the family Gammaridæ. This family and its genera are diagnosed in the following fashion:—

Fam. GAMMARIDÆ.

Last joint of antennæ composed of several minute articulations; upper pair longest, four-jointed; under ones five-jointed.

- a. Second pair of feet larger than first, with a compressed hand *Melita*, *Mæra*.
- b. Four anterior feet nearly equal in size and form, with ovate hands..... *Gammarus*, *Amphithoë*.
- c. Four anterior feet with a filiform hand *Pherusa*.

To this, the first published description, we must in all fairness appeal; and this description is true of the specimens of *Pherusa* that Leach had*. Moreover, it enabled Leach

* I will not go so far as to assert that I should have described the hands as filiform, although as compared with the hands of, *e. g.*, Leach's *Mæra* their shape may well be expressed by the words. It is enough for all purposes that the statement is relatively true.

to recognize his specimens of the genus from his specimens of all other genera; or, in other words, it contains a distinct exposition of the essential characters. What more could be expected of him? Is the name that he proposed to be discarded (1) because his definition of it does not enable Mr. Walker to select the species from a collection of all the Amphipoda known at the present time to occur on the British coasts? or (2) because it has since been found that the male, which was unknown to Leach, has hands of a different shape from the female?

These it seems to me are the only two props that Mr. Walker has to support him; and I fear he will find it exceedingly difficult to maintain his balance on a two-legged stool of this description. But I trust he will abandon the attempt. It seems to me that he must admit that, in accordance with a legitimate and practical interpretation of an ambiguous rule, the genus may still stand as Leach's, for it can only be overthrown by an impractical rendering of it.

But to take the name from Leach and give it to Bate, as Mr. Walker proposes, is to add insult to injury by punishing the innocent to reward the guilty. Fortunately, on any plea, the transference is inadmissible, for Oken and Rafinesque have put in a prior claim for it.

But Leach's claims are incontestable; and those who swear by the law of priority, which ultimately must prevail, will say *fiat justitia, ruat cælum*—give Leach the credit of the name, no matter to what temporary condition of chaos the synonymy of the group be thereby brought.

MISCELLANEOUS.

Description of a new Species of Tristomum from Histiophorus brevirostris. By F. JEFFREY BELL.

Among the specimens in the collection of the late Mr. F. Day are some labelled as "Parasites from *Histiophorus* (sic) *brevirostris*, Madras." These are all examples of a species of *Tristomum* which is clearly allied to but is quite distinct from *T. coccineum*. The characters of the latter species have been so clearly stated by Dr. Taschenberg* that it is an easy matter to distinguish the new species, which may be called *Tristomum histiophori*. With a close resemblance to *T. coccineum*, it is distinguished by the absence of

* Abh. der naturf. Ges. zu Halle, xiv. Heft 3.

parallel rows of chitinous corpuscles and by the fact that the posterior sucker projects by about one third of its diameter beyond the margin of the body.

Breadth 12: length (including suckers) 15 millim.

„ 11.5 „ „ „ 14 „

„ 10 „ „ „ 10.5 „

As *T. coccineum* has been taken from the gills of *Xiphias gladius*, it is interesting to observe that an allied form is taken from an allied fish.

Note on the Authors of the Specific Names in John White's 'Journal of a Voyage to New South Wales,' 1790.

The descriptions and names of animals discovered by John White have usually been attributed by later writers to the discoverer. If, however, we closely examine the book this is found not to be the case.

In the Advertisement (sig. A 2) the editor returns his grateful thanks to Dr. Smith, Dr. Shaw, and John Hunter, whose abilities and communications have enabled him to surmount those difficulties that necessarily attended the description of so great a variety of animals.

With regard to the plants, the fact that they were described by J. E. Smith seems doubtful if we read the sentence on p. 221; but Mr. Carruthers kindly informs me that the evidence of Robert Brown on this point is indisputable (Prod. Flor. N. Holland, 1810, p. 382). Mr. Carruthers also suggests that the authors probably sent their MS. descriptions to the editor (? unknown), who worked them into his editorial text without individual acknowledgment.

With regard to the animals, George Shaw, in his 'General Zoology,' expressly stated that he himself described the following species for the first time in White's 'Journal':—*Motacilla australis*, *Lacerta scincoides*, *L. muricata**, *L. tenuolata*, *L. platura*, *Fulco albus*, *Corvus graculinus*, *Cottus australis*; and as these occur here and there among other species, we may reasonably assume the following to be by the same author:—*Fulica alba*, *Caprimulgus cristatus*, *Rana exrrulea*, *Procellaria fuliginosa*, *Lacerta varia*, *Chetodon armatus*, *Mo. willa superba*, *M. pusilla*, *Psittacus pusillus*, *P. discolor*, *Labrus cyprinaceus*, *Lophius dubius*, *Sparus compressus*, *Mullus fasciatus*, *Balistes granulatus*, *Atherina australis*; for on p. 269 we are told that John Hunter described the animals [Mammals] which follow, and to these no specific names have been given.

C. DAVIES SHEARBORN

Natural-History Museum,
Cromwell Road, S.W.

(Index gen. et spec. anim.).

* 'General Zoology,' Amphibia, vol. iii. pt. 1, 1802, p. 211; only one reference is given here, as sufficient to prove the case.

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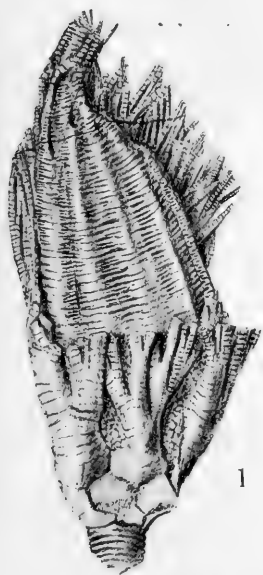
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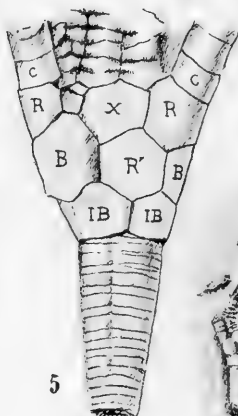
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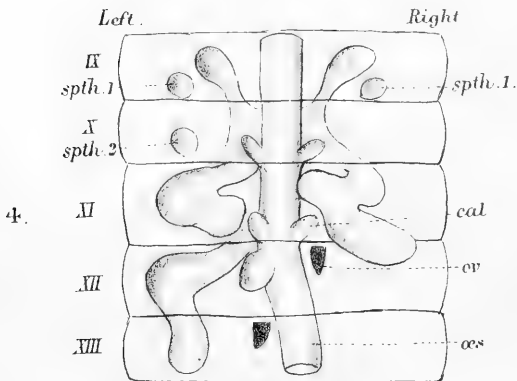
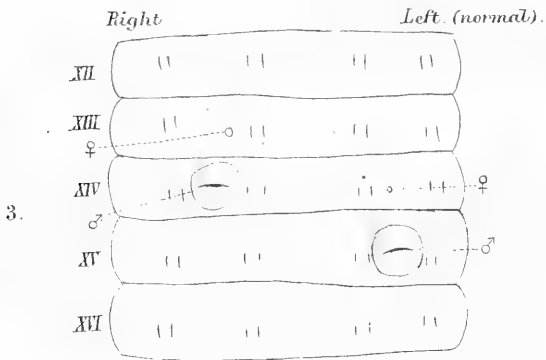
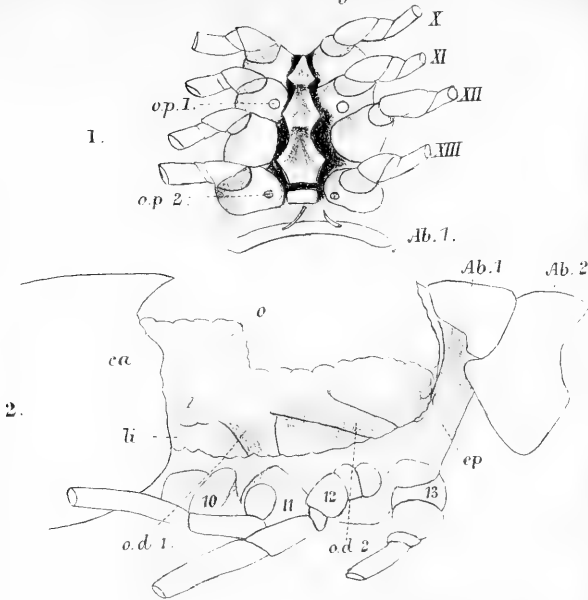
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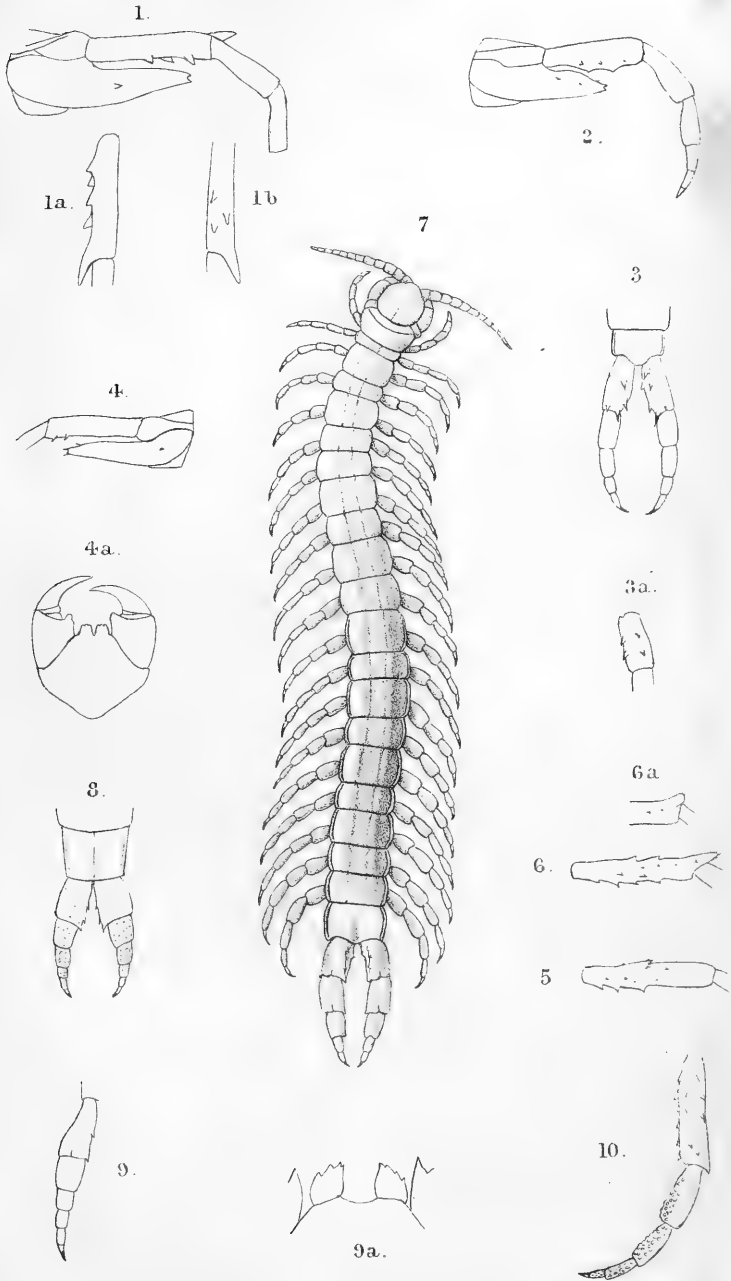
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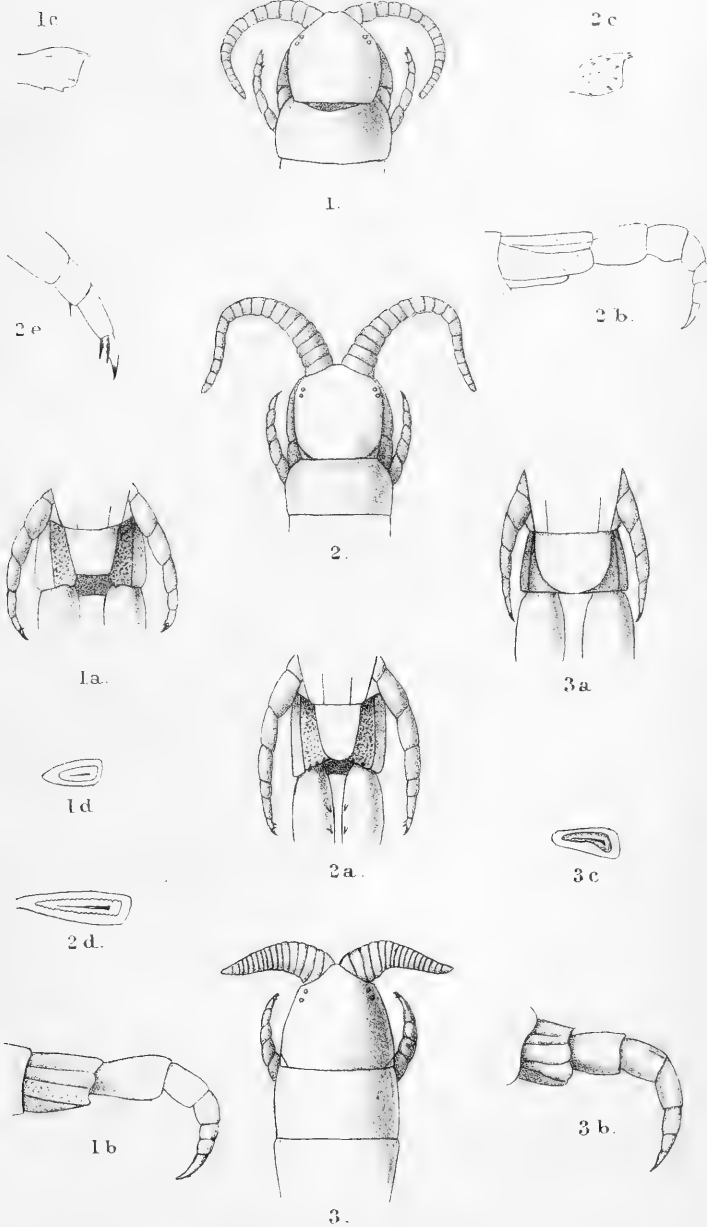




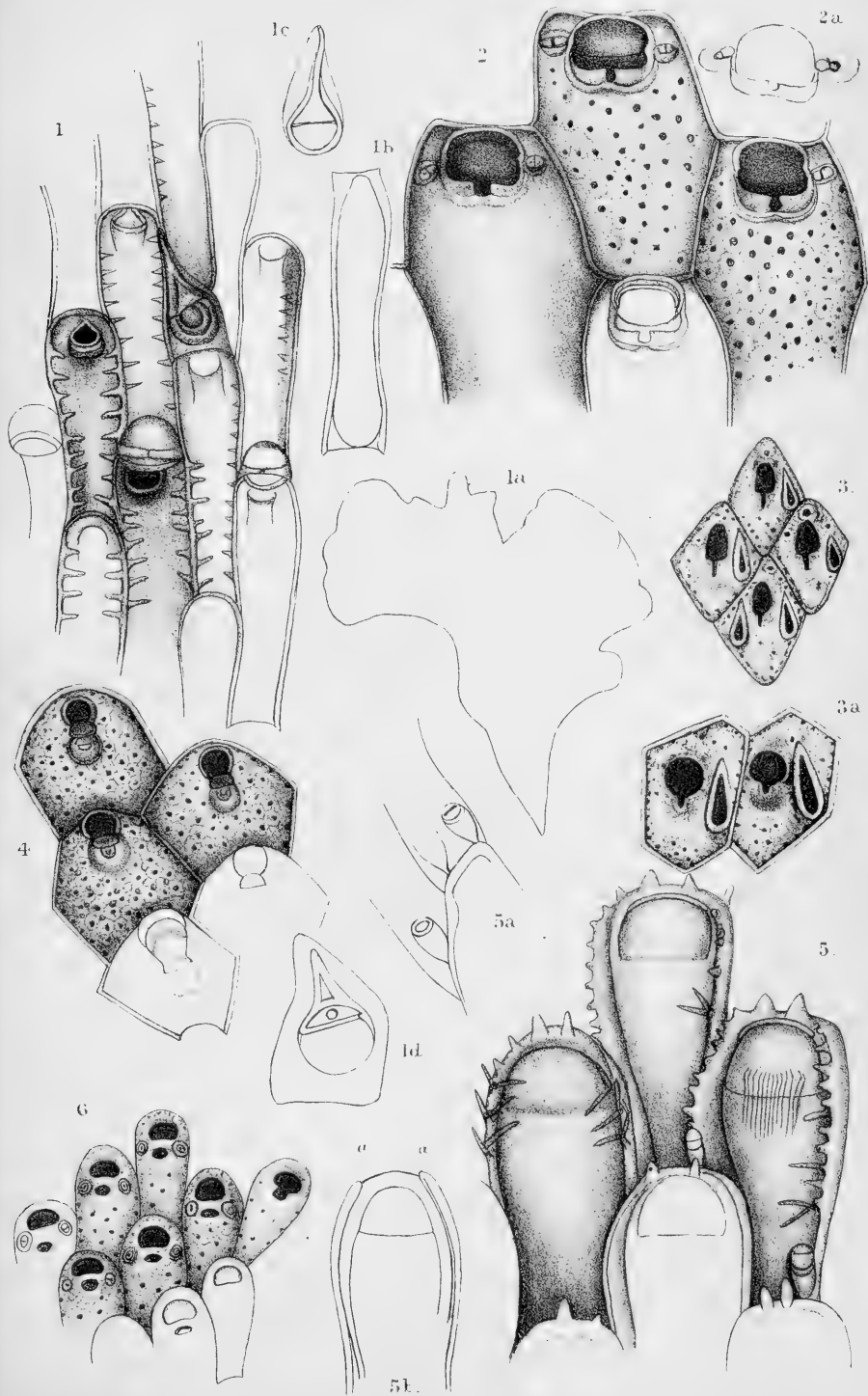


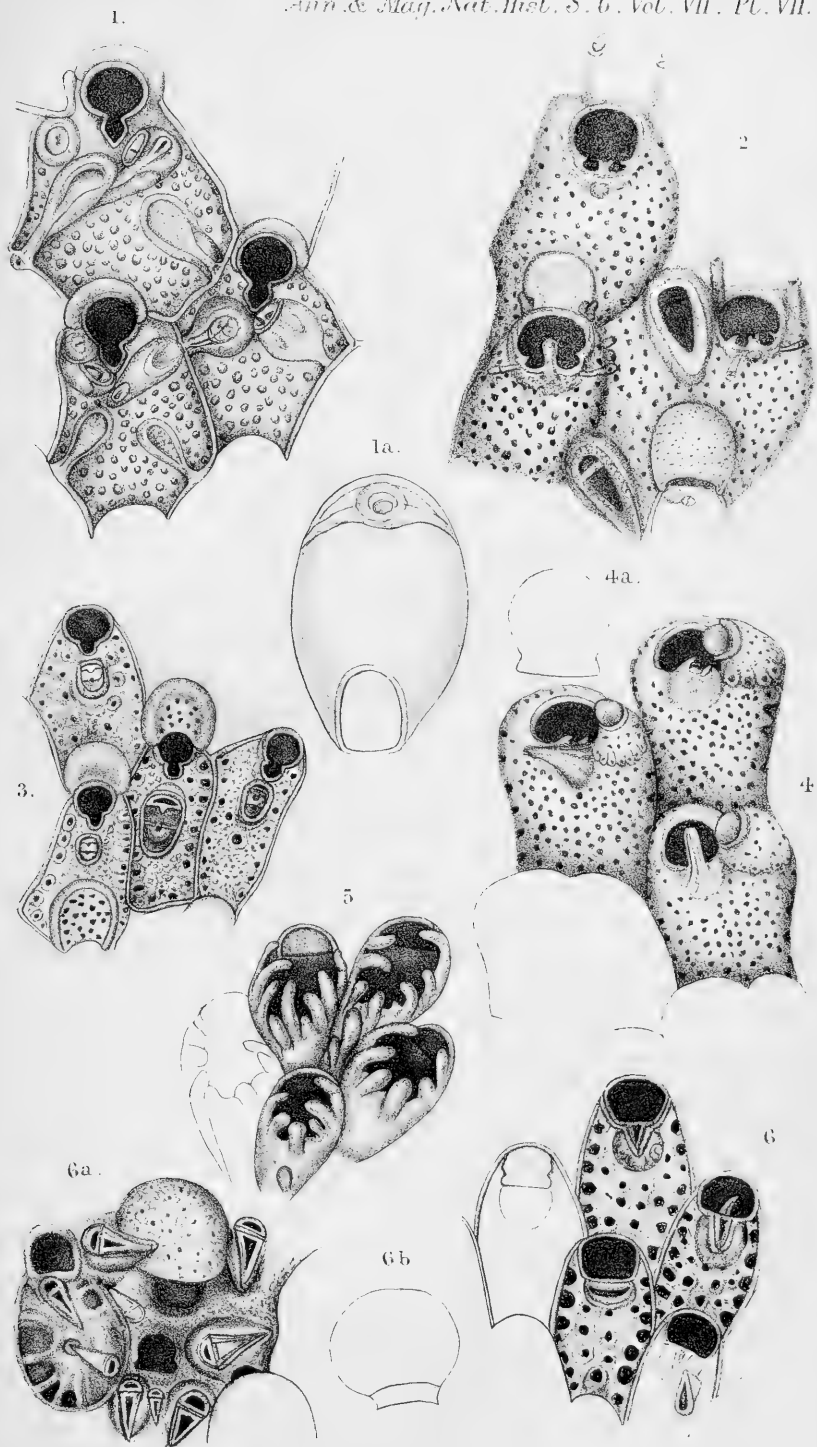


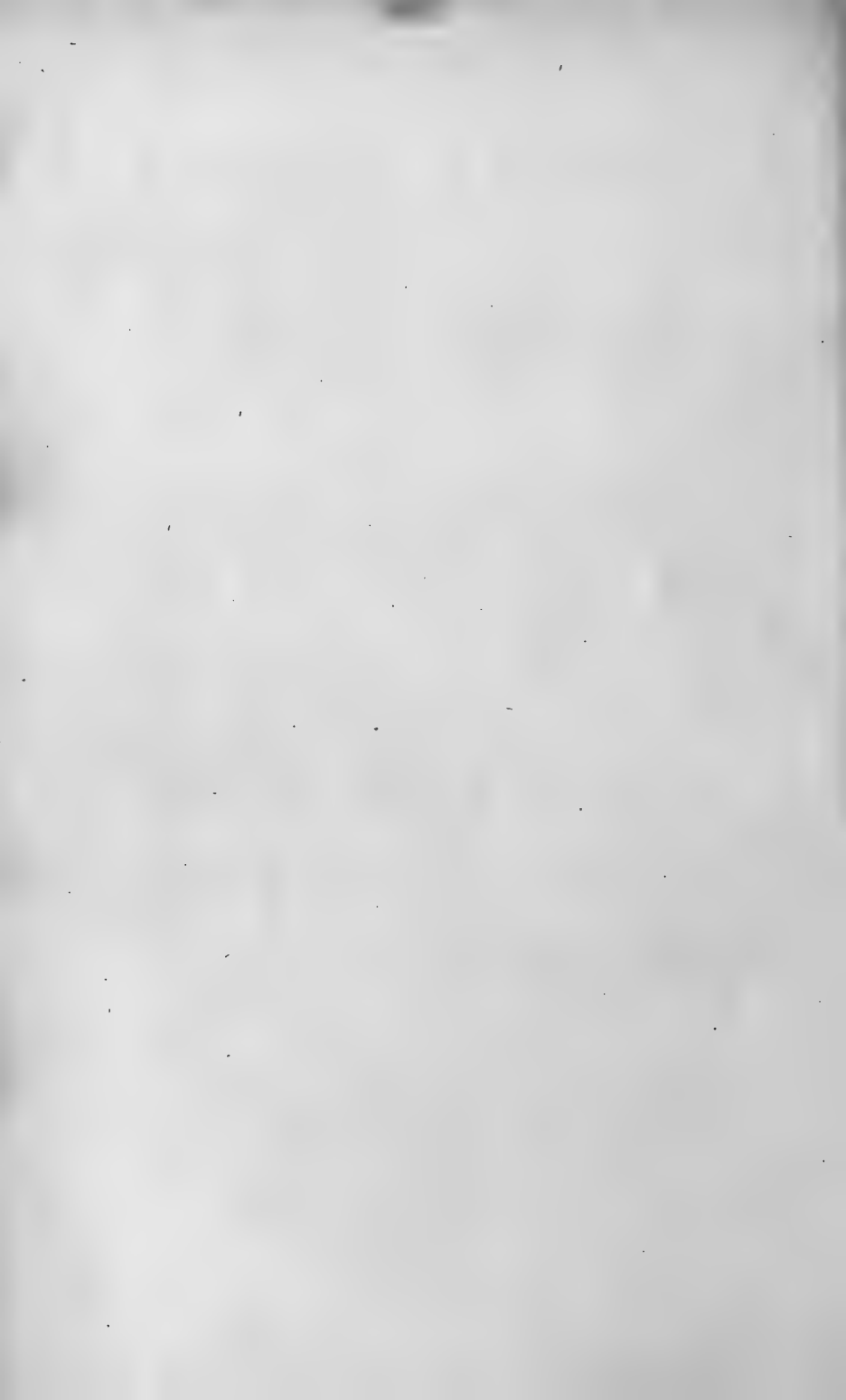


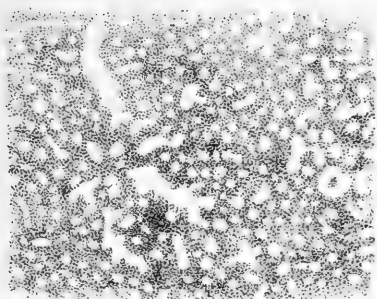




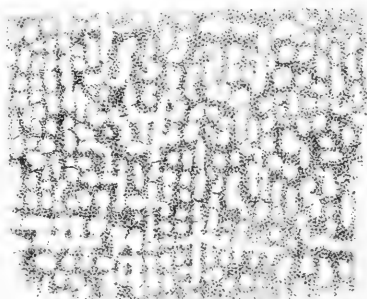




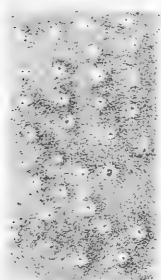




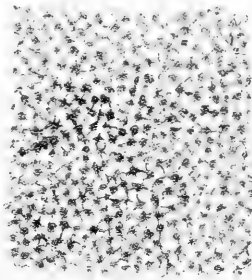
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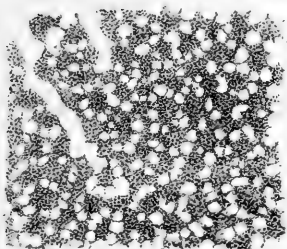
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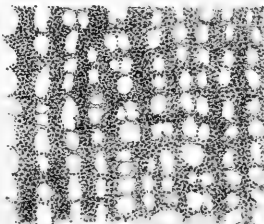
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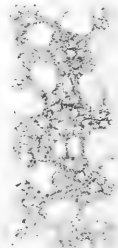
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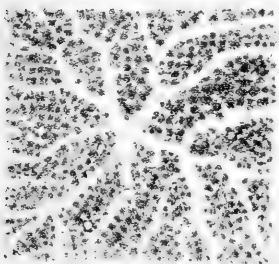
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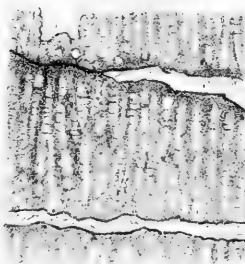
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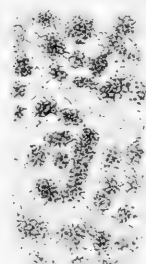
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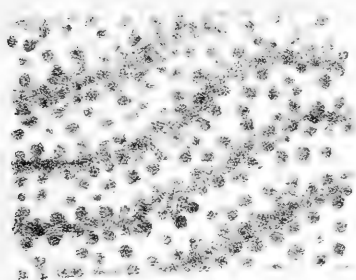


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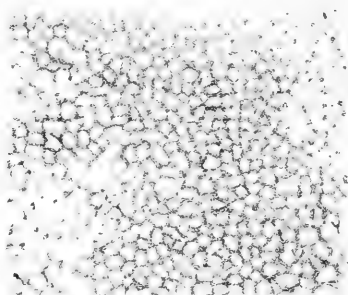
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A. T. Hollick lith.

Mintern Bros. imp.

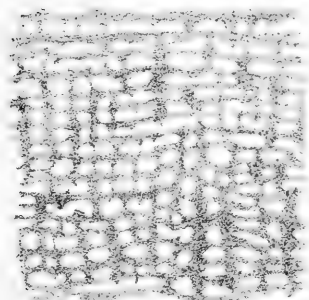




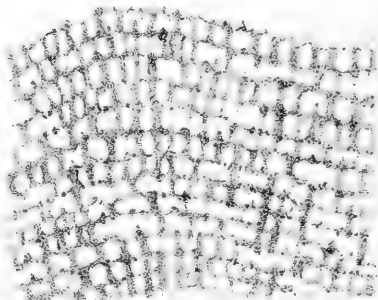
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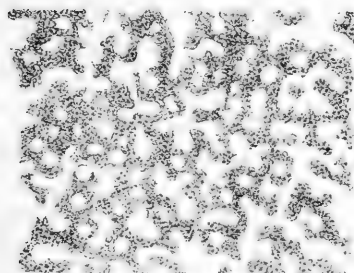
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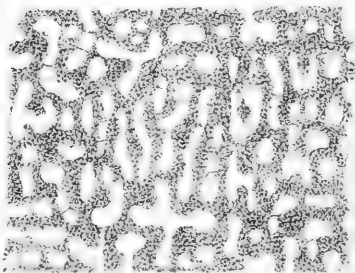
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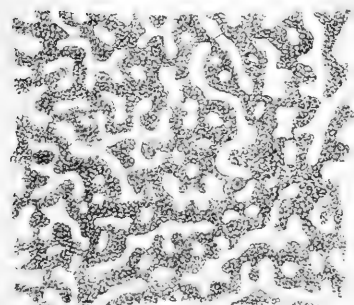
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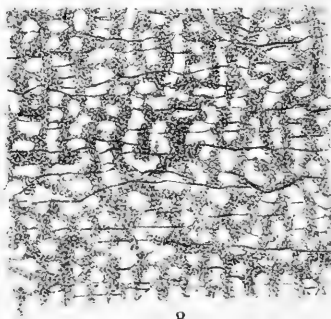
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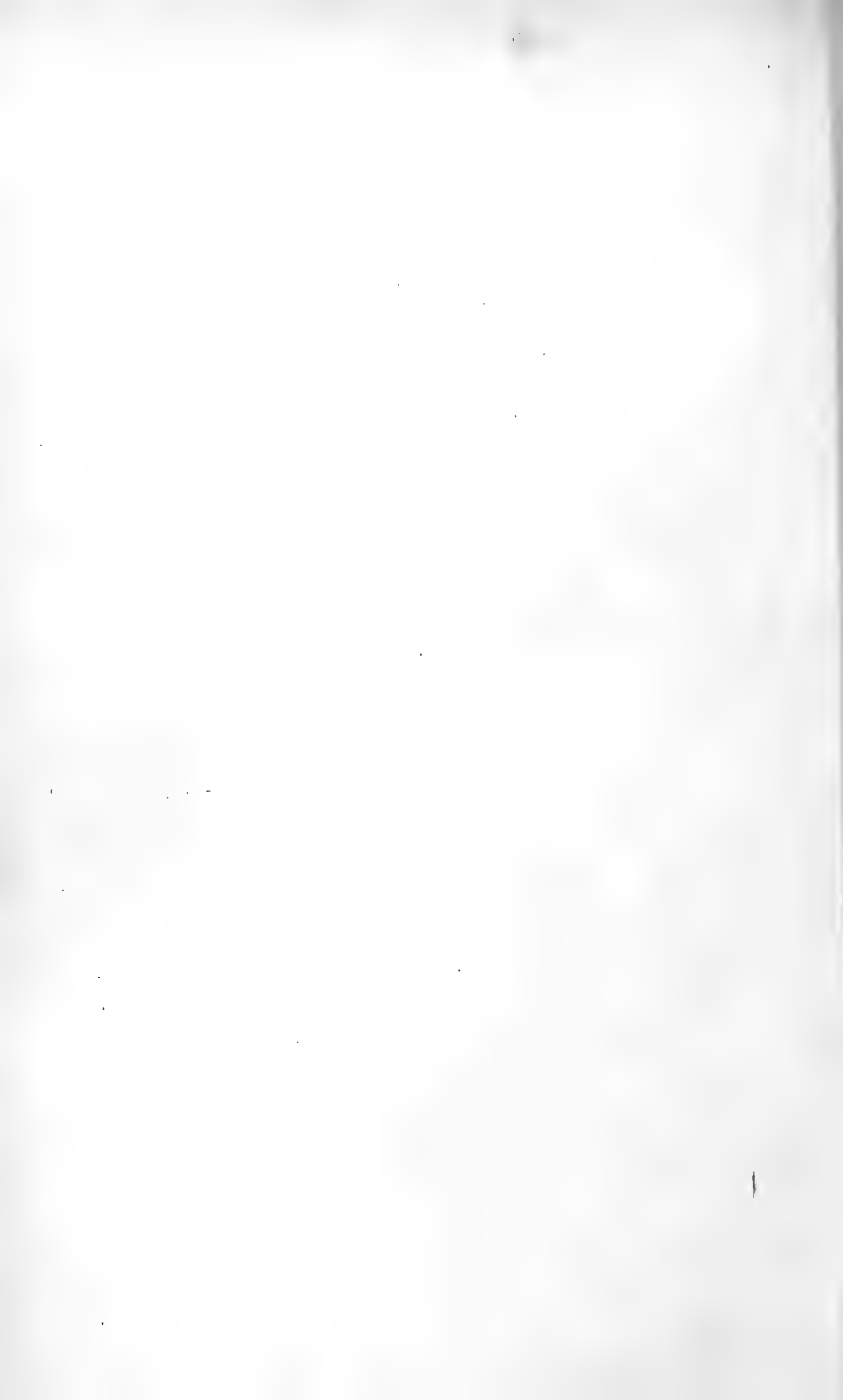
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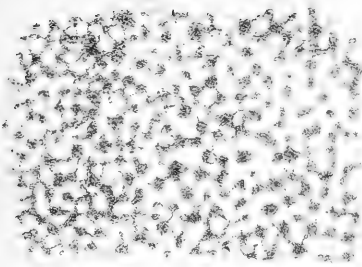


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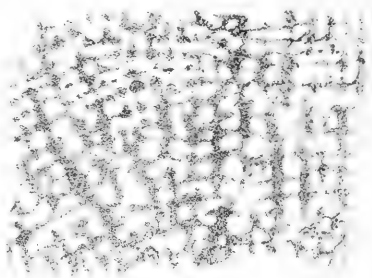


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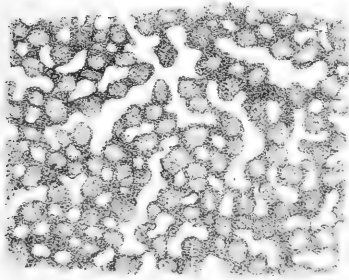




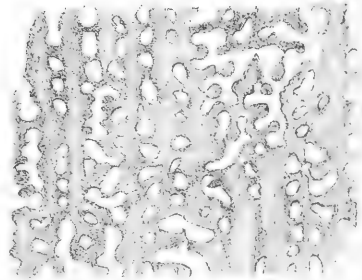
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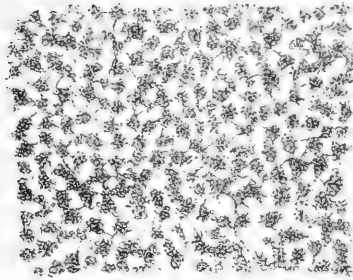
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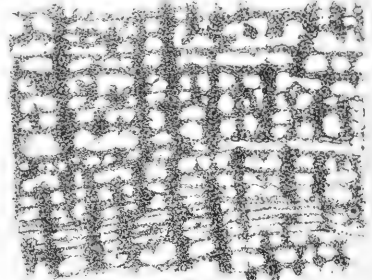
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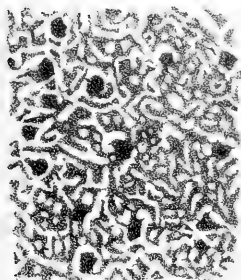
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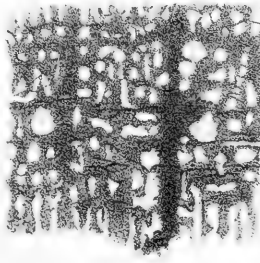
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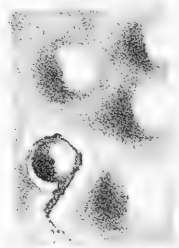
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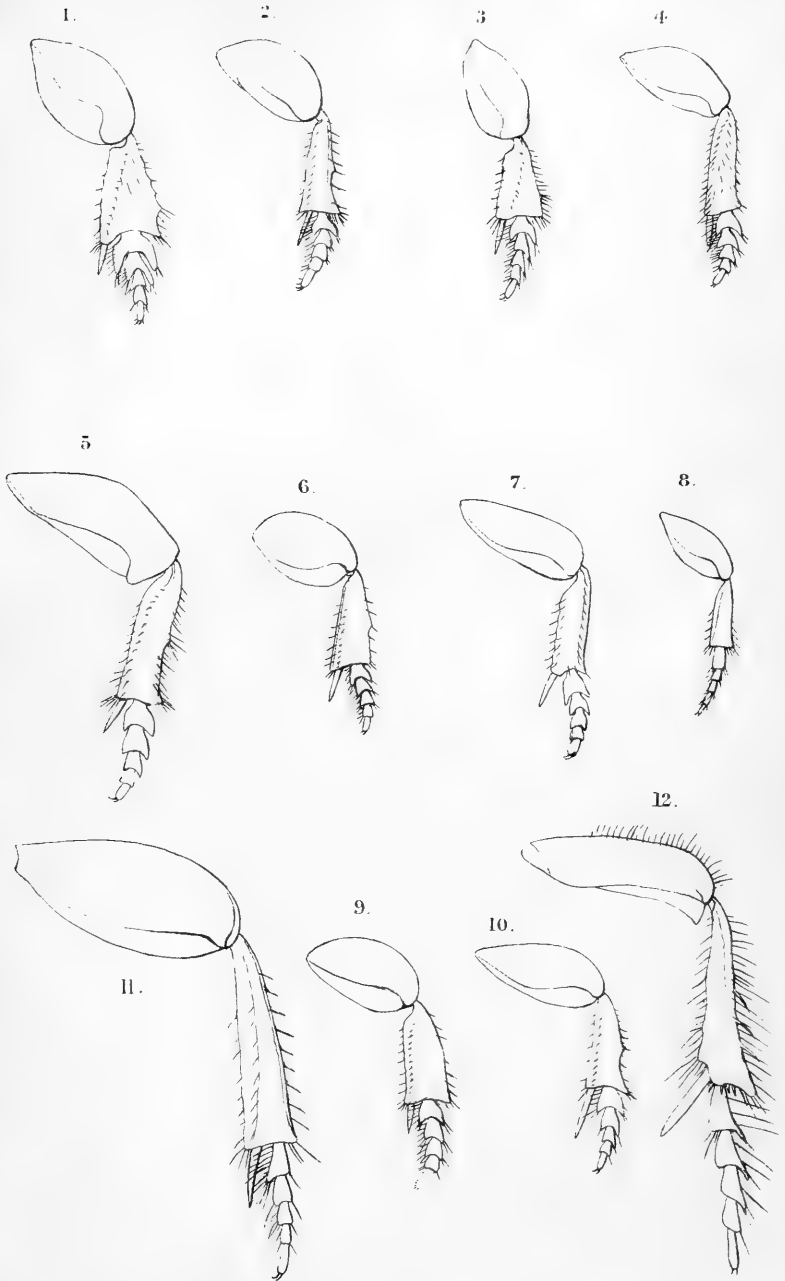


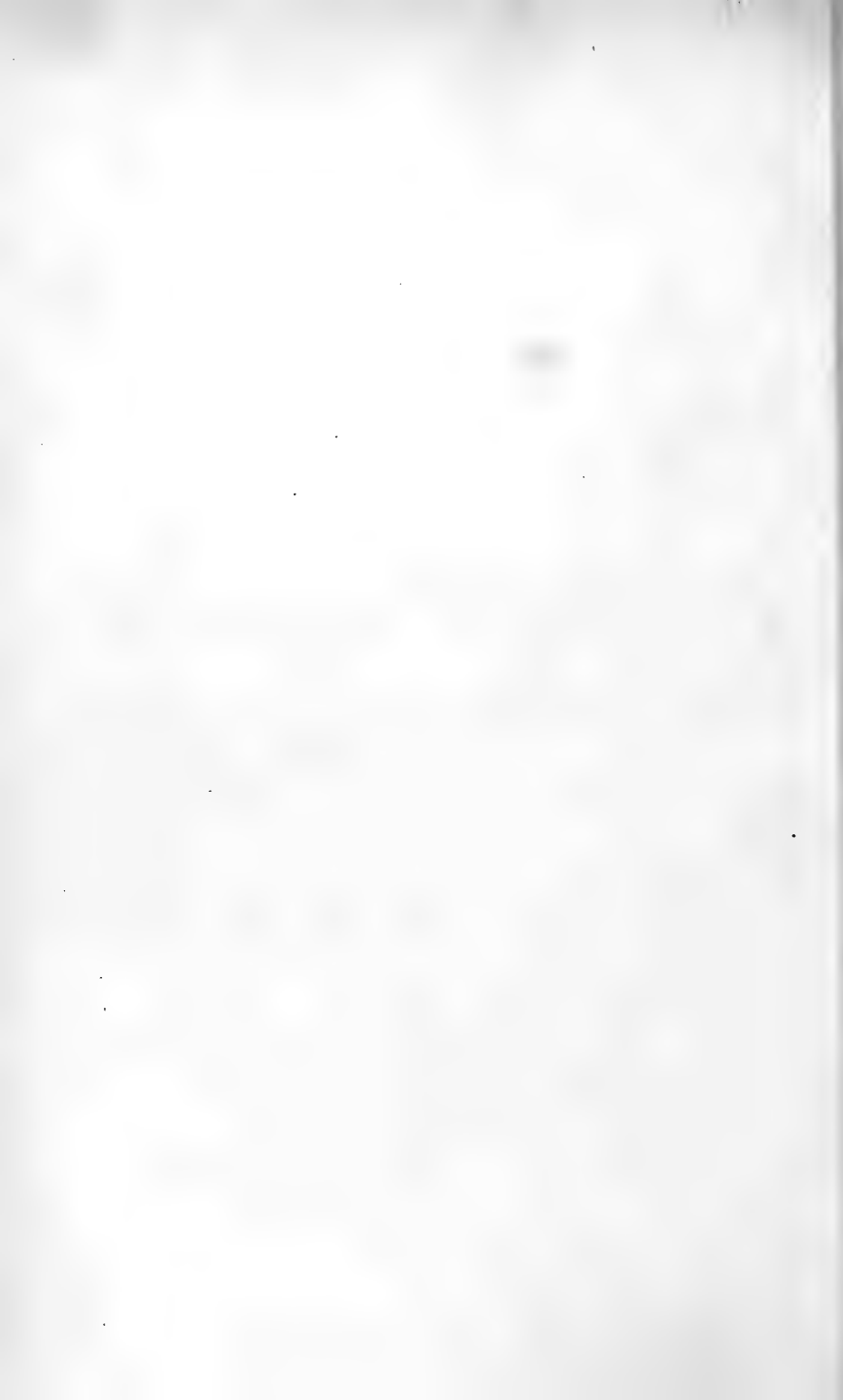
9.



7.







HALISTEMMA
Natural Size.



