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AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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

CONDUCTED BY

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

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

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

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

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

No. 19. JULY 1879.

I.—*Descriptions of new or little-known Species of Maioid Crustacea (Oxyrhyncha) in the Collection of the British Museum.* By Edward J. Miers, F.L.S., F.Z.S., Assistant in the Zoological Department.

[Plates IV. & V.]

The present paper contains descriptions of all the species of Oxyrhyncha in the British-Museum collection that appear to have been hitherto unrecorded, with the exception of a few specimens whose age or condition is such as to render it unadvisable to describe them as new to science. Two or three were noticed, but not described, by White, so long ago as 1847, in the 'List of Crustacea in the Collection of the British Museum.'

For diagnoses of the new genera briefly referred to below, and characters of the families, I must refer to my paper on "The Classification of the Maioid Crustacea," published in the 'Journal of the Linnean Society, Zoology,' vol. xiv. p. 634, for the present year.

The following is a systematic list of the species:—

Systematic List of the Species described.

Inachidæ.

Achæopsis Güntheri, sp. n. (Pl. IV. fig. 1.)

Carapace broadly triangulate, moderately convex. Rostrum short, spines acute. There is a small supraocular spine. The spines of the carapace are disposed as follows:—There is a very large perpendicular spine upon the gastric region, a large blunt conical tubercle upon the cardiac, and a smaller tubercle upon each of the branchial regions. The postocular spine is small. Behind the eyes, on the subhepatic region, is a blunt tubercular prominence. The anterior legs (in the female) are small. The ambulatory legs are smooth, of moderate length; the terminal joints in the first pair long, slender, and nearly straight; in the following pairs slightly curved. Length to base of rostrum $\frac{1}{2}$ inch.

Hab. Cape of Good Hope (*H.M.S. 'Herald'*).

A single adult female is in the collection. Length of carapace about $\frac{1}{2}$ inch.

This species is easily distinguished by the remarkably prominent gastric spine. The terminal joints of the legs and the carapace in front of the gastric spine are slightly hairy. In

Achæopsis spinulosus, Stm., also from the Cape of Good Hope, of which specimens of both sexes are in the collection, and which is the only other known species of the genus, there are three spinules on the gastric region and several upon the sides of the carapace. The genus *Achæopsis* appears to represent *Inachus* in the southern hemisphere.

I dedicate this species, which is certainly one of the most striking of those here to be described, to Dr. Günther, F.R.S., Keeper of the Zoological Department, by whose continual kindness and encouragement my studies have been so greatly facilitated.

Eucinetops? Stimpsoni, sp. n.

Carapace subpyriform and convex, upper surface without spines or tubercles. Rostrum deflexed; the spines of which it is composed small, flattened, acute, and separated by a narrow fissure. Immediately behind the eyes are two small blunt prominences; and a third, at a little distance, represents the postocular spine. There are two very small tubercles at the distal end of the slender basal antennal joint. The second and third joints are not, as in *E. Lucasii*, very broad, but cylindrical. Anterior legs (in the female) very slender and smooth. Both the body and legs are pubescent. Length of carapace $\frac{5}{6}$ inch.

Hab. N.E. coast of Australia (*Cuming*).

This species is represented only by a single female specimen.

I am in some doubt as to whether this species should not be made the type of a genus distinct from *Eucinetops*. It resembles the Californian *E. Lucasii*, Stimpson, in the small and deflexed rostrum, the great length and mobility of the eyes, the very small epistome, &c., but differs in the more elongate-triangular carapace, and in the non-dilatation of the second and third joints of the flagellum of the antennæ. If distinct as a genus, I should propose to designate it as *Anacinetops*. It comes very near to *Camposcia*, but is distinguished by the presence of a distinct rostrum and by the longer, slenderer eye-peduncles.

Halimus truncatipes, sp. n.

Carapace elongate-ovate, moderately convex; gastric region with about eleven tubercles, of which four anterior are arranged in a transverse series, and three posterior in a median longitudinal series, the others are lateral; cardiac region with two obtuse tubercles, and, posterior to these, three in a longitudinal median series; the last of these, on the posterior margin of the carapace, is an acute spine. There are three or four obscure tubercles on each branchial region, and six spines on each lateral margin, including the two spines which represent the upper orbital margin. The spines of the rostrum are acute and strongly divergent. There is a spine at the extero-distal angle of the basal antennal joint. The merus joint of the outer maxillipedes is strongly produced at its antero-external and the ischium joint at its antero-internal angle. The anterior legs (in the male) are small; arm with a spine at the distal end of its upper margin; wrist obliquely carinated; palm slender, smooth, and compressed; fingers straight and acute. The penultimate joints of all the ambulatory legs are dilated and almost square-truncated at their distal ends, and the terminal joints strongly curved and acute. Postabdominal segments (in the male) with a slight convexity in the middle line. Length of female nearly $1\frac{1}{2}$ inch.

Hab. Australia (*Bowerbank*).

The legs are clothed with long fulvous hairs.

This species is distinguished from *H. aries* and specimens I refer to *H. spinosus* by the much more squarely truncated joints of the ambulatory legs, from *H. auritus* by the existence of a spine on the posterior margin of the carapace, and from *H. tumidus* by the prominent lateral marginal spines, &c. In Hess's description of *H. spinosus* the form of the penultimate joints of the ambulatory legs is not stated. If the specimens now described as *H. truncatipes* belong to that species, it will be necessary to give a distinct designation to those in the Museum collection (from Victoria and King George's Sound, West Australia) which are now referred to *H. spinosus*.

Of *H. truncatipes*, besides a fine female example from Australia, there is a male, without definite locality, in the British-Museum collection.

Trigonothir obtusirostris, gen. et sp. nov. (Pl. IV. fig. 2.)

The carapace is triangular, narrowing anteriorly, and smooth; cardiac region convex. There is a large and prominent rounded tubercle on the cardiac region; and the antero-lateral margins, which are straight and otherwise unarmed, terminate posteriorly in similar prominent lobes; on the posterior margin of the carapace are two small tubercles. The very prominent rostrum is rounded above and in front, and perfectly flat on its under surface; the lateral carinæ are acute and on a level with the flat under surface. The basal antennal joint is unarmed; and the slender flagellum is concealed beneath the rostrum. The anterior legs (in the male) are rather small, palm compressed, and fingers excavate at tips. The ambulatory legs are smooth, decrease regularly in length, and their terminal joints are slightly arcuate and acute.

The male postabdomen is apparently six-jointed (though now broken at the tip), the penultimate and antepenultimate joints coalescent. Length nearly $\frac{3}{4}$ inch.

Hab. Unknown.

A single male is in the collection.

The *Huenia pyramidata* of Heller, from the Red Sea, should perhaps be referred to the genus *Trigonothir*, but differs from *T. obtusirostris* in the absence of the lateral rostral carinæ, &c.

The genus *Trigonothir* is characterized principally by the form of the prominent obtusely rounded rostrum, which is armed, in *T. obtusirostris*, with lateral carinæ. It is further distinguished from *Menœthius* by its immobile eyes and the want of a præocular spine; from *Huenia* by the latter character; and from *Simocarcinus* by the form of the anterior legs.

Huenia pacifica, sp. n. (Pl. IV. fig. 3.)

Carapace elongate-triangular, smooth, with three small tubercles on the gastric region, which is somewhat elevated, and a more prominent tubercle on the cardiac region. The antero-lateral margins, which are nearly straight, terminate posteriorly in a small tubercle or spine. The rostrum is very long, slender, compressed, and straight; the præocular spine is very small. The basal antennal joint is angulated, and has a very small tubercle at its extero-distal angle. Postabdomen of male 7-jointed, smooth; the edge of the sternal plastrum is reflexed, and forms a raised rim around the margin of the terminal postabdominal segment. Length of carapace $5\frac{1}{2}$ lines, rostrum 4 lines.

Hab. Fiji Islands, Ngau (*H.M.S. 'Herald'*).

The description is taken from a male example, in which, unfortunately, all the legs are wanting.

In a female specimen in the collection from Ovalau in the Fiji group, which may very probably belong to the same species, the rostrum is much shorter, the lateral expansions of the carapace are unequal and separated by a semicircular emargination, the anterior are larger and rounded, the posterior truncated at the end. The ambulatory legs are very slender and not at all dilated, with a small tubercle at the distal end of the merus joints. The fourth to sixth postabdominal segments coalescent.

This species differs from the *H. proteus*, De Haan, and *H.*

heraldica, White, in the much longer, slenderer rostrum of the male, which is not vertically deep as in those species.

H. Grandidieri, A. M.-Edwards, from Zanzibar, is founded on a female example, which differs from the female from the Fijis in the Museum collection in the truncated anterior lateral and subacute posterior lateral lobes of the carapace. *H. depressa*, A. M.-Edwards, also founded on a female example, seems to belong to the following genus (*Simocarcinus*).

Simocarcinus, Miers.

I propose to establish a new generic division under the above name for the species *Simocarcinus simplex*, typified by the *Huenia simplex*, Dana, from the Sandwich Islands, which differs from the typical *Hueniæ* in having a more robust body, much shorter rostrum, no præocular spine, the lateral lobes of the carapace in the female much smaller, the anterior legs in the male with the palms turgid, not compressed, and ambulatory legs cylindrical, not compressed or dilated.

The two species described by Dana (*H. simplex* and *H. brevirostrata*) are, beyond a doubt, the male and female of one and the same form. Specimens from the Sandwich Islands are in the collection of the British Museum, of both sexes. The females in the Museum collection differ slightly from that figured by Dana in having the anterior lateral lobes of the carapace larger and subtruncated; but this is perhaps due to the age of the specimens.

Cyclonyx, gen. nov.

This new generic division is established for the remarkable species described by White as *Huenia frontalis* (P. Z. S. 1847, p. 223; and Zool. Samarang, Crust. p. 21, pl. iv. f. 3, 1848). The single specimen in the British Museum is apparently the exuvia of a female, and resembles the females of *Huenia* in the laterally expanded carapace; but in *Cyclonyx frontalis* the lateral expansions are continuous, not divided into anterior and posterior lobes. The rostrum is flattened and of a transversely oval form, and completely conceals the flagellum of the antennæ, whose basal joint is scarcely distinguishable from the surrounding parts of the body. The eyes are set in the narrow emargination between the margins of the carapace and rostrum. The epistome is short. The outer maxillipedes have the merus joint small and not much produced at its antero-external angle. The anterior legs are now wanting. The ambulatory legs (of which only the second and third are now perfect) are angulated, cristate above, the penultimate joints truncated at their distal ends, against which the terminal joints are retractile. In the postabdomen the sutures of all the joints are clearly distinguishable.

Hab. —— ?

Perhaps, when the examination of specimens in good condition shall have determined the structure of the orbits and antennæ of this remarkable form, it will be found necessary to remove it to the Periceridæ. For the present I retain it in the neighbourhood of *Huenia*, to which it is allied in many respects. The form of the rostrum alone suffices to distinguish it from all its allies.

Maiidæ.

Chorilibinia gracilipes, sp. n. (Pl. IV. fig. 4.)

Carapace subpyriform, smooth, and spinose above, the spines disposed as follows:—four in the middle line, of which two are on the gastric, one longer on the cardiac, and one strong curved spine upon the posterior margin. There are two strong spines upon the branchial regions above; and below them, immediately above the bases of the ambulatory legs, are four small blunt spines. The posterior margin of the carapace is produced and forms a thin edge. Below, upon the pterygostomian region, is a rather strong spine; and there is a blunt spine at the antero-lateral angles of the buccal cavity. The rostrum is prominent, the spines coalescent at base and divergent in their distal half. The upper orbital margin is prominent and divided by a narrow fissure; and there is a wider fissure below. The anterior legs are small, slender, smooth, palm slightly compressed, and fingers straight and acute. The ambulatory legs are long and very slender, and are clothed with distant tufts of small curled hairs. The first ambulatory legs in particular are very greatly elongated, and with the terminal joints very long and slender. The postabdominal segments (in the male) are all distinct. Length of carapace to base of rostrum, in the larger specimen, nearly $\frac{1}{2}$ inch.

Hab. Papua (*H.M.S.* '*Herald*;' the locality may be doubtful).

Two male individuals are in the collection of this very interesting species. I assign it to the genus *Chorilibinia* of Lockington without much hesitation, although the generic diagnosis and specific description of his species (*C. angusta*) from California leaves much to be desired in point of completeness. The structure of the rostrum and orbits is the same; and the basal antennal joint bears a long spine on its outer margin. The inferior surface of the body is densely pubescent. *C. angusta* is distinguished by the existence of three spines on the antero-lateral margins &c.

Paramithrax (*Leptomithrax*) *compressipes*, sp. n.

Carapace subpyriform, moderately convex, and covered with numerous small, wart-like, rounded tubercles, but without spines, except that on the gastric and cardiac region there is a small conical spine. On the antero-lateral margins, behind the strong spines of the upper margin of the orbit, is a series of six small spines. The spines of the rostrum are short, slender, and but slightly divergent. The basal antennal joint is not much enlarged, and has two granulated spines at its distal end, and one on its inner margin. There is a blunt granulated tubercle on the anterior margin of the epistome, below the antennulary fossæ. The merus joint of the outer maxillipedes is broad and rounded at its antero-external and produced and subacute at its antero-internal angle. The anterior legs (in the female) are small, slender, and perfectly smooth, without spines or tubercles. The ambulatory legs are smooth and very robust, with the antepenultimate and penultimate joints longitudinally sulcated; the antepenultimate joints in all except the last pair are flattened and greatly dilated distally; the terminal joints are straight and smooth; postabdomen wanting. Length of carapace to base of rostrum 2 inches.

Hab. Canton (*Hon. E.-India Co.*).

This species is represented by a single female specimen. In the form and tuberculation of the carapace it resembles *P. barbicornis*, Latr., but differs from that species and all others of the genus in the smoothness of the anterior legs and the remarkable dilatation of the antepenultimate joints of the ambulatory legs. It is probable that the carapace and legs were densely pubescent in the living animal. It would also appear to be allied to *P. ursus*, Herbst, which, according to Gerstæcker's description, has the "tibia" anteriorly triangularly dilated, but differs in having very broad and short rostral spines and a greatly enlarged tooth posterior to the postocular tooth.

Paramithrax (*Leptomithrax*) *brevirostris*, sp. n.

Carapace subtriangular, without spines on its upper surface, but covered with small scattered tubercles. Antero-lateral margins with five spines (not including the postocular). Spines of rostrum very short, triangular, and acute. Basal antennal joint with two prominent spines at its distal end. Anterior legs (in the female) slender; arm minutely spinulose above;

wrist with small tubercles; palms smooth, longer than the wrists; and fingers straight, smooth. Ambulatory legs with the antepenultimate joints longitudinally sulcated, but not dilated (as in the preceding species). Postabdominal segments (of the female) smooth, distinct. Length of carapace to base of rostrum $1\frac{5}{6}$ inch.

Hab. —— ?

The form and extreme shortness of the spines of the rostrum serve to distinguish this species from its congeners.

Paramithrax (*Paramithrax*) *spinosus*, sp. n.
(Pl. IV. fig. 5.)

Carapace subpyriform; surface covered with small scattered granules, and with spines disposed as follows—an acute spine, followed by a rounded tubercle, on the gastric region, a bituberculated prominence on the cardiac region, two spines on each branchial region, a spine on the intestinal region, and a very small spine on the posterior margin of the carapace. The spines of the upper orbital margin are blunt; and posterior to them, on the antero-lateral margins, are one or two small spinules. Spines of rostrum divergent and acute. Pterygostomian regions granulated. Basal antennal joint rather narrow, longitudinally sulcated, and with a small tubercle at its antero-external angle. Merus joint of outer maxillipedes small and without a distinct notch at its antero-internal angle. Anterior legs (in the male) robust; arm granulated on its outer surface, and with two or three spinules above; wrist spinulose above and with a dentated crest on its outer surface; palm compressed and perfectly smooth; fingers arcuate and meeting only at the tips, which are denticulated and acute; there is a strong tubercle on the inner margin of the upper finger near the base. Ambulatory legs slender. Postabdominal segments distinct, the terminal one the longest. Length to base of rostrum $\frac{3}{4}$ inch.

Hab. Norfolk Island, on a fish taken at a depth of 23 fathoms (*H.M.S. 'Herald.'*)

One male individual is in the collection. This species, in the form of the merus joint of the outer maxillipedes, approaches *Acanthophrys*. It comes near in external appearance to specimens in the Museum collection from Australia and New Zealand, which I formerly referred to *P. Gaimardi*, M.-Edwards, but now to *P. sternocostulatus*, M.-Edw., but differs in the number and position of the spines on the branchial regions and lateral margins, and in the much slenderer basal antennal joint, which has not two spines at its distal extremity.

Paramithrax (*Paramithrax*) *halimoides*, sp. n.

Carapace elongated, and scarcely narrowing anteriorly, with five long spines in a longitudinal median series, of which two are on the gastric, one on the cardiac, and one on the intestinal region, and one on the posterior margin directed backward; also one on each branchial region. The spines of the rostrum are long, acute, and slightly divergent. The præocular spine is prominent and acute, the postocular large and lamellate, and it is followed by a smaller prominence on the hepatic region. Basal antennal joint rather narrow, with two spines, of which one at the antero-external angle is prominent and directed outward. Merus joint of the outer maxillipedes with a notch for the insertion of the following joint at its antero-internal angle; exognath narrow. Anterior legs (in the male) small and slender; arm with a slight dentated crest on its under surface, wrist carinated above, palm compressed, and fingers straight and acute. Ambulatory legs slender, with a prominent spine at the distal end of the merus joints. Postabdominal segments (in the male) distinct, slightly tuberculated in the middle line. Length of carapace to base of rostrum about $\frac{2}{3}$ inch.

Hab. Eastern seas (*H.M.S.* '*Samarang*').

This species is mentioned but not described, under the name of *Chorinus halimoides*, by White, in the 'List of Crustacea in the British Museum,' p. 123 (1847); and De Haan's *Halimus incisus* is referred to doubtfully as synonymous with it; but it has nothing to do with that species, which belongs to the genus *Pugettia*, and has recently been received by the British Museum from the Japanese seas. It is not referred to in the 'Zoology of the Voyage of the Samarang.' It is distinguished from *Paramithrax aculeatus* (*Chorinus aculeatus*, M.-Edw.), and *Paramithrax longispinus* (De Haan), and *P. acanthonotus* and *P. verrucosipes*, Ad. & White, all of which have been referred to *Chorinus*, by the number and disposition of the spines of the carapace. I believe it to be necessary to restrict the genus *Chorinus* to the single species comprehended in Milne-Edwards's first section of the genus, the West-Indian *C. heros* (Herbst).

Acanthophrys paucispina, sp. n.

Carapace subpyriform and spinose above; there are two or three small spinules in a longitudinal median series on the gastric region, another on the cardiac region, followed by a prominent spine, and a tubercle on the intestinal region; there are two spines on each branchial region. Over the eye is a very prominent and triangular spine; the postocular is smaller and blunt, the rostral spines are acute and divergent, the basal antennal joint is very large, with a spine, directed forward, at its antero-external angle. Outer maxillipedes smooth; ischium joint very narrow; merus joint large, concealing the following joints, without a notch at its antero-internal angle, and much produced and rounded at its antero-external angle; exognath very large, broader than the ischium joint. Anterior legs (in the male) smooth; palm compressed and carinated above, fingers nearly as in *Paramithrax spinosus*. Ambulatory legs slender and smooth, terminal joints slightly curved. Postabdominal segments (in the male) smooth, distinct. Length of carapace to base of rostrum nearly $\frac{1}{2}$ inch.

Hab. Fiji Islands, Ovalau (*H.M.S. 'Herald'*).

I propose to restrict the genus *Acanthophrys* to the species having the outer maxillipedes of the form described above. I have not seen the type specimens of either of M. A. Milne-Edwards's species; but this character (if we may judge from the figure) seems to exist in his *Acanthophrys cristimanus*; and it certainly does in a specimen which I refer to it from the Marquesas in the British-Museum collection, and which is labelled "*Pisa cristimana.*" There seems to be no other positive character to distinguish this genus from *Paramithrax*. One male individual of *A. paucispina* is in the collection.

Pisa carinimana, sp. n. (Pl. IV. fig. 6.)

The carapace of this pretty little species is subpyriform, closely pubescent, and with a few longer curled hairs. There are six very obscure tubercles or granules disposed in two transverse series of three each upon the gastric region, and two tubercles on the branchial regions, besides the small lateral epibranchial spine; the cardiac region is very convex, elevated, and rounded; and there is a small median tubercle upon the posterior margin of the carapace. The upper orbital margin projects considerably; and the hiatus in it encloses a small tooth. Behind the postocular tooth or lobe is another small tooth. There is a row of granules on the pterygostomian regions. The spines of the rostrum are rather long, slender, and divergent from a point at some distance above their base. The anterior legs in the male are rather small; arm granulated on its upper, outer, and lower margins; wrist obscurely carinated on its outer surface; palm compressed, carinated above and below, and longitudinally faintly sulcated on its outer surface. The second pair of legs are much longer than the succeeding. Fingers denticulated on their inner margins, and nearly straight. All the ambulatory legs are slender, cylindrical, and unarmed. Length to base of rostrum 5 lines, breadth 4½ lines.

Hab. Canaries (*R. MacAndrew, Esq.*).

This species shows a relation to *Hyastenus* in its greatly elongated second legs. In the form of the rostrum it approaches *P. erinacea*, A. M.-Edw., a West-Indian species. It differs very markedly from the *Micropisa ovata*, Stimpson, from the Cape-Verds, as figured by M. A. Milne-Edwards, in its slenderer, more divergent rostral spines, narrower carapace, and longer second legs. Specimens both of *M. ovata* and of *M. violacea*, A. M.-Edwards (the latter from W. Africa), are in the Museum collection, and have so great an affinity with the species of *Rhodia*, Bell, and *Herbstia*, that I think it will be impossible to maintain the genera *Micropisa* and *Rhodia* as distinct from *Herbstia*.

Hyastenus (*Chorilia*) *gracilirostris*, sp. n.
(Pl. IV. fig. 7.)

Carapace subpyriform, with three spinules in a longitudinal median series on the gastric region, a strong conical spine on the cardiac, a tubercle on the posterior margin, and two spines on each of the branchial regions, of which the larger occupies the usual position of the lateral epibranchial spine. Spines of the rostrum very slender and divergent. Basal antennal joint rather broad, and with only a small tubercle at its antero-external angle. Merus joint of outer maxillipedes small, transverse. Anterior legs rather small; arm and wrist slender; palm compressed; fingers arcuate and meeting only at the tips, which are denticulated and acute. Ambulatory legs very slender, the first pair much the longest. Postabdominal segments distinct. Length of carapace to base of rostrum about ½ inch.

Hab. Fiji Islands, Nairai (*H.M.S. 'Herald'*).

One male example is in the collection.

This species differs from all its congeners in the disposition of the spines and tubercles of the carapace.

Pseudomicippe? varians, sp. n.? (Pl. IV. fig. 8.)

I designate by this name, with much hesitation, two specimens, male and female, in the British Museum. They agree with one another in the characters of the orbital and antennal region, and in the number and disposition of the tubercles of the carapace, and also in these particulars with the figures and description of *Pseudomicippe tenuipes*, A. Milne-Edwards. There do not exist, however, on the ventral surface of the cephalothorax the granulated crests mentioned by A. Milne-Edwards. Moreover these specimens differ very remarkably in the form of the rostrum from one another. In the female the gastric region is very convex and the rostral spines deflexed and short, as in the other species of *Pseudomicippe*, whereas in the male they are much longer, slender, and nearly horizontal. The anterior legs, as usual in the male sex, are more developed, palm larger and compressed. It seems scarcely possible that these specimens, which were collected on the same occasion and at the same locality, can belong to distinct species; and if not, it is very remarkable that the deflexed rostrum, which is one of the principal characters of the genus, should fail in the male sex in this particular species. Length of carapace to base of rostrum (in the male) 7 lines.

Hab. Shark's Bay, Western Australia (*H.M.S.* '*Herald*').

Paramicippe affinis, sp. n.

Carapace suboblong, deeply concave on the hepatic regions, surface uniformly and evenly granulated; on the gastric region are two somewhat larger granules, placed one behind the other, and followed by one on the cardiac region; there is also one on each branchial region; the lateral and posterior margins are granulated; the fissures of the upper orbital margins are very small; the rostrum is broad, spatulate, obliquely deflexed, with a small triangular notch at its distal end, and with its antero-lateral angles rounded, without teeth or spines. The anterior legs (in the female) are very small and smooth; the ambulatory legs are densely hairy. Length about 6 lines.

Hab. Bass's Straits (*H.M.S.* '*Challenger*').

The single example (a female) was found among the 'Challenger' collection of fishes, and is very nearly allied to *P. platipes*, Rüppell, with which *P. bicarinata*, Ad. & White, and *Micippe hirtipes*, Dana, are probably identical. It differs in its more evenly granulated carapace, the absence of the spine on the antero-lateral margins of the rostrum, and the more densely hairy legs.

Micippe parvirostris, sp. n. (Pl. IV. fig. 9.)

Carapace triangulate-oblong, narrowing anteriorly; its whole surface covered with close-set but very prominent granules, which tend to become small spinules; rostrum composed of two very small, truncated, subvertically deflexed spines. The lateral margins are armed with six spines, including the postocular, which is bifid. The sides of the body, beneath the lateral marginal spines, are granulated, like the surface of the carapace. The eye-peduncles are very long, compressed, smaller at the distal end, with a small blunt tooth on their anterior margin. The basal antennal joint is but moderately enlarged, with a very small spine at its antero-external angle; and the two following are somewhat dilated and compressed. Anterior legs (in the female) very small; arm and wrist granulose, palm and fingers smooth. Ambulatory legs robust; merus joints slightly granulated. Post-abdominal segments (of the female) distinct. Length 6½ lines.

Hab. South Australia, Port Lincoln (*Mus. Zool. Soc.*).

This species is remarkable for the length and mobility of the eyes, the smallness of the basal antennal joint, the non-definition of the lower orbital wall, and the smallness of the rostrum. One female example is in the collection.

Periceridæ.

Tylocarcinus, Miers.

The genus *Tylocarcinus* is nearly allied to *Microphrys*, M.-Edwards (*Milnia*, Stimpson), and to *Tiarinia*, Dana, but differs from them both in the very slender basal antennal joint, the distal spine of which is short, as in *Tiarinia*, and is not visible in a dorsal view; from the former genus it is further distinguished by the narrow and elongated carapace, and from the latter by the divergent rostral spines.

Tylocarcinus styx.

Cancer styx, Herbst, Naturg. Krabben, &c. iii. p. 53, pl. lviii. fig. 6 (1803).
Pisa styx, Latreille, Encycl. Méth. x. p. 141 (1825); M.-Edw. Hist. Nat. Crust. i. p. 308 (1834).
Microphrys styx, A. M.-Edwards, Nouv. Arch. Mus. Hist. Nat. viii. p. 247, pl. xi. fig. 4 (1872).

Carapace subpyriform and covered with rounded tubercles; of these, two are placed in the interorbital space, four in a transverse series on the front of the gastric region, followed by three in a triangle. There are three, similarly disposed, on the cardiac, two on the intestinal region, three on the posterior margin, three or four on the front and two on the hinder lobe of each branchial region, and about six on the lateral margins. The spines of the rostrum are acute, rather short, and divergent from a point at some distance above their base. Præocular spine prominent, acute. Anterior legs (in the male) slender and nearly smooth. Ambulatory legs robust, with the merus joints spinulose, the following joint (in the first and sometimes the succeeding pairs) armed with a strong spine. Postabdominal segments smooth, distinct. Length of carapace in the largest individual $\frac{2}{3}$ inch.

Hab. Fiji Islands, Ngau, Totoya, Ovalau; Conway Reef (*H.M.S.* '*Herald*').

The tubercles of the carapace are larger posteriorly, and are most distinct in the oldest individuals. In some examples the carapace is narrower and the rostral spines are longer; but these are not characters confined to one or the other sex. This species inhabits the coral reefs.

To facilitate the identification of the types of this new genus, I have given at length the description of the above, which I refer with some hesitation to the *Cancer styx* of Herbst. It is certainly the species figured by M. A. Milne-Edwards (*l. c.*) as *Microphrys styx*.

There is an adult male from the Mauritius in the British-Museum collection, which differs from an adult male of the species described above only in the greater enlargement of the hands, and in the greatly arcuated fingers, which meet only at the tips. I am not disposed to regard it as distinct, since M. A. Milne-Edwards has noted that *P. styx* is distributed throughout the Indo-Pacific region.

Tylocarcinus gracilis, sp. n.

Carapace elongate-pyriform, surface covered with granules and small tubercles. On the front of the gastric region are several small granules followed by four in a transverse line; the branchial, cardiac, and intestinal regions are very indistinctly tuberculated. The spines of the rostrum are long, very slender, and divergent nearly from their base. The spines on the third and fourth joints of the first pair of ambulatory legs are long and acute.

Hab. "Eastern seas" (*H.M.S.* '*Herald*').

This species differs from the foregoing principally in the much narrower and less distinctly tuberculated carapace, and in the form of the rostrum, and may perhaps prove to be only a variety of it; the spines of the rostrum are in *T. gracilis* more than half the length of the carapace; in *T. styx* they are much less than half its length.

Othonia quadridentata, sp. n. (Pl. V. fig. 1.)

Carapace rather broadly ovate, and smooth, without any trace of tubercles or granules. Lateral margins armed with four well-developed acute spines, without any trace of the fifth and sixth spines, which are observable in other species of this genus. Basal antennal joint not dentated, or with a single small tooth on its anterior margin. Anterior legs (in the female) small and weak. Ambulatory legs smooth, without tubercles or spines. Postabdominal segments (in the female) distinct. Length of carapace about $\frac{5}{6}$ inch, breadth between the third and fourth lateral marginal spines $\frac{2}{3}$ inch.

Hab. West Indies (*Scrivener*).

There are in the British Museum the carapaces of two individuals (sex unknown), which differ only in their somewhat greater proportional breadth. The length of the larger individual is about 1 inch and $\frac{1}{2}$ line, the breadth $11\frac{1}{2}$ lines. The colour of these carapaces is greenish upon a pale ground, the green hue predominating on the anterior portion and forming reticulations upon the back and sides of the carapace. Traces of the same reticulations are visible on the sides of the carapace in the typical specimens of *O. quadridentata*.

That all these examples belong to the same species can scarcely be doubted; the greater breadth of the carapace in the two last-mentioned may be due to age or sex. This species is distinguished from all its congeners by the nonexistence of the fifth and sixth lateral marginal spines, even in a rudimentary condition. The smoothness of the carapace further distinguishes it from all the species known, except *O. lævigata*, A. M.-Edwards. These may appear but slight diagnostic characters; but this species is more distinct from its nearest allies than *O. Lherminieri* (for example) is from *O. lævigata* or *O. sexdentata* from either. There appears to be no alternative between separating the species on such slight differences and uniting all, both from the eastern and western American coasts.

Parathoë rotundata, gen. et sp. n. (Pl. V. fig. 2.)

Carapace subtriangular, rounded behind, and indistinctly tuberculated; the gastric and cardiac regions are distinctly defined and nearly smooth; there are four or five indistinct rounded elevations on the branchial regions, and two tubercles on the posterior margin. The rostrum is very small, little prominent, and notched at its extremity. The anterior legs (in the male) are robust; arm and wrist smooth; palm enlarged, smooth and compressed; fingers arcuate, and meeting only at the tips, which are excavated. On the inner margin of the mobile finger, near its base, is a small tubercle. The ambulatory legs are robust, with the merus joints strongly tuberculated. The rather narrow basal antennal joint is unarmed at its distal end. The postabdominal segments (in the male and female) are smooth and distinct. Length $3\frac{1}{2}$ lines.

Hab. Totoya, Fiji Islands (*H.M.S. 'Herald'*); Port Curtis (*H.M.S. 'Herald'*).

Notwithstanding the small size of the specimens, they have all the appearance of being adult.

There is in the Museum collection a female example from the Gulf of Suez (*MacAndrew*), which seems to belong to this species.

The genus *Parathoë*, as its name imports, is most nearly allied to *Thoë*, Bell, but differs in the much narrower basal antennal joint, and in the non-dilatation of the merus joints of the ambulatory legs. From *Mithrax*, which it may be supposed to represent in the Indo-Pacific seas, it differs in the first-mentioned character and also in the form of the carapace and absence of antero-lateral marginal teeth.

Parthenopidæ.

Lambrus.

The genus *Lambrus* is one which is remarkable for the number and variety of its species; and it greatly stands in need of revision. Several of the described forms are insufficiently characterized; and it is therefore not without considerable hesitation that I have described so many below as new to science. The genus can be conveniently divided into two subgenera:—the first containing the typical *Lambri**, in which the carapace is rhomboidal rather than triangular, or rounded behind, and the anterior legs greatly elongated, considerably more than twice the length of the body, and more or less spinose; the second containing those forms in which the carapace is subtriangular, somewhat produced over the bases of the ambulatory legs at its postero-lateral angles, with the posterior margin straight or nearly so, and the anterior legs shorter, rarely exceeding twice the length of the carapace.

In the first of these subgenera the species may be further subdivided, according as the merus joints of the ambulatory legs are or are not spinulose along their margins. The second subgenus, in the shortness of the anterior legs, approaches *Parthenope*, and contains several forms which have been described as members of that genus. I believe it to be more convenient, however, to restrict the designation *Parthenope* to the long-known *P. horrida*, Lam., and its near ally *P. spinosissima*, A. M.-Edwards, which are characterized by the greater development of the basal antennal joint and of the spines of the ambulatory legs.

* The type of this subgenus is *L. longimanus*, and not, as stated by a *lapsus calami* in Journ. Linn. Soc. xiv. p. 672, *L. crenulatus*, Saus.

I may here observe that Dr. Stimpson has proposed to separate under the name of *Platylambrus* a certain number of *Lambri*, characterized by the excavation of the subhepatic and pterygostomian regions (the excavation forming an afferent branchial channel); but this peculiarity is developed in species otherwise so dissimilar, and these species pass so completely into the forms in which this channel is not developed, that I think the proposed character can scarcely be retained as a generic distinction.

§ 1. *Carapace usually rounded behind (the postero-lateral margins not in a line with the posterior margin); anterior legs greatly elongated and usually spinose.* (Typical *Lambrus.*)

a. Merus joints of the ambulatory legs spinulose along their upper or under margins, or both margins.

Lambrus longispinus, sp. n.

Carapace broader than long to base of rostrum, spinose and tuberculate above; there are four prominent spines in the middle line, of which three are on the cardiac and one on the gastric region; in front of the latter are two smaller spines; and there are also two on the posterior margin. On the branchial regions are several small spines, principally arranged in two oblique series on each side, and one larger spine. On the antero-lateral margins are about nine small, blunt, very faintly laciniated teeth, increasing in size posteriorly, and on the postero-lateral margins two long spines. The rostrum is prominent, triangular, acute, and obliquely deflexed. The anterior legs have ten or twelve spines on the anterior* margins of the arms, alternating in size, except the three or four nearest the distal end, which are small; also three very prominent spines on the upper surface, and two or three on the posterior margin of the arm; on the anterior margin of the upper surface of the hands are seven larger, granulated, triangular spines and two or three smaller, and four larger and three smaller on the posterior margin. The lower surface of the arms, wrists, and hands is covered with rather large, rounded, granulated tubercles. The merus and sometimes the following joints of the ambulatory legs are compressed and dentated. Length to base of rostrum about 1 inch, breadth nearly 1 inch 2 lines.

Hab. Shanghai (*Jamrach*).

This species is allied to the Japanese *L. validus* and *L.*

* In describing the species of *Lambrus* I have regarded the large anterior legs as fully laterally extended; consequently the terms "anterior" and "posterior" are used for the margins of these limbs, instead of "inner" and "outer," the latter terms being often misleading.

laciniatus, De Haan, and also apparently to the West-Indian *L. Pourtalesii* and *L. fraterculus*, Stm., but differs in the longer spines of the carapace and the form and disposition of the tubercles on the under surface of the anterior legs, and in other characters.

There is in the British Museum a female from Australia (*Stutchbury*) in very bad condition, which probably belongs to this species, but differs in the broader, more obtuse and rounded rostrum, and the shorter spines on the posterior margin of the arms. If distinct, it may be named *L. latirostris*.

Lambrus Holdsworthi, sp. n. (Pl. V. fig. 3.)

Carapace broader than long to base of rostrum; branchial and cardiac regions covered with small, scattered, unequal tubercles; there are three blunt prominences or spines in a median longitudinal series, of which one is on the gastric and two are on the cardiac region. The antero-lateral margins are armed with about ten small tubercles, after which follow, on the postero-lateral margins, three prominent triangular flattened spines, which are granulated on their margins; the last of these is the smallest; the posterior margin is tuberculated, three of the tubercles being larger. The rostrum is prominent, triangular, smooth, and slightly concave above. The anterior legs have the arms tuberculate and spinose on their upper surface and anterior and posterior margins; of these, four on the anterior margin, three to four on the upper surface, and two to three on the posterior margin are larger; the wrist is tuberculated on its upper surface and armed with spines, similar to those of the hand, on its outer margin; the upper surface of the hand is flat and smooth, but has a few irregular tubercles near its posterior margin; on its anterior margin are about a dozen flattened triangular spines, which increase in length distally; on the posterior margin are about nine flattened triangular spines, of which four are larger; the inferior surface of wrist and hand has a longitudinal series of small tubercles, but is elsewhere smooth. The merus joints of the ambulatory legs are spinulose on their upper margins. Length to base of rostrum about 6 lines, breadth about 7 lines.

Hab. Ceylon (*E. W. H. Holdsworth, Esq.*).

This species is apparently most nearly allied to *L. laciniatus*, De Haan (among the forms having the merus joints of the ambulatory legs spinulose above), but differs in the form and number of the spines of the anterior legs. In *L. Holdsworthi* the spines of the outer margin of the hand are much broader and in contact at their bases. I may notice that the subhepatic region is channelled, but the channel does not lead to the afferent branchial aperture, but is continued beneath the margin of the carapace.

All the specimens are females. The smallest of all (length 4 lines) bears ova. In two of intermediate size, the smaller tubercles of the carapace are nearly obsolete.

Lambrus lævicarpus, sp. n. (Pl. V. fig. 4.)

Carapace scarcely broader than long (to base of rostrum), with numerous tubercles on its upper surface, and four small spines in a longitudinal median series, of which one is on the gastric and three are on the cardiac region; there are also two spines on each branchial region. The lateral marginal tubercles (about twelve in number) are small, and similar to those of the surface of the body. The front is moderately prominent, triangular, acute, with a tubercle on each side near the base. Anterior legs with the arm spinose and tuberculate above, the teeth granulated and principally disposed in three longitudinal series of alternately larger and smaller ones on the anterior and posterior margins and upper surface; there are about seven larger teeth on the anterior and posterior margins, and four on the upper surface; the wrist is spinose on its posterior margin, granulated on the anterior, and smooth above; the anterior margin of the hand is armed with sixteen to eighteen granulated tubercles, which are larger toward the distal extremity; the upper surface is flat and smooth, with about a dozen tubercles in an irregular longitudinal series; on the posterior margin are about seven larger granulated tubercles alternating with smaller ones. The under surface of the anterior legs is perfectly flat and smooth, and the inner margin of the under surface of the hands is finely granulated. The tubercles on the merus joints of the ambulatory legs are very small. Length (to base of rostrum) and breadth about 5 lines.

Hab. Eastern seas (*H.M.S. 'Samarang'*).

This species is remarkable for the perfect smoothness of the under surface of the anterior legs and of the upper surface of the wrists. It presents also another character which is rarely found among the species of *Lambrus*; the basal (*i. e.* the real second) joint of the outer antennæ is larger than the next joint.

Lambrus longimanus?

?*Cancer longimanus* ♀, Linn. Mus. Lud. Ulr. p. 441 (1764); Syst. Nat. p. 1047 (1766).
Lambrus longimanus, M.-Edw. Hist. Nat. Crust. i. p. 354 (1834).

Carapace depressed, much broader than long, with shallow concave interspaces between the regions, and covered with small conical acute tubercles; the spines of the lateral margins are conical and scarcely longer than those of the surface of the body. Rostrum very small, acute, with a spine on each side of the median one; interocular space smooth, concave. Anterior legs greatly elongated; arm spinulose above and on its anterior margin; on the posterior margin are seven longer spines, alternating with smaller ones; wrist minutely tuberculate above, and with six or seven alternately larger and smaller spines on its posterior margin; hand spinulose or tuberculate above, its anterior margin with fifteen to eighteen compound or branching spines, which increase in size towards the distal extremity, posterior margin with five to eight longer, alternating with smaller spines; under surface of arm and wrist nearly smooth, of hand minutely granulated or tuberculate. Spinules of the merus joints of the ambulatory legs very small. Penultimate joint of the postabdomen of the male armed with a spine or tubercle. Length of an adult male to base of rostrum $\frac{5}{6}$ inch; breadth 1 inch.

Hab. Eastern Seas; Javan Sea (*H.M.S. 'Samarang'*); Dunk Island (*J. Macgillivray, Esq., H.M.S. 'Rattlesnake'*); Isle of France (*Old Collection*).

I have described this species at length because, although it is probably the species intended by M.-Edwards in his short diagnosis of *L. longimanus*, it is possibly not the *Cancer longimanus* of Linnæus. I may here note that the specimens in the British Museum from India, Singapore, and the Philippines, referred by White ('List Crust. B. M.' p. 11) to *Lambrus longimanus*, appear to belong to *Lambrus affinis*, A. M.-Edwards. This latter species has evidently a very wide range, and may perhaps be identical with the long-previously described *L. pelagicus*, Rüppell, as it differs only in the smoothness of the arms on the front part of their upper surface, and in the greater prominence of some of the tubercles on the posterior (outer) margin of the hand; and specimens of both varieties are in the British Museum from Zanzibar.

b. Merus joints of the ambulatory legs not armed with spines or distinct tubercles.

Lambrus deflexifrons, sp. n. (Pl. V. fig. 5.)

The carapace is strongly constricted behind the orbits, with the cardiac region very convex, and with an oblique but shallow sulcus on the branchial regions, and is covered with closely-set small tubercles; the antero-lateral margins are unarmed; but there are two larger tubercles or small spines on the postero-lateral margins. The rostrum is vertically deflexed, triangular, and granulated above. The basal antennal joint is very small; the epistoma is large; the subhepatic and pterygostomian regions are not channelled. The anterior legs have the arm rounded and tuberculate above, with small spines on its anterior margin; the wrist is tuberculate; the hand with a few tubercles on its upper surface, the anterior margin armed with about ten, and the posterior with four granulated spines. The under surface of arm, wrist, and hand is closely granulated. The ambulatory legs are smooth, and are not compressed and cristate as usual in the genus. Length to base of rostrum, and breadth, nearly ½ inch.

Hab. Ceylon (*E. W. H. Holdsworth, Esq.*).

The vertically deflexed rostrum and carapace, devoid of spines on its surface and anterior margins, and non-compressed ambulatory legs are characteristic of this species. It seems to be allied to *L. gracilis*, Dana, a species from the Fijis, in the form of the carapace and legs; but in that species the carapace has a spine on the cardiac and each branchial region, and elsewhere appears to be smooth.

Lambrus hoplonotus.

Lambrus hoplonotus, Ad. & White, Zool. Samarang, Crust. p. 35, pl. vii. fig. 3 (1848).

In the typical form of this species, as exemplified by the specimen bearing White's label in the Museum collection, the carapace is covered with large, rounded, granulated tubercles, and the spines of the antero-lateral margins are small, obtuse, and rounded, the last only (lateral epibranchial spine) being greatly elongated. The rostrum is very small, triangular, and acute. The eye-peduncles are short and thick. The upper surface of the arm, wrist, and hand is covered with irregularly disposed rounded tubercles; the spines of the anterior and posterior margins of the hand are straight and granulated at base; the under surface of the arms is strongly tuberculated. White's specimen is labelled only as from the "Eastern Seas."

Below are described three very distinct forms which are provisionally regarded as varieties of *L. hoplonotus*. They are, unfortunately, represented each by only one, two, or three specimens; and a larger series might either establish them as distinct species, or show that *L. hoplonotus* is a widely distributed form, subject only to local variations.

Var. *granulosus.*

Carapace considerably broader than long, granulated above, the granules closest upon the surface of the branchial, gastric, and cardiac regions. Antero-lateral margins with about a dozen small obtuse teeth, followed by a very long acute spine, to which succeeds a shorter spine on the back of each of the branchial regions; the posterior margin of the carapace between these spines is granulated. Rostrum triangular, not deflexed, and minutely granulated on its lateral margins. Anterior legs elongated; arm with about five long spines on its posterior margin, alternating with very small spines, with about four tubercles on its upper surface, in a longitudinal series, and twelve to fourteen unequal tubercles on its anterior margin; wrist granulated above, and with four or five spines on its posterior margin; hand with about six long spines, alternating with smaller ones, on its posterior margin, with about four distant tubercles in a longitudinal series on its upper surface, and nine or ten spines on its anterior margin, increasing in length toward the distal extremity; the under surface of arm, wrist, and hand is nearly smooth. Length of carapace to base of rostrum 5 lines, breadth 6 lines.

Hab. Philippine Islands, Corregidor (*Cuming*).

The specimens described above have been referred by White, in the 'List of Crustacea in the British Museum,' p. 12 (1847), to *L. serratus*, M.-Edwards; but they differ in nearly all the characters mentioned in his brief diagnosis. They are much more nearly allied to the typical *Lambrus hoplonotus* of Adams and White, and may, indeed, be the young of that species, but differ in the much smaller granules of the carapace, and much fewer tubercles on the upper surface of the hands. In both varieties the margins of the carapace and anterior legs are clothed with close long hairs.

Var. *longioculis.* (Pl. V. fig. 6.)

This variety is allied to the preceding and to the typical *L. hoplonotus*; but the tubercles of the carapace and of the upper surface of the anterior legs are much longer, and, like the teeth of the antero-lateral margins, tend to become veritable spines. The lateral epibranchial spine is relatively much shorter than in *L. hoplonotus*. The rostrum is perfectly smooth above and upon the lateral margins. The eyes are remarkably long for a species of this genus, and project beyond the orbits, the outer margins of which are deeply sulcated. The ambulatory legs are more robust. Length of carapace to base of rostrum, and breadth, $\frac{1}{2}$ inch.

Hab. Australia, between Percy Islands and the main, lat. 21° 50′ S., long. 150° 20′ E. (*H.M.S. 'Rattlesnake,' J. Macgillivray*).

Two specimens, males, are in the collection, dredged in 17 fathoms, on a bottom of coarse sand and shells.

Var. *planifrons.* (Pl. V. fig. 7.)

In this variety the carapace is covered with numerous, small, rounded tubercles or granules, and with rather larger rounded tubercles on the antero-lateral margins. The lateral epibranchial spine (in an adult female) is rather short. The eyes are short and thick. The orbital margins are distinctly granulated; the rostrum is triangular, rather prominent, flat, smooth, and scarcely acute at its distal end. The upper surface of arm, wrist, and hand are tuberculated. The spines of the anterior and posterior margins of the hands are straight, flattened, and rather broad and not granulated at base; the under surface of the anterior legs is nearly smooth. Length of carapace to base of rostrum nearly $\frac{2}{3}$ inch.

Hab. Ceylon (*E. W. H. Holdsworth, Esq.*).

The form of the rostrum, of the spines of the hand, the granulations of the carapace, and the short lateral epibranchial spine serve to distinguish this variety.

There are some young individuals from the Gulf of Suez (*MacAndrew*) which differ from all the preceding forms in the existence of a small blunt tooth on each side of the rostrum, which is sulcate above; but these I will not at present designate by a distinct name.

Lambrus curvispinus, sp. n.

This is a species belonging to the same section of the genus as *L. hoplonotus*, and closely allied to it. It has the granules of the upper surface of the carapace small and subspiniform. The rostrum is very small, acute, and granulous on its lateral margins. The teeth of the antero-lateral margins are much longer and become well-developed spines as they approach the lateral epibranchial spine, which is extremely long. The inner margin of the arms is minutely spinulose; and the spines of the anterior margin of the hands are long, acute, and curved upward and forward at the tips. Length of carapace to base of rostrum $\frac{3}{4}$ inch.

Hab. Java Sea (*H.M.S. 'Samarang'*).

§ 2. *Carapace usually produced over the bases of the ambulatory legs at its postero-lateral angles, and with the postero-lateral margins nearly in a straight line with the posterior margin. Anterior legs shorter, margins dentate, but rarely spinose.* (Parthenopoides.)

Lambrus (*Parthenopoides*) *erosus*, sp. n.
(Pl. V. fig. 8.)

Carapace triangular, slightly produced over the bases of the ambulatory legs, its postero-lateral angles forming a decided angle with the straight posterior margin; its surface is without tubercles or spines, but is uniformly and deeply pitted and eroded; somewhat larger pits mark the interspaces between the gastric, cardiac, and branchial regions; the rostrum is small, triangular, and deflexed. The inferior surface of the carapace is similarly but more regularly pitted. The anterior legs are robust and eroded; the arm greatly dilated; the hand with a prominent, oblique, scarcely dentated crest on its anterior surface; lower finger broad and triangular in shape. The ambulatory legs are eroded and pitted like the body. Length 5 lines, breadth about 6 lines.

Hab. Eastern Seas (*H.M.S.* '*Herald*').

This species cannot be confounded with any other of the genus known to me.

Lambrus (*Parthenopoides*) *expansus*, sp. n.
(Pl. V. fig. 9.)

Carapace subtriangular, and greatly produced at its postero-lateral angles over the bases of the ambulatory legs; the gastric and cardiac regions are very prominent; the surface of the carapace behind and on either side of the gastric region is very concave. There are three obscure rounded tubercles on the gastric region, an obscurely granulated ridge on the branchial regions, parallel to the antero-lateral margins, and a few small granulations on each side nearer the cardiac region. The straight posterior margin of the carapace and the lateral margins, near the postero-lateral angles, are minutely denticulated; the lateral marginal series of denticles are continued forward onto the pterygostomian regions. The front is rather prominent, slightly concave above, granulated near and obtuse at its distal end. The anterior legs are smooth and not eroded above; arm with a series of closely-set granulated teeth on its anterior margin; upper surface and posterior margin obscurely granulated; hand very robust, with five or six teeth on its anterior margin; posterior margin uneven, but not toothed; fingers thick, smooth, and curved.

The under surface of the arm, wrist, and hand is obscurely granulated. The ambulatory legs are compressed, but scarcely denticulated. Length to base of rostrum $3\frac{1}{2}$ lines, breadth $5\frac{1}{2}$ lines.

Hab. Madeira (*Rev. R. Boog Watson*).

This species is distinguished by the great development of the postero-lateral expansions of the carapace and the smoothness of its upper surface and of the anterior legs, in which respects it is distinguished from the *L. rugosus*, Stim., and *L. pulchellus*, A. M.-Edwards, both from the Cape-Verd Islands. It would seem to be more nearly allied to the species very shortly characterized by A. M.-Edwards under the name of *P. trigona*, of which the habitat is not known; but that species is described as having the arm strongly eroded.

A single male example is in the collection of the Museum.

Cryptopodia spatulifrons, sp. n. (Pl. V. fig. 10.)

Carapace transversely triangulate, with the postero-lateral angles truncated, everywhere punctate and granulated, the granulations being largest and most conspicuous on the elevated cardiac and branchial regions, and on the postero-lateral and posterior expansions of the carapace. The branchial and cardiac regions are much elevated; there is a strongly marked depression in the centre of the carapace; and the surface of the carapace behind the antero-lateral margins and posterior margin are concave; the antero-lateral margins are denticulated and the postero-lateral and posterior margins crenulated. The rostrum is prominent, not deflexed, smooth, and of a semielliptical shape, subacute at the extremity, and with a series of submarginal punctures. The anterior legs are very robust; surface smooth but coarsely punctured; the anterior and posterior margins of the arm are produced into dentated crests, the posterior expansion being greatly dilated towards the distal extremity; the oblique crest on the anterior surface of the hand is armed with six prominent triangular teeth, the posterior margin being three-dentated; the under surface of the anterior legs is coarsely punctulated and granulated. The ambulatory legs are smooth, longitudinally carinated on their upper and under surfaces. Length of carapace to base of rostrum about 1 inch, breadth nearly 2 inches.

Hab. Shark's Bay, Western Australia (*H.M.S. 'Herald,' F. M. Rayner, Esq.*).

The description is taken from an adult male example. It is distinguished from *C. fornicata* by the granulated carapace, from *C. contracta*, Stm., from Hong Kong, by the non-contraction of the carapace behind the orbits. Moreover the carinæ on the merus and ischium joints of the ambulatory legs are not armed with spines as in *C. contracta.*

Cryptopodia spatulifrons, var. *lævimana.*

There are in the British Museum two smaller specimens (males) which probably belong to the same species as the one described above. The carapace is tuberculated only upon the elevated parts of the branchial and cardiac regions, and on the posterior and postero-lateral expansions; elsewhere it is smooth, scarcely even punctured. The upper surface of the arm and hand is smooth; the lower is also smooth, except for a longitudinal median ridge of granules. Of this variety one specimen was obtained on the coast of Borneo, the other is without indication of locality. As the specimens are of smaller size, they probably represent the younger condition of the species.

Ceratocarcinus spinosus, sp. n. (Pl. V. fig. 11.)

By this name I propose to designate a specimen of very snall size, which may be immature, yet differs more remarkably from the type species of the genus (*C. longimanus*, Ad. & White) than do the other described species, *C. speciosus*, Dana, and *C. dilatatus*, A. M.-Edwards. The spines of the rostrum, lateral margins, and gastric region are far longer than in either of the species above mentioned; and there is in addition a smaller spine upon each of the branchial regions, two spines upon the wrist, and one at the distal end of the upper margin of the hand and of the merus joint of each of the ambulatory legs. Length only $1\frac{1}{2}$ line.

Hab. Eastern seas (*H.M.S.* '*Herald*').

The specimen appears to be a female; as in the other species of the genus, the antennæ are completely excluded from the inner orbital hiatus.

EXPLANATION OF THE PLATES.

Plate IV.

Fig. 1. *Achæopsis Güntheri,* female individual: nat. size. 1 *a.* Lateral view of carapace of the same, showing the very prominent dorsal spine: nat. size.

Fig. 2. *Trigonothir obtusirostris,* male individual: $\times 1\frac{1}{2}$ diam. 2 *a.* Rostrum of the same, viewed from the side: further enlarged.

Fig. 3. *Huenia pacifica,* male individual: $\times 1\frac{1}{2}$ diam. 3 *a.* Lateral view of rostrum of the same: $\times 2$ diam.

Fig. 4. *Chorilibinia gracilipes*, male individual: × 1½ diam. 4 *a*. Lateral view of carapace of the same, showing the disposition of the dorsal spines: × 1½ diam.
Fig. 5. *Paramithrax* (*Paramithrax*) *spinosus*, male individual: nat. size.
Fig. 6. *Pisa carinimana*, male individual, × 1½ diam. 6 *a*. Outer view of hand of the same: × 3 diam.
Fig. 7. *Hyastenus gracilirostris*, male individual: × 1½ diam.
Fig. 8. Lateral view of front of carapace and rostrum of *Pseudomicippe varians*, male individual: × 3 diam. 8 *a*. Lateral view of the same parts in a female individual, showing variation in the form and direction of the rostral spines: × 3 diam.
Fig. 9. *Micippe parvirostris*, female individual: nat. size.

Plate V.

Fig. 1. Carapace of *Othonia quadridentata*: nat. size.
Fig. 2. *Parathoë rotundata*, male individual: × 2 diam. 2 *a*. Inferior view of frontal and antennal region of the same: × 4 diam.
Fig. 3. *Lambrus Holdsworthi*, female individual: nat. size.
Fig. 4. *Lambrus lævicarpus*, male individual: nat. size.
Fig. 5. *Lambrus deflexifrons*, male individual: nat. size. 5 *a*, Lateral view of front of the cephalothorax of the same, showing the deflexed rostrum: × 2 diam.
Fig. 6. Front of carapace and rostrum of *Lambrus hoplonotus*, var. *longioculis*: × 3 diam.
Fig. 7. Front of carapace and rostrum of *L. hoplonotus*, var. *planifrons*: × 2 diam.
Fig. 8. *Lambrus* (*Parthenopoides*) *erosus*, male individual: × 1½ diam.
Fig. 9. *Lambrus* (*Parthenopoides*) *expansus*, male individual: × 1½ diam.
Fig. 10. *Cryptopodia spatulifrons*, male individual: nat. size.
Fig. 11. *Ceratocarcinus spinosus*, female individual: × 2 diam. 11 *a*. Inferior view of antennal and orbital region of the same: further magnified. 11 *b*. Outer view of hand: further magnified.

II.—*Notes on the Palæozoic Bivalved Entomostraca.* No. XII. *Some Carboniferous Species belonging to the Genus* Carbonia, *Jones.* By Professor T. Rupert Jones, F.R.S., and James W. Kirkby, Esq.

[Plates II. & III.]

In previous papers on Carboniferous Entomostraca we have attempted to show, and critically examine, what has been already done in investigating this interesting though somewhat difficult group of fossils.

In a paper published in May 1865 *, we gave the result of an examination of a series of specimens from Bavaria,

* Ann. & Mag. Nat. Hist. ser. 3, vol. xv. p. 404.

illustrative of the species described by Count Münster in 1830 *.

In July 1866, in another paper †, we discussed what had been done by British authors, from the time of Ure (1793) to that of M'Coy (1844), our observations being based, in several instances, on an examination of type specimens.

In 1867 we gave, in the 'Transactions of the Geological Society of Glasgow,' a list and short account of the Entomostraca occurring in the Carboniferous rocks of Scotland ‡. The list included a great many new species (discovered by Mr. John Young and other Members of the above Society), most of which have yet to be described and figured.

In 1870 one of us described some species (*Carboniæ* &c.) from South Wales §.

Lastly, in 1875 ‖, we noticed some Russian specimens presented to us by the late M. d'Eichwald, with a few from the late Sir R. I. Murchison's collection.

These papers, though slight, have helped to clear the way for the description of new species, by showing what others have done in this field of research, and what our opinion was of the results of their work, with a view to the rectification and unification of the synonymy, and to the determination of numerous species not yet described.

Among other materials which have accumulated in our many years' study of Carboniferous Entomostraca is a large suite of specimens belonging to a group of seven species, hitherto referred to *Cythere*, but which apparently belong to the genus *Carbonia*, established by one of us, in 1870, for the reception of two species from the Coal-measures of South Wales. It is proposed to give a brief account of the seven species in the present paper.

The species in question have the form of ordinary *Cytheræ*, but differ from them in possessing a circular muscle-spot near the centre of each valve, after the manner of *Leperditia*. The muscle-spot is commonly seen in casts as a slightly raised tubercle. When the interior of the carapace-valves is exposed (which is not often), the spot appears as a shallow excavation. In some of the ironstones of the west of Scot-

* Leonhard und Bronn's 'Jahrbuch für Mineralogie' &c. Jahrg. 1830, pp. 60–70.

† Ann. & Mag. Nat. Hist. ser. 3, vol. xviii. p. 32.

‡ Trans. Geol. Soc. Glasgow, vol. ii. p. 213.

§ Geol. Mag. vol. vii. p. 214.

‖ Ann. & Mag. Nat. Hist. ser. 4, vol. xv. p. 52.

land, where the valves are of a bright black colour, the spot is white.

These *Carboniæ* are from:—(1) the Calciferous Sandstone or Lower Carboniferous series of Scotland; (2) the coal-bearing strata of the Carboniferous Limestone series of the same country; and (3) the Coal-measures of England, Wales, and Scotland. They occur in bituminous shales, in blackband and clayband ironstones, in parrot-coals, and in impure limestones. Individuals of some of the species, more particularly of *C. fabulina*, appear to have swarmed in the waters in which these deposits were formed. Some of the strata are literally full of their remains. They are essentially characteristic of the carbonaceous portions of the Carboniferous System. Wherever conditions suitable for the laying down of *Coal-measures* prevailed, there these Entomostraca flourished, almost to the exclusion of species of other genera.

It ought to be mentioned that we are greatly indebted, for multitudes of specimens from the west of Scotland, and for much information as to the distribution of the species, to Mr. John Young, of Glasgow, who is also the discoverer of several of the species here described. For other specimens we have to thank Mr. James Armstrong and Mr. James Thomson of Glasgow, Dr. Rankine of Carluke, Mr. Grossart of Shotts, Mr. E. W. Binney of Manchester, Mr. John Ward of Longton, and other friends. Our examination of the very numerous specimens collected by the Geological Surveyors of Scotland has greatly enlarged our knowledge of this genus.

Genus Carbonia, Jones (1870).

Valves (as known) subovate, ovate-oblong, or elongate; anterior third usually smaller than the posterior; the right valve slightly larger than the left, overlapping it sometimes along the middle portion of the ventral edge. Hinge-line in the middle third of dorsal margin, more or less defined between the anterior and posterior curved slopes of the dorsal margin. Hinge simple. Muscle-spot circular, enclosing three or four translucent spots or a lobed pattern; level or slightly depressed on the outside, somewhat hollow within. The valves are bent inwards, in some cases, near the muscle-spots, and leave slight, subcentral, transverse furrows on the cast.

The round and spotted muscle-mark, hollow within, is characteristic of this genus.

1. *Carbonia fabulina*, Jones and Kirkby.
(Pl. II. figs. 1–10.)

Cythere fabulina, J. & K. Trans. Geol. Soc. Glasgow, 1867, vol. ii. p. 217.
Cythere ? fabulina, J. & K. Geol. Mag. 1870, vol. vii. p. 218.

1. *Typical examples*: length $\frac{1}{35}$, $\frac{1}{30}$, and $\frac{1}{20}$ inch.

More or less bean-shaped. Dorsal border arched, highest behind; anterior extremity more acutely rounded than the posterior; ventral border straight or slightly incurved about the middle, where the right valve overlaps the left. Height more than half the length, sometimes fully two thirds. Dorsal and ventral aspects acutely ovate, widest behind. Surface of most specimens smooth, but, in well-preserved valves, pitted or rudely reticulate. A circular muscle-spot, subcentrally placed, is indicated externally in some examples; but it is best seen in casts as a slightly raised spot or tubercle.

The above gives the characters of what may be taken as typical examples of the species. Other specimens show differences that appear of varietal value. The more important of these are:—

2. Var. *humilis*. (Pl. II. figs. 11–14.)

Elongate; dorsal border flatly convex; extremities rounded and more nearly alike than in type specimens; ventral border straight. Length $\frac{1}{30}$ to $\frac{1}{25}$ inch.

3. Var. *inflata*. (Pl. II. figs. 15–19.)

A thick-shelled, obese form, greater in width than in height, and with the greatest width nearer the posterior end than in other forms, which thus gives the dorsal and ventral aspects of the carapace a subcuneiform outline. Length $\frac{1}{30}$ inch.

4. Var. *subangulata*. (Pl. II. figs. 20–23, and 24 ?.)

A gibbous, robust variety, of great relative height, with a subangular dorsal border, and a very abrupt postero-dorsal slope. Length $\frac{1}{17}$ inch.

This variety is the largest of any of the forms of *C. fabulina*. We figure with it a specimen from Millburn, Campsie, which possesses a similar dorsal border, but less angulate, and of very different relative height (fig. 24). This may ultimately prove to belong to another variety.

C. fabulina has some resemblance to *Cythere cuneola*, J. &

K., of the marine beds of the Carboniferous Limestone series. The latter is usually smaller than ordinary examples of *Carbonia fabulina*; and its valves have not the same ventral overlap. Otherwise it is not always an easy matter to distinguish them.

Localities and Mode of Occurrence.—At Pittenweem, in the Calciferous Sandstone series, about 800 feet below the base of the Carboniferous Limestone, *C. fabulina* occurs in blackband ironstone, associated with *Carbonia Rankiniana*, J. & K., *Leperditia scotoburdigalensis* (Hibbert), coprolites (possibly of *Rhizodus*), and the remains of *Lepidodendron*.

At Millburn, Campsie, in the Carboniferous Limestone series, it is found in impure limestone, together with *Spirorbis carbonarius*, Murch., and Stigmarian rootlets.

In the same formation at Crossgatehall, near Edinburgh, it is met with in ironstone, with *C. Rankiniana*, *C. pungens*, *Spirorbis* sp., and *Lingula squamiformis*, Phill.

In the Coal-measures at Provanhall, Lanarkshire, it is found in black carbonaceous shale, with fish-remains and plants.

Also in the same formation at Pirnie Colliery, Fifeshire, in parrot-coal, with *Carbonia Rankiniana*, and associated with the remains of the Amphibian *Loxomma Allmani*, Huxley, and Fish, such as *Strepsodus sauroides*, Ag., *Megalichthys Hibberti*, Ag., *Cœlacanthus lepturus*, Ag., *Ctenodus* sp., *Pleuracanthus gibbosus*, Ag., and others; also *Anthracomya pumila?*, Salter, *Spirorbis carbonarius*, Murch. (attached in numbers to drifted fragments of *Sigillaria*), and species of *Antholites*, *Lepidodendron*, *Calamites*, and *Stigmaria*.

At the same locality, on another horizon, the variety *inflata* occurs in coarse ironstone, which is filled with fragments of Calamites, the Entomostraca being found within the filled-up stems of the plants as well as in the matrix. A similar fact was observed by Mr. John Young, who obtained a number of examples of this species from the stem of a *Lepidodendron*, at Possil, near Glasgow *.

Near Hylton, west of Sunderland, it is met with high in the Durham Coal-field, in a clayband ironstone, associated with great numbers of an *Estheria*-like fossil, *Ancylus? Vinti*, Kirkby, *Carbonia Rankiniana*, J. & K., *Beyrichia arcuata* (Bean), a species of *Anthracomya*, Plant-remains, and the wings of Orthopterous Insects.

Other localities we give, with less detail, as follows:—

* 'List of Carbon. Fossils of West of Scotland,' by John Young and James Armstrong, p. 27.

Coal-measures:

Longton, Staffordshire, in black shale, from Mr. J. Ward.

Blakemoor, Wyre Forest, Shropshire, in ironstone, with Fish-remains and *Spirorbis carbonarius.*

Bradford, near Manchester, in black shale.

Ryhope Colliery, near Sunderland, in black shale and ironstone, with *Carbonia scalpellus*, *Anthracosia* sp., *Lingula Credneri*, Geinitz (rare), the remains of Ganoid Fishes, and Plants.

Wooley Colliery, Durham, in black shale, with *Anthracosia* sp., *Spirorbis carbonarius*, and *Calamites.*

Cramlington Colliery, Northumberland, in black shale, with *Anthracosia acuta*, Sow., *Spirorbis carbonarius*, and Plants.

Prestwick Colliery, Northumberland, in black shale, with *Anthracosia* and Fish-remains.

Coast south of Newbiggen, Northumberland, in black shale.

Coast near Blyth, Northumberland, in black shale and ironstone.

Shotts Iron-works, Lanarkshire, in clayband ironstone.

Whifflet, near Glasgow, in ironstone.

Kiltongue, near Glasgow, in blackband ironstone.

Carluke, Lanarkshire, in "Musselband" ironstone, and on other horizons.

Ardrie, Lanarkshire, in blackband ironstone.

River Leven, near Kirkland Dam, Fife, in black shale with macrospores.

Scoonie, Fife, in ironstone from the roof of "8-foot coal," with *Anthracosia acuta* (Sow.) and *A. aquilina* (Sow.).

Muiredge Colliery, Fife, in dark-grey shale, with *Anthracosia acuta*, *A. aquilina*, *Anthracoptera carinata* (Sow.), and *A. modiolaris* (Sow.).

Methil, Fife, in blackband ironstone, with *Carbonia Rankiniana*, *C. pungens*, *Leaia Leidyi* (Lea), *Spirorbis carbonarius*, *Anthracomya* sp., Ganoid scales and bones, and Stigmarian rootlets.

Carboniferous Limestone series:

Rae's Gill, Carluke, in ironstone.

Possil, north of Glasgow, in blackband ironstone, with *Carbonia Rankiniana*, *Anthracoptera* sp., *Rhizodus Hibberti*, Ag., *Megalichthys*, *Palæoniscus*, *Lepidodendron*, and *Stigmaria.*

Craigenglen, Campsie, Lanarkshire, in "white limestone," with *Carbonia pungens*, *Rhizodus Hibberti*, and Stigmarian roots and rootlets.

Fife coast, near Pathhead, in ironstone.

Lochgelley Colliery, Fife, in blackband, with *Spirorbis* sp., *Lepidostrobus*, and other plant-remains.

On the Fife coast, near Kilrenny Mill, Anstruther, in ironstone, about 3500 feet below the Carboniferous Limestone, associated with *Carbonia Rankiniana*, *Leperditia scotoburdigalensis*, a thin-shelled *Myalina*, and Ganoid scales.

The Binn Quarry, Burntisland, Fife, in shale, associated with *Carbonia subula*, *Littorina scotoburdigalensis*, Etheridge, and *Spirorbis* sp.

2. *Carbonia Rankiniana*, Jones and Kirkby. (Pl. III. figs. 1–8.)

Cythere Rankiniana, J. & K. Trans. Geol. Soc. Glasgow, 1867, vol. ii. p. 217.

Elongate, convex (usually), with the greatest height and width at the posterior third; height less than half the length. Dorsal border sloping flatly from the posterior third towards the anterior extremity, which is rounded; ventral border straight or slightly incurved; posterior extremity rounded, with an abrupt dorsal slope. Right valve rather the largest, overlapping the left along the middle of the ventral edge. Muscle-spot round or somewhat oval. A transverse furrow is often shown on casts near the centre of each valve, indicating a local contraction or partial thickening of the shell at this spot. Surface usually smooth; but in some specimens a reticulation is discernible. Length $\frac{1}{20}$ to $\frac{1}{18}$ inch.

The muscle-spot is rarely seen in this species; but the transverse furrow (fig. 6) is often present in casts. This feature also characterizes *C. subula*; and it has been noticed by one of us in *C. Agnes* from the South-Wales coal-field.

This species ranges through the same portions of the Carboniferous series as *C. fabulina*; but, though widely distributed, it is less abundant than that species.

Localities and Mode of Occurrence.—Coal-measures:

Blakemoor, Wyre Forest, in ironstone, with fossils as before.

Hylton, W. of Sunderland, in ironstone.

Shotts Iron-works, Lanarkshire, in ironstone and parrot-coal.

Ardrie, Lanarkshire, in blackband ironstone.

Carluke, Lanarkshire, in ironstone, with *Spirorbis carbonarius*.

Whifflet, near Glasgow, in ironstone.

Provanhall, near Glasgow, in carbonaceous shale, with fossils as before.

Pirnie Colliery, Fife, in parrot-coal, with fossils as before.

Methil, Fife, in blackband ironstone, with fossils as before.
Methil, Fife, in soft hematite, with Ganoid scales.

Carboniferous Limestone series :

Rae's Gill, Carluke, Lanarkshire, in clayband ironstone.
Crossgatehall, near Edinburgh, with fossils as before.

Calciferous Sandstone series :

Fife coast, west of Pittenweem, in blackband ironstone, 800 feet below the base of the Carboniferous Limestone, with fossils as before.

Fife coast, near Billow Ness, in dark shale, 2950 feet below the base of the Carboniferous Limestone, with *Rhizodus* scales, *Spirorbis* sp., *Cyclopteris? flabellata*, Brong., and *Lepidophyllum*.

Fife coast, near Kilrenny Mill, Anstruther, in ironstone, about 3500 feet below the Carboniferous Limestone, with *Carbonia fabulina* &c. as above.

A form very similar to, if not identical with *C. Rankiniana* occurs in the Yellow Sandstone of Cultra, Holywood, Ireland, low down in the Carboniferous series (see Ann. & Mag. Nat. Hist. ser. 3, vol. xviii. p. 49).

3. *Carbonia subula*, Jones and Kirkby.
(Pl. III. figs. 9–13.)

Cythere subula, J. & K. Trans. Geol. Soc. of Glasgow, 1867, vol. ii. p. 222.

Very elongate, subcylindrical. Dorsal border slightly convex; with an easy slope to the anterior extremity, which is relatively broad, and projectiug above; and with a more abrupt and deeper slope to the posterior extremity, which is rounded or, in some examples, bluntly pointed; ventral border straight or very slightly concave where the right valve seems to show a small overlap of the left. Dorsal and ventral aspects lenticular. Surface smooth, so far as known. Length ($\frac{1}{25}$ inch) nearly four times the height.

C. subula has the greatest length compared with height of all the *Carboniæ*. We, in a measure, assume that it belongs to this genus, not having seen specimens with the muscle-spot*, though casts showing the transverse furrow, as noticed in *C. Rankiniana* and *C. Agnes*, have repeatedly occurred to us. Moreover the general habit of the carapace is the same as in the species previously described.

It is found in the Calciferous Sandstone and Carboniferous Limestone series. It has not been seen in the Coal-measures.

* Mr. John Young informs us that he has seen what he considers to be the muscle-spot of this species.

Localities and Mode of Occurrence.—Carboniferous Limestone series:

Crossgatehall, near Edinburgh, in ironstone nodules, with *Carbonia Rankiniana*, *pungens*, and *fabulina*, *Spirorbis* sp., and *Lingula squamiformis*.

Craigenglen, Campsie, Lanarkshire, in impure limestone, with *C. Rankiniana*, *pungens*, *secans*, and *fabulina*, and remains of *Megalichthys*, *Palæoniscus*, *Eurynotus*, *Spirorbis carbonarius*, and *Lepidodendron*.

Calciferous Sandstone series:

Coast of Fife, near Pittenweem, in shale, 2350 feet below the base of the Carboniferous Limestone, associated with *Leperditia scotoburdigalensis*, Fish-remains, and Plants.

Coast of Fife, east of Pittenweem, in dark tough shale and ironstone, 2460 feet below the base of the Carboniferous Limestone, with an Aviculoid shell.

Coast of Fife, near Billow Ness, in grey shale, 3200 feet below the base of the Carboniferous Limestone, with many individuals of *Myalina modioliformis*?, Brown, some remains of Fishes, *Beyrichia subarcuata*, Jones, and *Leperditia* sp.

Coast of Fife, Anstruther, in shale and ironstone, 3600 feet below the base of the Carboniferous Limestone, with *Leperditia scotoburdigalensis* and a thin-shelled *Myalina*.

Coast of Fife, near Randerstone, in shale and ironstone, with *Myalina modioliformis*? and *Leperditia scotoburdigalensis*.

Binn Quarry, Burntisland, Fife, in shale, with *Carbonia fabulina* &c. as above.

4. *Carbonia scalpellus*, n. sp. (Pl. III. figs. 14–17.)

Elongate and somewhat compressed. Dorsal and ventral margins nearly parallel, the latter, however, being slightly concave near the middle; the posterior extremity blunt and subtruncate; the anterior extremity more produced and rounded. Dorsal and ventral aspects flatly lenticular, with the posterior end rather obtuse. Muscle-spot circular, rather large, and placed a little towards the anterior end. Surface smooth (?). Length $\frac{1}{14}$ inch.

This species is easily distinguished from *C. subula* by the difference in outline, greater height, and less relative width of the carapace.

It has been found only in the Coal-measures, at Ryhope Colliery, near Sunderland, where it occurs in black shale and ironstone, 592 feet below the base of the overlying Permian deposits. The associated fossils are *Carbonia fabulina*, the remains of Ganoid Fishes, *Anthracosia* sp., *Lingula Credneri* (rare), *Sigillaria*, *Lepidodendron*, and *Calamites*.

5. *Carbonia secans*, Jones and Kirkby.
(Pl. III. figs. 18–20.)

Cythere secans, J. & K. Trans. Geol. Soc. of Glasgow, 1867, vol. ii. p. 222.

Mytiloid, compressed. Dorsal border arched, highest behind, sloping rapidly in front to the anterior extremity, which is pointed; posterior extremity rounded; ventral margin slightly concave, with a small overlap of the right valve. Dorsal and ventral aspects compressed; the width is less than one fourth of the length; the height less than half the length. Surface smooth. Length $\frac{1}{32}$ inch.

This species is of comparatively rare occurrence.

Localities and Mode of Occurrence.—Coal-measures:

Blakemoor, Wyre Forest, in ironstone, with *C. fabulina* &c.

Hylton, west of Sunderland, in ironstone, with *C. Rankiniana* &c.

Carboniferous Limestone series:

Craigenglen, Campsie, Lanarkshire, in impure limestone with *C. fabulina.*

6. *Carbonia pungens*, Jones & Kirkby.
(Pl. III. figs. 21–23.)

Cythere pungens, J. & K. Trans. Geol. Soc. of Glasgow, 1867, vol. ii. p. 222.

A small subcylindrical *Carbonia*, pointed at the anterior end. Dorsal border flatly convex, highest behind, sloping gently in front to a pointed anterior extremity; ventral border straight; posterior extremity bluntly rounded. Height considerably less than half the length. Dorsal and ventral aspects cuneiform, being nearly as wide as high behind, and acutely pointed in front. Muscle-spot situate rather anterior to centre of valve. Surface smooth, so far as known. Length $\frac{1}{36}$ inch.

This species is the smallest of the series here described; and though somewhat resembling *C. secans*, it can be distinguished by its general outline being less Mytiloid, and by its wedge-shaped dorsal and ventral aspects.

It is not a rare form in Scotch Carboniferous strata, but is, as yet, of unknown occurrence in England.

Localities and Mode of Occurrence.—Coal-measures:

Provanhall, near Glasgow, in black shale, with fossils as before.

Carluke, Lanarkshire, in ironstone, with fossils as before.

Pirnie Colliery, Leven, Fife, in parrot-coal, with fossils as before.

Methil, Fife, in blackband ironstone, with fossils as before.

Carboniferous Limestone series:

Craigenglen, Campsie, Lanarkshire, in impure limestone, with *C. fabulina* and other fossils as before.

Crossgatehall, near Edinburgh, in ironstone nodules, with fossils as before.

7. *Cythere*? (*Carbonia*?) *bairdioides*, n. sp.
(Pl. III. figs. 24, 25; 26 and 27?.)

We have specimens of a form from Pirnie Colliery, Fife, and Craigenglen, Campsie, which may ultimately prove to belong to *Carbonia*. Only few examples of it, however, have occurred, and its muscle-spot has not been seen; so that for the present we figure and notice it as a *Cythere*, with doubt. Length $\frac{1}{17}$ inch.

It simulates a *Bairdia* in outline, having a regularly arched dorsal border, with one end rather pointed, the other rounded, and a very slightly convex ventral border.

The Fifeshire specimens are much the largest, being $\frac{1}{17}$ inch in length. A similar form, given to us by Mr. John Ward, occurs in the Upper Coal-measures at Longton, Staffordshire.

We have given particulars of the mode of occurrence and associated fossils of the Entomostraca which we have just described, with some detail, as such facts bear on the question of the physical conditions under which they existed. It will have been seen that the fossils usually found with most of the species are the remains of Fishes, Amphibia (in a few instances), *Anthracosia* and shells of that family, the ubiquitous *Spirorbis carbonarius*, and Plants (Ferns excepted). These are, of course, the common fossils of the Palæozoic coal-bearing strata; and about their natural habitats we do not know much after all. In two localities species of *Lingula* * are associated with them. In another (where *Carbonia fabulina* attains its largest development) *Leperditia scotoburdigalensis* is abundant; and this *Leperditia* in other localities has sometimes marine companions. One species, *Carbonia subula*, is commonly accompanied by *Myalina modioliformis* ?, Brown, which is a very common fossil in the lower portion of the Calciferous Sandstone series, and repeatedly occurs with marine fossils, such as species of *Axinus*, *Aviculopecten*,

* In the Trias of Germany *Lingula* is associated with *Estheriæ* of brackish-water habitat. See 'Monogr. Fossil *Estheriæ*,' Pal. Soc. 1863, pp. 48, 49.

Murchisonia, *Bellerophon*, and *Orthoceras*. Thus in some few instances we find *Carboniæ* associated with fossils that are either estuarine or marine, or have decided marine affinities. In the majority of cases they are found with fossils whose natural habitats we do not know. This is the substance of our present knowledge on the question of the physical conditions belonging to deposits containing the above-described species.

The following list may be of use in showing what Entomostraca occur in the British Coal-measures besides six of the seven described in this paper.

List of Bivalved Entomostraca described from the Coal-measures of Great Britain, with References to Figures of the Species.

1. Cypridina radiata, *J.*, *K.*, *& B.*, Monograph of Brit. Carb. Entomostraca, part i. 1874, p. 14, pl. v. fig. 6.
2. Beyrichia arcuata (*Bean*), Ann. & Mag. Nat. Hist. 1836, vol. ix. woodcut 55, at p. 377.
3. —— subarcuata, *Jones*, Monogr. Foss. Estheriæ, 1863, p. 120, pl. v. figs. 16, 17.
4. Leperditia inflata (*Murchison*), "Siluria," 4th (3rd) edit. 1867, woodcut 83, p. 301.
5. Candona? Salteriana, *Jones*, Monogr. Foss. Esth. 1863, p. 122, pl. v. figs. 13, 14.
6. Cythere? bairdioides, *J. & K.*, figured in present paper.
7. Carbonia Evelinæ, *Jones*, Geol. Mag. vol. vii. 1870, p. 218, pl. ix. fig. 4.
8. —— Agnes, *Jones*, Geol. Mag. vol. vii. 1870, p. 218, pl. ix. figs. 6–10.
9. —— ? sp., *Jones*, Geol. Mag. vol. vii. 1870, p. 218, pl. ix. fig. 5.
10. —— fabulina, *J. & K.*, figured in present paper.
11. —— Rankiniana, *J. & K.*, figured in present paper.
12. —— scalpellus, *J. & K.*, figured in present paper.
13. —— secans, *J. & K.*, figured in present paper.
14. —— pungens, *J. & K.*, figured in present paper.
15. Estheria Adamsii, *Jones*, Geol. Mag. vol. vii. 1870, p. 217, pl. ix. figs. 1, 2.
16. —— striata (*Münster*), and vars., Monogr. Foss. Estheriæ, 1863, p. 23, pl. i. figs. 8–18.
17. —— tenella (*Jordan*), Monogr. Foss. Estheriæ, p. 31, pl. i. figs. 26, 27, &c.
18. Leaia Leidyi (*Lea*), and var. Williamsoniana, *Jones*, Monogr. Foss. Estheriæ, p. 115, pl. i. figs. 19, 20, pl. v. figs. 11, 12; and Geol. Mag. vol. vii. p. 219, pl. ix. figs. 11–14.

EXPLANATION OF THE PLATES.

Plate II.

All the figures magnified 25 diameters, except 9 and 10, which are more highly magnified.

Fig. 1. *Carbonia fabulina*: left valve. Millburn, Campsie.
Fig. 2. The same: right valve, showing muscular spot. Craigenglen.

Fig. 3. The same: cast of right valve, showing muscle-spot. Millburn, Campsie. *Fig.* 4. Dorsal view. *Fig.* 5. Ventral view.
Fig. 6. The same: right valve. Ryhope Colliery, Sunderland.
Fig. 7. The same: right valve. Millburn, Campsie. *Fig.* 8. End view.
Fig. 9. The same: portion of surface of specimen from Provanhall. × 75 diam.
Fig. 10. The same: portion of surface of specimen from Whifflet. × 75 diam.
Fig. 11. *Carbonia fabulina*, var. *humilis*: left valve. Craigenglen.
Fig. 12. The same: right (?) valve. Craigenglen. *Fig.* 13. Dorsal outline.
Fig. 14. The same: left valve, showing muscle-spot. Pirnie Colliery, Leven, Fife.
Fig. 15. *Carbonia fabulina*, var. *inflata*: left valve and part of the edge of right valve. Pirnie Colliery. *Fig.* 16. Ventral view. *Fig.* 17. End outline.
Fig. 18. The same: cast of right valve, showing muscle-spot. Craigenglen. *Fig.* 19. Dorsal outline.
Fig. 20. *Carbonia fabulina*, var. *subangulata*: left valve. West of Pittenweem.
Fig. 21. The same: cast of right valve, showing muscle-spot. West of Pittenweem. *Fig.* 22. Ventral outline. *Fig.* 23. End outline.
Fig. 24. *Carbonia fabulina*, var. *subangulata* (?): right valve. Millburn, Campsie.

Plate III.

All the figures magnified 25 diameters, except fig. 8, which is more highly magnified.

Fig. 1. *Carbonia Rankiniana*: left valve. West of Pittenweem.
Fig. 2. The same: right valve. Provanhall. *Fig.* 3. Dorsal outline. *Fig.* 4. Ventral outline. *Fig.* 5. End outline.
Fig. 6. The same: cast of right valve, showing transverse furrow. West of Pittenweem.
Fig. 7. The same: cast of right valve, showing muscle-spot and slight furrow. West of Pittenweem.
Fig. 8. The same: portion of surface. Provanhall. ×75 diam.
Fig. 9. *Carbonia subula*: left valve. Crossgatehall, near Edinburgh.
Fig. 10. The same: right valve. Gilmerton. *Fig.* 11. Ventral outline. *Fig.* 12. Dorsal outline. *Fig.* 13. End outline.
Fig. 14. *Carbonia scalpellus*: cast of left valve, showing muscle-spot. Ryhope Colliery.
Fig. 15. The same: right valve, showing muscle-spot. Ryhope Colliery. *Fig.* 16. Ventral outline. *Fig.* 17. End outline.
Fig. 18. *Carbonia secans*: right valve. Craigenglen.
Fig. 19. The same: left valve. Craigenglen. *Fig.* 20. Dorsal outline.
Fig. 21. *Carbonia pungens*: cast of left valve, showing the muscle-spot. Methil.
Fig. 22. The same: right valve. Craigenglen. *Fig.* 23. Dorsal outline.
Fig. 24. *Cythere* (?) *bairdioides*: right valve. Pirnie Colliery. *Fig.* 25. Dorsal outline of single valve.
Fig. 26. *Cythere*? near *C.*? *bairdioides*: right valve. Craigenglen. *Fig.* 27. Dorsal outline.

III.—*On a small Collection of Arachnida from the Island of Johanna, with Note on a Homopterous Insect from the same Locality.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

[Plate I.]

In the year 1877 Mr. C. W. Bewsher sent to the British Museum a series of Arthropoda collected by himself in the island of Johanna, Comoro group.

Of the insects under my immediate charge the Hemiptera Homoptera were alone represented, by an apparently new species of *Phymatostetha*, Stål. Unfortunately the example was sent over in spirits of wine, and is so discoloured and shrivelled as to render it impossible to characterize it with certainty.

The Arachnida are represented by seven species of Araneidea, five of which appear to be distinct from any thing hitherto described; they exhibit a strongly marked Mascarene character: the two most interesting forms in the collection are a new species of *Spermophora* (Pholcidæ) and a probably new species of *Pasithea.*

The following is a list of the species :—

1. *Scytodes amarantea.*

Scytodes amarantea, Vinson, Aran. de la Réunion, Maurice et Madagascar, p. 11, pl. i. fig. 2 (1863).

The single specimen sent is unfortunately destitute of abdomen. This fact, taken in conjunction with the long legs of the species (the femora of which are distinctly rugulose), gives it so completely the facies of a Phalangid, that until I had subjected it to a careful examination I was completely puzzled as to what genus it belonged to.

2. *Pasithea foliifera*, n. sp. (Pl. I. fig. 1.)

Cephalothorax fulvous, marked with black dots and lateral divergent lines, as in *P. Lucasii*; eyes black; legs fulvous, rather thickly studded with long black spines, but not banded with black; abdomen bright sap-green, the whole central area on the upper surface occupied by a broad, central, longitudinal, slightly darker green band, of a leaf-like form, bordered and intersected with white; ventral surface with pale central area bounded by two slightly divergent curved white stripes.

Structure similar to that of *P. Lucasii*; relative length of legs 1, 2, 4, 3; length of cephalothorax and abdomen together 14 millims.

It is just possible that this may be a remarkable variety of

P. Lucasii (*Sphasus Lucasii*, Vinson, Aran. des îles de la Réun., Maur. et Madag. pl. xiii. fig. 3); but the differences in the coloration of the abdomen and legs are so well marked, that it seems probable that it is distinct.

3. *Attus Bewsheri*, n. sp. (Pl. I. fig. 2.)

♂. Cephalothorax shining blackish piceous; a transverse subcruciform marking just beyond the middle; three unequal oblique white lines (only visible when the spider is dry) just behind the posterior lateral pairs of eyes; abdomen brassy brown, crossed in the centre and towards the posterior extremity by two slightly arched white lines interrupted in the middle; two white spots close to the posterior margin; legs piceous, with the terminal tarsal joints fulvous; metatarsi of posterior pair of legs indistinctly banded with fulvous; palpi piceous, clothed with silky whitish hairs, terminal joint fulvous below; falces piceous; pectoral shield and coxæ fulvous; venter grey.

Cephalothorax square to the middle, thence slightly and gradually contracted, and with its posterior margin convex; superior surface smooth, its highest point being in the centre, which is bounded by the posterior lateral oculiferous tubercles; on each side of this central ridge the surface is oblique; abdomen subcylindrical, truncated at each end, slightly wider in front than behind; relative size of eyes as follows—anterior central, anterior lateral, posterior lateral, intermediate lateral, the *a c** pair being about six times the size of the *a l* pair, the *i l* being situated at about the centre of the interval between the two other lateral pairs; relative length of legs 1, 2, 4, 3; length of cephalothorax and abdomen 6 millims.

4. *Attus Johannæ*, n. sp. (Pl. I. fig. 3.)

♂ ♀. Cephalothorax blackish piceous, dull, crossed behind the middle by a bisinuate fulvous band (obscured by white pile when dry); the lateral margins, borders of anterior oculiferous tubercles, and a spot on the caput white; abdomen blackish, with the margins and an ornamental longitudinal sceptre-like central stripe white; legs and palpi piceous, banded with white; under surface of terminal joint of palpi, coxal joints of legs, and pectoral shield fulvous; venter whitish, with central and lateral longitudinal blackish lines.

Cephalothorax inverted-bell-shaped, its superior surface

* For brevity I should propose to indicate these by letters thus—*a c*, *a l*, *p l*, *i l*.

flattened in front and shelving behind; abdomen subcylindrical, narrower behind than in front, with truncated anterior margin; relative size and position of eyes as in the preceding species, briefly expressed as follows—*a c* 6, *a l*=*p l* 1, *i l* $\frac{1}{4}$; relative length of legs 1, 3, 2, 4, but the three posterior pairs differing very slightly in length; cephalothorax and abdomen together 7 millims.

This species seems to be intermediate in character between *A. baptizatus* of Rodriguez and *A. muscivorus* of Réunion and Mauritius; it is, however, unquestionably nearest to the latter.

5. *Attus anjuanus*, n. sp. (Pl. I. fig. 4.)

♀. Cephalothorax piceous (when dry of a golden bronzy colour), crossed behind the middle by a bisinuated castaneous belt, behind which the coloration is paler than on the caput; abdomen whity brown, with a longitudinal arched black stripe on each side; anterior border black-speckled; spinners blackish; legs and palpi castaneous, clothed with white hairs; falces piceous; legs below and pectoral shield fulvous; venter whitish.

Cephalothorax rather elongated, inverted-bell-shaped, flattened in front and obliquely arched from behind the posterior oculiferous tubercles, the latter placed at anterior third; abdomen ovate, with convex anterior margin, posterior margin acuminate; relative size of eyes, *a c* 6, *a l*=*p l* 1, *i l* $\frac{1}{6}$; relative length of legs 1, 3, 2, 4; cephalothorax and abdomen together 8 millims.

Apparently allied to *A. africanus* of Réunion.

6. *Spermophora comoroensis*, n. sp. (Pl. I. fig. 5.)

Fulvous, with whitish abdomen; falces below reddish castaneous.

Cephalothorax inverted-heart-shaped, posterior margins of the caput indicated by a depressed V-shaped line, from which a central depressed longitudinal line runs to the posterior margin; abdomen ovoid; legs somewhat sparsely but regularly covered with minute black granular dots; tarsi clothed with short setæ; palpi setose; pectoral shield elongate scutiform; eyes six in number, about equal in size, placed in pairs; the anterior pair placed in the centre of the anterior portion of the caput, the lateral pairs at about the same distance from the anterior pair as is covered by the two eyes themselves, and placed obliquely; male palpus with the fourth joint barrel-shaped, much larger than the three preceding it, terminating in a bulb-like joint fringed externally with stiff bristles, and bearing on its inner surface the seminal organ, which is also bulb-shaped and tapers above into a long spine-like corneous process; relative length of legs 2, 4, 1, 3; cephalothorax and abdomen together, of ♂ 7 millims., of ♀ 8 millims.

I have to thank the Rev. O. P. Cambridge for referring me to the genus of this species.

7. *Gasteracantha madagascariensis*?, var.

Gasteracantha madagascariensis, Vinson, Aran. de la Réunion, Maurice et Madagascar, p. 242, pl. ix. fig. 6 (1863).

In coloration the example sent agrees far better with *G. mauritia* of Walckenaer, the cephalothorax and femora being reddish castaneous, the tibiæ and tarsi black, the abdomen above (in the spirit-example sent) buff-yellow, with black spines and depressed spots ("sigilla," Cambr.), below black spotted with yellow. The Rev. O. P. Cambridge thinks it more probably a variety of *G. madagascariensis*; and if this be so, I see no reason why the latter should not be conspecific with *G. mauritia*, since the difference of form, so far as I can judge, seems to be very slight between these two spiders.

As regards the strange modification of pattern which must have taken place if this be in truth a pale variety of *G. madagascariensis*, I may mention that, so far as can be determined from dried specimens, *G. flavomaculata* seems to show a tendency towards a similar modification.

EXPLANATION OF PLATE I.

Fig. 1. *Pasithea foliifera*, Butl. (twice the natural size). 1 *a*. Profile view of the same, slightly enlarged.
Fig. 2. *Attus Bewsheri*, Butl. (twice the natural size). 2 *a*. The same, in profile.
Fig. 3. *Attus Johannæ*, Butl. (twice the natural size). 3 *a*. The same, in profile. 3 *b*. Male palpus, much enlarged.
Fig. 4. *Attus anjuanus*, Butl. (twice the natural size). 4 *a*. The same, in profile.
Fig. 5. *Spermophora comoroensis*, Butl. (twice the natural size). 5 *a*. The same, in profile. 5 *b*. Male palpus, much enlarged.

IV.—*On* Plocamia plena, *a new Species of Echinonematous Sponge*. By W. J. Sollas, M.A., F.G.S., &c.

[Plates VI. & VII.]

Plocamia plena, n. sp. (Pl. VI.)

(Examined in the dry state.)

Sponge fan-shaped (Pl. VI. fig. 1): a horizontal incrusting base (*b*), $\frac{1}{20}$ inch thick, smooth and irregular on the under surface, areolate on the upper, growing proliferously upwards into simple stem-like processes (s) and a thin wide flabellate expansion (f). The latter, which is seated on a short stout stalk, is formed apparently by the union of a number of simple stems, which, fusing together basally, give rise to the stalk, and then, diverging and branching radiately upwards and outwards, produce the fan-like plate, on which their course is marked by radiating ridges costating both surfaces of the plate, while the lines along which they unite are indicated by radiating furrows left between the ridges. These furrows are frequently bridged over by irregular transverse connexions, and thus become converted into series of deeper or shallower irregular pits. Two open window-like spaces (f) perforating the midst of the plate are due to the failure of the component ribs in these places to unite. The lower half of the incrusting base and the central two thirds of the stems and ribs grey in colour and dense and compact in texture; succeeded by an irregularly cavernous, sulphur-yellow, intermediate layer, which supports a thin drab dermal membrane, through which, in places, a number of large pointed spicules project, rendering the surface hirsute (Pl. VI. fig. 2).

Skeleton. The hard parts are those of the axis or base, of the intermediate and dermal layers, and of the sarcode.

Axial spicules with a smooth cylindrical shaft, terminated at each end by a spherical microspined inflation, 0·0075 inch long, 0·0005 inch diameter (Pl. VI. fig. 4); confusedly entangled together in a felt-like manner (Pl. VI. fig. 2).

Intermediate spicules of two kinds:—(i.) a long, robust, curved, conical acuate, sharply pointed at one end and generally spherically inflated at the other, inflation usually smooth (Pl. VI. fig. 3), sometimes minutely spined (Pl. VII. fig. 8); length 0·041 inch, diameter of shaft 0·0018 inch, of head 0·002 inch; collected in short columns, projecting at right angles from the axial core, in the external layer of which the inflated ends of some of the spicules are imbedded (Pl. VI. fig. 2); (ii.) a smaller curved, spined acuate, 0·01 inch long, 0·001 inch broad, pointed at one end, inflated spherically at the other, spines on inflation blunt (Pl. VII. fig. 16), or pointed, with the points directed from the head to the other extremity of the spicule (Pl. VII. fig. 17); spines of the shaft commencing about the middle of its length, and extending within a short distance of its point, conical, recurved, numerous; inflated heads of the spicules imbedded in the axial cord or in the penicillate columns of larger acuates, pointed ends projecting echinately (Pl. VI. fig. 2).

Dermal simple, straight, conical acuates, rounded obtusely at one end, seldom inflated, sharply pointed at the other (Pl. VI. fig. 6 and Pl. VII. fig. 28); rounded end smooth, sometimes sparsely microspined (Pl. VII. fig. 27), 0·015 inch long, 0·0004 inch broad; arranged matted together felt-like, supported on the ends of the large intermediate acuates, about which they sometimes accumulate in a tent-like projection (Pl. VI. fig. 2).

Sarcode. Flesh-spicules of two kinds, both very minute, not exceeding 0·0003 inch in length—one a tricurvate (Pl. VI. fig. 7 and Pl. VII. fig. 19, *b*), the other an equianchorate, with a straight or curved shaft and three recurved minute arms at each end (Pl. VI. fig. 7 and Pl. VII. fig. 19, *a*), dispersed through bright yellow sarcode.

Hab. Marine.

Loc. West Africa, lat. 15° S.

Coll. Bristol Museum, presented by John Thwaites, Esq

Obs. The single specimen of this sponge is in a very perfect state of preservation, having been well dried without losing its sarcode. How it was obtained by Mr. Thwaites, and from what depth in the sea, there is nothing to show; but its occurrence on the western side of Africa so far south as 15° from the equator is interesting, since both Oscar Schmidt's* species of *Plocamia* came from the other side of the Atlantic and north of the equator, viz. one from Florida at a depth of 195 fathoms (*P. gymnazusa*), and the other from Cuba at a depth of 270 fathoms (*P. clopetaria*).

It is clear from O. Schmidt's definition of the genus *Plocamia* that our form must be referred to it; and this reference is made all the more certain by the close general agreement between *P. plena* and the two previously described species, both in structure and spiculation. In *P. gymnazusa*, O. S., there is a large acuate in the intermediate layer, like that of *P. plena*; but our spined echinating acuate is represented by a smooth form without spines; the needle-like spicules of the dermis appear to be present in both, as well as the dumbbell-headed, handle-like spicules of the axis. O. Schmidt does not make any mention of flesh-spicules; but as in *P. plena* these are very minute, it is just possible that, if present in the other forms, they may have escaped his attention.

Putting these on one side, then, the distinction between *P. gymnazusa* and *P. plena*, so far as it can be learned from description merely, appears to lie chiefly in the different form of the echinating acuates:—in the latter a richly spined, straight, or curved acuate with an inflated head; in the former a smooth,

* Grundzüge einer Spongienfauna des atlantischen Gebietes, pp. 62, 80, Taf. iv. figs. 17, 18.

abruptly bent acuate, sharply pointed at one end and merely rounded off at the other. In *P. clopetaria*, O. S., a fat clumsy tuberculated spicule is said to be characteristic, and travesties rather than represents our echinating acuate.

As regards the affinities of the genus, O. Schmidt considers it related on one hand to the Suberites, and on the other to the genus *Clathria*. That it is a true echinonematous sponge (*i. e.* allied to *Clathria*) there is no doubt; and certainly the spicules of the axial column and lower part of the base are arranged in a very suberitic fashion. The scopiform bundles of acuates in the intermediate layer remind one of *Microciona*; and if one added to the membranous base of the latter a layer of felted spicules, the resemblance would become almost complete, especially as *Myxilla*, which in at least some of its species is identical with *Microciona*, frequently grows upwards into stalked processes, which appear to resemble those of *P. plena*.

In the relation of the scopiform bundles of spicules to the axial columns of the sponge, *Plocamia* shows some similarity to *Dictyocylindrus ramosus*, Bwk.; but the latter has not the spicular dermal layer which occurs in the former. In *Phakellia* the dermal layer is present, but the scopiform bundles are replaced by long plumose fibres. Thus the affinities of the sponge are all with Echinonematous forms; and it should apparently be referred to the family Ectyonidæ, where it will form a group by itself, viz. the Plocamianina, with the following definition:—Sponge growing proliferously upwards from an incrusting base; skeleton consisting of axial columns of dumb-bell-headed spicules supporting scopiform bundles of large acuates, which, as well as the axial columns, are echinated by smaller acuates of another form, the exterior provided with a dermal spicular covering, and the sarcode containing very minute flesh-spicules.

Order ECHINONEMATA, Carter.

Family **Ectyonidæ**, Carter.

Group *Plocamianina*, Sollas.

Genus Plocamia, O. Schmidt.

Species: 1. *Plocamia gymnazusa*, O. S.

2. *Plocamia clopetaria*, O. S.

3. *Plocamia plena*, Soll.

It is worthy of notice that no horny material is discoverable in these sponges. O. Schmidt says that none is present in the two species he had examined; and to determine whether there might not be some in mine I mounted a few slices of the sponge in glycerine jelly, which makes the siliceous spicules almost invisible, and so brings into greater distinctness the other parts. The sarcode was thus rendered very visible; but no kerataceous material could be detected. The sarcode, we may mention, soon parted with some of its intense yellow colouring-matter to the surrounding medium, which thus at first assumed a yellow tint that has since almost entirely disappeared. By the absence of horny matter in it *Plocamia* does not quite meet the requirements of Carter's definition of his order; but this is a small point of difference; and from the examination of a large number of Echinonematous sponges I am inclined to think that the presence or absence of horny matter is not of ordinal value, or, more properly, that the passage from a spiculose horny fibre, whether echinated or not, to a wholly spicular not horny fibre is so gradual that it is impossible to draw a hard-and-fast line between the two, and that, just as a Renierid may be regarded as a Holorhaphidote development of a Chalinid, so there may be sponges among the Echinonemata which may be regarded as Holorhaphidote developments of the Ectyonidæ; and such I believe is the nature of *Plocamia* for one, not to mention others.

If we adopt a monophyletic origin for the various forms of spicules found in *Plocamia* and other sponges, we shall naturally be led to look for some evidence of this amidst the wide variations which the spicular forms assume; and such evidence is, I think, to be readily found. In the first place, leaving out of account the flesh-spicules, of which we know too little at present, and which may have a separate origin to the others, one observes a close family likeness in all the forms of spicules to be found in *Plocamia*: thus, though they differ considerably in proportion, they all present a conical or cylindrical form, without any tendency to become fusiform, they all exhibit a tendency to acquire spines, and they all vary in the same kind of way. The dermal spicules, for instance, often acquire an inflated head, and, though usually very straight, sometimes become slightly curved; on the other hand, the large intermediate acuates sometimes lose their terminal inflation and so present merely a rounded-off end, and, though usually curved, they sometimes become straight; while in both dermal and intermediate acuates the head often becomes more or less spined. The only constant difference which distinguishes these two forms thus lies only in size and proportion; and even in the latter character variation occurs, the intermediate acuates becoming thinner and the dermal acuates thicker, and so approaching the one to the other. Hence I see no difficulty in believing that the spicule-cell of the larger acuate is a direct descendant of that of the dermal spicule. Again, the dermal spicule sometimes becomes rounded off at both ends, and in one instance was observed with an inflation at each end, each inflation being sparsely microspined (Pl. VII. fig. 20); on the other hand, the dumbbell-like axial spicule loses one of its inflations, retaining the other, so that at one end it possesses a spherical head, and at the other is merely rounded off (Pl. VII. fig. 26), or terminated sometimes by a blunt mucrone (Pl. VII. fig. 25), which, however, still retains its microtuberculation, though the tubercles exhibit a tendency to acquire the characters of small spines; again, the axial spicule varies much in proportional length, being sometimes very short and stumpy, like Pl. VII. fig. 21, and at others elongating and narrowing till one has the attenuated form, Pl. VII. fig. 22, very similar in proportion to one of the dermal spicules. Thus the passage of a dermal spicule into one of the dumbbell-like forms is by no means inconceivable. As regards the spined echinating spicules, these exhibit as many variations as the others; the extent to which the pointed end is spined is very inconstant, some forms remaining almost smooth (Pl. VII. fig. 13, for instance), in which case they closely resemble the young spinose-headed forms (Pl. VII. fig. 12) of the intermediate acuates, from which they might easily have been derived. Our theory of the relationship between these various spicules may be expressed in the following diagram:—

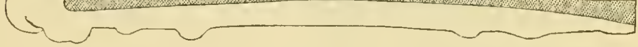
$$
\begin{tikzcd}
\text{Adult smooth acuate (fig. 3).} & & \\
\text{Young form of acuate (fig. 12).} \arrow[u] \arrow[d] & \text{Dermal spicule (fig. 28).} \arrow[l] \arrow[r] & \text{Axial spicule (fig. 4).} \\
\text{Adult spinose acuate (fig. 5).} & &
\end{tikzcd}
$$

Of other variations displayed by the spicules one may notice the tendency, very frequently displayed by the large acuates, to exchange the pointed for a rounded extremity, thus passing into the cylindrical spicule, Pl. VII. fig. 9; and this may be combined with a general stunting in linear growth, which leads to such forms as figs. 10, 11, Pl. VII., and might, if carried far enough, give us a truly globular form as the end of the series. It would not do, however, to regard such a globular spicule as in any way resembling the balls of the Geodidæ; for in the latter the growth is purely radiate, in the former as purely concentric; one is an overgrown stellate spicule, the other an aborted acuate; and the difference between them is made very manifest by treatment with boiling alkali, the *Geodia*-globule dissolving rapidly from the centre outwards, the *Plocamia*-cylinder obdurately resisting all solution and never admitting the potash to its interior.

Finally, the acuates sometimes become bent upon themselves, to the extent of 90° or much more (Pl. VII. fig. 18); and as bending usually foreshadows branching, so we sometimes find a spicule putting forth a spine-like branch near its extremity, into which enters correspondingly a branch from the axial canal; such a bifurcation of the end of one of these acuates carries us much nearer the trifid spicules of the Pachastrellidæ and Pachytragidæ than the bi- and trifurcation in the echinating spicules of *Plectronella*, since in the latter it is the head end which is so divided, while here, as in the groups just mentioned, it is the pointed end of the spicule.

In conclusion we have to consider the behaviour of the spicules when treated with boiling solution of potash. The spined acuates under these circumstances readily dissolved both within and without, in just the same manner as uniaxial spicules usually do; and I was able to make quite certain that no branches were supplied to the spines by the axial canal; the spines are merely local thickenings of the exterior of the spicule, not aborted branches as is the case with *Plectronella*.

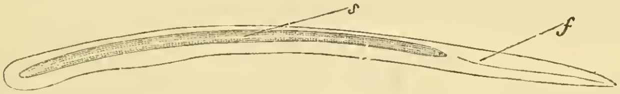
Fig. 1.



Echinating acuate after treatment with boiling potash (× 435).

The dumbbell spicules and the large acuates with both ends rounded seldom underwent internal solution, unless they had been broken across so as to make the axial canal accessible. Solution of the exterior proceeded rapidly, coat after coat of the acerates being removed, and, indeed, of the dumbbell forms as well, exposing the successive forms through which they had passed during their growth; and it is worth mentioning that the forms so revealed were always similar to that of the spicule from which they were derived, a conical acuate always remaining a conical acuate, and a stunted cylindrical one always remaining stunted and cylindrical; and thus Bowerbank's notion that the latter are young forms of the former, and would become pointed and conical with growth, is refuted; the cylindric are aborted, not immature forms of the acuates. The statement that residual acuates are of the same or similar form to the original ones may appear difficult to verify, since when the outer coat has been removed there is nothing left to show what the form originally was; and since the solution takes place while the spicules are being boiled, one cannot witness the removal of a coating. That is true: but it is a remarkable fact that solution does not wholly remove the outer coat; in other words, the solution is partial only; for after the potash has dissolved away the silica of one of the envelopes there remains behind a less soluble residue, which has the appearance of a delicate, soft, membranous film, and which retains very closely the original form of the envelope from which it was derived. Thus in fig. 2 we have a sketch

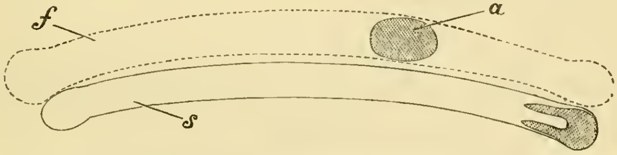
Fig. 2.



Smooth acuate after treatment with potash (× 140). *s*, residual spicule; *f*, residual membrane.

of the residual film of an acuate enclosing within its slightly folded, delicate, almost invisible substance (*f*) the solid, strongly defined spicule (*s*). In fig. 3 an axial spicule is represented with the residual film of an outer envelope washed

Fig. 3.



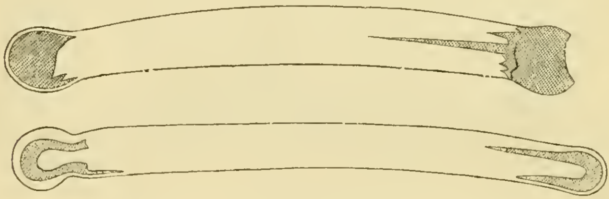
Axial spicule after boiling with potash. *s*, remainder of spicule; *f*, outer sheath separated from it; *a*, air-bubble (× 435).

from it and lying on one side; the air-bubble (*a*) within this sheath indicates the tenuity of its walls.

What, then, is the nature of this residual substance, which, though presenting a strangely organic appearance, is yet able to resist the effects of boiling solution of alkali? From the fact that some small pieces of cork, which were accidentally present with the boiling spicules, had not suffered any marked decomposition, nothing more than a separation, to a certain extent, of their cells, it occurred to me that it might be a form of cellulose, which is known to occur now in various groups of animals, and which would not be an unlikely accompaniment to the green colouring-matter (probably chlorophyll) which characterizes some kinds of sponges. On testing with Schulze's solution, however, the membrane was not coloured, while the associated fragments of cork became stained of a deep violet; on exposing to a high temperature it appeared to become carbonized; it did not affect polarized light. These are the only observations I have made with regard to this substance at present; my next step will be to submit some sponge-spicules to organic analysis; till then I regard the composition of their organic foundation as an open question.

The heads of the axial spicules appear to suffer far more from solution than their shafts, the whole interior of a head being sometimes eaten out without the shaft showing any evident signs of solution. Can this in any way be connected with the micro-tuberculation of the heads?

Fig. 4.



Two of the double-headed axial spicules after boiling with potash (× 435). Shaded parts indicate the cavities which have been excavated by solution.

From the cavity thus excavated in the head, the potash sometimes finds its way into the axial canal; but quite as often it dissolves a path for itself outside the site of the axial canal down each side of the spicule.

EXPLANATION OF THE PLATES.

Plate VI.

Plocamia plena.

Fig. 1. *Plocamia plena* (nat. size). *b*, incrusting base; *s*, single upright stem; *r*, a rib of the fan-like expansion cut across (the fan is incomplete on this side); *f*, an opening in the fan, left between two diverging ribs. From a photograph.

Fig. 2. Section across the base of fig. 1 (magnified about 50 diameters).
Fig. 3. Large acuate of the intermediate layer.
Fig. 4. Dumbbell-like spicule of the base or axis.
Fig. 5. Spined echinating acuate.
Fig. 6. Needle-like spicule of the dermal layer. The head is a little too inflated to be normal.
Fig. 7. Equianchorate and tricurvate spicules of the sarcode.

Figs. 3-7 all magnified 140 diameters.

PLATE VII.

Varieties of the spicules of *P. plena.*

Fig. 8. Common variety of the large acuate, with a spinose head.
Fig. 9. Common variety of the large acuate with the distal end rounded off.
Fig. 10. A similar but extremely stunted form.
Fig. 11. A variety intermediate between those of figs. 9, 10.
Fig. 12. A young form of the large acuate, with spined head.
Fig. 13. A nearly spineless variety of the echinating acuate.
Fig. 14. Similar, but with a larger number of spines.
Fig. 15. Spined acuate, bent abruptly to one side.

Figs. 8-15 are all magnified 140 diameters.

Figs. 16, 17. Normal forms of spined echinating acuates (× 435).
Fig. 18. Large smooth acuate, bent upon itself hook-like (× 140).
Fig. 19. Flesh-spicules. *a*, equianchorates; *b*, tricurvates. × 435.
Fig. 20. Dermal spicule with both ends inflated and microspined (× 435).
Fig. 21. Short stout form of axial or dumbbell spicule.
Fig. 22. Attenuated form of the same spicule.
Fig. 23. Same kind of spicule bent upon itself at right angles.
Fig. 24. Same spicule, doubly inflated at one end.
Fig. 25. Same spicule, with one end rounded off and produced into a blunt mucrone.
Fig. 26. Similar, but without the mucrone.

Figs. 21-26 all magnified 140 diameters.

Fig. 27. Head of a dermal spicule, magnified 435 diameters, to show the minute spines.
Fig. 28. Ordinary dermal needle (× 140).
Fig. 29. Normal dumbbell form (× 435).

V.—*On the Occurrence in North America of rare Extinct Vertebrates found fragmentarily in England.*—No. 2. By Prof. R. OWEN, C.B., F.R.S., &c.

[Plate VIII.]

[Continued from ser. 5, vol. ii. p. 223.]

Part III. RESTORATION OF *LEIODON ANCEPS.*

IN the section on Mosasauroids, in the "Report on British

Fossil Reptiles" for 1841*, a genus *Leiodon* was defined on a modification of mosasauroid teeth in a fragment of jaw discovered in a Cretaceous formation in Norfolk, and figured in plate lxxii. figs. 1, 2, of my 'Odontography.'

Certain vertebræ from the Greensand of New Jersey, North America, submitted to my examination by Prof. Henry Rogers, in 1849†, presented mosasauroid characters, but differed from those which had been referred by Cuvier‡ and Goldfuss§ to the type genus *Mosasaurus* in a degree which led me to remark that "they might belong to the genus *Leiodon*;" but I, provisionally, described and figured them under the name of "*Macrosaurus lævis*." Similar vertebræ were subsequently discovered by Prof. Emmons in Cretaceous deposits of North Carolina, and were referred by him to the genus *Macrosaurus*||.

Dr. Joseph Leidy, in his excellent work 'On the Cretaceous Reptiles of the United States,' 4to, 1864, notices mosasauroid teeth from other localities in the United States, several of which he states to "correspond in all anatomical characters with the teeth described by Prof. Owen as characteristic of a distinct genus, to which he has given the name of *Leiodon*"¶; but in the figures of his plate xi. those teeth are referred to *Mosasaurus*.

Prof. E. D. Cope, in his richly illustrated volume on the Vertebrata of the Cretaceous Formations of the West, describes and figures specimens which enabled him to show that the vertebræ of *Macrosaurus* were actually those of *Leiodon lævis*, and also to define other species of that mosasauroid genus** obtained from the "Kansas chalk."

Finally, in the 'Transactions of the Kansas Academy of Science' for 1877–8, vol. vi., Prof. F. H. Snow describes and figures characteristic portions of an almost entire skeleton of a *Leiodon* which he had the good fortune to expose in the

* Report of the British Association for the Advancement of Science for 1841, 8vo, p. 144.

† Quarterly Journal of the Geological Society of London, vol. v. (1849), p. 380, pl. v.

‡ Recherches sur les Ossemens Fossiles, 4to, 1824, tome v. 2e partie, p. 310.

§ Nov. Act. Acad. Nat.-Cur. vol. xxi. p. 179 (1845).

|| Report on the Geology of North Carolina, 1858, p. 213, fig. 34, *a*.

¶ Smithsonian Contributions to Knowledge, vol. *ut suprà*, p. 130.

** "Several names have been proposed for our species, the earliest of which is *Macrosaurus*, Owen. This name applies to species with compressed dorsal vertebræ, as *L. lævis* and *L. Mitchellii*, both from New Jersey Greensand."—Section "LEIODON, Owen," *op. cit.* 4to, 1875, pp. 160, 161, pls. xxviii.-xxxiii.

"yellow limestones belonging to the Niobrara group of the Cretaceous Formations"*.

From these American materials a restoration of the *Leiodon* modification of the Mosasauroid Lacertians may be undertaken. Of the skull I have little to add to the description given in my paper "On the Rank and Affinities of the Mosasauroids"†. The edentulous production of the premaxillary (Pl. VIII. fig. 1, *a*) beyond the alveoli of the $\frac{2-2}{}$ incisors may be noticed as suggestive of a rudiment or beginning of the Ziphioid modification of the cetaceous cranium. The mandible is slender, with a low coronoid process and slightly produced angle. A specimen has been found 26 inches in length‡.

The vertebral column of *Leiodon anceps* (Pl. VIII. fig. 1) exhibits the range of modification in its several regions characteristic of these great extinct 'Lacertia Natantia'§, and contrasting with the comparative uniformity of the vertebræ in *Python* and other Ophidia.

The atlas (ib. fig. 2) consists, as in lizards||, of a pair of neurapophyses, *n*, and a detached hæmapophysis, *h*, simulating a centrum¶. The transverse exceeds the vertical diameter, although the latter is extended by a short obtuse hypapophysial spine, *y*, less developed than in *Mosasaurus***. Each neurapophysis presents a large subconcave facet for articulating with part of the occipital condyle; a rudimental diapophysis projects from the outer side.

The axis (ib. fig. 3) consists of a long body, including the proper centrum of the atlas, *c a*, coalesced with that of the axis, *c x*. The latter develops a hypapophysis, *y*, to which is articulated a short hæmapophysis, *h*. A compressed vertical ridge-like process (par-diapophysis, *d*) extends from each side of the centrum; it may be for the support of a rudimental cervical rib.

A few of the succeeding vertebræ are characterized by both diapophysis (ib. fig. 4, *d*) and hypapophysis, *y*—the latter with a rough articular surface for ligamentous attachment of a

* *Op. cit.* p. 54, plate opposite same page, and woodcut p. 57.

† Quarterly Journal of the Geological Society, vol. xxxiii. p. 695, fig. 15.

‡ In the grey shale of the Niobraska chalk; referred by Prof. Cope to a *Leiodon nepæolicus* (*op. cit.* p. 177).

§ 'Fossil Reptilia of the Cretaceous Formations,' 4to, 1851, p. 29.

|| Cuv. Oss. Foss. 4to, vol. v. pl. xvii. fig. 10.

¶ See 'Annals and Magazine of Natural History,' vol. xx. p. 217, figs. 4, 5.

** Cuv. *op. cit.* pl. xx. fig 14, *c* (after Camper).

short imperforate hæmapophysis, *h*. The series of these hæmapophyses are homologues of those described by Sir Philip de M. Grey Egerton under the name of "subvertebral wedge-bones" in *Ichthyosaurus**. They are present in similar intervertebral position in *Amblyrhynchus*†, where they are five or six in number. They are represented by confluent pieces in *Cyclodus*‡. But the presence of hypapophyses for their support distinguishes the Mosasauroid from other families of Lacertilia as well as from both Ichthyo- and Sauropterygia.

The diapophysis of the third cervical supports a rib; and a similar costigerous process§ is present in the dorsal vertebræ. This series may be conveniently, though artificially, defined by the suppression of the hypapophysis. The zygapophyses (figs. 5 and 6, *z*, *z'*) disappear in the posterior dorsals as in fig. 7. The diminution in vertical and increase in longitudinal extent, together with its descent in position from the side of the centrum, reduce the "transverse process" to a "parapophysis," *p*, fig. 8, which characterizes the lumbar vertebræ. This change is attended with a modification of the shape of the centrum, the transverse section of which becomes triangular with the base downward, instead of the elliptic shape shown in the vertebræ from the antecedent part of the column. There is no sacrum by ankylosis: a single vertebra supports a pair of small rib-like, feebly curved, iliac bones (ib. fig. 1, *l*), with a slightly expanded, distal, bifaceted, syndesmosal surface, the larger division for the ischium. The pubics, *u*, have a smaller syndesmosal terminal expansion, are slender and nearly straight. The ischia (*m*) are broader, have a short posterior process, offer proximally a syndesmosal surface divided between the ilium and the femur, and have a distal surface for a symphysis with their fellow, completing the inverted arch below.

The anterior caudal vertebræ add to the parapophyses (fig. 9, *p*) a pair of hypapophyses, *y*, to which is articulated a hæmal arch formed by the apical confluence of a pair of hæmapophyses, *h*, from which confluence extends obliquely backward a hæmal spine, *h s*, rivalling or surpassing the neural one, *n s*, in length. The parapophysis gradually shortens and disappears at about the anterior third of the tail (fig. 10), which thereafter shows its natatory compression and

* Trans. Geol. Soc. ser. 2, vol. v. p. 187, pl. 14 (1836).

† Ann. & Mag. Nat. Hist. *ut suprà*, fig. 4, p. 221.

‡ Ib. ib. fig. 5, p. 223.

§ This, though marked *d*, combines the origins of both *di-* and *par-*apophyses; in fig. 8 it becomes *p*.

vertical extension attended with piscine confluence of the hæm- (*h*) with the hyp- (*y*) apophyses (ib. fig. 11).

No Mosasauroid has hitherto been discovered so entire and undisturbed, or exhumed with such exact care, as to yield a precise numerical vertebral formula. Even in the skeleton of the *Leiodon* described by Prof. Snow, "only two of the twenty vertebræ, which were scattered over the slab in all positions, remained united"*.

The nearest approaches to the true number in the genus *Mosasaurus* I believe to have been made by Cuvier (who assigns 133) and by Goldfuss (157). Of *Leiodon* I estimate, provisionally, from the various data at command, the following:—

		Number.
Atlas and axis		2
Vertebræ	(type 4) with hæmapophysis, hypapophysis, diapophysis, and zygapophysis	5
„	(type 5) with hypapophysis, zygapophysis, and diapophysis	7
„	(type 6) with zygapophysis and diapophysis	18
„	(type 7) with diapophysis	22
„	(type 8) with parapophysis	15
„	(type 9) with parapophysis and unankylosed hæmal arch	24
„	(type 10) with unankylosed hæmal arch	14
„	(type 11) with ankylosed hæmal arch †	44
„	(type 12) with centrum and neurapophyses rudimental or none	7
		158

The vertebræ of *Leiodon* are devoid of the accessory zygantral and zygosphenal articulations.

All the ribs or pleurapophyses, where present or preserved, are monocipital.

In entering upon the description of the British Fossil Reptilia ‡ I found the descriptive phrases applied in Anthropotomy to the parts and processes of the vertebræ cumbrous, if at all applicable to the homologous parts in those of the lower (especially the cold-blooded) Vertebrates, some apophyses in which had no homologues in the human vertebræ. I therefore proposed a "Nomenclature," substituting "names" for "phrases," and devised names for parts which previously had none.

* *Op. cit.* p. 57.

† All the above have the centrum (*c*) and ankylosed neural arch and spine (*n s*).

‡ "On the *Plesiosaurus macrocephalus*," Trans. Geol. Soc. vol. v. ser. 2, p. 515 (1838); "Reports on British Fossil Reptiles," in Transactions of the British Association for 1840 and 1841.

The general adaptive characters of the Mosasaurian vertebræ relate to aquatic life; and in the category (type 7) in which the zygapophyses disappear, not to return, there is a significant indication of a tendency towards the Cetacea; in a great extent of the caudal series (type 11) a piscine character prevails. Both these modifications are engrafted on, or associated with, the lacertian type of the procœlian vertebra.

The movements of this gigantic reptile among the sea-waves, mainly executed by the long and flexile vertebral column, were guided or modified by the action of both pectoral and pelvic fins: the retention of both pairs is more piscine than cetacean; or, we may say, the common vertebrate number of limbs, in Mosasaurs as in Ichthyosaurs, has not been departed from, as in some later and more modified forms of warm-blooded marine Vertebrates. Are the pelvic and femoral rudiments, which are concealed beneath the skin in modern whales, the remnants of the ventral fins of the cold-blooded marine air-breather? or are they remnants of the hind legs of a warm-blooded, ancestral, shore-haunting quadruped? Such pleasant speculations as a solace to the work of acquisition of positive facts may be condoned.

The framework of the pectoral fin was first restored by Prof. Marsh *, in the American Mosasauroid which he calls *Lestosaurus simus* (*Platecarpus*, Cope): the Lacertian type of this framework is illustrated, in comparison with the Cetacean and Enaliosaurian types, in the undercited work †. In the large proportion of a *Leiodon* discovered by Prof. Snow of the Kansas University, in the "yellow limestones along the Hackbury Creek, in Yove County, Kansas," the framework of the pectoral fin was found "lying underneath the ribs and vertebræ, with the bones in natural position." Fig. 13, Pl. VIII., is a reduced copy of the Professor's figure of this fin ‡. Assuming the accuracy of the arrangement of the bones, the first (innermost or radial) digit (I) is the longest, and includes a metacarpal (*m*) and eleven phalanges; the second digit (II) has the same number of phalanges and nearly the same length; the third (III) has nine phalanges; the fourth (IV) shows seven, but one or two small terminal bones seem to be wanting; the fifth, outermost or ulnar, digit (V) has evidently been the shortest, and retains but five phalanges. In the general shape of

* American Journal of Science and Arts, vol. iii. p. 4, pl. x. (1872).

† Quarterly Journal of the Geological Society, vol. xxxiv. p. 748, figs. 1–4 (1878).

‡ Transactions of the Kansas Academy of Sciences, vol. vi. p. 57, (1878). This volume had not appeared at the date of the reading of my second paper, "On the Affinities of the Mosasauridæ," June 5, 1878.

the fin, decreasing in length from the radial, 54, to the ulnar, 55, side, the fin of *Leiodon* resembles more that of the Cetacean* than does the fin of *Lestosaurus*, but with the marked difference of the first digit being the shortest in Cetacea and the longest in the present genus of Mosasauria.

The most instructive addition to the anatomy of this extinct family of marine Saurians is the degree in which the dermal skeleton is preserved in the Kansas example of *Leiodon* †.

Prof. Marsh had referred certain dermal scutes to Mosasauroid reptiles, and conceived them "to be mainly from the lower part of the neck." "In the genus *Liodon*," he adds, "the scutes are also imbricate, and somewhat similar to those above described" ‡ (in the genus *Edestosaurus*). But Prof. Snow has brought to light an extensive series of such osseous scales, indicative of a more general dermal scutation. Fig. 14, Pl. VIII., is a copy of a portion of this armour from one of the flanks of the *Leiodon*, of the natural size. In no known Ophidian are the scales formed in any proportion by bone; the purely epidermal tissue of their exuvial coat would be wholly dissolved in remains from a Cretaceous matrix, or, indeed, of one of more recent date. The Sheppey and other Eocene serpents are represented only by the parts of their endoskeleton; and so large a proportion of this has been found in natural articulation as to lend ground for expectation that the dermal scales would have been preserved if, as in lizards, they had included petrifiable parts §. In the existing members of the Lacertian order bone is developed at the base of the scale in several genera, e. g. *Trachysaurus*, *Tribolonotus*, *Ophisaurus*, &c. And if the curious fossils called "granicones," found in the "Feather-bed" shales of the Middle Purbecks, have been rightly interpreted ||, they likewise exemplify the osseous supports of the scales of an extinct lizard (*Nuthetes destructor*)—and, by virtue of their tissue, have been susceptible of fossilization, and testify to the dermal character of that species.

The formal character of both maxillary and mandibular

* Quart. Journ. Geol. Soc. vol. xxxiv. p. 749, fig. 1.

† "On the Dermal Covering of a Mosasauroid Reptile (*Liodon dyspelor*, Cope)," by Prof. F. H. Snow, *op. cit.* p. 54. The figure occupies p. 55.

‡ 'American Journal of Science and Arts,' vol. iii. p. 11 (April 1872).

§ Owen, 'History of British Fossil Reptiles,' 4to, p. 146, pl. *Ophidians*, 4. I have lately been favoured, by Mr. Shrubsole of Sheerness, with an opportunity of examining a greater extent of the vertebral column of *Palæophis toliapicus* than the subject of my plate, but unaccompanied by any trace of scutes.

|| Transactions of the Royal Microscopical Society, vol. i. p. 233, pl. xii. (1878).

teeth, attributed to the genus *Leiodon* and exemplified by transverse sections in fig. 15, Pl. VIII., has been found constant and characteristic of those teeth in the species of the genus noted as from the various localities in Leidy's 'Monograph on the Cretaceous Reptiles of the United States,' and represented in pls. ix.–xi., and in the woodcuts of pp. 58–69. The subject of Leidy's cut no. 18, and of fig. 7, pl. ix., from Monmouth County, New Jersey, is noted as corresponding in all its anatomical characters with those of *Leiodon* (p. 62).

The Mosasauroid or family characters of the teeth are strictly retained. The crown, composed of hard dentine with a thin coat of enamel, is supported by, and as it were wedged into a basis (fang or root) of the modified osteine called "cement." This is much thicker than the crown, and presents a rounded or full elliptical transverse section, whatever be the shape of the crown (compare the outline *a* (root) with *b* (crown) of a tooth of *Leiodon*, fig. 15, Pl. VIII.).

The root, when first formed, is implanted in a distinct socket, and the "thecodont" type of dentition is manifested. But this is a transitory condition; the cement becoming confluent with the bone of the socket, and, partially rising above the alveolar border of the jaw, the tooth then exhibits the "acrodont" type. But a much larger proportion of the orginal and independent tooth can be traced in the substance of the jaw than is the case in the existing acrodont Lacertilia. The pulp-cavity remains in the basal half of the crown, and descends a short way into the cemental fang, where it is closed by a coarser and more vascular modification of the cement. The vertical or longitudinal extent of the enamelled crown at its outer and exposed surface is about one third that of the fang.

The teeth are displaced and succeeded by others, many times during the life of the individual, as in modern Lacertilia. At least I have met with no specimens in which a reserve cavity with a more or less advanced successional tooth has not existed at the postero-internal side of the implanted base of the functional tooth*. The germ of a third generation in the form of the enamelled apex of the crown may be detected within the pulp-cavity of the second, which is in course of succeeding and displacing the first or fully formed tooth †.

The nearest resemblance to the Mosasauroid type of tooth is now presented by certain Cetacea, as, *e. g.*, the Cachalots ‡, Platanists §, and more especially by the Ziphioids, in which

* 'Odontography,' p. 259, pl. 72. fig. 2.
† See Leidy, *ut suprà*, pl. xi. fig. 4, *d*.
‡ 'Odontography,' pl. 89. fig. 2. § Ib. pl. 87 *a*.

the enamelled crown is borne upon an enormously developed cemental root, to which conical mass it sometimes appears as a mere apex*.

EXPLANATION OF PLATE VIII.

Fig. 1. Restoration of *Leiodon anceps*, Ow., as shown by an outline of the skeleton, omitting certain of the estimated numbers of the constituent types of vertebræ, for lack of space.
Fig. 2. Side view of atlas vertebra.
Fig. 3. „ axis vertebra.
Fig. 4. „ cervical vertebra.
Fig. 5. „ dorsal vertebra (first type).
Fig. 6. „ dorsal vertebra (second type).
Fig. 7. „ dorsal vertebra (third type).
Fig. 8. „ lumbar vertebra.
Fig. 9. Front view of caudal vertebra (first type).
Fig. 10. Side view of caudal vertebra (second type).
Fig. 11. Front view of caudal vertebra (third type).
Fig. 12. „ terminal caudal vertebra.
Fig. 13. Bones of right antebrachium and fin.
Fig. 14. Portion of dermal scutation of the side of the trunk.
Fig. 15. Outline of transverse sections of maxillary tooth. *a*, root; *b*, crown.

(All the figures, save 14 and 15, are much reduced in size.)

VI.—*Studies on Fossil Sponges.—V. Calcispongiæ.* By Karl Alfred Zittel.

[Continued from vol. iii. p. 379.]

Revision of the Fossil Calcispongiæ.

Family 1. **Ascones**, Häckel.

Stomach-wall thin, penetrated by inconstant cutaneous pores, wall-less and temporary openings in the parenchyma. Skeletal spicules usually in a single layer parallel to the surface.

No fossil representatives at present known.

Family 2. **Leucones.**

Stomach-wall thick, irregularly traversed by curved, branched, usually anastomosing canals, running without any definite arrangement. Parenchyma-skeleton consisting of

* See 'Monograph on British Fossil Cetacea,' p. 12, pl. 1. fig. 5, *a*, in the volume (4to) of the Palæontographical Society issued in 1870.

irregularly placed spicules; besides these special dermal and gastral layers.

Fossil forms unknown*.

Family 3. Pharetrones, Zittel.

Wall thick, with curved branching canals, or without any canals. Skeletal elements arranged in anastomosing fibres. A dermal layer often present.

Eudea, Lamx.

(Exp. Méth. p. 46, pl. lxxiv. figs. 1–4, 1821).

Eudea p. p., D'Orb.
Verrucospongia p. p., D'Orb.
Epeudea, *Ependea*, *Stegendea*, From.
Spongites, *Orispongia*, Quenst.
Solenolmia, *Verrucospongia*, *Eudea*, *Elasmeudea*, Pom.

Sponge simple or branched, cylindrical, clavate or pyriform, attached, with a narrow tubular central cavity reaching to the base. The skeleton consists of coarse anastomosing fibres, which spread out like lamellæ at the surface, except at the vertex, become fused together, and form a smooth, dense dermal layer, in which are situate round or misshapen, sometimes margined apertures, which are connected with shallow depressions. In the same way the wall of the stomachal cavity also consists of a smooth layer, which is only pierced by pore-like openings.

The canal-system is indistinctly developed in consequence of the large-meshed texture of the skeleton; the water probably passed through the large ostia of the surface into the sponge-body, circulated between the large spicular fibres, and reached the stomachal cavity through the above-mentioned pores. In cut specimens no canals appear either in longitudinal or in transverse sections.

Of this genus a species from the Great Oolite of Caen was

* A few days ago two fragments of rock belonging to the older Cretaceous, from Pirot, in Bulgaria, were sent to me by Prof. Toula of Vienna. They consisted almost entirely of small subcylindrical bodies narrowed downwards, about 10–15 millims. in length, and 3–4 millims. in thickness. These evidently organic hollow bodies most resembled the *Gyroporellæ* of the Trias, but they wanted the characteristic pores and canals of the latter. It is true that radial canals open into the central cavity, and these become more oblique downwards, and finally rise from below perpendicularly into the stomachal cavity; but there is no fibrous texture. On the other hand, we sometimes observe a few large bacillar spicules, and tri- and quadriradiate spicules, in the usually homogeneous wall; but their form cannot be exactly ascertained. If these bodies, which occur in such quantities, belong, as I suppose, to the Leucones, this family would consequently commence in the Cretaceous.

described as early as 1821 by Lamouroux, who named it in honour of M. Eudes-Deslongchamps. Michelin (Ic. pl. lviii. fig. 8) gives a new and excellent figure of the same species, but, curiously enough, regards the characteristic smooth epidermis of the surface as a foreign parasitic body, for which he retains the name of *Eudea*, whilst its supposed support is described as *Scyphia clavarioides* or *cymosa*.

D'Orbigny restores Michelin's *Eudea cribraria* to Lamouroux's species, but applies the name of *Eudea* to a great number of cylindrical sponges with well-developed canal-systems.

Fromentel finally, in opposition to all the rules of terminology, retains the name of *Eudea* for a great part of the forms referred by D'Orbigny to Lamouroux's genus, and gives the typical species (*E. clavata*, Lamx., =*Eudea cribraria*, Mich.) a new generic name, *Epeudea* (or *Ependea*). Subsequently Fromentel established a distinct genus *Stegendea* (more correctly *Stegeudea*) for the branched forms.

Pomel, indeed, reverts to Lamouroux's conception, but establishes the superfluous genera *Elasmeudea* and *Solenolmia*.

By Quenstedt the Upper-Jurassic species were described in his earlier works as *Spongites*, but in the 'Petrefactenkunde Deutschlands' under the generic name *Orispongia*.

Several species of *Eudea* occur in the Alpine Trias; but the genus has its principal distribution in the Upper Jura. Here the specimens are frequently silicified, sometimes at the surface, sometimes throughout.

1. *Scyphia Manon*, Münst. Beitr. iv. pl. i. fig. 15. Trias, St. Cassian.

2. *Scyphia polymorpha*, Klipst. Œstl. Alp. Taf. xix. fig. 12. St. Cassian.

Verrucospongia polymorpha, Laube, Fauna von St. Cass. Taf. i. fig. 12.

3. ? *Epeudea pusilla*, Laube, *l. c.* Taf. i. fig. 1. St. Cassian.

4. *Eudea clavata*, Lamx. Exp. Méth. pl. lxxiv. figs. 1–4. Bathonian.

Eudea cribraria, Mich. Ic. pl. lviii. fig. 8.

5. *Spongites perforatus*, Quenst. Jura, Taf. lxxxiv. figs. 26, 27. Upper Jurassic.

Orispongia perforata, Quenst. Petref. Bd. v. Taf. cxxiv. figs. 22–28.

6. *Orispongia globata*, Quenst. *l. c.* Taf. cxxiv. figs. 29–34. Upper Jura.

Manon peziza p. p., Goldf. Taf. xxxiv. fig. 8, *a*.

7. *Orispongia pisum*, Quenst. *l. c.* Taf. cxxiv. figs. 35, 36.

8. *Epeudea macropora*, From. Pol. Cor. de Gray, pl. xv. fig. 2. Coral Rag.

9. *Eudea corallina*, Etal. Actes Soc. Jur. d'Emul. 1860, p. 147, fig. 13.

10. *Ependea elongata*, From. et Pill. Coll. de Lem. pl. xii. figs. 5, 6. Tithonian.

11. *Stegendea Pilleti*, From. et Pill. ib. pl. xiii. fig. 8. Tithonian.

COLOSPONGIA, Laube.

(Fauna von St. Cassian, p. 17, Taf. i. fig. 16.)

Manon p. p., Münst., Klipst.
Amorphospongia p. p., D'Orb.

Sponge cylindrical, clavate, sometimes branched, built up of globular or annular segments, which are indicated externally by deep constrictions. Surface coarsely porous, the lower segments sometimes clothed with a smooth, dense dermal layer. Vertex convex, with the small circular osculum of a narrow central cavity, which passes through the whole sponge-body.

The segments internally are occupied by an extremely loose anastomosing fibrous tissue, which is somewhat condensed at the walls. Canal-system wanting.

I have modified Laube's diagnosis in accordance with a well-preserved branching specimen from the Seeland Alp, which in transverse section shows a central cavity, and nowhere exhibits an epitheca. *Colospongia* unites *Eudea* with *Verticillites*. From the latter the present genus differs by possessing imperfectly developed transverse floors, and also by the circumstance that the segments are not hollow internally, but filled with loose tissue. The only species is from the Alpine Trias:—

Colospongia dubia, Laube, *l. c.* Taf. i. fig. 16.
Manon dubium, Münst. Beitr. iv. Taf. i. fig. 11.
Manon pertusum, Klipst. Œstl. Alp. Taf. xix. fig. 14.

VERTICILLITES, Defrance.

Verticillites (Ellis), Defr., D'Orb.
Scyphia, Goldf.
Verticillopora, Blainv., Sharpe (non M'Coy).
Verticillocœlia, From.
Verticillites, *Cystopora*, Pom.
Verrucospongia p. p., Laube.

Sponge simple or bushy. Isolated individuals cylindrical or clavate, frequently with horizontal constrictions at the surface. Vertex with a circular osculum. The whole sponge-body built up of thin-walled hollow rings, each of which fits upon the preceding one in such a manner that the horizontal or arched cover of the first forms at the same time the floor of the following one. These rings are traversed by a vertical central tube, extending from the osculum to the base. The wall of the central cavity, the external wall, and the transverse floors are repeatedly perforated and furnished with canals, which lead into the interior of the hollow segments. All the walls consist of a tissue of anastomosing calcareous fibres. In certain species the floors of the hollow rings are united to each other by fine vertical processes of the skeletal substance.

The microstructure of the calcareous skeleton is in general destroyed; so that, when highly magnified, the fibres merely show a radiate crystalline texture. In a specimen of *Verticillites anastomosans*, Mant., however, from the Aptian of La Presta, I have succeeded in demonstrating that the fibres are composed of usually distinctly triradiate spicules. By this means the relationship of this genus (which in its general habit is most intimately connected with *Peronella*) to the sponges is established with certainty.

I am acquainted with various species from the Trias and Lower Cretaceous.

a. *From the Trias.*

1. *Scyphia armata*, Klipst. Beitr. Taf. xix. figs. 13, 14.
   Verrucospongia armata, Laube, Fauna von St. Cassian, Taf. i. fig. 10.

I have obtained, through Dr. Loretz, a number of specimens from the Seeland Alp, which show remarkably well the hollow rings, the somewhat arched horizontal floors, and the perforated wall of the central tube.

b. *From the Cretaceous.*

1. *Verticillopora anastomosans*, Mant. Wonders of Geol. p. 636. fig. 3; Medals, 2nd ed. p. 227. fig. 4, p. 229. fig. 3.
   Verticillopora anastomosans, Sharpe, Q. J. G. S. vol. x. 1854, pl. v. fig. 1.
   ? *Verticillites truncata*, D'Orb. Prodr. ét. xvii. p. 560.
   ? *Discœlia helvetica*, Loriol, Urgon. Land. pl. v. figs. 4–11.
2. *Verticillites digitata*, D'Orb. ib. ét. xix. p. 357.
3. *Verticillites incrassata*, D'Orb. ib. ét. xx. p. 768.
4. *Thalamopora siphonioides*, Mich. Ic. pl. liii. fig. 9.
5. *Verticillites cretaceus*, Defr. Dict. Sci. Nat. 1829, vol. lviii. p. 5.
   Verticillite d'Ellis, Defr. Dict. Atl. Polyp. pl. xliv. fig. 1.
   Verticillopora cretacea, Blainv. Man. Act. pl. lxvi. fig. 1.
   Verticillites cretaceus, Bronn, Leth. Geogn. pl. xxix. fig. 5.
6. *Verticillites Goldfussi*, D'Orb. Prodr. ét. xxii. 1463.
   Scyphia verticillites, Goldf. Taf. lxv. fig. 9.

Celyphia, Pomel.

(Pal. d'Oran, p. 229.)

Manon p. p., Münst., Klipst.
Hippalimus p. p., D'Orb.
Verrucospongia p. p., Laube.

Sponge composed of globular or ovate individuals, irregularly arranged upon one another, often united into nodular masses, constantly increasing in size according to their age. Wall of the individual dense, pierced by isolated margined oscula. This wall encloses a cavity which is very incompletely occupied by a very loose web composed of fine anastomosing fibres.

Under the microscope both the wall and the fibrous tissue in the interior appear solid. As, however, the same constitution is observed in many true Calcispongiæ from St. Cassian, it may be regarded as a consequence of late alterations.

I place this very peculiar genus with many doubts among the Calcispongiæ. Its whole external appearance, and its constitution of separate, well-defined chambers, rather reminds one of certain Foraminifera; but the partial filling of the chambers with a loose-meshed tissue is irreconcilable with the idea of a Foraminifer.

The structure furnishes no information as to the zoological position of the genus, which, however, may be best arranged beside *Colospongia* and *Verticillites.*

The only species is from the Trias of St. Cassian:—

Manon submarginatum, Münst. Beitr. iv. Taf. i. fig. 9.
Manon pisiforme, Münst. ib. Taf. i. fig. 8.
Verrucospongia submarginata, Laube, Fauna von St. Cass. Taf. i. fig. 11.

Himatella, Zittel.

Tragos p. p., Münst., Klipst.
Lymnorea p. p., D'Orb.
Lymnorethcles p. p., Laube.

Sponge obconical, simple. Vertex slightly convex, with a central circular osculum, the efferent orifice of a narrow tube traversing the whole sponge. Surface furnished up to the margin of the vertex with a smooth or concentrically wrinkled dermal layer. No radial or other canals. In longitudinal section the fibrous skeleton shows a tendency to become condensed parallel to the vertex at regular distances, so as to produce a faint indication of transverse floors.

This genus unites *Peronella* with *Colospongia* and *Verticillites.* The narrow perforant central cavity and the absence of radial canals remind one of *Peronella*, and the indication of segment-formation, although but slight, of the two last-mentioned genera. The smooth epitheca, which extends up to the vertex, is characteristic of *Himatella*.

The only known species occurs in the Alpine Trias:—

Tragos milleporatum, Münst. Beitr. iv. Taf. i. fig. 17.

Peronella, Zittel.

Scyphia, *Siphonia*, *Spongia*, auctt.
Eudea p. p., *Hippalimus* p. p., D'Orb.
Siphonocœlia p. p., *Polycœlia* p. p., *Discœlia* p. p., *Stenocœlia*, From.
Pareudea p. p., Etal.
Dendrocœlia, Laube.
Cœloconia, *Dyoconia*, *Lymnorea*, *Pliocœlia*, *Siphonocœlia*, *Lænocœlia*, Pom.
Spongites, *Dermispongia*, *Radicispongia*, Quenst.

Simple, or branched by gemmation; individuals cylindrical, thick-walled; vertex convex, rarely flat, in the middle with the narrow circular osculum of the tubular stomachal cavity, which, retaining nearly the same diameter, traverses the whole length of the sponge-body to the vicinity of the base. Incurrent canals wanting. Wall of the stomachal cavity and surface porous. Outer surface either naked or coated with a dense concentrically wrinkled epidermis at the base, and sometimes up to the neighbourhood of the vertex.

The skeleton consists of generally coarse, vermiform, anastomosing fibres, which form a confused tissue. In the irregular-shaped meshes and interstices of this the water circulated, no special canals or ostia being necessary. The pore-like orifices on the surface and on the wall of the central canal are merely gaps in the vermiform tissue.

In general the skeleton still consists of carbonate of lime; but in certain localities, especially of the Upper Jura, nearly all the specimens are silicified. In the latter the spicules of which the fibres consist are never preserved. In calcareous skeletons, on the contrary, the microstructure may usually be detected with certainty, although distinctly preserved spicules are rarely observed.

The vermiform fibres appear chiefly to be composed of triradiate (perhaps also quadriradiate) spicules, but simple bacillar spicules are often associated with these in great numbers. The size and form of the triradiates, and especially the length of the individual, sometimes curved arms, vary considerably in the different species.

This rich genus, which extends from the Trias into the Upper Cretaceous, may be distinguished easily from the allied forms by the narrow tubular central cavity of the cylindrical body and by the absence of any radial canals. The forms belonging to it were named by the older writers *Scyphia*, *Spongia*, or *Siphonia*; D'Orbigny erroneously united them with Lamouroux's genera *Eudea* and *Hippalimus*.

Etallon (Etudes pal. sur le Haut-Jura, 1859, p. 142) proposed for a part of the species described by D'Orbigny as *Eudea* and *Hippalimus* the generic name *Pareudea*, under which are included the Jurassic forms of the present genus, as well as several *Eusiphonellæ*.

In the same year Fromentel (Introd. p. 31) established the genera *Siphonocœlia* and *Polycœlia*, which, in general, represent Etallon's *Pareudea*. The monozoic forms were named *Siphonocœliæ*, the polyzoic *Polycœliæ*, and, as the latter name was already occupied, subsequently *Discœliæ* (Cat. rais. Spongit. Neoc. 1861, p. 4). This correction has escaped most authors; and the name *Polycœlia* was therefore replaced by *Dendrocœlia* by Laube, by *Cœloscyphia** by R. Tate, and by *Pliocœlia* by Pomel.

A generic separation of the monozoic and polyzoic forms is quite inadmissible in this genus; for sometimes the same species makes its appearance as a simple individual and as a composite stock. Nor does the genus *Stenocœlia*, From. (Cat. rais. p. 4) seem to me to be any better founded. Fromentel refers to it those *Discœliæ* in which the individuals are fused together laterally almost to the vertex, so that nodular stocks with perforated wart-like elevations are produced.

In his most recent work Quenstedt describes the Jurassic forms under the generic denominations *Spongites*, *Vermispongia*, and *Radicispongia*, and the Cretaceous ones generally as *Scyphiæ*.

The above-cited genera of Pomel are distinguished partly by the supposed siliceous or calcareous nature of the skeleton, partly by the thickness of the anastomosing fibres, and partly by the external form.

It appears to me not improbable that when we have a better knowledge of the spicules which compose the skeletal fibres, a division of the forms united under *Peronella* into several genera may be practicable; for that in this respect very important differences occur, may be seen at once from a comparison of the spicules of *Peronella cylindrica* from the Upper Jurassic, and of *P. multidigitata*, Mich., from the

* Judging from the figure of *Cœloscyphia sulcata*, Tate (Quart. Journ. Geol. Soc. xxi. p. 43), I suppose that this species does not belong to the Calcispongiæ, but to the Hexactinellidæ, and, indeed, in the neighbourhood of *Polyblastidium*, Zitt.

Middle Cretaceous. The defective state of preservation, however, presents insuperable obstacles to a systematic employment of the forms of spicules in the fossil Calcispongiæ.

The following species may be mentioned as examples of the genus *Peronella*:—

a. *From the Devonian.*

1. *Scyphia conoidea*, Goldf. Taf. ii. fig. 4.
2. *Scyphia constricta*, Sandb. Verst. Rhein. Uebergangsgeb. Taf. xxxvii. fig. 10.

Scyphia turbinata, Lonsd. non Goldf.

b. *From the Trias.*

1. *Peronella Loretzi*, Zitt. Seeland Alp near Schluderbach.

Siphonocœlia, sp. n., Loretz, Zeitschr. deutsch. geol. Ges. 1875, p. 838.

2. *Scyphia subcæspitosa*, Münst. Beitr. iv. Taf. i. fig. 14.
3. *Scyphia caminensis*, Beyr. in Eck. Ueber die Formation des Bunter Sandst. und Muschelk. in Oberschles. Taf. i. fig. 2.

c. *From the Dogger.*

1. *Spongia cymosa*, Lamx. Exp. Méth. pl. lxxxiv. fig. 7.

Scyphia cymosa, Mich. Ic. pl. lviii. fig. 3.

2. *Spongia pistilliformis*, Lamx. ib. pl. lxxxiv. fig. 5; Mich. Ic. pl. lviii. fig. 4.
3. *Spongia mamillifera*, Lamx. ib. pl. lxxxiv. fig. 11.
4. *Spongia clavarioides*, Lamx. ib. pl. lxxxiv. figs. 8–10.
5. *Tragos tuberosum*, Goldf. Taf. xxx. fig. 4.

Spongites mamillatus, Quenst. Petr. Taf. cxxxi. figs. 37–39.

6. *Spongites fuscus*, Quenst. ib. Taf. cxxxi. fig. 42.

d. *From the Malm.*

1. *Scyphia cylindrica*, Goldf. Taf. ii. fig. 3, and Taf. iii. fig. 12.

Scyphia elegans, Goldf. Taf. ii. figs. 8 and 13.
Scyphia cylindrica, Quenst. ib. Taf. cxxiii. figs. 6, 7, 9–15.

2. *Pareudea jurassica*, Etal. Et. Pal. Haut-Jura; Monogr. de l'ét. Corall. p. 142; and Sur la Classif. des Spongit. fig. 14.
3. *Pareudea mosensis*, Etal. ib. p. 144.

Scyphia furcata, Mich. Ic. pl. xxvi. fig. 3.

4. *Spongia floriceps*, Phill. Geol. Yorksh. iii. fig. 8.
5. *Scyphia radiciformis*, Goldf. Taf. iii. fig. 11.

Radicispongia radiciformis, Quenst. Petr. Taf. cxxiii. figs. 15–26.

6. *Pareudea amicorum*, Etal. Leth. Bruntr. pl. lviii. fig. 27.
Siphonia lagenaria, Mich. Ic. pl. xxvi. fig. 4.

7. *Polycœlia bullata*, From. Introd. pl. i. fig. 9.
8. *Spongia mamillaris*, Mich. Ic. pl. xxvi. fig. 5.
9. *Spongites nodulosus*, Quenst. Petr. Tab. cxxxi. figs. 28–30.
?10. *Spongites squamatus*, Quenst. ib. Taf. cxxxi. figs. 30–32.

c. *From the Cretaceous.*

1. *Scyphia clavata*, Röm. Nordd. Ool. Taf. xvii. fig. 24. Hils.
? *Siphonocœlia cylindrica*, From. Cat. Rais. pl. i. fig. 4.

2. *Polycœlia divaricata*, Röm. Spongit. Taf. i. fig. 8.
3. *Polycœlia ramosa*, Röm. Nordd. Ool. Taf. xvii. fig. 27. Hils.
4. *Discœlia porosa*, From. Cat. Rais. pl. ii. fig. 4. Neocomian.
Polycœlia punctata, Röm. Spongit. Taf. i. fig. 7.

5. *Limnorea monilifera*, Röm. Spongit. Taf. i. fig. 5, and Taf. ii. fig. 5. Hils.
6. *Discœlia dumosa*, From. Cat. Rais. pl. i. fig. 6. Hils.
? *Scyphia subfurcata*, Röm. Nordd. Ool. Taf. xvii. fig. 28.
Elasmocœlia sequana, Röm. Spongit. Taf. i. fig. 11, non From.

7. *Siphonocœlia compressa*, From. Intr. pl. iv. fig. 7. Neocomian.
8. *Discœlia macropora*, From. Cat. Rais. pl. i. fig. 7. Neocomian.
9. *Polycœlia gemmans*, From. Intr. pl. iv. fig. 4. Neocomian.
10. *Discœlia strangulata*, From. Cat. Rais. pl. ii. fig. 2. Neocomian.
11. *Polycœlia tuberosa*, Röm. Spongit. Taf. i. fig. 9. Hils.
12. *Discœlia Perroni*, From. Cat. Rais. pl. ii. fig. 1. Neocomian.
13. *Discœlia Ricordiana*, From. ib. pl. ii. fig. 3. Neocomian.
14. *Discœlia glomerata*, From. ib. pl. ii. fig. 6. Neocomian.
15. *Discœlia Cottaldina*, From. in Loriol Et. Val. d'Arzier, pl. viii. figs. 7, 8. Valanginian.
16. *Discœlia arzieriensis*, Loriol, ib. pl. viii. figs. 11, 12. Valanginian.

17. *Siphonocœlia tenuicula*, Loriol, Urgon. Land. pl. iv. fig. 9. Urgonian.
18. *Siphonocœlia cyathiformis*, Lor. ib. pl. iv. figs. 10–12. Urgonian.
19. *Discœlia Gillieroni*, Lor. ib. pl. iv. figs. 16–18. Urgonian.
20. *Discœlia flabellata*, Lor. ib. pl. iv. figs. 19–21. Urgonian.

Hippalimus flabellatus, D'Orb. Prodr. ii. p. 97.

21. *Discœlia Cotteaui*, Lor. ib. pl. v. figs. 1–3. Urgonian.
22. *Scyphia furcata*, Golf. Taf. ii. fig. 6. Tourtia.
23. *Spongia multidigitata*, Mich. Ic. pl. li. fig. 9. Cenomanian.
24. *Scyphia micropora*, Röm. Kr. Taf. ii. fig. 6. Senonian.

Elasmocœlia, Römer.

Elasmojerea, From.

Sponge consisting of one or several arched laminæ, more or less grown together, which are pierced throughout their whole longitudinal axis by numerous round stomachal cavities of equal thickness. These tubes are placed in one or more rows; and their round orifices are situated at the upper margin. Radial canals wanting. Skeletal fibres coarse. Surface and walls of the tubes porous.

This genus was first described by Fromentel (Introd. p. 34) under the name of *Elasmojerea*; but F. A. Römer showed that it had nothing to do with *Jerea*, but must be placed near *Siphonocœlia*. He therefore altered the name to *Elasmocœlia*. Although Römer's *E. sequana* is not identical with Fromentel's *Elasmojerea sequana*, but belongs to *Peronella dumosa*, From., the remark is nevertheless correct that the *Elasmocœliæ* consist only of *Peronellæ* serially arranged and grown together by their sides. They perhaps form only a section of *Peronella*, coming nearest to *P. dumosa*; but the external habit is so peculiar that I would retain the genus *Elasmocœlia*.

All the species are from the Lower Cretaceous.

1. *Elasmojerea sequana*, From. Intr. pl. ii. fig. 3. Neocomian.
2. *Elasmojerea crassa*, From. Cat. Rais. pl. ii. fig. 10. Neocomian.
3. *Elasmojerea plana*, From. ib. pl. ii. fig. 9. Neocomian.

?4. *Elasmojerea irregularis*, From. ib. pl. ii. fig. 8. Neocomian.

5. *Elasmocœlia orbiculata*, Röm. Spongit. Taf. ii. fig. 11. Hils.

6. *Elasmojerea tortuosa*, Loriol, Urgon. Land. pl. v. figs. 16, 17. Urgonian.

Conocœlia, Zittel.

Siphonocœlia p. p., From.
Limnorea p. p., Röm.

Sponge obconical or top-shaped, simple, or polyzoic by gemmation at the upper margin, very thick-walled; vertex broadly truncate, with a central, very deep, funnel-shaped stomachal cavity. Surface porous, with horizontal rings of growth. A true canal-system is deficient; but the sponge-body consists of successively formed horizontal layers of coarse anastomosing fibrous tissue, which have between them narrow interspaces for the circulation of water.

Among the spicules of the skeletal fibres I believe I have recognized simple bacillar spicules as well as triradiates. Some of the latter are four or five times as large as the others.

This genus, united with *Siphonocœlia* by Fromentel, from its laminar structure, which somewhat reminds one of that of certain Rudistes (*Radiolites* and *Sphærulites*), and also, from the unusual thickness of the wall, the truncated upper margin, and the occasional singular budding of the latter, acquires so peculiar an aspect that it can readily be distinguished from *Peronella*.

In the French Neocomian only monozoic individuals usually occur; but in the North-German Hils polyzoic specimens are also found. Through Prof. Ottmer of Brunswick I have obtained a number of specimens which leave no doubt that *Limnorea centrolævis*, Röm., is united by all transitions with simple individuals of the form of *Conocœlia crassa*, From.

The two species at present known are from the Lower Cretaceous.

1. *Siphonocœlia crassa*, From. Cat. Rais. pl. i. fig. 1.
2. *Limnorea centrolævis*, Röm. Spongit. Taf. i. fig. 18.

Eusiphonella, Zittel.

Scyphia, Goldf.
Siphonocœlia and *Discœlia* p. p., From.
Pareudea p. p., Etal.

Sponge simple or branched by basal or lateral budding. Individual persons cylindrical, narrowed below, thin-walled, with a wide tubular or funnel-shaped stomachal cavity extending to the base. Wall of the stomachal cavity with elongated ostia standing in vertical rows and serving as the efferent apertures of horizontal radial canals. Surface with coarse pores.

The anastomosing fibres of the skeleton are comparatively thin and form a loose web.

This genus, hitherto known only in the Upper Jura, is readily distinguished from *Peronella* by the well-developed system of horizontal canals.

1. *Scyphia Bronni*, Münst. Goldf. Taf. xxxiii. fig. 9; Quenst. Petr. Taf. cxxiv. fig. 1–15.

Siphonocœlia elegans, From. (nec Goldf.) Intr. pl. i. fig. 7.
Pareudea gracilis, Etal. Leth. Bruntr. pl. lviii. fig. 30.

2. *Scyphia intermedia*, Münst. Goldf. Taf. xxxiv. fig. 1; Quenst. Petr. Taf. cxxv. figs. 55–58.

3. *Scyphia perplexa*, Quenst. ib. Taf. cxxv. figs. 56–63.

[To be continued.]

VII.—*Observations on the* Chlamydoderæ *or Bower-birds, with Description of a new Species.* By John Gould, F.R.S.

The Bower-birds are so named from their extraordinary habit of building "playing-places" or "halls of assembly," placed on a thick platform of sand, turf, &c., variously decorated with shells, bleached bones, or any glittering substance which may be at hand. The Bower-birds are naturally shy in disposition, and consequently seldom seen in the forest unless closely looked for. In affinity they are generally supposed to be allied to the "Birds of Paradise," an opinion with which I am inclined to agree. Besides these extraordinary feats of building "playing-places," constructed of fine branches of trees, where the birds meet to have their gambols, most of them are also distinguished by peculiarities in their plumage. Many of the species have a decorative patch at the nape of the neck of an extremely beautiful lilac; others have no such decoration. One pleasing feature belongs to the members of this group: it is that they appear to become easily domesticated, bearing captivity well; and if one or more are placed in an aviary, and materials be thrown about, they commence building their curious bower, and play and coquet in the most pleasing manner: this was the case with the Bower-birds at different times in the Zoological Gardens.

It must not be supposed that these structures on the ground are for the purpose of breeding: the little known on this subject is that *Chlamydodera maculata* makes a round, moderate-sized, cup-shaped nest, like that of the English jay (*Garrulus glandarius*), and placed among the branches of high trees.

The new species, *Chlamydodera orientalis*, is a native of Queensland, and tolerably common at Port Denison. In size it is about the same as *C. nuchalis*, whose habitat is on the opposite part of the continent. The bird figured by Jardine and Selby was from one of these western countries; it is also the bird spoken of by Capt. Grey in his travels, as well as the one mentioned by the officers Bynoe and Dring of the surveying-ship 'Beagle;' lastly, specimens were brought over to this country by the lamented Elsey, who collected them at the Victoria river.

It is not by writing ever so minutely that I can make the public perceive the difference in these two nearly allied birds; but if a series of skins from both countries are placed side by side it will be at once perceptible. The great peculiarity in the present species (*orientalis*) is the barring of the upper plumage, almost approaching to that of *C. maculata* and *C. guttata*. This new bird is less silky in its plumage than the western species, particularly the head, cheeks, throat, and under surface. Elsey's specimens are in the British Museum; and I have others in my own collection.

VIII.—*A third Contribution to the Knowledge of the* Cetoniidæ *of Madagascar*. By CHARLES O. WATERHOUSE.

THE British Museum has recently received some interesting additions to the collection of Cetoniidæ from Madagascar. All the species here described are from the neighbourhood of Antananarivo (with the exception of *Coptomia elegans*, which is from Fianarantsoa), and were collected by Mr. Kingdon.

Stenotarsia picta.

Elongata, subparallela, nigro-picea, supra nigra, velutina; thorace linea circumdata flava; elytris ad suturam impressis, singulis macula triangulari ante medium ferruginea lineisque duabus tenuibus flavis. ♂ ♀.

Long. 7 lin.

This species has much the appearance of some narrow species of *Macronota*; but the legs and tarsi are long and slender, as in *Stenotarsia*, and the elytra slightly embrace the abdomen. Above dull velvety black, except the head, which is pitchy. Thorax a little broader than long, obliquely narrowed in front of the middle, subparallel posteriorly, only very slightly sinuate at the sides, broadest at the posterior angles, the base straight, with a pale yellow line all round the margins, but not touching the posterior angles. Scutellum yellow at the apex. Elytra deflexed at the sides and apex, at the shoulders much broader than the thorax, then suddenly narrowed, subparallel to the apex; each elytron with a rusty-yellow triangular spot at one third from the base; this spot is bordered posteriorly by a narrow yellow line; a little beyond this is a second yellow line, which ascends obliquely towards the suture; the apex is truncate and is bordered with yellow. The second segment of the abdomen has a greenish-yellow fascia; and the fifth segment is margined with the same colour. The anterior tibiæ are tridentate in both sexes. The pygidium in the male is oblong, rounded at the apex, and thickly punctured, the punctures each having a very short yellow hair; in the female there is a very deep ovate impression at the apex.

Sometimes the rusty spot on the elytra has a short curved line above it on the side, and there is also another line connecting the spot with the suture. The sternal process is in the form of an equilateral triangle, its sides sloping.

Note.—In the same collection with the above there was a male example of *S. discoidalis*, differing from my original type in having the discoidal patch on the thorax divided into three black spots.

Euchilia picipes.

Oblonga, nitida, viridi-olivacea; elytris striis decem nigris impressis; tibiis tarsisque piceis.

Long. $8\frac{1}{2}$ lin.

This species is very close to *E. costata*, and might be easily mistaken for it. It is, however, of a darker, more olive green, tinged frequently with blue; the thorax is less ample, rather less convex; the clypeus is less strongly punctured; the lines on the elytra are finer, and the lateral deflexed portion is not bounded above by a well-marked ridge, but is more gradual; the upper part of the femora, the tibiæ, and tarsi are deep pitchy red; the three teeth on the anterior tibiæ are less acute, extremely blunt in the female.

Euchilia costifera.

Oblonga, supra depressa, nitida, olivaceo-viridis; thorace cæruleo micante, discrete obsolete punctulato; elytris lineis nonnullis

impressis, sutura interstitiisque secundo et quarto costiformibus; pygidio parce punctato. ♂ ♀.
Long. 7½ lin.

General form of *E. sulcata*, but with the thorax less ample; the shoulders of the elytra are more prominent, and are more excised immediately below. Bright bluish green, shining; clypeus rather thickly and finely punctured. Thorax convex, rather obscurely and not very thickly punctured. Scutellum smooth. Elytra with the suture much raised; each elytron with four slightly sinuous impressed lines, which are very obscurely punctured; the second and fourth interstices narrow and costiform; the first and third interstices have a few large punctures in a line. Pygidium with punctures scattered over the surface. In the female the three teeth of the anterior tibiæ are a little closer together than in the male.

Euchilia cupricollis.

Viridi-olivacea, nitida; fronte, thorace, scutello, elytrorum disco, pygidio corporeque subtus plus minusve rufo-cupreis, tibiis tarsisque piceis. ♀.
Long. 7½ lin.

Very close to *E. picipes*; but, besides the coloration, it differs from that and all the other species in having the base of the thorax gently arcuate, and not at all sinuate before the scutellum. Thorax convex, finely coriaceous, the sides subparallel and gently sinuate behind the middle. Elytra each with five black striæ, the deflexed margins not bounded above by a marked ridge. Pygidium obscurely and not very thickly punctured. Anterior tibiæ with three strong sharp teeth. The coloration closely resembles that of *E. puncticollis*, W., but that has the thorax thickly punctured, and has a slight sinuation before the scutellum.

Euchilia tarsalis.

Olivaceo-viridis, nitida; thorace crebre fortiter punctato, sat pubescente; elytris punctato-striatis, interstitiis secundo quartoque costiformibus; pygidio parce punctato, pubescente, tibiis tarsisque subtus ciliatis.
Long. 8–8½ lin.

Clypeus deeply incised, finely punctured; the forehead more distinctly punctured, and having black hairs arising from the punctures. Thorax convex, thickly and strongly punctured, the base very gently arcuate, not perceptibly emarginate before the scutellum. Elytra each with six well-marked impressed sinuous lines, which are strongly punctured; the suture and the second and fourth interstices raised, this latter abbreviated; the first and third interstices with some strong punctures; the subapical callosity obtuse, the apex smooth. The pygidium with a few punctures. Tarsi black.

The male has the anterior tibiæ with three acute small teeth, the anterior tarsi short and extremely thick; the posterior tarsi as long as the tibia, moderately stout.

The female has the three teeth of the anterior tibiæ close together. The anterior tarsi are short and more slender, the posterior tarsi are much shorter than the tibia, less stout than in the male.

This species is very peculiar, and recedes somewhat from *Euchilia*, but agrees better with that genus than with *Coptomia*.

Pygora bella.

Viridi-prasina, subtus plus minusve cyaneo micans, nitidissima; clypeo piceo; thorace olivaceo, linea mediana tenui lateribusque viridibus, his cupreo tinctis; elytris octostriatis, olivaceis vel cyaneis, marginibus viridibus et cupreo-aureo tinctis; pygidio leviter convexo, cyaneo, parce punctato; pedibus pallide piceis.

Long. 6 lin.

Head and clypeus very thickly and rather strongly punctured, the latter very slightly emarginate. Thorax moderately thickly and distinctly punctured, nearly parallel at the sides to a little in front of the middle, then obliquely narrowed anteriorly, olive-green (or dark cyaneous), with a fine mesial line and the sides pale green. Scutellum smooth, pale green. Elytra each with four strong striæ; the third interstice nearly flat, the others convex; the shoulders pitchy.

The male has two acute teeth to the anterior tibiæ, with an indication of a third; and the first abdominal segment has a white spot on each side.

The female has three acute teeth to the anterior tibiæ; and the abdomen has no spots.

In the same collection with the above were two examples of rather larger size (7 lines), which have the sides of the thorax, the scutellum, and the sides of the elytra bright golden coppery; the colour of the thorax and elytra is less dark. I believe them to belong to the same species.

Pygora puncticollis.

Depressa, latior; capite crebre punctato, vertice viridi, clypeo piceo; thorace ante medium oblique angustato, postice subparallelo, nigro-cyaneo, crebre fortiter punctato, lineis tribus longitudinalibus viridibus, cupreo micantibus, scutello viridi lævi; elytris piceis, fortiter octostriatis, interstitiis convexis, sat crebre punc-

tulatis, lateribus sub humeris cyaneis, apicem versus viridibus et cupreo tinctis; pygidio piceo, medio cyaneo, sat crebro punctato; pedibus piceis; pectore abdomineque cyaneis, viridi variegatis. ♀.
Long. 7 lin.

This is a much broader and flatter species than the preceding. I have not seen the male. The mesial line on the thorax is smooth.

Pygora versicolor.

Viridi-prasina, nitidissima; thorace antice parum angustato, lateribus punctatis; elytris sexies striatis, striis punctatis; pygidio punctulato.
Long. $4\frac{1}{4}$ lin.

This species varies in colour. Sometimes it is entirely green or dark olive; the elytra are generally darker at the base, sometimes green with the base purple-blue or violet, with a pale yellowish-lilac ovate spot a little way from the base; sometimes the whole elytra dark blue. The clypeus is closely and rather finely punctured, the forehead more strongly and less closely punctured. Thorax very convex, not much narrowed in front of the middle, subparallel behind, not angular at the sides, gently arcuate at the base, not emarginate before the scutellum, smooth on the disk, rather thickly punctured towards the sides. Scutellum smooth. Elytra each with six strongly impressed punctured lines, the fifth and sixth closer together, not impressed posteriorly, the suture and the second interstice raised; there are generally some large punctures around the shoulders and on the first interstice; the deflexed margins are rather thickly punctured, the apex generally nearly smooth. Pygidium evenly convex, obscurely and not very thickly punctured. Mesosternal process almost none. Tibiæ and tarsi pitchy.

Pygora hirsuta.

Longe pubescens, versicolor; thorace crebre sat fortiter punctato; elytris fortiter octostriatis, interstitiis secundo quartoque sat convexis, lateribus parce punctatis; pedibus obscure piceis.
Long. 4 lin.

Head thickly and strongly punctured, pubescent, green on the vertex, the clypeus pitchy. Thorax obliquely narrowed in front of the middle, subparallel behind, scarcely emarginate before the scutellum, rather strongly and thickly punctured (especially in the female), green, with a large triangular patch on each side of the disk of olive, pitchy, or lilac colour, the sutural line often coppery. Scutellum smooth, green or coppery. Elytra green, with the space between the first and fourth striæ pitchy yellow, pale greenish yellow, or tinted with lilac. Body below green, the abdomen frequently blue. Pygidium evenly convex, not very thickly punctured. Sternal process almost none. The anterior tibiæ have three sharp teeth in the female, and two, with an indication of a third, in the male.

Pantolia rufobasalis.

Nigra, nitida, lævis; elytris basi rufa vel rufo-flava, regione scutellari nigra. ♂ ♀.
Long. 5½–7 lin.

Almost identical in form and colour with *P. scapha*, but is at once distinguished by the absence of the lines of strong punctures on the elytra, which are only represented by a few punctures in a slight transverse impression a little behind the middle. The clypeus is delicately punctured in the middle; and the lateral longitudinal impressions are not strigose as in *scapha*. The apex of the elytra is almost destitute of punctures; the pygidium is finely and densely strigose. The tibiæ and tarsi are sometimes pitchy.

Variety.—Thorax and elytra brownish red, with the discoidal impressions of the elytra and the scutellar region black. Pygidium pale brownish red.

Pantolia polita, Waterh.

I described this species from a single example. We have now received several specimens of both sexes. Some of the examples measure as much as 8½ lines in length. Among them were two or three examples which, instead of being entirely black above, have the sides of the thorax broadly margined with pitchy red; the margins of the elytra and a fascia across the middle (slightly interrupted at the suture) are also bright pitchy red. The tibiæ are pitchy. Some of the smaller specimens have the lines of punctures on the elytra more extended, especially towards the shoulders and along the suture towards the apex; these specimens have the clypeus more punctured, and the thorax is sparingly and excessively finely punctured instead of being smooth: three of these smaller examples have the sides of the thorax and the entire elytra obscure pitchy.

Coptomia elegans.

Viridis, nitidissima; elytris flavis, striis octo impressis, linea submarginali, sutura ad apicem guttisque duabus post medium viridibus; pygidio parce punctato. ♀.
Long. 6½ lin.

Very close to *C. 4-maculata*, W., but much smaller, the thorax with a few punctures scattered over the surface, the elytra distinctly striated, the green spots differently placed, the pygidium sparingly punctured in the same way, but without any transverse ridge at the base, the sternal process short and blunt. Clypeus finely punctured, very slightly emarginate at the apex. Scutellum and elytra smooth, the latter each with four well-marked impressed lines, which do not, however, reach the apex; there is a lateral green line extending from the shoulder to the apical callosity, an oblong green spot behind the middle between the third and fourth striæ, and the apex of the suture is also green; the apical callosity is obtuse and is at the extreme apex.

Fianarantsoa. Collected by Mr. G. A. Shaw.

Coptomia fulgida.

Viridis, nitens, aureo tinctus; fronte, thorace elytrorumque plaga laterali subapicali rufo-cupreis; thorace crebre punctato. ♂ ♀.
Long. 6–8 lin.

Clypeus very delicately punctured; the forehead with stronger punctures. Thorax bright coppery red, with the extreme margins sometimes green, rather closely and strongly punctured and slightly hairy. Scutellum green or coppery, smooth. Elytra green or deep blue, with the lateral half towards the sides more or less coppery; each elytron with two slightly raised costæ, the outer one shorter. The pygidium generally coppery in the middle, with strong punctures freely scattered over the surface.

The male has three distinct teeth on the outer side of the anterior tibiæ; the tarsi rather long.

The female has three approximate strong teeth on the anterior tibiæ; the posterior tarsi much shorter than in the male.

Coptomia lucida.

Viridi-olivacea, nitida, depressa; thorace subtilissime punctulato; elytris disco sæpe cæruleo micante, singulis costis duabus parum elevatis; pygidio parce punctato; tibiis tarsisque piceis. ♂.
Long. 8 lin.

Bright pale olive-green, more or less suffused with blue on the elytra. Rather depressed. Clypeus very finely and rather closely punctured. Thorax not very thickly but evenly and extremely delicately punctured. Scutellum smooth. Elytra each with six impressed lines, which are generally very obscurely punctured; the second and fourth interstices slightly costiform; the subapical callosity rather acute, close to the extreme margin, the apex smooth. Pygidium with a few punctures scattered over the surface. The anterior tibiæ almost simple, with scarcely any indication of teeth. Tarsi very long and slender.

This species belongs to the same group as *C. 4-maculata*, W.,—depressed, with the pygidium sparingly punctured.

Coptomia modesta.

Olivacea, nitida; thorace discrete fortiter punctato; elytris bicostulatis; pedibus piceis.
Long. 6–6½ lin.

This species is close to the preceding, but is of a much darker colour, and is smaller. The thorax has rather strong punctures scattered over the surface, especially on the sides. The elytra have each five impressed lines; the second and fourth interstices are slightly raised; the subapical callosity is more obtuse than in the preceding species. The pygidium has some transverse punctures scattered over the surface, rather obscure in the male. The anterior tibiæ have two distinct teeth at the apex in the male; in the female there are three teeth. Tarsi long and slender.

One of the specimens has the disk of the elytra suffused with blue.

Coptomia marginata.

Viridi-prasina vel cyanea, nitida; thorace lateribus sat crebre fortiter punctato; elytris singulis striis sex fortiter impressis et crebre punctatis, interstitiis sat elevatis lævibus, margine laterali plus minusve cupreo; pygidio parce punctato. ♂ ♀.
Long. 6–8 lin.

Oblong, moderately convex, usually bright grass-green, but sometimes blue, with the sides of the elytra generally coppery, but in the blue varieties green or lilac; the legs pitchy. The clypeus finely punctured, not very deeply emarginate. Thorax not much narrowed in front, moderately thickly and strongly punctured, smooth in the middle, with some fine hairs here and there. Elytra with the margin near the apex and the apex sparingly strigose-punctate; the subapical callosity not prominent, not very close to the apex. Pygidium convex, generally with a few punctures. Sternal process transversely ovate. Anterior tibiæ tridentate, the upper tooth in the male not very prominent. The abdominal impression in the male very wide.

Coptomia lævis.

Læte viridi-prasina, omnino lævis; tibiis tarsisque obscure rufis, illis æneo tinctis. ♂.
Long. $11\frac{1}{2}$ lin.

The largest species of this group at present known to me. Uniform shining grass-green, without any punctuation above or on the pygidium, except a few punctures between the eyes. The sides of the metasternum are sparingly punctured. The propygidium is strigose.

The only species which this resembles is *Coptomia mutabilis*, W. (Ann. & Mag. Nat. Hist. 1878, ii. p. 139), from which it differs in being of a more elegant and elongate form, in the longer legs and tarsi, in the absence of the strigosity on the subapical callosity of the elytra, and in having no punctures on the pygidium. The sternal process is more slender.

Coptomia uniformis.

Castanea, viridi tincta, nitidissima; capite thoraceque olivaceis, cupreo tinctis; elytris pallide olivaceis; tibiis tarsisque rufo-piceis. ♂ ♀.
Long. 9–10 lin.

Very close to *C. mutabilis*, but less bright green, more castaneous below, of a narrower form, and with the sternal process much more porrect. Pale olive-green above, the head and thorax more generally showing a castaneous or coppery tinge. The head moderately thickly punctured between the eyes. Thorax smooth. Elytra with very obscurely punctured lightly impressed lines; the side of the apical callosity and the apex rather closely strigose. The pygidium with distinct punctures scattered over the surface.

Coptomia crucigera.

Nigra, nitida; thorace, elytris, pedibus pygidioque apice rufo-ochraceis; thorace vitta mediana lata et elytrorum sutura fasciaque nigris. ♂ ♀.

Most nearly allied to *C. nigriceps*, W., but quite distinct by its coloration from all known species. The black on the suture of the elytra is narrow, but dilates towards the base and surrounds the scutellum; the transverse mesial fascia is broad. The pygidium is very densely and extremely finely strigose. The anterior tibiæ are a little more slender than in the female, and the three teeth are less strong; the abdominal impression is very slight.

Coptomia crassa.

Castanea, crassa, sat nitida; capitis vertice, thorace maculis duabus magnis triangularibus, scutello utrinque, pectore abdomineque nigris; elytris punctatis, costis duabus parum elevatis. ♂ ♀.
Long. $9\frac{1}{2}$–$10\frac{1}{2}$ lin.

Very robust, especially the female. Castaneous, the elytra darker than the rest of the body. Thorax convex, regularly narrowed anteriorly, finely coriaceous, thickly punctured, rather more strongly in the female than in the male, with two small olive-black spots at the anterior margin (close together), and two large triangular patches behind, united at the posterior margin. Scutellum coriaceous and finely punctured, black, with a mesial brown line. Elytra each with two slightly raised lines, the suture blackish. Pygidium transversely densely strigose, more strongly and closely so in the female than in the male. Anterior tibiæ tridentate.

The male has the elytra with five or six lines of rather strong punctures, the lateral margins and the apex densely rugulose.

The female has the elytra more or less strongly punctured all over, except the two costæ; the sides and apex rugulose as in the male.

Antananarivo and Fianarantsoa.

Valgus albolineatus.

Niger, supra depressus, longitudinaliter aciculatus; thoracis angulis posticis, singulorum elytrorum striga obliqua, corporeque subtus albo-squamosis; pygidio piceo.
Long. $2\frac{1}{4}$ lin.

Thorax elongate, gently narrowed in front of the middle, behind the middle moderately narrowed and gently sinuate, with a fine mesial carina above; the surface covered with large, closely placed, ovate punctures, which have a tendency to form lines; on each side at the margin there is a large deep fovea; and the base is impressed on each side; the margins anteriorly are finely crenulate. Elytra a little longer than broad, rather concave on the back, the sides somewhat raised before the deflexed portion; the surface densely longitudinally scratched; each elytron has an oblique dirty white stripe about the middle. The propygidium and the whole of the underside of the body are clothed with white scales; the fourth abdominal segment has above, on each margin, a small acute tooth. The pygidium is pitchy, shining, densely punctured, impressed in the middle at the apex.

IX.—*On some Spheroidal Lithistid Spongida from the Upper Silurian Formation of New Brunswick.* By Prof. P. Martin Duncan, F.R.S.

[Plate IX.]

In 1875 Mr. G. J. Hinde, F.G.S., sent a number of fossils to the Geological Society with a short paper, which was published in abstract*. He described them as coming from the calcareous shale of Lower Helderberg or Upper Silurian age in New Brunswick, and felt disposed to classify them with the Tabulata; but he had not, at the time, the opportunity of amply examining them.

The spheroidal shape of the fossils and their evidently former free existence attracted my attention a few weeks since, as I was investigating the similarly shaped organic remains from the Himalayas, which have been classified under the order Syringosphæridæ amongst the Rhizopoda. Mr. Hinde very kindly allowed me to investigate the structure of the fossils he had sent; and this communication is the result of their examination.

The four specimens of the spheroidal fossils which have come under examination are oblate, symmetrical, rounded at the top and bottom, and slightly produced at the equatorial bulge. The heights are $\frac{7}{10}$, $\frac{6}{10}$, $\frac{5}{10}$ inch, and the breadths respectively $1\frac{3}{20}$ inch, 1 inch, and $\frac{9}{10}$ inch. It would appear that the growth was more in height than in breadth. The fourth specimen had been polished on its poles and equator in more than one place, and therefore could not be measured correctly.

The outside of the fossils is, where the organism has been preserved, minutely granular to the eye, and is covered with minute depressions between the granules. A low magnifying-power shows that the granules are separate, rounded, minutely irregular on their surface, about as high as broad, and that the three or four which are round each depression are imperfectly connected by low and narrow processes. The granules, however, are often broad and irregular, and form much of the sides of the depression; their general equality in size and the vast number of the pore-like spaces included by them are evident enough.

In some places on the surface, where the weathering has been greater, or where rubbing has removed more or less of it, and especially at the edges of the abrasion, the bottom of the

* "Description of a new Genus of Tabulate Coral. By G. J. Hinde, Esq., F.G.S." Abstracts of the Proc. Geol. Soc., No. 305.

pore-like depressions may be seen as spaces filled with dark homogeneous calcite. They are very minute, of different sizes, and oval, square, or more or less triangular in outline. There are no points projecting into them; and neither septa nor spiculate septa-like processes exist.

Where abrasion has been carried on so as to destroy the granules and partly to level the intermediate narrow processes, the structures become very comprehensible. A reticulate appearance is presented, the white calcareous meshes of the skeleton surrounding dark polygonal or oval spaces. The breadth of each space or reticulation is from $\frac{1}{150}$ to $\frac{1}{200}$ inch; and the sides are formed by narrow irregular cylinders, whilst the angles are swollen and faintly nodular. These nodular parts are the bases of the external granules. No septa or projections resembling those of the Perforata exist.

Slightly deeper abrasion and polishing exhibit indications of the junction of the irregular cylindrical sides of the meshes, sometimes at the nodules or angles, or in the midst of the cylinder, one part being received into the other. The swellings at the angles are less, but are still prominent features; and two conditions of the environed area are to be noticed: in one, and the most usual, the space is filled with clear dark calcite, and no structures are seen in it; in the other a white or opalescent film intrudes from the sides nearly to the centre, leaving there a small circular space of dark calcite. This second condition resembles an imperfect tabula belonging to an endotheca, such as is present in *Chœtetes*. In many spaces there is perfect occlusion; but the texture of the substance thus simulating a perfect tabula, is not that of the calcareous mesh, it is that of infilling foreign matter. This is proved to be the case in radial sections.

The areas differ much in size; but none are very large, nor are any surrounded by sets of smaller ones in regular series. Their measurements correspond nearly with those given on the surface.

At this stage of the inquiry, if a good illumination is employed, with a magnifying-power of about 30 diameters, the latticework of the calcareous skeleton of the fossil, seen on a deepish abrasion, is found to consist of separate elements conjoined, each being resolvable into two prongs and a stem of the same thickness and length; and at their junction a nodular process or another stem exists. A triradiate or quadriradiate spicule with straight or bent limbs irregularly papillary here and there on the edge, is the element; and at the extremities of the limbs there are swellings not unlike frills, some being rather convex there and others concave; and the convexity of one is embraced by the concavity of a neighbouring spicule.

Radial sections were made of some of the specimens, and were examined by reflected, transmitted, and polarized light. The dark-spot method of illumination was particularly successful. The powers employed were from 30 to 450 diameters; and the investigation was assisted by the action of dilute hydrochloric acid as a solvent.

The original hard parts are white and nearly opaque, and when cut across and polished are almost homogeneous, only minute granulation being visible under high powers. They consist of carbonate of lime, and are white by reflected light, and either colourless or light brown or grey by transmitted light, the central dark-spot illumination producing an exquisite surface-opalescence. Polarized light produces but slight colour; but it indicates a vast number of minute refractive points: crystals of calcite are not seen, however; and there are no cleavage-planes in the hard original parts. The fossils are infiltrated with clear transparent or rather dusky calcite with very few cleavage-planes, and in some places giving indications, under polarized light, of a more or less acicular or fibrous structure, like aragonite. Rhombs of calc spar exist here and there; and the intensity of the colours elsewhere, under the crossed Nicols, varies much. Near the periphery of the fossils, what may be termed orbicular calcite covers the skeleton and intrudes in undulating contours on the homogeneous calcite; and this margin acts differently on light to the mineral on either side of it. In a few places the margin looks almost membranous, if such a term is admissible, whilst within it and near the skeletal elements the structure is sometimes acicular and close, or it presents the usual appearance of infiltrated calcite. It is the projection of this orbicular layer, with or without drusy cavities, which gives the appearance of a semiclosure of the canals here and there.

On the whole, this remarkable layer is in the position of the mass of dermal spicules in some recent Lithistids; but no trace of any can be seen.

Radial sections through the centre of the fossils show that there is a small space in the centre which is occupied by an irregular reticulation of not universally continuous skeletal elements. The meshes are wide, and are either without any definite shape, or are quadrangular or pentagonal in outline. In one section there are separate spicules in the centre.

From the edges of this central space a great number of radiating, more or less straight canals pass to the periphery, each being pervious throughout and without tabulæ. Each is in relation with those on all sides of it by means of regular three-, four-, or six-sided spaces in its walls. The canals are subequal; but here and there some are larger than the others. They arise from the central space, bifurcate occasionally, thus increasing in number, and end at the surface in the areas between the nodules and reticulation seen there. The largest canals measure $\frac{1}{75}$ inch in diameter, and the smallest about $\frac{1}{100}$ of an inch. Their length varies with the size of the specimen; for they constitute the larger part of the fossil.

They are more or less hexagonal or quadrangular in section, and are filled with the minerals already noticed. They were patent throughout before fossilization took place, and neither cross pieces, tabulæ, nor septa encroached on them; but it should be noticed that under a hand-lens tabulate structures appear very evident here and there; but they are resolved into parts of overhanging canal-walls under the compound microscope and careful focusing.

The canal-walls and their reticulation, as well as that on the outside, which is the expression of the outermost skeletal element of the canals, and the reticulation of the central part, are composed of similar structures, which are closely united in the first, and less so or separate in the last place.

The union of the spicules (for such are the skeletal elements) is often so intimate that the canal-walls appear to be continuous. But in thin sections, and in certain places in others, the skeleton resolves itself into numerous combinations of spicules closely resembling those of the Tetraclade Lithistidæ in shape and method of junction.

These canal-wall spicules resemble those which are free or nearly so in the central space. In no instance, however, has a central canal, or a canal in the three or four arms of a spicule, been observed.

Typical spicules, from the central space, consist of three arms in one plane uniting at a common point, from which another arm may spring and be in a plane at right angles, more or less, to the others. These tripod-stemmed spicules are often ragged or papillate on one or more surfaces, appear solid under the microscope, and are often compressed. They differ in size, and are usually the largest in the outer parts of the central space, where the canal-system is commencing. The simplest form of spicules has two straight or slightly curved arms, which are widely apart, forming an angle of 35° to 45° where they meet and join a smaller and shorter third, which lies in a different plane. The larger arms are flattish; and their opposed surfaces (sometimes the others) are nodular or marked with irregular swellings, but the rest plain. Their tips are slightly expanded and faintly frilled. The smaller arm is nearly cylindrical, but more or less conical.

Under transmitted light these spicules appear nearly homogeneous; but polarized light enables minute granules, crystals, and very rarely cleavage-planes to be seen; nevertheless the refraction of the mineral is insufficient to produce much colour on crossing the Nicols.

The breadth of the arms is from $\frac{1}{500}$ to $\frac{1}{350}$ of an inch; and the length is from $\frac{1}{75}$ to rather more than $\frac{1}{100}$ inch. Some of these spicules, whilst retaining their general typical form, differ much in external aspect. They may have two arms slightly bent, expanded at the end, and rough (not on the sides forming the angle), and the third visible arm may be stunted; or the arms may be equal and straight, with a fourth like a well-developed knob or a long shaft.

Spicules from the canal-system are invariably joined with their neighbours to form a latticework. They consist of normal trifid forms, of trifid forms with short and large third limbs, of four-limbed forms, the extra limb resembling the others or longer or shorter. In some the fourth limb is situated at the junction of the other three, and, being in a plane at right angles to them, produces a general swelling at the junction, so as to interfere with the angle of the union of the limbs, it being occasionally replaced by a concavity or even a slight swelling. The limbs are usually plain on one side and roundedly dentate, or irregularly rounded and slightly spinose. The junction of the spicules with their neighbours may take place through the ends of the limbs uniting in a kind of suture, or by a joining which leaves no indication of its exact position. The skeleton thus formed is very irregular at the outer part of the central space, and then, as the canal-system commences, becomes very regular. The symmetrical arrangement of the spicules of the sides of the canals is very exact; and one canal is separated from its neighbours by common latticed walls. The diameter of the canal-space is greater than that of any of the openings in its walls; and the one is produced by four or five spiculate series extending around a space; and the others are the spaces left between the arms of neighbouring spicules.

The junction of the spicules is usually by the ends of the limbs; and the exceptions are rare; but in the centre of the body of the fossil instances are to be seen where the end of the limb of one spicule is attached to the middle of the cylindrical limb of another. The method of normal junction of different spicules is by the clasping and surrounding of a smaller limb by a frilled or irregular cup-shaped expansion of a slightly larger; and the line of suture is visible. It often happens that the spicules do not quite touch, and the expanded limb-end of one and the corresponding smaller termination of the other and opposite limbs are separated by a microscopic interval. Sometimes one limb, frilled or digitate or simply rounded, projects, without that of any other spicule being near; and deformed specimens of these solitary parts are not unusual. Here and there the junction, as has been noticed already, is by direct fusion; and this occurs in the broad flat spicules of the canals more than elsewhere.

As the canals are close, and radiate to the periphery, increasing in number by bifurcation not far from the limits of the central space, each one must be surrounded by several others. Four, five, or six canals may environ the canal under observation; and a tangential section closely reproduces the appearance seen in abraded specimens when looking down on the reticulate ends of the canal-skeleton from the outside. Each canal is therefore polygonal in section (tangential). There is no duplication of the wall of a canal; and this structure is merely the space left by the interlacement of numerous sets of spicules in longitudinal series.

The symmetry of the parts of these spheroidal fossils is great; and there is a very constant resemblance, in every part and in different individuals, of the skeletal elements and their disposition.

No separate spicules differing from those already noticed are present; and the tubulation of the spicules is not seen.

A superficial examination of the specimens would lead to the belief of their being Perforata or Tabulata, amongst the Actinozoa and Hydrozoa; but the areolation and structure of the skeleton is not that of the one, nor are there tabulæ or the peculiar hard parts of the other group.

The shape of the skeletal element in the mass is not unlike that of some of the flat *Manons* or *Jereas* of the Cretaceous formation. The arms of the spicules do not bifurcate, however. In the general arrangement of the spicules in the canal-systems there is some resemblance to that in *Turonia*, and there is only a slight one to that of *Aulocopium*, Oswald, which is the only hitherto described Palæozoic organism which resembles the Tetraclade Lithistids. In this form, which is free, hemispherical, and even sometimes spherical, there is a central cavity.

The resemblance is not sufficiently great between the new form and *Aulocopium* to place them together in the same classification; nevertheless there can be no doubt that both have the general and some of the special characters of those Lithistid Spongida which belong to the Tetracladina.

But the fossilization of the skeletal parts of the new form is not that which is characteristic of mechanical infilling after outgoing of a former mineral—such, for instance, as is seen in calcareous replacement of siliceous spicules. The calcareous mineral of the skeleton is not in distinct crystals, and cleavage-planes are rare; on the contrary, the mineralization resembles that of fossils which were originally of carbonate of lime.

There is a point of some interest which offers some evidence that the original skeleton was not siliceous. In the midst of the long canals, in their interspaces, and passing over the skeletal parts in close proximity are many relics of a large form of *Palæachlya penetrans*, Dunc.; and in sections the passage of the tubes of the parasite through and along the inside of the spicules can be seen. Usually the tube is crammed with the spherical spores; and they frequently extend beyond it and collect in masses. In one instance they crowd a spicule. The tubes and spores are, as in the specimens described in a former number of the 'Quarterly Journal of the Geological Society,' carbonized.

It does not appear to me to be likely that these parasitical plants penetrated after the calcareous fossilization of the interstices was completed; they must be regarded as having grown at the expense of the organic matter of the spicules during the lifetime of the organism. Moreover it must be conceded, from the knowledge we have of the physiology of the *Achlya* group, that it is not probable that they could penetrate and live in silica.

These little spheroidal fossils are, then, of considerable interest; and the more they are critically and carefully examined with all the appliances of the microscope, the more do they resemble the Spongida. Their texture is not that of the perforate coral; and they have no accurate and minute resemblance to the Tabulata; but they are most suggestive from their transitional appearance.

If all the modern Lithistids were siliceous, there must have been a former mimetic and calcareous group of Spongida. Or, as the Lithistids appear to have been rare in the earlier fossiliferous rocks, and *Aulocopium* of the Silurian is the first known, it is possible that a group of Calcareo-Spongida lived contemporaneously and became extinct or merged into a higher form as the parent of Zoantharia Perforata. I have named the fossils, after their discoverer and their shape, *Hindia sphæroidalis.*

Genus Hindia.

The body is free, without an involution of the texture, and consists of a small central space occupied by spicules which soon form a series of bifurcating, long, straight, radiating canals, which open at the surface. The spicule element is calcareous, more or less in the shape of a stemmed tripod, with four limbs, and swollen or fringed at the ends, where junction takes place in the others.

The skeleton is remarkable for its regularity.

Hindia sphæroidalis, mihi.

The sponge-body is spheroidal. On the surface are papilliform eminences corresponding with the ends of canal-spicules. Centrally the spicules are unattached, are tripod-stemmed in shape, with swollen extremities, and have papillose limbs. Canal-system occupying much space; canals straight, narrow, radiating, opening into their neighbours, and formed by combinations of tetraclade spicules resembling those of the central part, and very regular in shape and size.

Locality. Lower Helderberg calcareous shale, New Brunswick.

EXPLANATION OF PLATE IX.

Fig. 1. The figures thus marked are those of separate spicules, showing their three- or four-limbed nature, occasionally expanded ends, and the frequent irregular outline of one or more sides. 1. Solitary spicule from the central space. 1 *a.* A group of united spicules and others whose limbs are not quite in contact, from the outer part of the central space.

Fig. 2. Junction of limb-ends of different spicules (normal). 2 *b.* Junction of limb-end and side. 2 *c.* Expanded ends of limb. 2 *d.* Junction of spicules in part of the canal-system: the frills are shown in two instances in a side view and in one from above. 2 *e.* Junction of the limb-end of a spicule and the side of another.

Fig. 3. The ragged semidenticulate appearance of one of the edges of a spicule-limb. 3 *a.* From the outer part of the central space tangential to some commencing canal-systems: showing the irregular surface of the spicules, and the aborted junction ends.

Fig. 4. The broad spiculate formation of the floor of a canal-system, and a part of a side with included spaces leading to neighbouring canals: this is a longitudinal or radial view. 4 *a.* Tangential section of some canal-systems, not near the surface: they are small systems; and the dark limbs were united in the perfect fossil with other elements. 4 *b.* The reticulation around the canal-openings just beneath an abraded surface. 4 *c.* The nodules on the surface surrounding the openings of the canals or pores, each nodule being a *fourth limb* to a spiculate element.

Fig. 5. Part of a radial section, magnified.

Fig. 6. The body of the fossil, natural size.

Fig. 7. *Palæachlya penetrans*, Dunc., within the skeleton, magnified.

BIBLIOGRAPHICAL NOTICES.

The Great Atlas Moth of Asia (Attacus atlas, *Linn.*), *with a coloured Plate of its Transformations.* By Philip Henry Gosse, F.R.S. 8vo. London: West, Newman, & Co. 1879.

In this little book that veteran naturalist Mr. Gosse gives a short account of his experience in rearing the larvæ of the great talc-spotted Atlas moth of South-eastern Asia. The species is one of those silk producing Bombyces to which attention has been of late years directed in consequence of the fatal diseases which have attacked the common silkworm; and, according to Mr. Frederick Moore, it is from its cocoons that the Tusseh silk of China is obtained. In this country, at any rate, the cultivation of *Attacus atlas* would seem to be attended with considerable difficulties; for out of eighty larvæ Mr. Gosse only succeeded in bringing one to what would appear to be the mature stage (after five moults); but even this did not spin up. The author gives a detailed description of the larvæ in their various stages up to the sixth, as just mentioned, when they are large handsome caterpillars of a general delicate pale green tint, and adorned along the back with numerous spiniform processes; and he completes his account of the transformations by describing the cocoon and pupa from a specimen imported in that state. Coloured figures are given of the eggs and larvæ (the latter in their first, fourth, and sixth stages), and of the pupa and cocoon. The remarks on the natural history of the insect, and the details of its author's proceedings in his attempt to rear the larvæ, contained in this little work will prove both interesting and useful to all who devote their attention to this branch of entomology.

Supplement to the Second Edition of 'Acadian Geology,' &c. By J. W. Dawson, M.A., LL.D., F.R.S., &c. 8vo, 102 pp. Macmillan and Co., London &c., 1878.

This Supplement, containing additional facts as to the geological structure, fossil remains, and mineral resources of Nova Scotia, New Brunswick, and Prince-Edward Island, constitutes an appendix of new matter for the Third Edition of the 'Acadian Geology,' the Second Edition of which we noticed as a most satisfactory and useful work in 1868.

Principal Dawson, of M'Gill University, Montreal, collecting together all the important facts illustrative of the geological structure of the Dominion, long ago worked out not only a local natural history, but a cosmopolitan view of his great subject, and elucidated it with knowledge obtained from every source available to geologist, mineralogist, and naturalist.

Still collecting and comparing facts and opinions, the author has much to add about the strata, fossils, and mineral productions, very little to retract as to hypothetical views in matters of dispute, and much to enforce in corroboration of his views of modified uniformitarianism, glacialization of a mixed character, the origin and nature of the coal-growths, the existence of a *Devonian* flora, and the occurrence of fossils in the Lower Palæozoic rocks. His comparison of the old rocks of the Canadian regions with those of other parts of the world, in the Table at p. 92, is very interesting and suggestive. From the Ludlow beds downwards to the older gneisses of Scotland and Scandinavia, including the lately recognized Pebidian and Dimetian series, Dr. Dawson finds probable equivalents, of definite characters and position, in Canada and its vicinity.

The new edition of his work, with its well-considered additions, will prove to be valuable to the increasing population of British America, in the presence of the enlightenment of modern education, and the necessity of understanding the nature and whereabouts of the mineral productions of the rocks and the capabilities of the soil.

The Gault, being the Substance of a Lecture delivered in the Woodwardian Museum, Cambridge, 1878, *and before the Geologists' Association,* 1879. By F. G. Hilton Price, F.G.S. 8vo, 81 pp. Taylor and Francis, London, 1879.

In this very useful history of the Cretaceous division of strata known as "the Gault," the author gives a special description of the Gault at Folkstone, bed by bed (pp. 10–23); a more general account of this formation as seen at the exposures along its outcrop in the various counties from Kent to Devonshire and Yorkshire (pp. 24–34); and a sketch of the Gault in France (pp. 34–42). The Greensand of Blackdown, the "Red Chalk" of Norfolk and Yorkshire, the various phosphatic and other nodular beds, and the results of the deep borings penetrating the Gault near London are specially noticed. An extensive and synoptical catalogue of the fossils (pp. 44–81) shows their occurrence at different localities and their range through the several zones of the Gault.

Besides thus indicating the geographical range of this important formation in England and France, and correlating the equivalents of the eleven zones which he recognizes in the Gault of Copt Point, Folkestone, the author has in view a hydrographical sketch of the area in which this important Cretaceous formation was deposited (pp. 8, 9). He notes that its composition varies much in different localities, according to the depth of water and the nature of the adjacent lands at the time of the deposition of its component parts; also that the fauna varied in the several regions according to the nature and conditions of change in the water and sea-bed. Further, he observes that the clays and sands of the Gault originated in the trituration of lands and cliffs composed, for the most part, of Jurassic and Neocomian rocks in what is now England, on the west side of the Anglo-Parisian Cretaceous basin, of Primary (Palæozoic) rocks in the north-east of the basin at the Ardennes, and of granites, porphyries, Jurassic, and Neocomian rocks on the east and south-west sides of the basin.

A careful list of books and memoirs treating of the Gault and its fossils is given at pp. 1–7.

MISCELLANEOUS.

On the Body-cavity of the Sedentary Annelids and their Segmental Organs; with some Remarks on the Genus Phascolosoma. By M. Cosmovici.

The general body-cavity of the sedentary Annelids is divided into several compartments by diaphragms, which sometimes exist only in a portion of the cephalothoracic region (*Arenicolæ, Terebellæ, Clymeniæ*), sometimes throughout the length of the body (Serpulidæ); and then each segment has a cavity more or less independent of its neighbours. There are also divisions in the opposite direction. In sections there are seen a central cavity filled by the digestive tube, and two lateral ones separated from the former by muscular bands in the form of oblique diaphragms. A communication exists between all the cavities through the interstices of the fibres of the partitions. The lateral cavities contain the feet with their retractor muscles and the segmental organs: these are the *pedal cavities.*

In *Chætopterus pergamentaceus* the arrangement of the cavities in the three vesicular segments is interesting. The median cavity, containing the digestive tube and the genital glands, does not communicate with the lateral cavities, which are occupied by the reno-segmental organs, except by the segmental pavilion which opens in the wall of separation.

In the *Clymeniæ* the *corpora Bojani* are very long; and at their anterior extremity the segmental organs are attached. After the eleventh segment there are no longer any renal bodies, and in their place there is a plexus of blood-vessels of remarkable abundance. The position of these networks is such that we may say that they represent *so many* corpora Bojani *formed solely by their vascular framework.*

The ovum of these animals is remarkable for the separation into two parts of the vitelline mass; one of these, the larger one, is formed of large granules, the other of very small ones. In the latter is situated the germinal vesicle and the spot, which becomes strongly coloured by picrocarminate.

Pectinaria belgica exhibits first a pair of very large *corpora Bojani*, and then two pairs furnished with segmental organs. The genital gland is on the median line, on each side of the supranervous vessel. The animal is as transparent as glass; and notwithstanding this the segmental organs cannot be perceived. It is curious that in less transparent animals these organs have nevertheless been observed by translucence and figured.

With regard to the segmental organs in the Errant Annelides, we find a pair of them in each segment, with a contorted tube having an internal pavilion and an opening outwards. In the Serpulidæ (a family very rich in genera), among the sedentary forms, the same thing is met with. Lastly, in all the other Sedentaria we find the segmental organs sometimes free, sometimes annexed to the *corpora*

Bojani, and in the majority of cases we may say that the segmental organs are independent of those bodies.

Hitherto we have been acquainted with three species of *hermaphrodite Spirorbes*; a fourth must be added, namely *Spirorbis communis*, which abounds at Roscoff.

In the group Gephyrea, in *Phascolosoma vulgare*, we find, on the anterior part of the two long blackish sacs, a tube furnished with a pavilion with two broad ciliated lips. The structure of the sacs shows them to be renal bodies, to which the segmental organs are annexed. The genital gland, male or female, is situate at the base of the posterior pair of the retractor muscles of the proboscis. The racemose gland is attached to an elastic thread, which is probably a blood-vessel. The ovum is remarkable for the presence of cilia at the surface of the vitelline membrane, which, when observed in front, appears finely striated.

In the subintestinal blood-vessel, in the midst of the elliptical blood-globules, we find encysted trematodes, which are carried along even into the papillæ of the proboscis, by the cilia with which this vessel is furnished. The above-mentioned papillæ appear to play a great part in respiration; in fact the whole circlet is in communication with the circulatory apparatus. The globules ascend along the walls and descend by the centre of the papilla. Processes of the walls in the interior of the papillary cavity cause the globules to remain a certain time in contact with the delicate wall of these organs, and thus facilitate an exchange of gases. This may explain why the animal, when quiet in a trough filled with sea-water, exserts its proboscis every moment.—*Comptes Rendus*, May 26, 1879, p. 1092.

Morphological Notes on the Limbs of the Amphiumidæ, as indicating a possible Synonymy of the supposed Genera. By John A. Ryder.

Little attention has apparently been given to the comparative history of the limbs of the known species of *Amphiuma*. Very young specimens do not seem to have been usually collected for museums. I have had the opportunity to study such a series, varying from 6 to 8 inches in length, and about $\frac{1}{4}$ inch, or a little more, in diameter; they were obtained in the vicinity of Biloxi, Mississippi, and are the property of the Smithsonian Institution at Washington.

From these it appears that the digital elements of the limbs are variable, or liable to variation, in the same individual; so that in some the number of digits (two) is characteristic of *Amphiuma*, and in others (three) they are characteristic of *Murænopsis*. This blending of the characters of the two genera may be illustrated as follows, indicating the number of digits on each limb by numerals arranged in fours, the first pair representing the digital formula of the fore limbs, thus:—(1) $\frac{2}{2}\,\frac{3}{3}$; (2) $\frac{2}{2}\,\frac{3}{2}$; (3) $\frac{3}{3}\,\frac{3}{3}$; and (4) $\frac{2}{2}\,\frac{2}{2}$; there was also a form which exhibited no outward indication of toes on the front pair of limbs, the digits being enclosed in a common investing integument; this fifth form may be represented in this manner, $\frac{\{2\ 3}{\{2\ 3}$. It is plain, from the foregoing, that at no very remote period the two forms which are now believed to characterize distinct genera were probably one and the same. The three-toed form (*Murænopsis*) is said to be confined to the Southern United States, whilst the two-toed form (*Amphiuma*) is more widely distributed, extending further north and also embracing the distribution of the former. The digital formula of (1) is *Amphiuma* in the front pair, and *Murænopsis* in the hind pair of limbs; that of (2) is *Amphiuma* on one side in the hinder pair, and *Murænopsis* on the other. Normal individuals of both genera also occur, as in (3) and (4); while (5) represents the beginning of the differentiation of a third generic type, if the number of digits be good and sufficient to characterize genera. Prof. Cope, who has probably handled more specimens of Amphibia than any other American naturalist, informs me that he thinks these variations very uncommon, as he has never in his experience met with any instance in which there was as much variation in the number of digits as exhibited in these Biloxi specimens. They can hardly, however, be regarded as monstrosities, as the percentage of varying specimens in this series is entirely too high. I am inclined to believe that they are simply instances on the one hand of reversion towards a still older and more unspecialized type, and on the other of a tendency to become specialized or reduced, as in the case where the two digits are covered by a common tegumental investment. If the distribution of species will in any case serve to throw light upon the differentiation of genera, I think that in this instance we may assume, with much show of reason, that the individuals most remote from the centre of maximum development of species and individuals exhibit the greatest tendency towards digital reduction. The most northern form, *Amphiuma*, seems to be constantly didactyle, whilst the more southern forms are both di- and tridactyle, which would seem to indicate that the forms most remote from the centre of distribution have been under conditions tending to produce didactylism synchronously with di- and tridactylism at the centre aforementioned. This, however, is only a hypothetical view of the case.

The admission of *Murænopsis* and *Amphiuma* to generic rank, on account of a difference which is here shown not to be constant, is doubtful. The digits, which, from the fact of their having undergone reduction, seem to be not so much rudiments as vestiges of former digits, render the legitimacy of the distinction even more open to question; for I think it cannot be doubted that such a tendency to degenerate, accompanied with a consequent tendency to produce synthetic characters, shows clearly that nature has not yet concluded that they shall be genera, notwithstanding the dicta and definitions of systematists.—*Proc. Acad. Nat. Sci. Philad.* Jan. 28, 1879.

On Haptophrya gigantea, *a new Opalinid from the Intestines of the Anurous Batrachia of Algeria.* By M. E. Maupas.

The intestines of the Batrachians harbour a whole world of parasites, which live in them and multiply with a truly surprising abundance. Micrographers especially may get from them the finest harvests of Infusoria and Bacterians. From this point of view I have often examined the contents of the intestine of *Bufo pantherinus*, *Discoglossus pictus*, and *Rana esculenta*, which live in the waters of the neighbourhood of Algiers. I have always found them richly populated, and have been able to recognize the following species—*Nyctotherus cordiformis*, *Balantidium elongatum*, *B. entozoon*, *Opalina dimidiata*, *O. intestinalis*, *O. obtrigona*, and *O. ranarum*. Swarming among these large ciliated Infusoria were myriads of Bodos, Monads, Amœbas, Bacilli, Vibrios, and Bacteria. All these species have already been recognized in Europe; but I have also very often met, in the intestine of the *Bufo* and the *Discoglossus*, less frequently in the frog, with a very fine species of Opalinid, which does not appear to me to have been described, and which, from several very curious details of its organization, must greatly interest protozoologists.

This Opalinid may be regarded as the giant of the Infusoria; for I have measured individuals the length of which exceeded 1 millimetre. The body is of a very elongate cylindro-conical form, tapering from the front backwards. The anterior extremity is pretty strongly depressed, and nearly twice the breadth of the posterior region, which measures from $\frac{80}{1000}$ to $\frac{90}{1000}$ millim. This depressed portion is occupied by a circular sucking-disk formed by the retreat inwards of the wall of one of the broader surfaces, which may be called the *ventral surface*. The action of the sucker is ensured by cords of sarcode which start from its inner wall and attach themselves to the opposite dorsal wall. The concavity caused by the traction of these cords is, of course, very slight, but it is nevertheless clearly visible by the microscope. The animalcule attaches itself to objects by means of this sucker. The surface of the body is very closely covered with rows of cilia. Four or five rows may be counted in $\frac{1}{100}$ millim.; and in the cavity of the sucker they are half as numerous again. The cilia, the length of which is $\frac{5}{1000}$ millim., are very close together, about 13 or 14 in each $\frac{1}{100}$ millim. These cilia are the sole organs of locomotion of this Infusorium, the progress of which is never very rapid.

The integument or ectosarc has a thickness of $\frac{45}{1000}$ millim. and consists of two very distinct layers—an external one, in which the continuation of the cilia may be traced in the form of bacilli, and an internal one composed of transparent and absolutely amorphous sarcode. This integument is entirely destitute of proper contractility, so that the animalcule cannot in any way spontaneously modify its form; on the other hand, its possesses great elasticity, which enables the body immediately to resume its normal contour when this has been modified by any obstacle. The endosarc consists of clear and liquid sarcode, at the periphery of which there exists a layer of large opaque granules.

The nucleus is free in the general cavity, and, following the movements of the body, can move from one extremity to the other. Its form is that of a very elongate and rather flat ellipsoidal shuttle. It may measure as much as $\frac{185}{1000}$ millim. Its substance consists of an opaque slightly yellowish gangue, in which we see numerous spherical corpuscles of nucleolar appearance. When, in consequence of the crushing of the body, a fresh nucleus is placed directly in the water, its substance contracts, and at the surface there appears a fine structureless membrane, as in the case of many Infusoria.

The body is traversed throughout its length by a long contractile canal attached to the dorsal face, the pulsations of which, from one systole to another, last a little more than a minute. This canal is not rectilinear, but describes numerous sinuosities irregularly disposed. Its diameter, in the state of diastole, is $\frac{18}{1000}$ millim. It is furnished with proper walls and thus constitutes a true vessel. In this character it differs from the contractile vacuoles of the other Infusoria, which are only temporary cavities hollowed out in the endosarc. The wall of the vessel, which is visible even in the living animals, becomes still more apparent with coagulant reagents. This vessel is moreover provided with orifices, which traverse the integument and open outwards in the form of very clearly visible pores in the midst of the rows of cilia. These pores place the vessel in communication with the external world, and serve for the issue of the interior liquid at the moment of systole, and very probably for the entrance of the exterior liquid during diastole. The pores, seven or eight in number in large individuals, are placed exactly in a straight line, at irregular distances on the course of the vessel. They are of an oval form, and measure $\frac{3}{1000}$ millim. in length.

This Infusory multiplies by dividing transversely into segments. The segmentation is at first indicated at the middle of the length of the body by a clear band in the endosarc. The nucleus divides into two; a constriction contracts the body at the point of segmentation; and the vessel becomes divided in two; the two segments remain soldered together. The same operation is then repeated at the middle of each of the segments, so that we see four segments soldered together; then a second time at the middle of each of these four segments, and the body is cut into eight segments still attached to one another, and completely recalling, by their external aspect and arrangement, the zoonites of the tapeworms. These segments afterwards separate; and one always finds many of them isolated in the rectum of the hosts of this Infusory.

This fine Infusory much resembles the Opalinid found by Von Siebold in *Planaria torva*, and figured by Max Schultze under the name of *Opalina polymorpha*. If we adopt the generic divisions established by Stein in the family Opalinidæ, it will have to take its place side by side with the last-mentioned species, in the genus *Haptophrya*; and on account of its large size I name it *H. gigantea*.—*Comptes Rendus*, May 5, 1879, p. 921.

Trichinosis in a Hippopotamus. By M. E. Heckel.

M. Heckel describes some observations made by him upon a young Hippopotamus, about two years old, which died on the 10th of May last in the zoological garden of Marseilles, having been received from Egypt about four months before. The animal was in bad health all the time of its residence at Marseilles; and its skin showed an eruption of confluent boils. When removed, the skin showed several lesions in the shape of deep ulcerations, which, having originated around a hair, had attacked the bulb, and thus formed a canal leading generally into a great purulent cavity. Smaller ulcerations led into smaller cavities bounded by a proper membrane, like true cysts, and filled with creamy pus. The examination of a section of the muscular tissue surrounding one of these cysts showed it to contain great numbers of *Trichina*-cysts, resembling those of *Trichina spiralis*, with which also the enclosed worm agreed. The cysts, however, seemed to be much more developed than in the pig or in man.

Upon this curious and interesting fact the author has the following remarks:—"I am ignorant," he says, "what relations may exist between the presence, in the same animal, of *Trichina* and of enormous cysts filled with pus; but the fact indicated by me appears to possess some interest . . . . because it seems to prove that the Pachyderms, more than other animals, are exposed to the spontaneous development of this terrible parasite—an important point which may serve to throw some light upon its hitherto unknown migrations. It has been attempted to explain the frequency of the *Trichina* in the pig, by the consideration of the voracity and filthy habits of that animal. The fact to which I now call attention seems to protest against this opinion; for the hippopotamus by no means shares in the mode of existence and the tastes of the pig; and we can hardly suppose that captivity, by the special diet which accompanies it, could have a marked influence upon the development of the Nematoid worm."—*Comptes Rendus*, June 2, 1879, p. 1139.

On the Apparatus of Sound in some South-American Fishes. By M. W. Sörensen.

During my residence, in 1877 and 1878, at the mouth of the Riacho del Oro, in the Rio Paraguay, I was enabled to make some investigations into the mode in which several fishes of these rivers, especially those of the families Siluroidei and Characini, produce peculiar sounds. The swimming-bladder is the principal organ employed. In the Siluroids the unossified portion of the swimming-bladder is slightly elastic, in a nearly equal manner throughout its whole extent; whilst in the Characini the elasticity depends especially upon flat bands or round cords in the wall. The swimming-bladder acquires its greatest development as an organ of sound in the Siluroids. In the species of the genera *Platystoma* and *Pseudaroides* it is divided by a longitudinal partition and by several transverse partitions into a number of chambers or cells, which, however, freely communicate with each other. In the genus *Doras* the swimming-bladder presents numerous diverticula, divided internally by incomplete septa into a great number of small cells. In all these fishes the transverse apophyses* of the two or three first vertebræ, and frequently a part of the arch of the first vertebra, are not only bound to each other, but also to the posterior part of the cranium and the apophyses of the first vertebra, by very strong elastic membranes. The transverse apophyses of the second or third vertebra, and sometimes of both these vertebræ, are shaped into the form of very powerful springs †, and closely united to the swimming-bladder. The sound is produced by the action of the muscles which are inserted either directly in the swimming-bladder or upon the transverse apophyses of the third vertebra. In the Characini the elastic parts of the swimming-bladder are stretched in the direction of their length by the contraction of the muscles; and the vibration that results from this rhythmic movement is transmitted to the air contained in the cavity of the swimming-bladder. In the Siluroids the anterior portion of the swimming-bladder is drawn alternately forward and backward by the contraction and relaxation of the muscles. During these movements the air, in passing across the incomplete transverse septa, sets the latter in vibration, and the sound is produced. The height or rather the depth of the sound is in direct proportion to the rapidity of the vibrations of the springs.

The fishes which I have been able to study in this connexion belong to the genera *Ageniosus*, *Doras*, *Platystoma*, *Pseudaroides*, *Prochilodus*, *Chalcinus*, *Pygocentrus*, and *Myletes*; several of them were observed living. None of these fishes respire by means of the swimming-bladder. A memoir containing the details of these observations will appear in the 'Naturhistorisk Tidsskrift' of Copenhagen.—*Comptes Rendus*, May 19, 1879, p. 1042.

* According to Weber ('De auri et auditu hominis et animalium,' p. 1, Lipsiæ, 1820) these apophyses, in the genus *Silurus* and in the species of the family Cyprinoidei, serve to put the ear in communication with the swimming-bladder. I cannot say whether there is an organ of sound in the latter family, not having yet examined them in this respect.

† According to John Müller ('Archiv für Anat. und Physiologie,' 1842, p. 319), this apparatus, in the genera *Auchenipterus*, *Synodontus*, *Doras*, *Malacopterurus*, and *Euanemus*, assists in locomotion by condensing or rarefying the air in the swimming-bladder. Upon this interpretation M. Moreau, in his excellent memoir on the swimming-bladder (Ann. Sci. Nat. 6e sér. iv. Art. no. 8), has already expressed certain doubts, the justice of which I am in a position to prove completely.

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X.—*On the Mode of Growth of* Stromatopora, *including the Commensalism of* Caunopora. By H. J. Carter, F.R.S. &c.

Struck with the practical nature of Mr. Champernowne's remarks on "some Devonian Stromatoporidæ from Dartington, near Totnes," published in the Quart. Journ. Geol. Soc. for February 1879, I lost no time in putting myself in communication with him on this subject, and having received, in reply, a kind invitation to visit the "Pit-Park Quarry" (whence his specimens had been taken), I availed myself of the opportunity on the 8th of May last.

During our inspection of the quarry, as well as during the short time I was with Mr. Champernowne, I learnt no less from the former than from the latter, whose cautious observations, combined with his opportunities of obtaining practical information, rendered his remarks very valuable in a scientific point of view.

On my return to this place (Budleigh-Salterton) I washed the specimens brought away from the Quarry, and dissected them by fracture, section, and polishing, as far as such means and such material would admit, whereby I learnt much more.

My general inference from our visit to the Quarry was that *Stromatopora* was essentially a "reef-building" organism, and that, like *Millepora alcicornis* in the West Indies, it grew profusely in its locality, not only entering and filling up the open interstices of other calcareous organisms during their growth, but enveloping their detritus (joints and stems of Encrinites, &c.), and, when not doing either of these things, growing into large masses of itself. Thus, by cementing every thing together after this manner, the great reef appears to have been formed which is now known by the name of "Devonian Limestone." This is not only evidenced by the composition of the *solidified* strata generally, when cut and polished, but more convincingly and particularly by a portion of it in "Pit-Park Quarry," which, having undergone partial decomposition, now yields up its contents even more separately than probably they have ever been since they were bound together by the ubiquitous *Stromatopora*.

In the first place, I could not help seeing how often *Stromatopora* had grown on *Favosites*; and on turning to the specimen which led me to the remarks on *Caunopora* in my paper on the probable nature of the animal of *Stromatopora* ('Annals,' 1878, vol. ii. pp. 311, 312), I felt constrained to fall back upon this coral; and I also saw that, although perfectly right as regards the difference between the "axial" and "tubulated" structure in *Millepora alcicornis* (ib. p. 316 &c.), this could not be applied to *Caunopora*.

Herein I was much influenced by Mr. Champernowne's showing me what Dr. Duncan had pointed out to him, viz. that the supposed genus "*Battersbya*" of MM. Edwards and Haime, who placed it among the Milleporidæ, consisted of a coral the interstices of which were filled up with a *Stromatopora*; so that, virtually, there was no such organism. We next examined specimens of *Syringopora*, in which the same thing was observed to have taken place. But why should I recount more instances of this nature when I have already stated that "Pit-Park Quarry" bore evidence of *every thing*, both living and dead, having been overrun by *Stromatopora* (including *Caunopora* under this head) during the formation of the "reef."

All this led me, on my return home, to again see what Baron Rosen had stated and illustrated of *Stromatopora Schmidtii*. I then found that *S. Schmidtii* could not be a species of *Caunopora*, as stated in my paper (*l. c.* p. 319); and, on referring to Rosen's account (p. 80), this was confirmed by his statement that Roemer was "right" in considering *Caunopora placenta*, Lonsdale, nothing but the tubes of a "coral" surrounded by *Stromatopora*.

To this view I am now inclined to accede, as to the presence of these tubes indicating that of an organism different from the matrix in which they are enveloped, after the manner of *Battersbya* &c., but not as regards an equally "coral" nature of the tubes, as will be seen hereafter; and, if this view be right, then, by eliminating *Caunopora* from the Stromatoporidæ, much will be gained by the latter in simplification. Still Rosen's general division of the structure of the *Stromatoporæ* into "curvilinear" and "rectilinear" cœnenchyma will remain the same; and the remark in my paper (*l. c.* p. 312), that in *Caunopora* I saw the same kind of *granulated* curvilinear fibre as in the coral called *Battersbya*, becomes intelligible.

That the tubes of *Caunopora* are adventitious or different from the curvilinear cœnenchyma of *Stromatopora*, which generally accompanies them, is proved by their occasional presence in another kind of Stromatoporoid cœnenchyma, *i. e.* in *Stromatopora elegans*, Rosen (vulg. "Stagshorn" hereabouts), of which I possess two specimens; while, in support of this, Mr. Champernowne states that the stromatoporoid cœnenchyma of *Caunopora* is "as variable as the *Stromatopora* itself is variable;" add to this that the different kinds of cœnenchyma constantly occur *without* the tubes peculiar to *Caunopora*.

Further, it happens that in a polished section of a specimen of *Caunopora* from "Pit-Park Quarry," which Mr. Champernowne gave me, the lower surface (which is in its natural state) is terminal; that is, the tubes do not pass through it, while at the bottom of the *polished part*, close to the angle it forms with the "natural surface," the tubes may be observed to turn out of their vertical course and become united to a horizontal tortuous tubulation simulating that of the *hydrorhiza* of hydroid zoophytes, which, under this aspect, appears to form the whole of the "natural surface;" and hence the ends of the tubes of the *Caunopora* do not project through this matted structure, as in most cases where the fractured part of the specimen has passed through the tubes themselves.

If this should be substantiated, then we can understand how the tubes of *Caunopora*, for the most part, should be without walls, *i. e.* appear as mere spaces, seeing that, while one kind of *Syringopora* was probably a calcareous hydroid, the tubes of *Caunopora* might, for the most part, have belonged to a chitinous or flexible kind, which in fossilization would only be represented as a mould made by the cœnenchyma of the *Stromatopora*. Still, as Mr. Champernowne observes, "crystallization, we know, acts, apparently, in the most capricious manner, and it *may* be the cause of these different aspects."

Here I might observe that the infundibular structure of *Syringopora* appears to be allied to the diaphragms produced by the "annulation" (or circular constrictions of the tube) which is such a very common feature among the flexible Hydroids, and thus frequently appears in a modified form in the tubes of *Caunopora*—the effect of such constrictions being to force the cœnosarcal tube into the centre of the flexible horny one, which in *Syringopora geniculata*, from the tubular processes of the infundibula passing into each other, gets beyond a mere constriction, and thus sometimes becomes a continuous calcareous central canal.

The tubes of *Caunopora* are, for the most part, straight or slightly flexuous, equal in calibre, unbranched and parallel in their course, and, although hardly ever appearing otherwise than in short fragments, were found by Mr. Champernowne, in a weathered-out instance from "Pit-Park Quarry," to attain 1¾ inch in length; so that it may fairly be assumed that, if it were not for their slightly flexuous course, they would be found to be continuous throughout, *i. e.* from their origin to their termination. But it by no means follows that because the main tubes pursued this course they were not often united by smaller ones, after the manner of *Syringopora*, from which it becomes almost impossible to separate them in every respect when all their structural *varieties* are taken into account.

Seeking among the flexible Hydroids for one that would afford analogous features, we find it in *Tubularia indivisa*, which grows so luxuriantly on our coasts, of which the Rev. T. Hincks (Hist. Brit. Hydroid Zoophytes, 1868, vol. i. p. 115) gives the following characters of the polypary, viz.:— "Clustered, simple, erect, without annulation, narrowed and twisted at the base, horn-coloured, rising to a height of from 6 to 12 inches." The tubes are about 1-16th of an inch in diameter, and seldom divide except near the hydrorhiza, which consists of "twisted and interwoven tubes often agglomerated together." But then there are not only other species of *Tubularia* which divide throughout much oftener, but one, viz. *T. bellis*, which is annulated throughout (*op. cit.* Atlas, pl. xxi.).

Now such Hydroid Zoophytes, whether flexible or calcareous, if overgrown with *Stromatopora*, would represent *Caunopora*; and if we require a similar instance of commensalism, it is afforded in *Stephanoscyphus mirabilis*, which Prof. Allman found on the south coast of France, and describes as consisting of a horny sponge traversed by "a congeries of tubes which penetrate the sponge-tissue and open on its surface, united by a common tubular plexus towards the base."

Dr. F. E. Schulze, of Gratz, subsequently found this in the Adriatic Sea, where the hydroid polyp &c. designated by him *Spongicola fistularis* was found to be the denizen of several different kinds of sponges; and his representation (Archiv f. mikroskop. Anatomie, Bd. xiii. Taf. xlii. fig. 8) might, the sponge being replaced by *Stromatopora*, pass for a specimen of *Caunopora* with the tubes much branched.

Again, it should be remembered that in commensalism the host is hardly ever without its guest; so that it becomes the habit of the latter to dwell with the former even from the commencement of life, and, while the guest may never be seen without its host, the latter is occasionally seen without its guest. In a beautiful preparation which Dr. F. E. Schulze has just kindly sent me, the guest, viz. *Oscillaria spongetiæ*, is already present in the *embryo* of *Spongetia pallescens*, which it afterwards pervades throughout life (Zeitschrift f. wiss. Zool. Bd. xxxii. p. 149, Taf. v. fig. 7). So that it is not surprising that *Caunopora*, i. e. the host and its guest *together*, should be occasionally found surrounding Corals also together in the way above mentioned.

I am aware that all but Roemer and Rosen (that is, all English authors on the subject) have, from Lonsdale downwards, viewed *Caunopora* as a distinct species of *Stromatopora*; but I myself now cannot help, from the facts above mentioned, regarding it as an instance of commensalism; and in this I am supported by Mr. Champernowne.

The fact, however, that *Caunopora* may thus be found to be a compound of two organisms does not invalidate what I have stated respecting *Millepora alcicornis*, in which there are distinct tubes among the Stromatoporoid cœnenchyma rising from an axial structure of a different form. *Millepora alcicornis*, too, overruns every thing in its way; thus, in the British Museum there is a large *Murex*, together with reticulated *Gorgoniæ*, covered with it. Ellis notices that it is one of the commonest corals in Jamaica, where it is principally used for burning into lime (Nat. Hist. Zoophytes, 1786, p. 142), and afterwards mentions a bottle that became incrusted with it; so that, as the branches coalesce between themselves, and in like manner this species of *Millepora* attaches to *itself* every foreign body that comes in its way, a reef-accumulation may be thus produced, similar to that which was built up by *Stromatopora*. By eliminating *Caunopora*, therefore, the description of *Stromatopora* is not only more simplified, but *Millepora alcicornis* and the *Hydractiniæ* are brought together, which, as Mr. Champernowne observes, afford the best key to a right understanding of what *Stromatopora* really was.

Again, with reference to my statement, that in the sponges the excretory canal-system commences in the ampullaceous sacs (*Wimperkörbe*) (Ann. 1878, vol. ii. p. 322), I have now to modify this assertion; for my figure of the pore-area in *Greyella cyathophora* directly opening into an excretory canal (Ann. 1869, vol. iv. pp. 192, 193, pl. viii. fig. 5, &c.), confirmed by that of *Axos spinipoculum* (ib. 1879, vol. iii. p. 290, pl. xxv. fig. 4, &c.), shows at least that a commencement in the ampullaceous sacs is not always the case, and presents quite a new feature in the offices of the excretory canals of sponges; although it does not alter the fact that the system is partly excretory in the sponge, while the stellate venation often appears *without any aperture at all* (Rosen, Taf. xi. fig. 7), as the hydrophyton or proliferous organ in *Stromatopora*.

Since the above was written I have seen C. F. Roemer's 'Rheinische Uebergangsgebirge,' 1844, in which, at p. 57, he observes that *Caunopora placenta*, Phillips, is "nichts Anderes, als *Stromatopora polymorpha* von Syringoporen durchwachsen," and, further, that the specimens from the Eifel, the Silurian outliers of Mark Brandenburg and Silesia, together with those of the Devonian Limestone are "undistinguishable."

XI.—*Description of a new Species of Porcupine from the Philippine Islands.* By Dr. A. Günther, F.R.S.

Before Mr. Everett left the Philippine Islands he obtained at Puerto Princesa, in the island of Paragua, a specimen of a small kind of Porcupine, which evidently is undescribed. It is distinguished at the first glance by its small size and by the shortness of its tail. In many respects it resembles *Hystrix crassispinis* from Borneo, but is considerably smaller and the quills are less thick. The specimens sent by Mr. Everett consist of the skin of a female which is nearly full-grown, and of the perfect skeleton of a very old male. The species may be called

Hystrix pumila.

All the upper and lateral parts of the body are densely covered with flat, deeply grooved, flexible bristles of moderate length. These bristles are gradually developed into spines on the hinder part of the back, the shorter spines continuing to be provided with a shallow groove above. The strongest quills are thicker in the middle than one of the incisors. Tail short, the pediculated terminal quills small. Colour greyish brown in front, the strongest quills black with a whitish base and with scarcely any white at the extremity. Lower parts greyish white. Some white hairs near the front claws.

	in.	lin.
Length of body (from tip of nose to root of tail)	14	6
Length from nose to ear..........................	2	10
Length of tail, with terminal quills	3	0
Length of fore foot..............................	1	6
Length of hind foot	2	4
Length of one of the largest quills	4	0
Length of one of the hollow caudal quills	0	6

The *skull* is distinguished by the shortness of the nasal bones, which are considerably shorter than the frontal suture. The facial portion is not very convex above, and concave on the sides. Infraorbital opening rather wide. Ascending ramus of the intermaxillary narrower than a nasal bone, and not extending so far backwards as the nasals. The palatal incision advances forward to opposite the middle of the hinder molar. The outline of the masticatory surface of the molars is almost circular in adult individuals.

I give some of the measurements of two skulls, one (A) being that of an old, the other (B) of a younger individual (in which the fourth molar is still undeveloped).

	A. millim.	B. millim.
Total length..................................	93	86
Length of nasal bones..........................	25	24
Length of frontal suture.......................	37 (?)	31
Least width of nasal bone	7·5	7
Length of fronto-intermaxillary suture	?	4
Least width of interorbital space	29	30
Distance between incisor and first molar	25	22
Length of upper molar series....................	19	19
Width of palate between the second molars	7	5·5

Skull A is that of a very old individual, in which nearly all the sutures have disappeared, so that the measurements of some are either uncertain or impossible. The shortness of the tail of this species is also indicated by a diminution in the number of caudal vertebræ: there are only ten; and the termination of the last shows that only one or two rudimentary vertebræ, if any, are missing. The numbers of the other vertebræ are the same as in *Hystrix javanica*, namely 7 cervical, 14 dorsal, 5 lumbar, and 4 sacral.

XII.—*Description of a new Species of* Didelphys *from Demerara.* By Dr. Albert Günther, F.R.S.

The British Museum has recently received from one of its correspondents in Demerara, the Rev. W. Y. Turner, a small opossum, which resembles *Didelphys crassicaudata* in the general form of the body, structure of the hair, and relative length and hairiness of the tail, but which is only half the size of that animal, and, besides, distinguished from all other opossums by having eight incisors only in the upper jaw. It seems to be undescribed, and may be named

Didelphys Turneri.

The muzzle is of moderate length and rather pointed; ears short, nearly naked, partially clothed with small hairs on the inside; fur of the head, body, and tail a little harsh, not woolly; tail rather shorter than the head and body taken together, with the basal third clothed with fur like that on the body, the remaining portion with short hairs. Colour uniform brown tinged with greyish, lower parts light brownish grey; hairs of the scrotum dark orange-coloured; the terminal two thirds of the tail black, with white apex; feet short.

	in.	lin.
Length from tip of nose to root of tail	9	0
Length of tail	8	3
Length from nose to ear	2	0
Length of hind foot	1	4
Length of skull	2	0
Width of skull	1	0
Length of nasal bones	0	$8\frac{1}{2}$
Length of palate	1	1
Width of palate between the posterior molar teeth	0	4

The specimen is an adult male.

XIII.—*Descriptions of new Genera and Species of* Gallerucinæ. By Joseph S. Baly, F.L.S.

[Continued from vol. iii. p. 84.]

Agelastica humeralis.

A. ovalis, convexa, rufo-fulva, nitida, labro, oculis, antennis, genibus, tibiis tarsisque nigris; thorace bifoveolato, tenuissime punctato; elytris apice paullo dehiscentibus, crebre punctatis, viridi-cyaneis, utrinque macula humerali rufo-fulva ornatis; abdomine (apice excepto) nigro-cyaneo.

Long. 3–$3\frac{1}{2}$ lin.

Hab. Moreton Bay.

Head longer than broad, wedge-shaped, front impressed with a deep fovea, which extends downwards between the encarpæ, the latter thickened, trigonate; carina well defined; antennæ nearly equal to the body in length, filiform, moderately robust, the second joint short, the third nearly twice its length. Thorax twice as broad as long; sides straight and very slightly diverging from the base to beyond the middle, thence rounded and converging to the apex; disk impressed on either side with a deep fovea, finely punctured, in some specimens the punctures only visible under a strong lens. Elytra much broader than the thorax, dehiscent at the extreme apex, convex, rather closely punctured; each elytron with a narrow humeral rufo-fulvous patch, which often extends along the basal margin nearly to the suture.

Agelastica melanocephala.

A. elongato-ovata, postice vix ampliata, rufo-fulva, nitida, capite, genibus, tibiis tarsisque nigris; thorace fere impunctato, sat profunde bifoveolato; elytris sat crebre punctatis, metallico-cæruleis, viridi tinctis.

Long. 4 lin.

Hab. Rockhampton, Queensland; Murray Island, North Australia.

Head wedge-shaped, vertex convex, shining, impunctate; encarpæ thickened, pyriform, contiguous; antennæ nearly equal to the body in length in the male, rather shorter in the female, moderately robust, the second joint short, the third obconic, nearly twice the length of the second. Thorax nearly twice as broad as long; sides straight and parallel, converging at the apex; disk impressed on either side with a deep, transversely oblong fovea. Elytra broader than the thorax, very slightly dilated behind the middle, their apices in the male subacutely rounded, more obtusely rounded in the other sex; above convex, closely but rather more finely punctured than *A. humeralis.*

This insect, in addition to the differences in coloration, may be at once separated from the preceding species by its narrower and more elongate form. With the exception of the bifoveolate thorax, the two species described above agree in all structural characters with *Agelastica*, in which genus I have accordingly placed them. Dr. Chapuis, in his diagnosis of the genus, gives the apex of the anterior tibia as unarmed; in all the specimens I have examined, both of our European species *alni* and of the nearly allied Japanese *cærulea*, I have found the apices of all the tibiæ armed with an acute spine.

Œdicerus apicipennis.

Œ. anguste oblongus, convexus, flavus, nitidus, oculis scutelloque nigris; thorace transverso, lateribus obtuse angulatis, disco lævi, ante basin leviter transversim sulcato; elytris oblongis, tenuiter punctatis, apice cæruleo-nigris.

Mas antennarum articulo tertio incrassato, oblongo-ovato, compresso, dorso profunde excavato.

Long. 3 lin.

Hab. India.

Head longer than broad, somewhat wedge-shaped; front above the encarpæ impressed with a deep fovea; encarpæ trigonate, contiguous; carina obsolete; clypeus large, transverse, pentagonal, the apical angle thickened; antennæ robust, the basal joint thickened, pyriform, the second very short, turbinate, the third very strongly thickened, oblong-ovate, compressed, excavated both above and below, but more deeply so on the upper surface (in the single specimen before me, the five upper joints are broken off). Thorax one half broader than long; sides straight and parallel from the base to beyond the middle, thence obliquely converging to the apex; disk shining, impunctate, impressed in front of the base with a slightly curved transverse sulcation, either end of which is more deeply excavated and forms a distinct fovea. Elytra much broader than the thorax, oblong, parallel, finely punctured.

Galerucella tropica.

G. anguste ovata, postice paullo ampliata, convexa, subtus nitida, sordide flava, tibiis apice tarsisque infuscatis, abdomine (apice excepto) nigro-fusco; supra subnitida, viridi-ænea, fusco-sericea, facie, labro antennisque basi fulvis, his extrorsum nigris; thorace fere glabro, rude rugoso-punctato, lateribus anguste fulvis, bisinuatis, medio angulatis; elytris granuloso-rugosis, extrorsum fulvo limbatis.

Long. 3–3½ lin.

Hab. Guinea, Camaroons.

Head coarsely rugose-punctate, nearly glabrous; encarpæ transverse, contiguous, pale flavo-fulvous, lower face very short, concolorous with the encarpæ, apices of jaws black; antennæ more than half the length of the body, the four lower joints fulvous, the rest black, the fifth to the eighth joints gradually increasing in thickness. Thorax twice as broad as long; sides parallel, bisinuate, their middle distinctly angulate; all the angles laterally produced, acute; disk somewhat flattened, coarsely rugose-punctate; sides narrowly edged with fulvous. Elytra oblong, slightly dilated posteriorly, closely granulose-rugose, densely clothed (as well as the scutellum) with sericeous hairs.

Genus Mesodonta, Baly.

Dr. Chapuis errs in saying that the apex of the mesotibia is unarmed in the female; in the specimens from which I drew up the diagnosis of the genus (two males and one female) the spine is equally distinct in both sexes.

Mesodonta limbata, Baly.

Mesodonta limbata, Baly, Trans. Ent. Soc. 1864, p. 230; Ent. Month. Mag. ii. p. 99.

Mas abdominis apice profunde concavo-foveolato.
Fœm. abdominis apice integro, disco longitudinaliter sulcato.

Mesodonta marginata.

M. elongato-ovalis, convexa, nigro-picea aut nigra, griseo-sericea, facie thoraceque minus dense sericeis, sordide flavis; hoc transverso, inequaliter excavato, utrinque distincte foveolato, nigro bimaculato; scutello sordide flavo; elytris anguste oblongis, viridi-olivaceis, sat dense sericeis, crebre punctatis.
Mas antennarum articulis tertio ad septimum leviter incrassatis, latitudine perparum vix increscentibus, octavo magis incrassato, clavato, apice oblique truncato, tribus sequentibus brevibus, abrupte angustatis, latitudine æqualibus; abdominis apice profunde concavo-excavato.
Fœm. antennarum articulo octavo non clavato, abdominis apice integro.
Long. 5 lin.

Hab. West coast of Africa, Camaroons.

Head exserted, closely punctured; vertex convex; front impressed with a longitudinal groove; encarpæ pyriform, contiguous; eyes smaller than in *M. limbata.* Antennæ more than two thirds the length of the body in the male, rather shorter in the female, robust, the second joint short, the third and fourth nearly equal in length, each more than twice as long as the second; the fifth rather shorter, slightly longer than the seventh, the eighth in the male suddenly thickened and elongate, clavate, its apex obliquely truncate; in the female this joint is not thickened, and equals the seventh in length; in the male the third to the seventh, in the female the third to the eighth, gradually but very slightly increase in thickness; the ninth to the eleventh joints in both sexes are abruptly narrowed and much shorter than any of the preceding joints, the second excepted. Thorax more than twice as broad as long; sides nearly parallel at the base, thence obliquely converging and slightly rounded to the apex; all the angles distinct but not produced; disk irregularly excavated, upper surface together with the head nearly glabrous, finely but closely punctured, obscure flavous, marked on either side with a large transversely ovate black patch, the centre of which is more deeply excavated than the rest of the surface. Scutellum obscure flavous, its sides converging, its apex obtusely truncate, obsoletely emarginate. Elytra broader than the thorax; sides parallel, very slightly dilated behind the middle in the female; convex, closely granulose-punctate, densely griseo-sericeous, olive-green, the entire outer limb (the space bordering the scutellum excepted) obscure flavous.

Momœa purpurascens, Hope.

Galeruca purpurascens, Hope, Zool. Misc. 1831, p. 29.

M. oblongo-ovata, postice vix ampliata, convexa, fulva, nitida, tibiis apice tarsisque piceo-nigris; elytris metallico purpureis, sericeis.

Long. 5 lin.

Hab. Nepal. My collection. (Hope's type in Mus. Brit.)

Vertex rather closely punctured; eyes black; antennæ filiform, the third joint four times the length of the second, one fourth longer than the fourth. Thorax twice as broad as long; sides angulate; disk shining, broadly excavated on either side, slightly excavated in the median line, just in front of the scutellum. Elytra oblong, slightly dilated behind the middle, convex, transversely excavated below the basilar space, constricted on either side before the middle, finely and closely punctured, clothed with griseous sericeous hairs.

Menippus cervinus, Hope.

Galeruca cervina, Hope, Zool. Misc. 1831, p. 29.

M. subelongato-ovatus, postice vix ampliatus, convexus, fusco-sericeus, subtus niger nitidus, supra opacus fulvo-fuscus, oculis nigris; thorace leviter ruguloso, lateribus rotundatis; elytris subcrebre punctatis, interstitiis granulosis.

Long. 4½ lin.

Hab. Nepal. My collection. (Hope's type in Mus. Brit.)

Head rugose; middle of clypeus with a distinct shining impunctate longitudinal ridge; encarpæ obsolete; antennæ nearly two thirds the length of the body, filiform, the third joint nearly one half longer than the second; eyes black. Thorax twice as broad as long, sides rounded, obsoletely angulate in the middle; disk rugose. Elytra oblong-ovate, rather coarsely punctured, interspaces granulose punctate.

Very similarly coloured to *M. cynicus*, Clark, one half the size, much narrower and much less regularly ovate.

Haplosonyx concinnus.

H. elongato-ovatus, convexus, rufo-fulvus, nitidus, genibus, tibiis dorso, tarsis antennisque nigris, his apice flavo-albidis, basi fulvis; thorace lævi, utrinque excavato; elytris viridi-æneis, concinne sat fortiter punctatis, obsolete costatis, utrinque infra callum humerale oblique sulcatis.

Long. 6–7 lin.

Hab. Celebes.

Vertex and front finely but distinctly punctured; encarpæ thickened, shining, impunctate, pyriform, separated by a deep groove: antennæ filiform, four fifths the length of the body, the second joint short, the third four times the length of the second, nearly equal to the fourth and fifth united; the two or three lower joints fulvous, stained above with black, the three or four upper ones yellowish white: apices of jaws black. Thorax twice as broad as long; sides obtusely angled just before the middle, sinuate behind the latter, the hinder angles recurved, thickened, acute, the anterior ones mucronate; upper surface nearly impunctate, broadly and deeply excavated on either side, the excavation extending to the lateral margin. Scutellum wedge-shaped, its apex obtusely truncate. Elytra broader than the thorax, narrowly ovate, slightly dilated behind the middle, obliquely rounded towards the apex, the extreme apex of each truncate; above convex, closely and rather strongly punctured; each elytron with three or four ill-defined longitudinal costæ, only visible on the middle disk (in some specimens these costæ are entirely obsolete); immediately below the humeral callus is a broad and ill-defined but distinct sulcation, which extends obliquely downwards and inwards for one third the length of the disk; immediately within the suture is also a very shallow depressed longitudinal space. The very long third joint of the antenna will at once separate this insect from its congeners.

Haplosonyx speciosus.

H. anguste oblongus, convexus, rufo-fulvus, nitidus; oculis, mandibulis apice, genibus, tibiis tarsisque nigris; antennis pallido flavis, articulis tertio ad quintum piceis; thorace transverso, medio obsolete foveolato, utrinque transversim sulcato; elytris oblongis, utrinque infra basin arcuatim excavatis, tenuiter punctatis (punctis in strias longitudinales confuse dispositis, ad apicem inordinatis), læte rufo-testaceis, plaga communi magna a basi fere ad medium extensa, superficiem fere amplectente, apice angulatim emarginata, nigra, cæruleo tincta, ornatis.

Long. 5–7 lin.

Hab. Manilla, Celebes.

Vertex and front shining, impunctate; encarpæ separated from the front by a deep impression, thickened, sublunate; antennæ more than half the length of the body, the second joint very short, moniliform, the third one half longer than the second. Thorax nearly three times as broad as long; sides parallel, sinuate from the base to beyond the middle, slightly converging at the apex, the anterior angles obtuse, the hinder ones produced, acute; disk finely punctured, impressed on the median line with a shallow, ill-defined, longitudinal fovea, broadly and deeply transversely excavated on either side. Elytra much broader than the thorax, oblong, not dilated posteriorly; moderately convex, the humeral callus thickened, the basilar space raised and well defined, being bounded on its outer side and behind by a deep groove, the hinder portion of which is strongly curved; surface minutely punctured; in the female these punctures are placed irregularly in longitudinal rows, which are most distinct on the middle disk; in the male the rows are obsolete and the punctures placed without order over the entire disk; the large bluish-black patch covers nearly the whole of the basal half of the elytra, its base extending entirely across the disk, its sides slightly contracted posteriorly, leaving a narrow rufo-testaceous line between its outer edge and the lateral margin of the elytron.

Haplosonyx Mouhoti.

H. anguste oblongus, postice paullo ampliatus, convexus, rufo-fulvus, nitidus, antennis (basi exceptis) nigris, articulo ultimo sordide albido; thorace transversim sulcato, distincte punctato; elytris sat crebre et fortiter punctatis, obscure metallico-purpureis, a vix pone medium ad apicem rufo-fulvis.

Long. 4 lin.

Hab. Siam, Cambodia. Collected by the late M. Mouhot.

Vertex and front smooth, impunctate, encarpæ thickened, transverse, separated from the front by a deep depression; antennæ four fifths the length of the body, filiform, the second and third joints very short, equal, the three lower joints obscure rufo-fulvous, the apical one dirty white. Thorax more than twice as broad as long; sides straight and parallel from the base to beyond the middle, thence rounded and converging to the apex; the hinder angles acute, the anterior ones not produced, subacute; disk broadly transversely excavated across the middle, distinctly punctured. Elytra broader than the thorax, dilated behind the middle, convex, not depressed below the basilar space, rather closely and deeply punctured.

Haplosonyx sexplagiatus.

H. oblongo-ovatus, convexus, nitidus, subtus niger, abdominis limbo externo pedibusque flavis, tibiis apice tarsisque nigro-piceis; supra flavus, scutello antennisque (his basi exceptis) nigris; thorace transversim sulcato, sulco utrinque magis fortiter impresso; elytris fortiter punctato-striatis, stria prima brevi, striis intermediis longe ante apicem abbreviatis, per paria approximantibus, interspatiis quinto septimo et nono pone medium elevatis; utroque elytro macula humerali, altera infra basin inter callum humerale et suturam posita, plagaque magna pone medium, subtrigonata, purpureo-nigris ornato.
Long. $4\frac{3}{4}$–$5\frac{1}{4}$ lin.

Hab. Flores. Collected by Mr. Wallace.

Antennæ more than half the length of the body, robust, filiform, very slightly thickened towards the apex, the third joint one third longer than the second, the three lower joints flavous, the rest black. Thorax twice as broad as long; sides angulate just before the middle; anterior and posterior angles acute, the former slightly excurved; disk smooth and shining, transversely sulcate across the middle, the sulcation more deeply impressed on either side the middle disk. Scutellum elongate-trigonate, its apex acute. Elytra oblong, convex, each elytron with eleven strongly punctured striæ, the first (basal) very short, the third to the eighth abbreviated long before the apex and approximating in pairs, the fifth and sixth abbreviated anteriorly, only commencing below the humeral callus; the interspaces smooth, those between each double row of striæ thickened and subcostate on the hinder disk.

Antipha chinensis.

A. ovata, postice paullo ampliata, convexa, flavo-fulva, nitida, scutello capiteque nigris, vertice æneo tincto; elytris viridi-æneis, fortiter crebre punctatis.
Long. 3 lin.

Hab. Northern China.

Vertex smooth, impunctate; encarpæ transverse-quadrate, separated by a longitudinal groove, which runs upwards for some distance on the front; antennæ slender, filiform, nearly equal to the body in length, the third joint rather longer than the second. Thorax about one half broader than long; sides straight and parallel, very slightly dilated before the middle, the anterior angles thickened, subtuberculate, the hinder ones produced, acute; disk shining, impunctate. Elytra broader than the thorax, oblong-ovate, slightly dilated behind the middle, convex, transversely depressed below the basilar space, closely and coarsely punctured; interspaces rugulose.

Antipha Nietneri.

A. ovata, postice ampliata, convexa, nigra, nitida, femoribus, vertice oreque sordide fulvo-piceis; antennis pallide piceis, basi sordide fulvis; thorace lateribus leviter rotundatis, fere parallelis, disco medio lævi, utrinque sparse punctato; elytris sat crebre, fortiter punctatis, piceo-fulvis, utrinque limbo angusto maculisque duabus, una vix ante medium, altera apicem versus positis, nigro-piceis.
Long. 3½ lin.

Hab. Ceylon. Collected by H. Nietner.

Vertex smooth, impunctate; encarpæ oblique, transverse-quadrate, separated (their extreme apices excepted) by the clypeus; front impressed immediately above the encarpæ with a deep but ill-defined fovea; antennæ rather more than half the length of the body, the third joint nearly twice as long as the second. Thorax more than twice as broad as long; sides slightly rounded, nearly parallel, all the angles produced, thickened; disk smooth and shining, impunctate on the middle portion, impressed on either side with a few scattered punctures. Elytra oblong-ovate, dilated posteriorly, convex, not depressed below the basilar space, strongly and rather closely punctured; piceo-fulvous, each with the extreme outer limb, together with two irregular patches, one just before the middle, the other (larger) rather more than half-way between the middle and the apex, nigro-piceous.

Antipha pulchella.

A. late ovata, postice ampliata, valde convexa, læte fulva, nitida; oculis scutelloque nigris; elytris metallico-cæruleis, sat fortiter, crebre punctatis, intra marginem exteriorem leviter costatis.
Long. 3 lin.

Hab. Borneo, Sarawak. Collected by Mr. Wallace.

Head smooth, impunctate; encarpæ transverse, curved, separated by the extreme apex of the clypeus; from the latter a very short longitudinal groove extends upwards on the front; antennæ slender, rather more than three fourths the length of the body, the third joint three times the length of the second. Thorax nearly three times as broad as long; sides straight and nearly parallel from the base to beyond the middle, thence very slightly converging to the apex, the anterior angles thickened, nearly rectangular, the hinder ones produced, very acute; disk smooth, impunctate. Elytra much broader than the thorax, subquadrate-ovate, dilated behind the middle, their apices conjointly broadly rounded; above very convex, each elytron faintly excavated below the basilar space, strongly and closely punctured; interspaces (more especially on the outer disk) rugulose; on each elytron, a short distance within the outer margin, is a slightly raised, but distinct longitudinal costa.

Antipha pretiosa.

A. late oblongo-ovata, postice ampliata, convexa, nigra aut nigro-picea, nitida, facie inferiore, antennis basi, thorace pedibusque sordide flavis, tarsis (posticis quatuor basi exceptis) nigro-fuscis; elytris viridi-cæruleis aut viridi-violaceis, convexis, infra basin transversim excavatis, intra marginem exteriorem leviter longitudinaliter unicostatis; crebre fortiter punctatis, punctis prope suturam substriatim dispositis.

Long. $2\frac{1}{2}$ lin.

Hab. Borneo, Sarawak.

Head smooth, impunctate; front, just above the encarpæ, longitudinally strigose, impressed in the middle with a deep fovea; encarpæ transverse, curved, separated by the apex of the clypeus; antennæ very slender, nearly equal to the body in length, the third joint more than three times the length of the second, the five to seven lower joints fulvous, the rest nigro-fuscous or entirely black. Thorax at the base three times as broad as long; sides straight, converging from base to apex, the hinder angles produced, subacute, the anterior ones slightly produced, obliquely truncate; disk smooth, impunctate, more or less stained with piceous. Scutellum shining black. Elytra much broader than the thorax, oblong-ovate, moderately dilated posteriorly, convex, transversely excavated below the basilar space, strongly punctured; each elytron near the outer margin with a distinct but only slightly raised longitudinal costa.

Less convex than *A. pulchella*, the thorax rather shorter and broader, its anterior angles more obliquely truncate, the elytra more deeply excavated below the basilar space.

Antipha discoidalis.

A. late oblongo-ovata, postice paullo ampliata, convexa, nigro-picea, nitida, capite pallide piceo, vertice sæpe infuscato, thorace pedibusque flavis; antennis extrorsum, tibiis apice tarsisque fuscis; thorace lævi, fulvo, lateribus fere rectis; elytris oblongis, postice paullo ampliatis, convexis, infra basin transversim excavatis, sat fortiter punctatis, punctis prope suturam substriatim dispositis; piceo-cyaneis, violaceo tinctis, singulis disco sordide flavis.

Var. A. elytris fulvo-piceis, limbo cyaneo fere obsoleto.

Long. $2\frac{1}{2}$ lin.

Hab. Borneo.

Vertex smooth, impunctate; lower portion of front longitudinally strigose; encarpæ oblique, slightly curved, separated by the apex of the clypeus; eyes prominent, shining black; antennæ very slender, longer than the body, the third joint nearly three times the length of the second. Thorax nearly three times as broad as long; sides nearly straight and nearly parallel, all the angles produced, the anterior ones obliquely truncate, the hinder ones subacute; disk shining, impunctate. Elytra broader than the thorax, oblong, slightly dilated posteriorly, convex, transversely depressed below the basilar space, strongly punctured, the puncturing on the inner disk forming irregular longitudinal striæ; the yellow colour occupies nearly the entire disk of each elytron, which may be described as obscure flavous, irregularly bordered with cyaneous.

Antipha Bretinghami.

A. oblonga, convexa, flava, nitida, postpectore scutelloque piceis, antennis (basi exceptis), tibiis tarsisque posticis fuscis; thorace lateribus fere parallelis, obsolete rotundatis, disco tenuiter subremote punctato; elytris oblongo-ovatis, postice vix ampliatis, convexis, infra basin vix depressis, minus fortiter et minus crebre punctatis (interspatiis lævibus), flavis, utrinque anguste piceo limbatis.

Long. 2 lin.

Hab. India. Collected by Mr. Bretingham.

Head impunctate; encarpæ transverse-quadrate, oblique, widely separated by the broad apex of the clypeus; antennæ filiform, nearly equal to the body in length, the third joint twice the length of the second; the six or seven outer joints fuscous. Thorax three times as broad as long; sides nearly parallel, obsoletely rounded, all the angles moderately produced, subacute; disk sparingly impressed with shallow punctures. Elytra broader than the thorax, oblong-ovate, scarcely dilated posteriorly, convex, obsoletely depressed below the basilar space, less strongly and less closely punctured than in many allied species.

Antipha costata.

A. subrotundato-ovata, postice paullo ampliata, convexa, fulvo-picea aut picea, nitida, labro antennisque sordide flavis, his gracillimis; thorace lateribus fere rectis, parallelis, disco obsolete transversim excavato; elytris subcrebre punctatis, utrinque tricostatis. Long. $2\frac{1}{2}$ lin.

Hab. Borneo, Sarawak.

Vertex smooth, impunctate; encarpæ oblique, transverse-quadrate, separated (their extreme apices excepted) by the clypeus; antennæ very slender, three fourths the length of the body, the third joint nearly twice the length of the second. Thorax more than three times as broad as long; sides straight and nearly parallel, obsoletely converging at the extreme apex, the anterior angles obliquely truncate, the hinder ones not produced, subacute; disk sparingly and minutely punctured, impressed across the middle with a broad, very shallow, transverse depression, more marked on either side than on the median line. Elytra much broader than the thorax, subquadrate-ovate, dilated posteriorly, very convex, transversely excavated below the basilar space, distinctly and somewhat closely punctured, the puncturing stronger near the outer margin; outer disk of each elytron with three narrow, rather strongly raised, longitudinal costæ, which commence below the shoulder and extend nearly to the apex.

The longitudinal costæ on the elytra will at once divide this species from its congeners.

Antipha frontalis.

A. breviter ovata, postice ampliata, sat valde convexa, sordide picea, subnitida, antennis corpore longioribus nigris, pectore thoraceque nigro-piceis, vertice fulvo bimaculato, labro, abdominis limbo femoribusque posticis sordide flavis; thorace hic illic sparse punctato, lateribus fere parallelis; elytris valde convexis, infra basin vix transversim excavatis, minus fortiter, subcrebre punctatis, pallide piceis, sutura margineque exteriore paullo obscurioribus. Long. 2 lin.

Hab. Singapore, a single specimen from Mr. Saunders's collection.

Vertex nearly covered with two parallel rotundate fulvous spots; encarpæ transverse, contiguous; lower portion of front finely impressed on the median line with a short longitudinal groove; antennæ slender, longer than the body, the third joint nearly twice the length of the second. Thorax nearly three times as broad as long; sides parallel, obsoletely rounded in the middle, the anterior angles subobliquely truncate, their outer edge laterally produced, the hinder angles produced, subacute; disk sparingly punctured. Elytra much broader than the thorax, oblong-ovate, dilated posteriorly, very convex, obsoletely impressed transversely below the basilar space, less closely and less strongly punctured than in the preceding species.

Antipha Bennetti, Hope.

Galeruca Bennetti, Gray, Zool. Misc. 1831, p. 29.

A. late ovata, postice ampliata, convexa, picco-fulva, nitida; elytris metallico violacco micantibus, fortiter crebre punctatis.
Long. $4\frac{1}{2}$ lin.

Hab. Nepal. Type in Brit. Mus., also in my own collection.

Front impressed with a deep fovea; encarpæ transverse, separated (their extreme apices excepted) by the clypeus; third joint of antennæ twice the length of the second. Thorax nearly three times as broad at the base as long; sides converging from base to apex, the anterior angles produced, their apices obtuse. Elytra broader than the thorax, dilated posteriorly, very convex, not depressed below the basilar space, strongly and coarsely punctured, the interspaces thickened, rugulose.

[To be continued.]

XIV.—*Studies on Fossil Sponges.*—V. *Calcispongiæ.* By Karl Alfred Zittel.

[Continued from p. 73.]

Corynella, Zittel.

Scyphia auctt.
Cnemidium p. p., *Myrmecium* p. p., Münst., Klipst.
Endea p. p., *Hippalimus* p. p., *Lymnorea* p. p., D'Orb.
Eudea, *Discudea*, *Polycnemiseudea*, *Siphonocœlia* p. p., *Polycœlia* (*Discœlia*) p. p., *Monotheles*, *Distheles*, *Epitheles* p. p., From.
Monotheles p. p., *Distheles*, *Endostoma*, *Polyendostoma*, Röm.
Copanon, *Distheles*, *Dycopanon*, *Cnemicopanon*, *Hallisidia*, *Pachytœcia*, *Holosphecion*, Pom.

Sponge simple, more rarely compound. Individual persons clavate, cylindrical, top-shaped or pyriform, thick-walled. Vertex truncate or convex. Stomachal cavity funnel-shaped, more or less impressed, rarely reaching to the base, usually divided at its lower end into a bundle of vertical tubes. Osculum of the central cavity often radiated by open radial furrows. Into the stomachal cavity open radial canals, usually curved outwards and downwards, which gradually become finer as they depart from the stomachal cavity. Surface furnished with the ostia of fine incurrent canals, which usually open obliquely inwards and downwards, and run into the radial canals of the stomachal cavity. Base sometimes with a dense dermal layer.

Skeletal fibres rather coarse, chiefly consisting of simple bacillar spicules, among which, however, there are some scattered large triradiates.

The development of the canal-system forms the essential character of this genus, and distinguishes it very definitely from *Peronella*, with which it most nearly agrees externally. The coarse radial canals of the stomachal cavity are always present; but, on the contrary, the incurrent tubules may sometimes become very fine, or, under circumstances, entirely disappear. In the latter case, of course, the ostia of the surface are absent. The constitution of these afferent canals varies extraordinarily according to the species; in general they are most strongly developed in the Triassic and Middle-Jurassic species.

The stomachal cavity is also very variable. Sometimes it becomes nearly tubular, as in *Peronella*, and reaches almost to the base, but then always shows large canal-ostia; sometimes it forms only a shallow funnel, from which issues a bundle of vertical and curvilinearly diverging coarse canals.

In spite of these differences, which strike even the passing observer, with respect to the constitution of the stomachal cavity and canal-system, the transition between the two extremes may be so completely demonstrated, that I have been unable to determine to divide this series of forms into several generic groups.

Fromentel, partly upon unimportant characters (occurrence as single persons or in composite stocks, presence or absence of an epitheca), and partly upon erroneous observations, has established a whole series of genera, which, in my opinion, are untenable.

The canal-system of *Eudea*, *Diseudea*, and *Polycnemiseudea*, From., is decidedly incorrectly described, inasmuch as the canals never pierce the wall. In *Monotheles* and *Distheles* the stomachal cavity is not, as described by Fromentel, shallow and superficial, but even in *Monotheles stellata* itself considerably impressed, funnel-shaped, and divided into vertical tubes at its lower extremity. A weak epitheca occurs at the base of several species; others, however, are quite naked.

The genus *Corynella* is distributed from the Trias up to the uppermost Cretaceous. As typical species may be mentioned:—

a. *From the Trias.*

1. *Myrmecium gracile,* Münst. Beitr. iv. Taf. i. figs. 26, 27.
2. *Cnemidium pyriforme,* Klipst. Beitr. Taf. xx. fig. 5.

3. *Eudea rosa*, Laube, Fauna von St. Cass. Taf. i. fig. 4.
4. *Cnemidium astroites*, Münst. Beitr. iv. Taf. i. fig. 24.
5. *Scyphia capitata*, Münst. ib. Taf. i. fig. 12.
6. *Stellispongia clavosa*, Laube, *l. c.* Taf. ii. fig. 3.

b. *From the Jura.*

1. *Spongia lagenaria*, Lamx. Exp. pl. lxxxiv. fig. 4; Mich. Ic. pl. lviii. fig. 5.

   Diseudea lagenaria, From. Intr. pl. i. fig. 5.

2. *Hallirhoa lycoperdioides*, Lamx. Exp. pl. lxxviii. fig. 2; Mich. Ic. pl. lviii. fig. 6.
3. *Alcyonites costata*, Stahl. Correspondenzbl. württ. landw. Ver. 1824, p. 84, fig. 29.

   Spongites astrophorus alatus, Quenst. Petr. Taf. cxxiv. figs. 54–57.

4. *Corynella Quenstedti*, Zitt.

   Spongites astrophorus caloporus and *cornucopiæ*, Quenst. Petr. Taf. cxxiv. figs. 58–64.

5. *Corynella stolata*, Zitt.

   Spongites astrophorus stolatus and *parabolis*, Quenst. Petr. Taf. cxxiv. figs. 65–69.

6. *Parendea cornuta*, Etal. Leth. Bruntr. pl. lviii. fig. 31.
7. *Cnemidium astrophorum* p. p., Goldf. Taf. xxxv. fig. 8, *a*, *c*.
8. *Crispispongia solitaria*, Quenst. Petr. cxxiv. figs. 51–53.
9. *Parendea prismatica*, Etal. ib. pl. lix. fig. 1.
10. *Cnemidium parvum*, Etal. ib. pl. lix. fig. 2.
11. *Cnemidium capitatum*, Münst. Goldf. Taf. xxxv. fig. 9.
12. *Siphonocœlia globosa*, From. Pol. Cor. de Gray, pl. xv. fig. 3.
13. *Siphonocœlia stellifera*, From. ib. pl. xv. fig. 4.
14. *Siphonocœlia pyriformis*, From. ib. pl. xv. fig. 5.
15. *Siphonocœlia aspera*, From. ib. pl. xv. fig. 6.
16. *Discœlia champlittensis*, From. ib. pl. xv. fig. 7.
17. *Madrespongia madreporata*, Quenst. Petr. Taf. cxxiv. figs. 70–72.

   Cnemidium astrophorum, Goldf. Taf. xxxv. fig. 83.

18. *Polycnemiseudea corallina*, From. Introd. pl. i. fig. 6.

c. *From the Cretaceous.*

1. *Scyphia excavata*, Röm. Nordd. Ool.

   Siphonocœlia truncata, From. Cat. Rais. pl. i. fig. 3.

2. *Siphonocœlia neocomiensis*, From. Cat. Rais. pl. i. fig. 2.

   ? *Polyendostoma pyriforme*, Röm. Spongit. Tab. i. fig. 3.

3. *Distheles excavata*, Röm. Spongit. Taf. i. fig. 19.

4. *Eudea globosa*, Röm. ib. Taf. i. fig. 1.
5. *Monotheles punctata*, Röm. ib. Taf. i. fig. 17.
6. *Monotheles stellata*, From. Introd. pl. ii. fig. 6.
7. *Distheles depressa*, From. Introd. pl. ii. fig. 7.
8. *Distheles inflata*, From. Cat. Rais. pl. ii. fig. 5.
9. *Distheles pediculata*, From. ib. pl. iii. fig. 1.
10. *Scyphia foraminosa*, Goldf. Taf. xxxi. fig. 4.
    Endostoma foraminosum, Röm. Spongit. Taf. xiv. fig. 6.
11. *Scyphia tetragona*, Goldf. tab. ii. fig. 2.
    Endostoma tetragonum, Röm. Spongit. Taf. xiv. fig. 7.
    Polyendostoma sociale, Röm. ib. Taf. xiv. fig. 4.

Myrmecium, Goldf.

(Petr. Germ. p. 18.)

Cnemidium p. p., Goldf.
Epitheles p. p., From.
Myrmecium, ? *Gymnomyrmecium*, Pom.

Sponge small, hemispherical, spherical, or cylindrical, narrowed below, shortly pedunculate, at the base with a smooth or concentrically wrinkled dermal layer, which sometimes also coats the whole of the sides. Vertex convex, with a round osculum in the middle, serving as an opening to a narrow tubular stomachal cavity, which traverses the whole sponge-body vertically. There are also numerous small poriform ostia distributed on the surface wherever it is not clothed with the covering layer.

In the central cavity terminate rather stout radial canals, which follow a curved course from without and below, and are furcate in the vicinity of the surface. Their ostia are generally placed in longitudinal series in the wall of the central tube. Other straight canals penetrate into the sponge-body obliquely inwards and downwards from the superficial ostia.

The skeleton consists of a narrow-meshed tissue of rather thin anastomosing fibres, usually composed of calcite, rarely of silica. I have been unable to recognize spicules with perfect certainty; but certain parts of the calcite fibres appear to me to contain three- or four-rayed stars.

This genus is distinguished from *Corynella* chiefly by the fine skeletal fibres, the narrow central cavity, and the greatly developed covering layer, which is always present and frequently envelops the sponge-body up to the vertex. It is for the present not very sharply defined; but the Upper-Jurassic species belonging to it bear so peculiar a stamp that I could not resolve to unite them with *Corynella*.

1. *Myrmecium hemisphæricum*, Goldf. Taf. vi. fig. 12.

Cnemidium rotula, Goldf. Taf. vi. fig. 6.
Spongites rotula, Quenst. Petr. Taf. cxxvi. figs. 1–41.

a. var. *biretiformis*, Quenst. *l. c.* figs. 2–4, 6, 7.
b. var. *foliata*, Quenst. *l. c.* fig. 5.
c. var. *cylindrata*, Quenst. *l. c.* figs. 8–10.
d. var. *coniformis*, Quenst. *l. c.* figs. 11–13.
e. var. *pedunculata*, Quenst. *l. c.* figs. 14–18, 30, 31.
f. var. *longiceps*, Quenst. *l. c.* figs. 21–26.

2. *Spongites indutus*, Quenst. Petr. Taf. cxxvi. figs. 42–46.
3. *Spongites circumseptus*, Quenst. ib. Taf. cxxvi. figs. 55–57.

? Hippalimus, Lamx.

Hippalimeudea, From. (non *Hippalimus*, D'Orb., Röm. &c.).

Sponge mushroom- or umbrella-shaped, pedunculate; vertex with a wide funnel-shaped central cavity. The sloping sides of the conical umbrella set with oscula. Lower surface of the umbrella, stem, and wall of the central cavity smooth, without oscula.

I know this genus only from figures, and am consequently uncertain about its systematic position. Possibly it belongs to the order Lithistidæ.

The single species, *H. lobatus*, Lamx., Exp. Méth. pl. lxxix. fig. 1, is from the Cenomanian of Villers in Calvados.

Lymnorea, Lamx.

Mamillipora, Bronn.
Lymnoreotheles, From.
Lymnorea, *Placorea*, Pom.

Sponge nodular, consisting of verruciform, mamilliform, or globular individuals, which are grown together and covered by a common, thick, and wrinkled basal epidermis. At the vertex of each individual there is a simple, sometimes radiate, and not very deep osculum.

Of the typical species of this genus I possess only insufficient material, which gives me no certain information as to the nature of the oscula and the depth of the stomachal cavity. In a specimen from Ranville I have made sections of several of the round heads: the shallow oscula, into which a number of radial canals opened, then soon disappeared; but there remained, instead of them, upon the cut surface, some scattered round sections of fine vertical canals; and that these traversed the whole sponge-body appears from the fact that on cutting through the base of the common peduncle a bundle of fine canal-sections was visible in the centre. The oscula consequently appear to be continued downwards into simple fine tubes.

The only species which certainly belongs here occurs in the Middle Jura:—

Lymnorea mamillaris, Lamx. Exp. Méth. pl. lxxix. figs. 2–4; Mich. Ic. pl. lvii. fig. 10.

STELLISPONGIA, D'Orb.

Manon, *Achilleum*, *Cnemidium* auctt.
Stellispongia, D'Orb.
Stellispongia, *Enaulofungia*, *Diasterofungia*, From.
Stellispongia, *Limnorethcles* p. p., Laube.
Stellispongia, *Asterospongia*, *Desmospongia*, *Didesmospongia*, *Ceriospongia*, Etal.
Ateloracia, *Cnemiracia*, *Holoracia*, *Trachysphecion*, Pom.

Sponge simple or, more frequently, composite. Individuals globular, semiglobular, clavate, or cylindrical; stock often nodular, clothed, almost always at the base, and sometimes also on the sides, with a thick, wrinkled, dermal layer. Vertex convex, with a shallow radiate osculum, into which open a larger or smaller number of efferent canals. The round ostia of the latter are situated partly at the bottom, partly on the sides of the osculum; the former are connected with vertical, the latter with radial canals. The uppermost radial canals are frequently open, and then form more or less impressed radial furrows. Over all the rest of the surface of the sponge-body, so far as it is not covered with epitheca, there are smaller ostia, connected with vertical or oblique incurrent canals.

The anastomosing skeletal fibres are generally of considerable thickness.

I have limited D'Orbigny's name *Stellispongia* to those calcareous sponges which are characterized by radiate oscula into which vertical and radial canals open, and by numerous smaller ostia on the surface. The round orifices at the bottom of the oscula have previously often been overlooked, but they are wanting in no true *Stellispongia*.

Fromentel's genus *Enaulofungia* is founded upon an erroneous observation; for upon the typical species (*E. corallina*) itself the ostia on the surface are very distinctly developed.

The species belonging to this genus are from the Trias Jura, and Cretaceous.

a. *From the Trias.*

1. *Cnemidium rotulare*, Münst. Beitr. iv. Taf. i. fig. 20.
Cnemidium Manon, Münst. ib. Taf. i. fig. 20?
Cnemidium astroites, Münst. ib. Taf. i. fig. 24.

2. *Cnemidium variabile*, Münst. ib. Taf. i. figs. 21–23.
 Cnemidium turbinatum, Münst. ib. Taf. i. fig. 19.
 Cnemidium stellare, Klipst. Oest. Alp. Taf. xx. fig. 6.
 Cnemidium concinnum, Klipst. ib. Taf. xx. fig. 7.
3. *Tragos hybridum*, Münst. Beitr. iv. Taf. i. fig. 16.

b. *From the Jura.*

1. *Spongia stellata*, Lamx. Exp. Méth. pl. lxxxiv. fig. 13.
 Spongia umbellata, Mich. Ic. pl. lviii. fig. 1.
2. *Enaulofungia corallina*, From. Introd. pl. iii. fig. 11.
 Enaulofungia globosa, From. ib. pl. iv. fig. 1.
 Cnemidium pisiforme and *rotula*, Mich. Ic. pl. xxvi. figs. 6, 7.
 Asterospongia corallina, Etal. Leth. Taf. lix. figs. 8, 9.
3. *Spongites glomeratus*, Quenst. Jura, Taf. lxxxiv. figs. 10, 11.
 Didesmospongia Thurmanni, Etal. Leth. pl. lix. fig. 3.
 Stellispongia pertusa, *aperta*, *hybrida*, and *glomerata*, Etal. Leth. pl. lix. figs. 4–7.
 Cnemidium stellatum, Mich. Ic. pl. xxvi. fig. 8.
 ?*Asterospongia rugosa*, Etal. Leth. pl. lix. fig. 10.
4. *Ceriospongia mundus-stellatus*, Etal. Leth. pl. lix. fig. 11.
 Diasterofungia mundistellata, From. Coll. de Lem. pl. xii. fig. 13.
5. *Ceriospongia bernensis*, Etal. Leth. pl. lix. fig. 12.
6. *Spongites semicinctus*, Quenst. Petr. Taf. cxxv. figs. 2–9.

c. *From the Cretaceous.*

1. *Stellispongia sequana*, From. Cat. Rais. pl. iii. fig. 2.
2. ? *Stellispongia subglobosa*, Röm. Spongit. Taf. i. fig. 20.

Sestrostomella, Zittel.

Tremospongia p. p., D'Orb.
Sparsispongia p. p., *Tremospongia* p. p., From.
Sparsispongia p. p., *Diestosphecion* p. p., Pom.
Spongites p. p., *Nudispongia*, Quenst.
Palæojerea, Laube.

Sponge simple, or more frequently compound, tufted or composed of verruciform individuals standing on a common base. Individuals distinctly separated, cylindrico-clavate or semiglobular; vertex with a shallow, sometimes radiate osculum, into which a great number of round ostia of vertical tubular efferent canals open. Surface porous, naked, or the base and sometimes also a part of the sides clothed with a dermal layer.

The calcareous sponges belonging to this genus have hitherto been described under the names of *Sparsispongia*, *Tremospongia*, or *Palæojerea*. Under the name of *Sparsi-*

spongia, D'Orbigny understood chiefly certain *Stromatoporæ* furnished with pores, as well as some calcareous sponges from the Upper Cretaceous, which were placed by Fromentel under *Tremospongia.* Of all the species of *Sparsispongia* mentioned in the "Prodrome," not a single one belongs to the present genus, whilst our diagnosis of *Sestrostomella* embraces most of the *Sparsispongiæ* and a part of the *Tremospongiæ* of Fromentel. Fromentel distinguishes these two genera principally according to the absence or presence of an epitheca. But that so unessential and inconstant a character cannot be employed for the discrimination of genera among the sponges any more than among corals, is most clearly seen in the fossil Calcispongiæ, among which, on account of this difference, we should have to place in different genera forms which agree perfectly in all other essential characters.

As Fromentel has applied D'Orbigny's names *Tremospongia* and *Sparsispongia* quite arbitrarily, and D'Orbigny himself characterizes them by very indefinite and, in part, erroneous diagnoses, I regard it as advisable to drop both names.

The genus *Sestrostomella* occurs from the Trias up to the Cretaceous.

a. *From the Trias.*

1. *Palæojerea gracilis*, Laube, St. Cass. Taf. i. fig. 4.
2. *Sestrostomella robusta*, Zitt.

Epeudea sp., Loretz, Zeitschr. deutsch. geol. Gesellsch. 1875, p. 832.

b. *From the Jura.*

1. *Jerea biceps*, Reuss, Denkschr. Akad. Wiss. Wien, xxvii. Sep. Abz. Taf. ii. fig. 9.
2. *Spongites* (*Nudispongia*) *cribratus*, Quenst. Petr. Taf. cxxv. figs. 14–18.

c. *From the Cretaceous.*

1. *Sparsispongia flabellata*, From. Cat. Rais. pl. iii. fig. 6.
2. *Sparsispongia varians*, From. ib. pl. iii. fig. 8.
3. *Tremospongia bullata*, From. Introd. pl. iv. fig. 10.
4. *Sparsispongia sulcata*, Loriol, Et. Val. Arz. pl. ix. fig. 4.
5. *Sparsispongia gemmata*, Lor. ib. pl. ix. figs. 5–7.
6. *Tremospongia valanginiensis*, Lor. ib. pl. ix. fig. 1.
7. *Tremospongia divaricata*, Lor. ib. pl. ix. fig. 2.
8. *Sparsispongia brevicauda*, Lor. Urg. Land. pl. v. figs. 19–21, pl. vi. fig. 8.
9. *Sparsispongia abnormis*, Lor. ib. pl. vi. figs. 3–6.
10. *Sparsispongia expansa*, Lor. ib. pl. vi. fig. 7.

Blastinia, Zittel.

Achilleum p. p., Goldf.
Actinospongia p. p., *Pterosmila* p. p., Pom.
Astrospongia p. p., Etal.
Tetrasmila p. p., From.

Sponge bud-like or clavate, simple, gradually narrowed below into a peduncle. Vertex with radially converging, more or less deep constrictions, which are continued over half or more of the height of the sponge. The lower half is coated with a wrinkled dermal layer; the upper half naked, rough, and porous. Skeleton consisting of vermiform interwoven fibres. Central cavity, ostia, and canals wanting.

This genus in many respects resembles *Stellispongia*, but is easily distinguished by the want of an orifice furnished with tubes in the vertex, and of a canal-system.

Pomel refers the typical species (*Achilleum costatum*, Goldf.) to *Actinospongia*, D'Orb.; but in *A. ornata*, upon which D'Orbigny had founded his genus, he remarks the presence of "perforant proctides" both in the furrows and on the costæ of the vertex. According to these characters, *Actinospongia*, D'Orb., should be identical with *Stellispongia*.

I believe also that *Spongites alatus*, Quenst., must be referred here, as the structure of several specimens from the Blauthal exactly agrees with that of *Achilleum costatum*. But whether *Ceriopora alata*, Goldf. (Taf. xi. fig. 8), is identical therewith, I regard as doubtful, notwithstanding the external resemblance. The state of preservation of the silicified specimens from Franconia permits no examination of the microstructure; and from the general habit I should regard the small-winged bodies which Fromentel refers to the genus *Tetrasmila*, and Pomel to *Pterosmila*, rather as Hydractiniæ or Bryozoa. Now that M. Steinmann * has demonstrated that *Thalamospongia* at least belongs to the Hydractiniæ, the whole family Porosmilinæ of Pomel, with the genera *Thalamospongia*, D'Orb., *Porosmila*, From., *Heterosmila*, Pom., *Cœlosmila*, Pom., *Pterosmila*, Pom., and *Cladosmila*, Pom., ought also probably to be removed to the same group.

All the species are from the Upper Jura.

1. *Achilleum costatum*, Goldf. Taf. xxxiv. fig. 7.
   Spongites costatus, Quenst. Petr. cxxv. figs. 19–23.
2. ? *Actinospongia subcostata*, Etal. Class. p. 150.
3. *Spongites alatus*, Quenst. Petr. Taf. cxxv. figs. 24, 25.

* Palæontographica, xxv.

Synopella, Zittel.

Tremospongia p. p., *Sparsispongia* p. p., D'Orb.; From.
Tremospongia, *Orosphecion*, *Aplosphecion*, Pom.

Sponge composite, rarely simple, hemispherical or nodular. Upper surface plain, convex, or warty, with irregularly scattered oscula, which are formed by the separated openings of two or more large excurrent canals. Besides these oscula, the surface is furnished with small ostia of fine incurrent tubules. Base, and frequently also the sides, coated with a thick wrinkled dermal layer. Skeletal fibres coarse.

This genus is difficult to define sharply from *Stellispongia* and *Sestrostomella*, although the typical species bear a peculiar stamp. If the oscula are radiated by radial canals, as now and then occurs, the distinction from *Stellispongia* is difficult; if, on the other hand, the roundish heads project more definitely from the mass, transitions towards *Sestrostomella* are produced. To the present genus I refer only nodular forms in which the individuals are not sharply defined, but amalgamated with each other.

The species are distributed through the different horizons of the Cretaceous formation.

1. *Lymnorea sphærica*, Mich. Ic. pl. lii. fig. 16.
2. *Tremospongia plana*, From. Introd. pl. iv. fig. 10.
3. *Manon pulvinarium*, Goldf. Tab. xxix. fig. 7.

Oculospongia, Fromentel.

Manon, Goldf.
Oculispongia p. p., *Tremospongia* p. p., Röm.
Oculospongia, *Sphecidion*, Pom.

Sponge nodular or clavate, massive; vertex with but slightly scattered, circular oscula, from which tubular canals penetrate into the skeletal mass. Outer surface with or without a wrinkled dermal layer. Skeleton consisting of coarse anastomosing fibres.

This genus is distinguished from *Synopella* merely by its simple circular oscula, which are not composed of several apertures. Jurassic and Cretaceous.

?1. *Spongites sella* and *binoculatus*, Quenst. Petr. cxxvi. figs. 58, 59.
2. *Oculospongia neocomiensis*, From. Introd. pl. ii. fig. 8.
3. *Tremospongia dilatata*, Röm. Spongit. Taf. i. fig. 24.
?4. *Limnorea mamillaris*, Röm. Spongit. Taf. i. fig. 14.
5. *Oculospongia flabellata*, From. Cat. Rais. pl. iii. fig. 4.
6. *Oculospongia irregularis*, Loriol, Land. pl. v. fig. 18.

7. *Manon capitatum*, Goldf. Taf. i. fig. 4.
8. *Manon tubuliferum*, Goldf. Taf. i. fig. 5.

CRISPISPONGIA, Quenstedt.

Manon p. p., Goldf.
Conispongia, Etal., Pom.
Crispispongia p. p. Quenst.
Verrucospongia p. p., Laube.

Sponge nodular, polymorphic, sometimes consisting of thick, contorted, and amalgamated leaves, usually adherent by a broad base to foreign bodies. Whole surface, or only the vertex, coated with a dense, smooth dermal layer, in which there are rather large, round or distorted, frequently margined oscula; these are either quite shallow or sunk into the sponge-mass in the form of a funnel, often furnished with canal-ostia at the bottom. The skeleton consists of coarse anastomosing fibres. Canal-system indistinctly developed.

Goldfuss admirably figured two species of the present genus under the name of *Manon peziza*, on Taf. xxxiv. fig. 8, *a*, *b*. Etallon (Classif. Spong. du Haut-Jura, p. 149) subsequently established the genus *Conispongia* for a conical species from the Coral Rag of Valfin; but as this name is quite inapplicable to all the other species, I have adopted the designation *Crispispongia* proposed by Quenstedt, but confine this name to the forms indicated below.

I am acquainted with a still undescribed species from the Trias of St. Cassian (like *Verrucospongia crassa*, Laube, Taf. i. fig. 13); all the rest occur in the Upper Jura.

1. *Crispispongia pezizoides*, Zitt.

Manon peziza p. p., Goldf. Taf. xxiv. fig. 8, *a*.

2. *Crispispongia expansa*, Quenst. Petr. Taf. cxxiv. figs. 38–47.

3. *Conispongia Thurmanni*, Etal. Actes Soc. Jur. d'Emul. 1860, p. 149, fig. 16.

ELASMOSTOMA, Fromentel.

Tragos p. p., *Manon* p. p., *Spongia* p. p., auctt.
Elasmostoma, *Porostoma* p. p., *Chenendroscyphia* p. p., From.
Tragos p. p., *Chenendopora* p. p., *Elasmostoma*, *Cupulospongia* p. p., Röm.
Elasmostoma, *Trachypenia*, *Coniatopenia*, Pom.

Sponge usually consisting of a rather thin, curved leaf, but sometimes funnel-shaped or cup-shaped. One surface with a smooth dermal layer, in which are very shallow oscula of a roundish or irregular form. Opposite surface naked, porous. Canal-system wanting.

Skeletal fibres coarse, apparently formed principally of uniaxial, frequently curved bacillar spicules and scattered triradiates.

All the species occur in the Cretaceous.

1. *Tragos acutimargo*, Röm. Nordd. Ool. Taf. xvii. fig. 26; Spongit. Taf. i. fig. 21.
   Elasmostoma frondescens, From. Introd. pl. iii. fig. 6.
2. *Elasmostoma neocomiense*, Loriol, Descr. anim. invert. foss. Néoc. du Mont-Salève, pl. xxii. figs. 1, 2.
3. *Chenendroscyphia crassa*, From. Cat. Rais. pl. iv. fig. 2.
4. *Porostoma porosa*, From. ib. pl. iii. fig. 3.
5. *Chenendroscyphia mamillata*, From. ib. pl. iii. fig. 4.

? 6. *Elasmostoma cupula*, Röm. Spongit. Taf. i. fig. 22.

7. *Oculospongia polymorpha*, Röm. ib. Taf. i. fig. 16.
8. *Manon macropora*, Sharpe, Q. J. G. S. x. pl. v. figs. 3, 4.
9. *Cupulospongia Normanniana*, D'Orb. Prodr. ii. p. 188.
   Manon peziza, Mich. Ic. pl. xxxvi. fig. 5.
10. *Manon peziza* p. p., Goldf. Taf. xxix. fig. 8.
11. *Cupulospongia consobrina*, D'Orb. Prodr. ii. fig. 188.
    Manon peziza p. p., Goldf. Taf. i. figs. 7, 8.
    Manon stellatum, Goldf. Taf. i. fig. 9.
12. *Spongia Trigeri*, Mich. Ic. pl. liii. fig. 2.

Diplostoma, Fromentel (non Röm.).

Forospongia p. p., D'Orb.

Like *Elasmostoma*, but both surfaces furnished with smooth epidermis and shallow oscula. Cretaceous.

1. *Diplostoma neocomiensis*, From. Introd. pl. iii. fig. 3.

Pharetrospongia, Sollas.

Manon p. p., *Chenendopora* p. p., auctt.
Cupulispongia p. p., D'Orb.
Cupulochonia p. p., From.
Cupulospongia, *Phlyctia*, *Trachyphlyctia*, ? *Heterophlyctia*, ? *Heteropenia*, Pom.
Pharetrospongia, Sollas.

Sponge cup-, funnel-, or leaf-shaped; in the last case the thick-walled leaf always bent or folded. Upper surface (=inner surface) usually smooth, with very small oscula or only simple pores. Outer surface rough, porous. Canal-system deficient, or consisting of fine tubes, which penetrate from both surfaces into the wall. Skeleton consisting of anastomosing vermiform fibres, which are entirely composed of simple bacillar spicules.

As Mr. Sollas has so admirably described (Quart. Journ.

Geol. Soc. 1877, p. 242) the microstructure and characters of the organization of *Pharetrospongia Strahani*, I extend this name to a number of calcareous sponges of similar structure and form which have hitherto generally been referred to *Cupulospongia*, D'Orb., or *Cupulochonia*, From. Under these names, however, the most different Hexactinellidæ, Lithistidæ, and Calcispongiæ have been thrown together; so that it does not seem advisable to maintain either of them.

I have somewhat altered Sollas's diagnosis, and associated with the typical species (*P. Strahani*), which consists of a folded leaf, a series of cup-shaped sponges which agree in their other essential characters. The genus has thus certainly attained a wide extent and a somewhat vague limitation; but some unsuccessful attempts to break it up into several genera have led me constantly back to the union of all the forms cited below. Very frequently the state of preservation causes notable differences which did not originally exist. Thus, probably, all the species in which both surfaces are of a rough and porous texture must have lost the smooth thin epidermis, which is so beautifully preserved in certain specimens from Farringdon, Essen, and Maestricht.

The development or the absence of canals depends, on the one hand, upon the size of the oscula and ostia, and, on the other, upon the coarser or finer meshes of the skeletal network. In *Cupulospongia farringdonensis*, for example, there is a double system of efferent and incurrent canals, whilst other species are entirely destitute of canals.

If we give the genus *Pharetrospongia* the increased extension proposed by me, it contains species from the Trias up to the uppermost Cretaceous.

a. *From the Trias.*

1. *Achilleum patellare*, Münst. Beitr. iv. Taf. i. fig. 6.

b. *From the Jura.*

1. *Spongia helvelloides*, Lamx. Exp. Méth. pl. lxxxiv. figs. 1–3.

c. *From the Cretaceous.*

1. *Cupulochonia cupuliformis*, From. Introd. pl. iii. fig. 5.
2. *Cupulospongia tenuipora*, Röm. Spongit. Taf. ii. fig. 7.
3. *Chenendopora multiformis*, Röm. ib. Taf. i. fig. 13, and ii. fig. 2.
4. *Cupulochonia sequana*, From. Cat. Rais. pl. iv. fig. 1.
5. *Cupulochonia tenuicula*, From. ib. pl. iv. fig. 3.
6. *Cupulochonia profunda*, From. ib. pl. iv. fig. 4.

? 7. *Cupulochonia spissa*, From. ib. pl. iv. fig. 5.

8. *Cupulochonia exquisita*, Loriol, Arzier. pl. ix. figs. 9, 10.

9. *Cupulochonia insueta*, Loriol, ib. pl. ix. fig. 11.

10. *Cupulochonia Couloni*, Loriol, Urg. Land. pl. vi. fig. 17, and vii. figs. 1, 2.

11. *Cupulochonia sabaudiana*, Loriol, ib. pl. vii. figs. 7–9.

12. *Cupulochonia Hiselyi*, Loriol, ib. pl. vii. figs. 11, 12.

13. *Manon farringdonensis*, Sharpe, Q. J. G. S. x. pl. v. figs. 5, 6.

Chenendopora fungiformis, Mant. (non Mich.) Medals, i. p. 228.

14. *Cupulospongia subpeziza*, D'Orb. Prodr. Et. 22, no. 1521.

Manon peziza, Goldf. Taf. v. fig. 1.

? 15. *Spongia boletiformis*, Mich. Ic. pl. i. fig. 1.

? 16. *Epitheles multiformis*, Röm. Spongit. Taf. xiv. fig. 2.

Pachytilodia, Zittel.

Scyphia p. p., Goldf.
Hippalimus p. p., Röm.

Sponge funnel-shaped or pyriform, large, very thick-walled, with a broad depression in the vertex. Base furnished with a smooth covering layer. Rest of the surface naked, without special oscula or canal-openings. Skeleton consisting of a coarse-meshed net of very thick, curved, anastomosing calcareous fibres, which sometimes coalesce to form regular lamellæ and vesicles, and among which the circulation of water took place without any special canal-system.

This genus is distinguished from *Pharetrospongia* by its thick skeletal fibres, the complete absence of a canal-system, and its very thick wall.

The typical species, *Scyphia infundibuliformis*, Goldf., Taf. v. fig. 2 (Quenst. Petr. Taf. cxxxii. figs. 1–3), occurs frequently in the Tourtia of Essen.

Leiospongia, D'Orbigny*.

Achilleum p. p., Münst.
Leiofungia, From.
Leiospongia, *Aulacopagia*, *Lænopagia*, ? *Elasmopagia*, Pom.

Sponge nodular or branched, on the sides with a smooth or

* The position of this genus among the Pharetrones cannot be regarded as perfectly certain until spicules have been detected in the skeletal fibres. Possibly *Leiospongia*, like most species of the genera *Actinofungia*, From., *Actinospongia*, D'Orb., and *Amorphospongia*, D'Orb., in which the skeleton consists of anastomosing calcareous fibres, is nearly allied to certain calcareous Hydrozoa (*Millepora*).

concentrically wrinkled surface; vertex consisting of a curled, rather coarse tissue of anastomosing calcareous fibres, which also composes the interior of the sponge-body. The circulation of water could only take place in the interstices of the skeleton.

In this genus I have been unable to detect spicules in the calcareous fibres. All the thin sections which I have prepared of specimens from St. Cassian or from the Seeland Alp exhibit a crystalline-radiate structure.

By Laube several true Bryozoa were united with *Leiofungia*, *Cribroscyphia*, and *Actinofungia*; and Pomel also refers a true Bryozoan (*Catenipora spongiosa*, Klipst.) to *Aulacopagia*. All these forms may easily be distinguished from the fibrous sponges by their tubular structure.

I am acquainted with the genus *Leiospongia* only from the Alpine Trias.

1. *Achilleum milleporatum*, Münst. Beitr. iv. Taf. i. fig. 5.
2. *Achilleum radiciforme*, Münst. ib. Taf. ii. fig. 20.
3. *Achilleum verrucosum*, Münst. ib. Taf. i. fig. 1.
4. *Achilleum subcariosum*, Münst. ib. Taf. i. fig. 2.
5. *Achilleum reticulare*, Münst. ib. Taf. iv. fig. 4.
   Non *Leiofungia reticularis*, Laube, St. Cass. Taf. ii. fig. 8.
6. *Achilleum rugosum*, Münst. ib. Taf. i. fig. 3.

Family 4. **Sycones**, Häckel.

Wall regularly composed of straight unbranched canals or tubes, directed radially towards the axis of the stomach (radial canals, radial tubes). Skeletal spicules regularly radially arranged; dermal and gastral skeletons separated from the parenchyma-skeleton.

Protosycon, Zittel.

Scyphia p. p., Goldf.
Siphonocœlia p. p., From.

Sponge simple, cylindrical or clavate, narrowed below, with a wide tubular central cavity extending to the base. The wall consists of hollow radial cones, placed in layers one above the other, with their bases towards the central cavity and their apices directed outwards. These hollow cones, opening inwards, produce, on the wall of the central cavity, numerous ostia, arranged in longitudinal rows, and leading into the hollow cones. As the latter are narrowed outwards and terminate in a truncated head, conical interspaces, but pointed inwards, are formed between; and if both the hollow cones and interspaces are filled with rock matter, it appears as if the wall were furnished with two kinds of radial canals, one set opening into the central cavity, while the others commence about the middle of the wall and widen outwards.

The skeleton appears to be composed chiefly of tri- and quadriradiate spicules; I have, however, never succeeded in distinctly displaying their form in thin sections.

I have no hesitation in referring this elegant genus to the Sycones. The whole external form of the cylindrical sponge-body, its construction of radial tubes, the numerous serially arranged ostia on the wall of the central cavity, and, finally, the mesh-like interspaces on the outer surface agree in a remarkable manner with certain living Sycones. It is, however, impossible to assign it precisely to a place among the recent genera, on account of the imperfect preservation of the skeletal spicules.

The typical species has been well figured by Goldfuss (Taf. iii. fig. 10) as *Scyphia punctata*. It occurs, not very abundantly, in the middle sponge-limestone of the White Jura. The skeleton almost always consists of calcite, and shows indistinct spicular structure. Rarely also specimens with a silicified skeleton occur; and one of these must have been taken by O. Schmidt for his figure (Atlant. Spong. Taf. i. fig. 21). The fragment probably shows the surface of the wall of the stomachal cavity with the ostia of the radial tubes, which stand in regular rows, and thus somewhat remind us of the Hexactinellidæ. That O. Schmidt indicates canals in the skeletal fibres is due to an illusion, at least if the figure in question belongs to *Scyphia punctata*.

In Quenstedt's 'Petrefactenkunde Deutschlands' there are good figures of *Scyphia punctata* (Taf. cxxxi. figs. 24–27).

XV.—*Description of a new Species of* Vesperugo *from Bermuda.* By G. E. Dobson, M.A., M.B., &c.

Vesperugo vagans, n. sp.

Ears short, triangular, like those of *V. pipistrellus*; the tragus reaches its greatest width in the upper third, its inner margin is slightly concave above, the outer margin straight in the lower two thirds, with a small rounded lobe at the base, not succeeded by an emargination, upper margin broadly rounded off, in general outline, on the whole, like that of *V. maurus*.

Postcalcaneal lobe well developed; the last rudimentary caudal vertebra alone free.

Fur, above, dark reddish brown; beneath similar, but paler at the extremities. The fur of the body extends upon the wing-membranes for a short distance above and beneath, and a very few hairs appear behind the forearm upon the under surface of the membranes; otherwise they are naked.

The upper incisors resemble those of *V. Temminckii* more than those of any other species; the inner ones are moderately long and unicuspidate, the outer incisor on each side very short and conical, scarcely exceeding the cingulum of the inner incisor in vertical extent, but nearly equal to it in cross section at the base; lower incisors nearly at right angles to the direction of the jaws, trifid, and crowded; first upper premolar extremely small, and with difficulty seen even with the aid of a lens, in the inner angle between the closely approximated canine and second premolar.

Length (of the type, an adult female preserved in alcohol), head and body 2″·0, tail 1″·8, head 0″·65, ear 0″·5, tragus 0″·2, forearm 1″·55, thumb 0″·3; third finger—1st ph. 1″·45, 2nd ph. 0″·6, 3rd ph. 0″·75; fifth finger—1st ph. 1″·3, 2nd ph. 0″·35, 3rd ph. 0″·35; tibia 0″·6, foot 0″·38.

Hab. Bermuda. Type in the collection of the British Museum.

The form of the upper incisors and the very small size of the first upper premolars at once distinguish this species. Externally it probably resembles *V. maurus* of Europe and Asia most closely.

The occurrence of a new species on the small island of Bermuda, 600 miles distant from the mainland, is very remarkable; but I have little doubt that this species will be found hereafter on the continent of America.

XVI.—*Notice of two new Species of Fishes from the South Seas.* By Dr. A. Günther.

The Museum Godeffroy has recently received, through its collectors, two interesting new species of fishes from the South Seas, which may be characterized as follows:—

Diagramma giganteum.

D. $\frac{13}{19}$. A. $\frac{3}{7}$. L. lat. 85.

The height of the body is contained twice and two thirds in the total length (without caudal), the length of the head twice and four fifths. The maxillary does not extend to the vertical from the front margin of the eye. Præoperculum with the posterior limb vertical and finely serrated. Dorsal spines of moderate strength. Upper margin of the soft dorsal convex; dorsals continuous, but separated from each other by a deep notch. Caudal emarginate; anal with long anterior and short posterior rays. Upper and lateral parts dark olive-coloured, each scale with two, three, or more whitish dots. A black line along the hind margin of the præoperculum.

Of this species a gigantic example, 3 feet long, has been sent by Herr Kubary from Ponapé. The collector says that it exceeds sometimes one metre in length, and that the natives call it "Koil."

Sphærodon euanus.

D. $\frac{10}{10}$. A. $\frac{3}{10}$. L. lat. 51. L. transv. 5/17.

Eye very large, one third the length of the head, equal to the width of the interorbital space, and more than the height of the præorbital. Scales on the cheek in four series, forming together a narrow vertical band. Dorsal spines rather feeble, broader on one side than on the other, the longest being a little shorter than the eye. The third anal spine much longer than the second. The first ventral ray produced into a filament. Coloration uniform, without any spots on the vertical fins. Posterior half of the pectoral fin light-coloured; base of the pectoral without black.

One specimen, 13 inches long, from Eua, Friendly Islands.

XVII.—*Notes towards the History of the Genus* Entoniscus. By A. Giard*.

[Plate X.]

I. Historical.

Almost all the zoologists who have studied the parasitic Cirripedes belonging to the group Suctoria have been induced also to pay attention to certain Isopod Crustacea of the family Bopyridæ, the history of which is intimately bound up with that of those animals. This was my own case when, in 1873, I commenced my researches upon *Sacculina carcini*. In fact this parasite itself bears a parasite, *Cryptoniscus larvæformis*, upon which I have already published some preliminary re-

* Translated by W. S. Dallas, F.L.S., from the 'Journal de l'Anatomie et Physiologie,' 1878, pp. 675-700.

marks*. In order to elucidate some doubtful points in the degraded organization of the *Cryptonisci*, I was obliged to have recourse to the examination of other Bopyridæ of less anomalous structure. I have thus collected materials of considerable importance upon this family of Isopods. But most of these animals are of great rarity; and the difficulty of tracing their embryogeny is also very great—a single female containing a great number of ova, it is true, but all in the same stage of development. Hence I have not yet been able to bring the monograph which I have projected to a point of perfection sufficient for the commencement of publication. I will now, however, at least make known some results obtained in the case of a very sparingly distributed genus, the genus *Entoniscus*†. I hope by this means to hinder from useless researches those who might be tempted to attack the same subject, and to furnish some data which will be made use of hereafter for a more general treatise‡.

The genus *Entoniscus*, established by Fritz Müller in 1862, includes animals which had been met with by Cavolini as long ago as 1787. Cavolini had observed *Sacculinæ* upon several species of crabs; and he regarded these parasites as the broods (*ponte*) of a small species of *Cyclops* grafted by the mother upon the tail of the Brachyurans. After bringing forward his observations upon this subject he adds:—

"Besides the *Cyclops* which we have just described, there is in the sea another insect which fixes its brood upon the body of our crabs, but in a manner much more inconvenient for those animals. It is, in fact, in the very midst of their viscera that the eggs are attached. Hitherto the *Depressus*§

* Giard, "Sur l'éthologie de *Sacculina carcini*," Comptes Rendus de l'Acad. des Sciences, 1874.

† A preliminary communication upon these animals has been printed in the Comptes Rend usde l'Acad. des Sciences (12th August, 1878). See Ann. & Mag. Nat. Hist. ser. 5, vol. ii. p. 346.

‡ I have already indicated briefly certain conclusions of this memoir. See Arch. de Zool. expér. tom. ii. 1873, p. 513, and tom. iii. 1874, Notes et Revue, pp. iii & iv.

§ It is impossible not to recognize *Grapsus varius* in the fine description given by Cavolini of his *Granchio depresso*:—

"Questo granchio è copiosissimo per gli scogli del nostro cratere, e sembra godere piuttosto di stare in secco, massimassime quando, pel calor della state, le acque presso i lidi si riscaldano, o si albanano: su di questi scogli di erbe vestiti è curiosa cosa vedere come in terra seduto, or con una, or con ambe le mani, colga quella verde conferva e alla bocca l'accosti. La forma del suo corpo è quadrilatera schiacciata, il colore di un verde cupo: le braccia son crasse e valide poco meno del paguro (*Eriphia spinifrons* of modern authors); la sua carne è mucilagginosa, e molto poca. Ma ciò che lo rende singolare, è la velocità del corso: bisogna esser destro per dargli sopra la mano; altrimenti o fugge sullo alone has appeared to me to be attacked. On the side of the stomach, at the point where the liver is situated, one sees a very voluminous mass, of a more or less yellowish or leaden colour, according to the degree of its maturity, occupying the place of the ovarian branch of the crab. This body pushes through the ribs of the carapace, and thus insinuates itself into the branchial cavity. It is not difficult to separate it from the crab, to which we find it to be attached by cellular tissue; the anterior part of this ovarian body, that which is placed in the viscera, becomes mature first, and consequently it is much more dilated, *a*, while the other, *b*, which is situated between the ribs, is still immature, and retains the impression of these solid parts. The ovarian sac is formed of a transparent tissue, and contains in this state the graduated series of the development of the ova which it encloses: the most mature are in *a*, and are visible to the naked eye only as a granular substance; in the figure, however, they have been drawn a little larger, in order to avoid confusion; the less advanced ones are in *b*. Seen by the microscope, the latter are of a rounded form, *c*; those which are a little less immature are figured at *m*; those which most nearly approach maturity are uniform and emarginate, as at *n*; lastly, the hatched embryos have the form represented in *r*, and run in all directions in the drop of water placed under the lens of the microscope. These insects have the body divided into a great number of rings, the first of which bears two eyes; the tail is bifurcate; and the last joint of the first four pairs of feet is claviform.

"This insect belongs to the race of the *Oniscus squilliformis*, very well described by Pallas; it presents a certain analogy with the species described under the name of *Oniscus locusta** by that illustrious naturalist, a species very frequent in the organic rubbish thrown up on the sand and bathed by the sea in its movements to and fro; it is our *sand-flea*. However, the species which is developed at the expense of the blood of the crab is much smaller than this sand-flea. It is true that I have been able to see this insect only at the

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scoglio fin chè in mare precipiti, o vero in una prossima buca si rimpiatta: perciò dai nostri pescatori si chiama *Granchio spirito*."

In the same memoir Cavolini describes and figures:—1, a Gregarina parasitic on the *Grapsus*, which he calls Tænia; 2, the zoëa of the *Grapsus* (pl. ii. figs. 7, 8, & 9). As early as 1768 Slabber, for his part, had discovered the metamorphoses of the Decapods; but it was only in 1823 that Vaughan Thompson generalized these observations, which had been completely forgotten.

* 'Spicilegia Zoologica,' fasc. ix. pp. 50–55 (Berolini, 1767).

moment of its exclusion; but the size of the eggs which I have found attached to the feet of our sand-flea has taught me that the young of this latter must be of a size greatly superior to that of the insect which I have described and drawn issuing from the ovaries contained within the body of the crabs.

"Now in what way does the mother *Oniscus* introduce her brood into the body of the crabs, when this body is completely defended by a hard and crustaceous skin? Here I must argue by conjecture, but by necessary conjecture, until it may be possible to obtain ocular proof of the fact of this penetration. We have already described above the two cavities situated one upon each side of the body of the crab, and in which the branchiæ move. The water enters and issues from these by two apertures provided with valves, and situated at the sides of the mouth in front of the lateral commissure of the upper portion with the lower portion of the carapace. The anterior part of these cavities is formed of a delicate membrane which clothes the viscera of the crab. We can therefore understand with the greatest facility that the mother insect penetrates with the water into such a cavity, and, perforating its delicate wall, introduces her brood into the body of the crab; the mother insect enters then in the same manner as the ova of *Serpulæ* or of oysters, which I have frequently found hatched or fixed against the ribs which exist in the above-mentioned branchial cavity.

"We have, therefore, in the crabs two cases of grafting of animal parts; the brood of these two insects, which need for their development juices elaborated in an animal body, could not be brought to its term by the mother. Nature has taken upon herself to furnish it with a fat and devoted nurse, namely the body of our crabs. The mother makes a small aperture in the skin which covers the intestine; sometimes she fixes her brood to the outside, sometimes introduces it into the body of the crab, enclosed in a membrane performing the part of a placenta; and, as the eggs contained in this membrane are animated and tend to develop themselves, it is certain that the canals of this ovary are suckers absorbing the liquids of the vessels of the living crab. By inosculating with these latter and forming anastomoses with them, they constitute a *system continuous* between the *living body* of the crab, and another *body*, likewise *living*, which tends to complete its evolution. In point of fact, a foreign fœtus has become the actual progeny of the crustacean, and has developed itself upon this animal in the same fashion as, among the Mammalia, the abdominal fœtuses are developed nearly as they would be in the uterus, which is their normal and true place of abode. If in a plant we make an incision and introduce into it a living branch of another plant, there is produced a graft by inosculation and union (*raccordement*) of the vessels; exactly the same thing takes place in our animals.

"I do not know whether, hitherto, any animals which graft themselves have been known. It seems to me that the opposite of what I have just indicated had rather been observed; it had been seen that the eggs of one animal deposited in the body of another animal produce tumours, which, by bursting, form regular wounds. This is the case with those flies which lay their eggs under the skin of cattle, in their nostrils, or their intestines, and which thus occasion a tumour, and afterwards a sort of blister, the matter from which nourishes their progeny*. Certainly the two parasites of the crabs just mentioned are rather grafted animals than animal galls. These latter are met with only in plants attacked by animals. The egg of an insect deposited upon a plant becomes soaked with the juices of the latter and grows at its expense; but it is not strictly correct to say that the canals of the egg anastomose with those of the plant and become continuous with these latter" †.

It is evident, from Cavolini's description and the figures which accompany it, that in this case, as in that of *Sacculina*, the supposed ovigerous sac is nothing but a crustacean degraded by parasitism; and the form of the young enables us to recognize immediately that we have to do here with an Isopod belonging to the group Bopyridæ. The few errors of detail which exist in the description of the larva or of the adult animal will be referred to hereafter. They cannot, however, in any way modify this first conclusion. As will be seen, these observations of Cavolini were very remarkable if we consider the period at which they were published.

Unfortunately, in this question of the Bopyridæ, as in that of the Suctoria, the bibliography is complicated in a regrettable manner; the very great difficulty of bringing together the original memoirs, often written in languages and published in repertories which are but little known, causes one to content one's self with quoting them from imperfect abstracts or unfaithful translations. Hence one has several times taken

* "Œstri larvæ latent intra pecorum corpus, ubi per totam hyemem nutriuntur: fonticuli vice gerunt &c."—Linnée.

See also the works of Vallisnieri and of Réaumur.

† See Cavolini, 'Memoria sulla generazione dei pesci e dei granchi' (Napoli, 1787), pp. 190–194, pl. ii. figs. 17, 18. We have thought it worth while to translate this curious passage *in extenso*, because now-a-days Cavolini's memoir is hardly to be procured.

the trouble to demolish errors which did not exist in the authors incriminated, and to rediscover truths which had long been known

Thus, quite recently, in his interesting memoir on the genus *Cryptoniscus*, P. Fraisse (2, p. 41) *, giving an analysis of the memoirs of Cavolini, makes the Italian naturalist say that it is very difficult to separate the *Entoniscus* (the supposed ovigerous sac) from the viscera of the crab. It is evident that if Fraisse had had the text of Cavolini before him he would not have translated "questo corpo non è difficile separare" by "er sagt (Cavolini) dass er sehr schwer zu trennen sei."

I am equally unable to understand why Fraisse (*l. c.* p. 41) reproaches Steenstrup with having falsified the sense of Cavolini's observations, saying that the Isopods observed by the latter were in the *Sacculina* and not in the body-cavity of the crabs. The following is, in fact, the very judicious appreciation, given by Steenstrup, of the facts observed by Cavolini:—

"Among the excellent observations," he says, "contained in the valuable memoir of Cavolini, we find figured a very curious mass of irregular form entirely filled with more or less developed ova. This mass was found in a crab; by one of its extremities it was fixed to the inner stomachal wall; by the other it was fixed between the two partitions which bound at the sides the segments forming the thoracic cavity of the crab. In fig. 18, *m*, *n*, Cavolini has represented ova taken in the mass in various stages of development; in fig. 18, *r r*, he has figured two young animals at the moment of their issuing from the egg. Cavolini compares these young animals to the *Oniscus squilliformis* described by Pallas, and designates them by that name. It is impossible not to recognize in the description and drawing of these embryos a form very nearly allied to the *Liriope* of Rathke, so near that one can hardly separate it therefrom; one is consequently led, in spite of one's self, to a comparison with the larvæ of *Bopyrus*. The form of the young therefore shows us that this mass filled with ova is, in all probability, nothing but a degraded crustacean parasite, and even an animal of the family Bopyridæ; only the animal is still more deformed, and, one might say, more monstrous than any other type of Bopyride, and even then *Peltogaster* and *Pachybdella*. It is more than an *Epizoon*; it is an *Entozoon*, a sort of intravisceral worm, since, like the singular Gasteropod (*Entoconcha mirabilis*) disco-

* These references throughout indicate the works of which a list is given at p. 157.

vered by Johannes Müller in *Synapta digitata*, it is also solidly attached to an internal organ."

It is clear from this passage that Steenstrup perfectly understood the general relations of the *Entoniscus* to the crab. Instead of referring to the Danish text, or to the German translation of Creplin, which is very correct, Fraisse has no doubt spoken of Steenstrup's work only from what Lilljeborg says of it. The latter (4, p. 291, 'Annales') has, in fact, confounded the *Entoniscus* observed by Cavolini with the *Liriope* (now *Cryptoniscus*) described by Rathke; and he has, moreover, very wrongly ascribed the same confusion to Steenstrup.

Even the learned carcinologist Spence Bate has not been able to keep himself clear of several errors in the citation which he makes of Cavolini's memoir *, in connexion with the genus *Cryptothiria*, Dana. He says:—"Cavolini first described and figured two different crustaceous animals (one of which he doubtingly referred to the *Oniscus squilliformis* of Pallas) which he had found parasitic within a sac attached to the tail of a crab belonging to the genus *Portunus* or *Carcinus*." There are, as will be seen, nearly as many inaccuracies as words in this short reference.

The first and only zoologist who, since Cavolini, met with parasites of the genus *Entoniscus* was Fritz Müller, who appears not to have known the observations of the Italian naturalist. It was in 1862 that Fritz Müller formed the genus *Entoniscus* for an Isopod crustacean which he had met with in the visceral cavity of a *Porcellana* of the coast of Brazil, and which he named *Entoniscus porcellanæ* †.

In 1871 the talented zoologist of Desterro made known a new species of the same genus (*Entoniscus cancrorum*), a parasite of several species of *Xantho*.

Besides these two species, Fritz Müller has also met with *Entonisci* under the following circumstances:—

1. In a small species of *Porcellana* which is found rarely among the Sertularians and Bryozoa upon the rocks (a single female of *Entoniscus* which could not be studied, so that it is impossible to assert that it belongs to the species parasitic on the common *Porcellana*).

2. In a *Porcellana* named by Fritz Müller *Porcellana* (*Polyonyx*) *Creplinii*. It is allied to *Porcellana biangulata*, Dana (*Polyonyx*, Stimps.), and usually occurs in pairs in the tubes of *Chætopterus*. Only three times did Müller meet with

* 'British Sessile-eyed Crustacea,' vol. ii. pp. 262 & 264.

† According to F. Müller this species of *Porcellana*, of a blackish-green colour, is excessively common under stones at Desterro. (Five per cent. of these crustaceans harboured the parasite.)

isolated individuals—once a female, twice a male. Each of these three individuals harboured an *Entoniscus*, whilst none were ever found in the paired individuals. Fritz Müller concludes from this that the presence of the *Entoniscus*, like that of the Rhizocephala (Suctoria), superinduces sterility in the animal infested, whence the abandonment of the latter by its partner.

The *Entoniscus* of *Porcellana Creplinii* differs from that of the ordinary *Porcellana* by the colour of the ovaries and the form of the ovigerous lamellæ.

3. In an *Achæus* living under rocks among Bryozoa and Ascidia; a single couple of *Entonisci*; the male, which is very characteristic, allows it to be affirmed that this species is distinct from *E. porcellanæ* and *E. cancrorum*.

This, therefore, makes at least four, and perhaps five, distinct species of this singular genus, all inhabiting a small corner of the Brazilian coast.

It would be very odd if a group of parasites, living upon animals so widely distributed as the Decapods, were localized in so small a space. It may be asserted, without fear of deceiving ourselves, that, when they are more carefully sought for, the species of the genus *Entoniscus* will soon be met with, more or less, everywhere.

It was with this idea that, during a residence of several weeks that I made at the Pouliguen (Loire-Inférieure), I carefully examined many Decapods of that interesting locality; and I was especially urged to this investigation by the extreme abundance, in the locality, of *Grapsus varius*, which I knew had furnished Cavolini with the first species of the genus *Entoniscus* *.

II. Biology and Anatomy.

The *Grapsi* collected in the small bays formed by the very broken coast of the Pouliguen on the side of Penchateau are very frequently infested by an *Entoniscus* which may be easily recognized as identical with that described by Cavolini, and which, for that reason, I propose to name *Entoniscus Cavolinii*.

The parasite is met with in both the males and the females. According to the statistics of my researches, it is found most

* I believe that *Grapsus varius* cannot go further north than the mouth of the Vilaine: I do not know it beyond Piriac; and it certainly does not exist at Concarneau. We find, besides, at the Pouliguen a number of southern types; without mentioning the flora in which this southern character is very strongly marked, we may cite, among insects, *Argynnis pandora*, *Dejopeia pulchella*, &c. &c.

frequently in the former. Of five infested individuals, four belonged to the male and one to the female sex. But I have learned from my investigations of the Rhizocephala that such statistics, to be of any value, must be founded upon hundreds of individuals *collected in the same locality*. Now my *Grapsi* came from various parts of the coast; and I have examined, at the utmost, two hundred individuals. I believe we may estimate at one in thirty the number of crabs which bear the parasite *.

Sometimes one finds two *Entonisci* in the same crab; and in this case one of them has hampered the growth of the other, which is a favourable circumstance for the observation of intermediate stages, always rare among parasitic animals, in consequence of the rapidity of the retrogression.

Entoniscus Cavolinii, like the species studied by Fritz Müller, is enclosed in a fine membrane in continuity with that which lines the inner surface of the branchial cavity of the crab. It is placed between the liver, the stomach, and the heart of its host. Generally the head is concealed among the hepatic cæca, and in part hidden under the anterior ovigerous sac; the tail is recurved upon the ventral part, and passes under the heart of the crab. The parasite is sometimes on the left, sometimes on the right side of its host, most frequently on the left side (three times more frequently) as it seems to me.

The general form is rather difficult to describe; moreover it varies according to the age and position of the parasite. We have represented it (Pl. X. fig. 1), as accurately as possible, from a living individual twisted upon itself. The colour also varies according to the state of development of the ova with which the animal is almost entirely surrounded; it is straw-yellow when the ova are but little advanced; at maturity it acquires the lead-grey tint so well observed by Cavolini. This tint is due to the formation of a peculiar pigment in the embryo.

We have represented in Pl. X. fig. 2 the same individual untwisted in such a manner as to bring the head into its normal position. In this figure the walls of the incubatory cavity and the abdominal plates are supposed to be removed,

* It is remarkable that none of the *Grapsi* that I have examined bore a *Sacculina*. Fritz Müller remarked a frequent coexistence of *Entoniscus porcellanæ* and *Lernæodiscus porcellanæ*. My zealous *collaborateur*, J. Prié, whose attention I had called to this point, has also never met with *Sacculina Benedenii*. Moreover the Suctoria seem to prefer calm and slightly impure waters; they are much more frequently found upon the various Decapods of the Bay of Penbron, at the Croisic, than on the same crabs collected on the open shore of Pouliguen.

so as to show the real form of the body, composed almost exclusively of the ovary and the digestive tube.

The incubatory chamber is composed of an anterior ventral cavity communicating laterally with two latero-anterior cavities. Besides these three cavities, which are in communication, and form, so to speak, a trilobate cavity, the whole dorsal part also presents a vast incubatory chamber, bilobed posteriorly, and falling laterally in two folds, which meet upon the ventral line when they are filled with ova.

These various parts are more clearly visible in the animal before it is completely transformed into the stage represented by Pl. X. figs. 3, 4 *. We then see distinctly the trilobed ventral cavity and the two chitinous crests of the ventral border of the dorsal chamber.

This curious arrangement of the incubatory chambers is very different from that indicated by Fritz Müller in the case of *E. porcellanæ* and *E. cancrorum*. The first of these two species presents thoracic plates which only differ from the ordinary plates of the Bopyridæ by their much greater development and fringed appearance. The second certainly presents an anterior ventral incubatory chamber; but this chamber appears much more reduced than in *E. Cavolinii*, and does not seem to communicate with the dorsal part of the parasite.

The terminal portion of *Entoniscus*, or that which corresponds to the abdomen of the other Isopoda, is most frequently recurved towards the ventral side of the parasite. At the dorsal part of the first segment of this abdomen we see the heart beating, which has never appeared to me to form a hernia as in *Entoniscus porcellanæ*.

The ventral portion of the abdomen bears five pairs of folded and undulated lamellar appendages, corresponding to the five pairs of ramified appendages of the abdomen in *Ione*. These appendages decrease in size from the origin of the abdomen to the extremity of the body; so that, apparently, the first pair forms two large lateral tufts, and the last four pairs a median posterior tuft, equivalent to each of the first two. The last pair of appendages, however, are not very visible, and are formed by a simple fold of skin on each side.

The body terminates in a triangular expansion presenting two dorsal folds. There does not appear to be an anus, which is explained, as we shall see, by the arrangement of the digestive tube.

* These figures relate to *E. Moniezii*, but, for the point now before us, they may equally apply to *E. Cavolinii*.

The lamellar appendages of the abdomen of our *Entoniscus* greatly resemble those which Fritz Müller has described and figured in *E. porcellanæ*. But in the latter the fringed laminæ are situated beneath the thoracic segments, and the abdomen is occupied by sabre-shaped feet.

In *Entoniscus cancrorum* Müller found fringed abdominal folds; but these folds, much less developed than in *E. Cavolinii*, form, on each side of the abdomen, an undulated continuous border, which does not extend so far as to the terminal part of the body.

From this point of view also, *E. Cavolinii* therefore differs considerably from the species hitherto described.

The head, of which we speak last of all, because, of all the external parts of the animal, it is the least visible at the first glance, is concealed beneath the folds of the ovigerous sac, and presents the form of a double sphere (Pl. X. figs. 2, 5). The anterior part, in which the mouth is situated, is furnished with two lamellar folds; we find no trace of antennæ; and, by its internal organization, this head should rather have the name of *cephalogaster*.

When we free the parasite from its ovigerous sacs and the ova or embryos which they contain, we obtain a body of a pretty constant form, composed in great part of the ovary and the digestive organs of the *Entoniscus*.

The ovarian body presents four lateral prolongations, two anterior and two posterior (Pl. X. fig. 2), which are directed from above downwards, towards the ventral part of the *Entoniscus*. We distinguish besides, also on the ventral part, two or three pairs of much smaller eminences, which, with the preceding, perhaps represent the traces of the thoracic feet which have disappeared. Vestiges of these organs are still, in fact, to be seen upon the less degraded animal in the stage represented by figs. 3, 4.

On the dorsal part we observe two long median protuberances slightly bent from behind forwards. The posterior is the longer one.

All these prolongations remind us of those observed in an animal allied to *Entoniscus*, namely *Cryptothiria balani* (*Hemioniscus*, Buchholz), of which I have been able to examine several individuals collected at Wimereux, in the interior of the *Balanus balanoides* which cover the Tour de Croy.

It is well known that, in certain species belonging to high groups, parasitism often recalls peculiarities of organization which are only to be met with in the larvæ of the other species of the same group. These phenomena of reversion to the atavic type by parasitic retrogression have frequently led astray the zoologists who busy themselves solely with taxonomy, and sometimes even embryogenists. Starting from this idea, one might be tempted to compare the singular dorsal processes of *Entoniscus* with the analogous protuberances which are observed in a great number of Crustacea in the zoëa-stage. It is a comparison which naturally occurs to the mind; and I thought it necessary to indicate it in my preliminary communication upon the genus *Entoniscus*. I have since reflected that more or less similar protuberances occur in a great number of parasitic Crustacea belonging to inferior types, notably among the Copepoda, where evidently they cannot have the same significance. Hence, while calling the attention of zoologists to the remarkable constancy of these appendages in *Entoniscus Cavolinii*, I do not venture to pronounce in so affirmative a manner upon their true morphological value.

If we pass to the internal anatomy of the *Entoniscus*, we shall see that it presents nothing particularly remarkable. Compared with the *Bopyrus*-type, our crustacean has only undergone a considerable reduction of its various systems of organs.

The tegumentary system, cuticle and dermis is very like that of the other Isopods. It is clothed internally with a muscular layer, which enables the animal to perform rather slow vermiform movements of contraction.

The nervous system appears to me to be reduced merely to the cervical and anterior ventral ganglia; but my researches in this direction are too incomplete to enable me to deny absolutely the existence of the ventral chain. The movement of the abdominal plates even leads me to suppose that this chain does exist.

The digestive tube commences with a mouth constructed for sucking, and placed at the lower part of two folds in the form of a sucking-cup; the mass in the form of a brain, called the *head* by Fritz Müller, is hollowed internally by a cavity, the walls of which are lined with folds and villosities like those in the stomach of the *Bopyri*. These villosities have already been indicated by Rathke, Cornalia, and Panceri. This is therefore a true gastric cavity; and this apparatus, as a whole, would be better called *cephalogaster*.

The digestive apparatus is then continued by a short straight tube, terminated cæcally, at the anterior part of which the so-called hepatic cæca open.

I have sought in vain for a terminal interstine comparable to that described by Buchholz in *Hemioniscus*; I have been unable to find any thing like it. Here, therefore, we have a fresh confirmation of the general law, according to which the more internal a parasite is, the more degraded is its digestive tube. This progressive degradation, which goes on increasing from the genus *Bopyrus* to attain its maximum in the *Entonisci*, passing through the genera *Hemioniscus* and *Cryptoniscus*, reminds us precisely of what is observed in the Diptera of the family Œstridæ, in which the degradation becomes progressively more marked from the cuticolar types to the gastricolar types, passing through the cavicolar forms.

The hepatic cæca (for which I retain this old name, but without wishing to prejudge their true physiological part) are certainly homologous with the organs of the same appearance which we meet with in all Isopoda *.

These cæca form two large lateral sacs which occupy all the thoracic portion and even a part of the abdomen of the *Entoniscus*; their internal cavity is very spacious, as may be seen from the section drawn in fig. 7. The wall is covered with slight glandular folds, enclosing a brown substance, the aspect of which reminds one of what we have agreed to call liver in invertebrate animals.

Kowalevsky was the first † to indicate that the racemose hepatic cæca described by Rathke ‡ in *Bopyrus* ('Icones zootomicæ' of V. Carus, Taf. xi. fig. 1, *h*) do not open directly into the digestive tube, but that they all open into a common canal, which itself opens at a single point into the stomach, as in the other Isopods. This observation is perfectly correct; and I have been able to verify it in several species of *Bopyrus* and *Phryxus*. All the difference between the hepatic gland of the *Bopyri* and that of the *Entonisci*, therefore, consists in that in the former this gland becomes ramified and acquires a higher degree of differentiation. It may be said to be a difference analogous to that which exists between the simple pulmonary sac of the Amphibia and the complicated lung of Mammalia and Birds.

The circulatory system consists, in the first place, of a median dorsal vessel, upon the course of which is placed the heart, the beatings of which are very visible through the transparent integument of the animal. There are besides, on

* These organs likewise exist in the *Cryptonisci*, in which I have indicated them, mistaking, however, their true relations. There cannot be any connexion between the ovary and these enormous cæca which open into the digestive tube.

† Kowalevsky, 'Entwickelungsgeschichte der Rippenquallen,' Einleitung, p. vii, Mém. de l'Acad. de St. Pétersb. 1866.

‡ Rathke, 'De Bopyro et de Nereide.'

the ventral side, lateral vessels which send forth branches to the fringed plates of the abdomen.

These fringed laminæ may be regarded as true branchiæ. Moreover they occupy the position of the branchial laminæ of the normal Isopods. Their excessive development in the *Entonisci* is easily explained in the following manner.

We have stated that the *Entoniscus* in the body of its host is completely surrounded by a fine membrane. This membrane does not belong to the parasite; it is the continuation of the membrane which clothes the viscera of the crab and separates them from the branchial cavity. This membrane is gradually drawn back by the growth of the *Entoniscus*, which is thus enclosed in a sort of pouch formed by invagination. From this it results that the *Entoniscus*, as Fritz Müller justly points out, is an external parasite, although it appears to be in relation with the most internal viscera of its host.

That the Bopyridæ need well aerated water constantly renewed, appears clearly from the position which they take up in the various animals to which we find them attached. The typical *Bopyri* lodge themselves in the branchial cavity of the Macrura and Anomura, where they draw from their host a revivified blood, and themselves find constant fresh supplies of water. Therefore their respiratory apparatus is, in general, but slightly developed. The *Phryxi* attach themselves to the abdomen of *Paguri* at the spot where the ova are collected in the females of those animals—that is to say, at the point where the movements of the infested animal also allow of a ready renewal of the water. Nevertheless, as this renewal is less perfect than in the preceding case, the abdominal laminæ are already much better developed than in the *Bopyri* properly so called.

In the *Entonisci* the position of the animal, in a deep invagination of the inner wall of the branchial cavity of the crabs, renders respiration much more difficult. Hence the respiratory lamellæ have attained a much more considerable development, and their undulated and crisped surface converts them into regular sponges constantly impregnated with liquid. Their movement of contraction, however, enables them to drive off this liquid, and to draw in fresh supplies when the necessity for so doing is felt.

In *E. porcellanæ*, in which the abdominal feet have retained an ancestral form, it is the appendages of the thorax that have been modified and converted into undulated lamellæ.

It is clear, moreover, that these various peculiarities are serviceable not only to the adult Bopyridæ, but also to their embryos, which, like the ova of all the other Crustacea, need, for their development in the incubatory cavities, perfectly aerated water. It is only necessary to place a female of *Bopyrus*, separated from her host, in a glass filled with sea-water, even very pure and renewed several times a day, in order to see that the development of the ova, contained under the ventral lamellæ, is soon arrested.

We have given above the description of the ovary. It will be sufficient to add that near the aperture of the ventral ovigerous sac we find two colleteric glands, the secretory ducts of which open not far from the apertures of the ovary near the small ventral eminences (Pl. X. figs. 7 & 2). These glands no doubt secrete the shell of the egg. There are analogous glands in *Hemioniscus*.

Notwithstanding careful search, I have been unable to meet with the male of either of the two species of *Entoniscus* that I have observed. I have vainly sought for it upon the body of the female and upon the crab parasitized. The notion that these *Entonisci* may be hermaphrodites evidently presents no absurdity *à priori*. In fact we are acquainted with hermaphrodite types in certain zoological groups which are composed principally of forms with separate sexes. Speaking very generally, parasitism, or even fixation (which is only a first degree of parasitism), pretty frequently induces the development of the two sexes in the same individual (Cirripedes*, Ascidia, Acephala).

As long ago as 1866 Kowalevsky† observed the testes and the mobile spermatozoids of a fine *Peltogaster* parasitic on *Callianassa subterranea*, and since described by Kossmann under the name of *Parthenopea*. He states, in the memoir, that he has met with hermaphroditism in several other species of *Peltogaster* and *Sacculina*.

Kossmann, in a memoir upon the Suctoria, has also figured (in 1872) the spermatozoids of several species, but did not see the mobile form of those elements. Kossmann's memoir was first published in a journal which is not much diffused ('Ver-

* The hermaphroditism of the parasitic Cirripedes of the group Suctoria or Rhizocephala was long in doubt in consequence of the numerous errors which have been published on this question. It is not very long since Hesse described as the male of *Peltogaster* a Bopyride Isopod crustacean! Such fancies would not deserve to be noticed here if they had not acquired a certain importance, even in foreign countries, by the support they have met with from certain Parisian *savants*. It is not without astonishment that we find a man of the importance of Spence Bate still asking in 1878, "What do we know of the male of the Suctoria?" (Ann. & Mag. Nat. Hist., June 1878).

† Rippenquallen, see note, p. 149.

handl. der phys.-med. Gesellsch. in Würzburg,' Bd. iii. Heft 4, p. 296, pls. xvi.–xviii.). Without knowing of these previous investigations, I occupied myself with the same question in 1873; and I then gave, in the 'Comptes Rendus' of the Academy of Sciences, the description of the testis and perfectly mature spermatozoids in *Sacculina carcini* and in two species of *Peltogaster*.

But in the present cases this hypothesis of hermaphroditism loses much of its probability, if we consider that Fritz Müller has described the male of all the species of *Entoniscus* that he has met with. There is very little probability that, in the same genus, species so nearly allied should present a physiological and morphological dissimilarity of such importance; and I prefer to assume that my unskilfulness, or my limited opportunities, have prevented me from meeting with the males of *E. Cavolinii* and *E. Moniezii*. I need not say that I have searched fruitlessly for a testicular gland, and that I have observed nothing resembling the spermatozoids of the Bopyridæ.

The youngest females of *Entoniscus Cavolinii* that I have been able to observe were in the same stage of development as the young *Entoniscus Moniezii*, figured Pl. X. figs. 3 & 4. The general form was identical; one saw the same rudiments of thoracic limbs, the commencement of the formation of the ventral ovigerous sac, and the two lateral ventral folds of the future dorsal pouch. But there were as yet no traces of the ovarian prolongations.

As a difference of specific value between *E. Cavolinii* and *E. Moniezii* at this period of evolution, I will indicate only the much greater development of the first pair of abdominal laminæ in *E. Moniezii*. In *Entoniscus Cavolinii* the first four pairs of laminæ have then nearly the same development; and it is only afterwards that the first pair grows more than the others.

III. Embryogeny.

The anatomical details which we have just given present a great number of gaps, which will be excused, I hope, by all zoologists who have paid attention to the study of parasites. The scarcity of materials and the obscurity of the subject are two terrible obstacles, over which it is very difficult to triumph.

What we have now to say as to the embryogeny of these animals is still more incomplete; and, unfortunately, long years will probably be necessary to arrive at satisfactory notions upon this subject. Notwithstanding the innumerable quantity of ova which the female *Entoniscus* contains, it may be said that we find ourselves in a state of actual poverty, since all these ova are at the same degree of development, and it is impossible to make them continue their evolution outside of the maternal organism.

I can say scarcely any thing about the embryo before its escape from the egg. The segmentation appears to be holoblastic; the embryo is bent backward, like that of all the Bopyridæ. The first six pairs of thoracic feet appear at first all similar; the seventh segment is destitute of appendages.

The five pairs of abdominal feet, which, in my opinion, correspond to the natatory feet of the *Cypris* form of the Cirripedes, or to the cirri of the adult *Lepas*, appear first, and all together.

On each side of the embryo, at the stage represented by fig. 9, we see a line of refringent bodies. I have seen similar lines in the embryos of several genera of Bopyridæ. In *Entoniscus* we see later on at the same place (fig. 9) two lines of pigment-cells. The pigment of *Entoniscus* has never offered me the characteristic odour of that of the *Cryptonisci*, an odour which is correctly indicated by Dr. P. Fraisse.

The embryo at the moment of its escape from the egg (fig. 10) is about 0·3 millim. in length. It presents two pairs of antennæ: the inner ones, which are short, are terminated by two tufts of setæ; the outer ones, which are much longer, are formed of six joints, of which the third bears two setæ, much longer than the others. The front is nearly straight, as in the embryo of *Entoniscus porcellanæ*. Besides the lateral eyes, which are double and correspond to the definitive eyes of the ordinary Isopods, it possesses a median eye, presenting exactly the structure of the nauplian eye of the Copepods &c. We find in it, in fact, two crystallines (figs. 11, 12), two optic nerves, and a strong black pigment-spot, the anvil-like form of which perfectly recalls that of the eye of the nauplius of the Cirripedes or of the free Copepods.

Fritz Müller indicates in the middle of the front of the embryo of *E. porcellanæ* a transparent spot, which, no doubt, is only the rudiment of a similar nauplian eye.

Dr. Fraisse has also observed something analogous in a species of *Cryptoniscus* (*C. monophthalmus*, Fr.). The male of this species possesses a single median eye instead of the lateral eyes of the other types of the same genus*.

* The *Cypris*-larva of an undetermined Cirripede, taken at Wimereux in September in the muslin net, also presented three eyes—the median eye of the nauplius and the two ordinary lateral eyes of the pupa-stage. A median pigment-spot also exists, besides the lateral eyes, in a branchiopod crustacean, *Holopedium gibberum*, Zaddach.

The presence of a nauplius-eye very distinctly formed in the embryo of *E. Cavolinii* appears to me to be of some importance as a trace of the nauplius phase in the embryogeny of the Isopods. Hitherto we had no factual argument to appeal to in order to connect the Isopods with the original form common to all the Crustacea. The opinion of Fritz Müller, who regards the embryonic membrane of *Ligia* or *Oniscus* as representing the nauplian skin, seems to me destitute of foundation. In all the groups in which embryonic membranes exist, these membranes are superadded in certain forms as protective organs of the typical embryo without modifying its essential characters. They are in general exodermic folds performing the part of an amnios. This is what takes place, for example, in insects, where these membranes may be formed in various fashions, and have no real morphological significance from the point of view of comparative embryogeny. These membranes are most frequently determined by physiological reasons, and may disappear or be retained in very nearly allied types.

The presence of the eye, so characteristic of the nauplius, seems to me, on the contrary, a mark of great value for the phylogeny of the Arthrostraca.

Each of the feet of the first five thoracic pairs terminates in a prehensile hand (fig. 8), of which the penultimate joint is oval, and bears two denticles on the side which is turned towards the opposable claw.

The sixth pair of thoracic feet, so exceedingly characteristic for the distinction of the species of the genus *Entoniscus*, does not at all resemble the same part in the types hitherto described. It consists of five joints; that which corresponds to the hand of the other pairs is more elongated (fig. 6, *a*), and terminates, on its inner margin, in a small curved fixed tooth; its outer border is produced into a straight rod, as long as the joint which supports it, and furnished at its extremity with a tuft of rigid setæ.

Here, then, we find a remarkable confirmation of the law demonstrated by Darwin and Fritz Müller:—When, in a group of animals, an organ presents an exceptional development, this organ is at the same time subject to great variability in the various species of the group.

It is probable that this sixth pair of feet aid the embryo to make its way into the interior of the crab in which it is to undergo its retrograde metamorphosis. The variations which it presents in the different species of *Entoniscus* are consequently in relation to the peculiar conformation of the branchial cavity of the animal infested.

The five pairs of abdominal feet are all constructed in the same fashion: the basal joint bears one or two setæ; the terminal setigerous joint presents a straight margin (fig. 10, *a*) which bears two setæ; a third is inserted at the acute extremity.

The only internal organs visible in the embryo are the hepatic cæca and the heart, which latter is seen beating actively in the dorsal part of the first segment of the abdomen.

In the following Table I summarize the characters of the embryo of *E. Cavolinii*, compared with those of the species described by Fritz Müller:—

E. PORCELLANÆ.	E. CANCRORUM.	E. CAVOLINII.
Length at hatching 0·2 millim.	Length at hatching 0·3 millim.	Length at hatching 0·3 millim.
Frontal margin nearly straight.	Frontal margin arched.	Frontal margin nearly straight.
Unpaired transparent spot on the frontal margin.	No such spot.	A median nauplian eye on the frontal margin.
Inner margin of the hand of the first five pairs of feet smooth.	Inner margin of the hand furnished with denticles.	Inner margin of the hand furnished with two teeth.
Sixth pair of feet short, three-jointed; terminal joint elliptical, without a hook.	Sixth pair of feet of five joints, with a hand furnished with a hook.	Sixth pair of feet of five joints, with a hand furnished with a hook and a rod.
Last segment of the thorax wanting (?).	Last segment of thorax present.	Last segment of thorax present.
Fifth pair of abdominal feet still but little developed, destitute of setæ.	Fifth pair of abdominal feet present, like the preceding ones.	Fifth pair of abdominal feet like the preceding ones.
Basal joint of the abdominal feet furnished with a seta.	Basal joint of the abdominal feet with two setæ.	Basal joint of the abdominal feet with one seta (?).
Terminal joint of the abdominal feet lancet-shaped.	Setigerous joint straightly truncate.	Setigerous joint straightly truncate.

The larvæ of *Entoniscus* can live for several days in sea-water. I have kept some alive that I had carried from the Pouliguen to Paris, and from Paris to Lille. In ten days they died without showing any modification. These embryos swim in the position described by Fritz Müller—that is to say, with the body recurved towards the ventral surface, and the sixth pair of thoracic feet projecting at the sides.

I incline to think, however, that with these animals, as with the other Bopyridæ, copulation takes place before the commencement of parasitic life. In most Isopods the male is smaller than the female; and sometimes the difference of size in the two sexes is very great. Several species of *Idoteæ* are remarkable in this respect. It has frequently happened to me to capture these animals in the muslin net; and almost always one meets with them in couples; the male, one third or one fourth the size of the female, is placed between the feet of the latter on the abdominal surface, absolutely in the same position as the male of the Bopyridæ. This is the case also with various Cymothoadæ; and in some species of this group it is necessary, as in the Bopyridæ, that copulation should precede parasitism. This occurs notably in a curious Javan species described by Herklots*.

In the course of this memoir I have several times alluded to a second new species of *Entoniscus*, which I have also met with at the Pouliguen, and which I have named *E. Moniezii*, dedicating it to R. Moniez, preparator of zoology at the Faculty of Sciences of Lille, who accompanied me in my journeys on the shores of the Loire-Inférieure.

This species appears to be very rare, since I have seen only two individuals of it—an adult female and another at a less developed stage (figs. 3, 4), both found in the same example of *Portunus puber*. This crab had been collected at the island of Leven, opposite to the point of Peu-Château and the open coast of Pouliguen. In order to find it again I have in vain examined several hundreds of the *Portunus* fished on the coast.

I have already indicated above some differences between this species and that of Cavolini in the stage represented (figs. 3, 4).

The adult individual unfortunately contained only slightly developed embryos; and I was unable to compare these embryos with those of the species from the *Grapsus*. The differential characters were furnished to me by the colour of the ovary and of the ovigerous sacs—peculiarities of which Fritz Müller ought to have made use to distinguish the various *Entonisci* parasitic on *Porcellanæ*. In *E. Moniezii* the ovigerous sac is of a nankeen-yellow, instead of presenting the greyish-yellow colour of *E. Cavolinii* at the same grade of evolution of the eggs. The ovarian gland is yellow with a rosy tint; it is straw-yellow in the parasite of the *Grapsus*.

* J. A. Herklots, "Deux nouveaux genres de Crustacés vivant en parasites des poissons: *Epicthys* et *Icthyoxenos*," Archives Néerlandaises, tome v. 1870, p. 120 (*Icthyoxenos Jellinghausii*).

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EXPLANATION OF PLATE X.

Fig. 1. *Entoniscus Cavolinii*, adult, natural size. V, ventral surface. D, dorsal surface; *t*, head recurved towards the belly; *o*, posterior extremity, also recurved towards the belly; $\alpha\ \beta\ \gamma$, ovigerous sac, through which the dorsal protuberances are distinguished; $\lambda\ \lambda$, anterior lateral protuberances; $\tau\ \tau$, posterior lateral protuberances; K, ventral ovigerous sac.

Fig. 2. The same, freed from the ovigerous pouches to show the form of the body. The letters have the same signification as in fig. 1. *c*, heart; *p*, *q*, *r*, prominences (traces of thoracic limbs ?).

Fig. 3. Young *Entoniscus Moniezii*, much enlarged, seen from the side. *o*, mouth; *l*, buccal ovigerous plates; *h*, hepatic cæcum; 1, 1′, the first two fringed abdominal lamellæ; 2, 3, 4, 5, last pairs of fringed lamellæ; *r*, rudiments of thoracic limbs.

Fig. 4. Embryo in the same stage, seen from the back.

Fig. 5. Head (*cephalogaster*) and mouth of *E. Cavolinii*, with its sucking-disks.

Fig. 6. Terminal joint of the sixth pair of thoracic feet of the embryo: *a*, of *E. Cavolinii*; *b*, of *E. cancrorum*; *c*, of *E. porcellanæ*. The last two from Fritz Müller.

Fig. 7. Section of *E. Cavolinii* towards the anterior third. *vd*, dorsal vessel; *h h*, hepatic cæca; *gl*, colleteric glands opening at the entrance of the ventral ovigerous sac.

Fig. 8. Terminal joint of the first five pairs of thoracic feet of the embryo of *E. Cavolinii*.

Fig. 9. Embryo of *E. Cavolinii* still in the egg. A, seventh thoracic segment still destitute of appendages; *pi*, line of pigment-cells.

Fig. 10. Embryo newly hatched. *c*, heart; *a*, terminal joint of an abdominal foot.

Fig. 11. Head of the embryo, showing the antennæ and the eyes. N, nauplian eye; *o*, *o*, *o′*, *o′*, the ordinary eyes.

Fig. 12. The nauplian eye much magnified. *l*, crystalline (double lens); *n*, optic nerve; *pi*, pigment-spot.

XVIII.—*On some Moot Points in Ornithological Nomenclature.* By Alfred Newton, M.A., F.R.S., &c.

Criticism by competent critics is the last thing of which an author ought to complain; and I am far from objecting to the spirit of the animadversions which Mr. Sclater and Mr. Seebohm, in 'The Ibis' for the present month, have made on certain birds' names used by me in the revised edition of Yarrell's 'British Birds.' Indeed I have to thank both those gentlemen for the friendly, not to say flattering, terms in which they are pleased to speak of my labours. It becomes me, however, to attempt to prove that I have not gone so far astray as they would lead their readers to suppose; and this, I trust, I may succeed in doing to the satisfaction of impartial judges.

Mr. Sclater begins his remarks ('Ibis,' 1879, p. 346) by regretting that I have not explained my reasons for adopting certain names in place of those usually current. To this my reply is, that, where space allowed me, I have done so, but that, in general, the amount of more important matter which I have had to insert has utterly precluded me from entering at any length on a subject like nomenclature, which interests but few persons—those few being experts, who commonly prefer investigating the subject for themselves.

My friend next touches the question of the type of the genus *Strix*. But here he has nothing new to offer, and contents himself with the opinions that had before been expressed thereon by Mr. Salvin and Mr. Sharpe. Of those opinions I need not say more now; for some years since I treated them in considerable detail ('Ibis,' 1876, pp. 94–105). To the remarks I then made Mr. Sclater does not refer. If he has forgotten them I freely forgive him the omission; if he has not forgotten them, I well understand that it may be easier to avoid than to answer the arguments therein adduced*.

We then come to the specific name of the Short-eared Owl, for which I have used that published by Pallas in 1771†.

* For those who may not have the third series of 'The Ibis' at hand, it may be convenient to state here that the two principal positions I maintained were:—

"(1) That the type, according to the modern notion, of the Linnæan genus *Strix*, is clearly and indisputably *S. stridula*.

"(2) That in subdividing a genus Brisson's right to affix its original name to the portion of it he chose is not affected by his exceptional position as regards specific names, and that the type of his restricted genus *Strix* is also *S. stridula*."

† Mr. Sclater says that herein "other authors have blindly followed" me. Who they may be I do not stop to inquire; but surely it is an assumption to infer that their eyes and opportunities of using them are not so good as his own.

Mr. Sclater expressly guards himself against affirming that the "*Stryx accipitrina*" of Pallas was *not* a Short-eared Owl; but he notices that its head is described as "*inauritum*," and that "no dimensions whatever are given." The latter statement "is not quite correct;" for Pallas begins his description with the words "*Magnitudo* circiter St. Vlulæ;" and as to the fact of his having overlooked the tufts with which the head of this species is furnished, he is neither the first nor the last ornithologist who has done the like—as witness Buffon (Hist. nat. Ois. i. p. 372, pl. xxvii.), and, with regard to the female, our own Bewick. Indeed, as every one must know who has handled fresh examples, its tufts are not generally seen till they are sought. Moreover Mr. Sclater asserts "that it does not appear that the *Strix accipitrina* was really ever obtained, but only 'observed.'" How then, I would ask, came Pallas to mention such a minute character as that of its *remiges* "extima sola serrata," unless he had pretty closely examined a specimen? But really to do away with any reasonable doubt as to what his bird was, we have his contemporary S. G. Gmelin, in 1774, giving (Reise u. s. w. ii. p. 163, pl. ix.) an effective and unmistakable figure of the species under that very name, and, speaking of various Owls he had met with at Astrakan, particularizing "wiederum eine besondere Art, die nach einem Privat-Schreiben des Herren Professors *Pallas* an mich in dem ersten Theil seiner Reise-Beschreibung unter dem Nahmen *Strix accipitrina* beschrieben seyn soll, dass ich von derselben auf der 9ten Platte nur eine deutliche Abbildung mittheile." The evidence thus afforded is irresistible, even if Pallas's description of the species, saving the omission of the tufts, were not quite as diagnostic as many descriptions I have elsewhere read of other Owls*.

The next point on which Mr. Sclater differs from me relates to the generic name of the Tawny Owl; but on this, from what I have above said as to the type of the genus *Strix*, I need not dwell, and so I pass to the question of the specific name of the Eagle-Owl. The erroneous statement that Thomas Forster "gave no such name" as *Bubo ignavus* to this species, and the ingenious hypothesis of that author's having published it "as a synonym which he did not adopt himself," might have been spared had my critic but looked further into the subject. In the second catalogue, wherein Forster says (p. 40) he has "founded a nomenclature," will be found (p. 46),

* Mr. Sclater also errs in asserting that Pallas "subsequently always called the Short-eared Owl *Strix ægolius*." In his 'Zoographia' he includes the species twice—once under the former name, but the second time (i. p. 322) under that of *S. ulula*!

in all the dignity of capitals, "BVBO IGNAVVS," as the author's deliberately adopted name for the Eagle-Owl, which no suggestion of its being in the first case a synonym can explain away! Perhaps Mr. Sclater may say that I ought to have added a reference to this fact; but it certainly never entered my head that the omission would mislead so well-read an ornithologist, and, accordingly, I thought it enough solely to quote the first use of the name, as is my custom*.

Lastly, as regards Mr. Sclater, I come to the case of *Athene* versus *Carine*. He rightly assigns the reason why I adopted the latter. *Athena* had a prior use in entomology, and no one can doubt that *Athena* and *Athene* are one and the same word, the difference of the final letter being merely dialectic. Now this is not so with *Pica* and *Picus*, which he cites as a parallel case. Those are perfectly distinct words, to which a perfectly distinct meaning has been attached from the days of Pliny to our own. I am sure Mr. Sclater is too good a scholar not to admit this fact on reconsideration; and that he objects to homonyms is evident by his substitution, in this very number of 'The Ibis' (p. 388), of *Calochætes* for *Euchætes*, because, though more than twenty years ago he conferred the latter on a Tanager, it had, more than twenty years before that, been applied to a Beetle.

The objections raised by Mr. Seebohm refer to another group of birds, the Warblers; and he has my fullest sympathy in his difficult task of trying to define it and of determining the names, generic and specific, which its different members should bear. Had I leisure to do so, there are several points in his article ('Ibis,' 1879, pp. 308–317), of far greater importance than nomenclatural quibbles, on which I would comment; for I confess that in some places I fail to catch his precise meaning; but here I shall limit myself to two, in which he has arrived at results differing from those I have reached.

The first of these concerns the specific name to be applied to the Greater Whitethroat. To the best of my belief, no other writer for the past sixty years and more has questioned the fact, that the bird represented by D'Aubenton (Pl. Enl. 581. fig. 1) was of this species†. Temminck, not once but twice,

* Mr. Sclater thinks that "the excellent name of *Bubo maximus*," bestowed by Fleming in 1828, should be adopted for this species. I have accordingly to remind him that Boie, six years earlier, called it *B. atheniensis* ('Isis,' 1822, p. 549), which looks as if Fleming's "name must therefore be rejected."

† There is an apparent but not real exception in Vieillot; for his *Sylvia fruticeti* is admittedly the Greater Whitethroat in autumnal plumage (*cf.* Degland, Orn. Eur. i. p. 536).

and that in both editions of his 'Manuel' (1815, pp. 113, 125; 1820, i. pp. 208, 226), spoke most positively on this point. Kuhl, Bonaparte, Gray, Gerbe, and others have cited the figure without hesitation, some of them more than once. Years ago I showed the plate to several of my ornithological friends, who were well acquainted with birds and also with the representations of them by draughtsmen of the period. No one of them but, after due examination, declared himself satisfied that the subject of the figure was a Greater Whitethroat taken in autumn. Indeed it cannot have been anything else; the rufous vertex, nape, and mantle, the rufous edging of the wing-feathers, coverts as well as quills, the white outer web of the external remiges are characters which admit of no mistake. And yet Mr. Seebohm not only asserts that "it is impossible to accept this figure as a clear definition of a Whitethroat," and "equally impossible to determine what bird stood as model for" it, but he suggests the serious charge that D'Aubenton "'evolved' the figure 'out of the depths of his moral consciousness,' and coloured it to agree with Buffon's description." This accusation seems to me groundless; and, for the credit of ornithology, I wish it were withdrawn. For more than a century D'Aubenton's draughtsman Martinet has enjoyed unblemished fame as a faithful portrayer who, if wanting in the artistic execution we have occasionally seen since, yet had skill to seize and reproduce the most characteristic features of any bird he figured, as he most certainly did those of the Greater Whitethroat in the plate which Mr. Seebohm, without adducing the slightest evidence, accuses him of drawing from imagination.

It remains to be said that the name *Motacilla rufa* bestowed by Boddaert applies solely to the subject of this figure, and not to any *Fauvette* or *Grisette* described by Brisson or Buffon. Mr. Seebohm's argument that Boddaert's name should be rejected on other grounds involves, I think, some confusion of ideas, upon which I need not dwell. Its admission would be incongruous with the rule of priority.

This same confusion of ideas seems to me to underlie some of Mr. Seebohm's remarks on the second point at issue, my having restored its Linnæan name to the Garden-Warbler; for the mistakes of subsequent authors form no valid objection to retaining it in its original sense. The state of the case is this. The *Motacilla salicaria* of the 'Systema Naturæ' rests actually on the bird described by that name in the 'Fauna Suecica:' synonyms have nothing to do with it; and here, as elsewhere in like cases, their consideration must be excluded. Turning to the work last mentioned (ed. 1761) we find the brief diagnosis quite compatible with that of the Garden-Warbler, and the description, which is much fuller than that given in the 'Systema,' incompatible in one character only—"*linea* albida supra oculos," while in other respects it fits the Garden-Warbler alone of all Swedish birds with which Linnæus was likely to have met. Mr. Seebohm considers that the phrase "superciliis albis" condemns the description; but I assure him he is in error, for *supercilium* does not necessarily mean an eyebrow, or still less a "superciliary stripe;" and the word is doubtless here used for the eyelids, which in the Garden-Warbler are clothed with white feathers. Again, the words "*Pedes fulvi*" form no part of the original description, while his suggestion that Linnæus's bird was an *Acrocephalus* is utterly at variance with the statements "*Rectrices* remigibus concolores," and "Habitat in sylvis," as well as with the closing remark of the description, "Avis valde affinis *Sylviæ* [*i. e.* the Greater Whitethroat], modo non sexu tantum distincta." Nilsson, unquestionably the best authority on the birds of Sweden, has never faltered in deeming the *M. salicaria* to be the Garden-Warbler *; and I cannot at all agree with my critic that, under all these circumstances, Linnæus "failed to define the species clearly," or that his description of it is invalidated by the single inaccuracy above noticed. As well might we declare that his *Falco haliaetus* is not the Osprey because he said of it, "Pes sinister semipalmatus" †!

I have thus tried, as briefly as I could, to answer the objections urged by my good friends, and, I trust, with some success, though I have not the vanity to suppose that I shall affect their opinions, for all must allow that a discussion on nomenclature is generally profitless. I cannot even say that I desire to make converts of them, since the names used by zoologists are almost a matter of indifference to me. I am simply striving to carry

* Herein Gloger (Handb. p. 243) and, it would seem, Lichtenstein concur.

† I said before that I had no wish to criticise such parts of Mr. Seebohm's paper as do not refer to myself; but I must remark that his comments on the *M. borin* of Boddaert seem to be beside the question. In almost every department of zoology we have long had local names brought into scientific nomenclature, witness *Lemur mongoz, Lanius tschagra*, *Coluber hadje*, *Rana pipa*, and *Salmo hucho*, among a multitude of others. The practice is not graceful; but *Motacilla borin* is hardly worse than any of the above, and quite as good as *Estrelda astrild*, *Hypsipetes ourovang*, or *Penelope marail*, which are in common use. I cannot help thinking that those writers who may hereafter forego the expressions *Sylvia cinerea* and *S. hortensis* will not do so in favour of *S. communis* and *S. simplex*, in spite of my friend's recommendation.

out strictly and honestly, so far as in me lies, the Rules set forth by the British Association, and this without regard to consequences. I only regret that the attempt involves so much toil and waste of time; but I will not prolong these tedious remarks on so trifling a subject; I will only say, I have no wish to be thought an infallible interpreter of those rules, and that I am no believer in nomenclatural finality; for I bear in mind that the truthful lines are here applicable :—

> "Critics I saw that others' names efface,
> And fix their own, with labour, in the place.
> Their own, like others', soon their place resigned,
> Or disappeared, and left the first behind."

Magdalene College, Cambridge,
July 11, 1879.

XIX.—*Description of two new Species of* Plectopylis, *a Subgenus of the Helicidæ.* By Lieut.-Colonel H. H. Godwin-Austen, F.Z.S. &c.

Among some specimens of *Plectopylis pinacis*, Benson, of large size from Darjiling, given me by Ferd. Stoliczka, are several smaller shells which no doubt are referable to *P. macromphalus*, W. Blf., var. *minor*, alluded to in the 'Journal of the Asiatic Society of Bengal,' 1870, p. 18. Mr. Blanford shows that it is quite distinct from *pinacis*, and, perhaps not having mature specimens of this Darjiling shell, considered it the same as the Khasi shell, to which it has a very great resemblance. I have now before me a very large number of this small form, also from Darjiling, given me to look through by Mr. G. Nevill; and on a closer examination the differences are well marked.

In a drawing made under the superintendence of Stoliczka the animal of this small form of *Plectopylis* is represented as of a pink colour.

In form the shell resembles *macromphalus*; but it may be distinguished by possessing a hairy epidermis, which, on microscopical examination, differs from *pinacis* in being laterally barred with brown, whereas *macromphalus*, in a large series, is uniformly coloured—also by the more distinct character of a ridge on the parietal side of the aperture, not present in the Khasi shell at its most advanced stage of growth. In most respects it is really a closer ally of *pinacis* from the same locality.

The second species is also supposed to have come from the same part of the Himalayas.

Helix (Plectopylis) minor, n. sp.

Locality. Darjiling hills.

Shell sinistral, openly umbilicated, discoidal, hirsute. Sculpture coarse, with irregular transverse ribbing, near the apex fine and regular ribbing; colour pale umber, with regularly disposed broadish transverse bars of sienna-brown; spire flat, only the first three whorls slightly rising above the others; suture shallow. Whorls five, subangular on the periphery of the last, which has four distinct rows of short hairs, entire at the point. Aperture oblique, slightly descending; peristome lunate, slightly flattened on the upper outer margin, but very little reflected, the inner margins connected with a distinct ridge on the parietal side.

The parietal vertical lamina is simple, with no distinct horizontal plica below it, as in *macromphalus*; the palatal plicæ are six in front, four behind, the basal one in front thin and longer than the others.

Plectopylis Hanleyi, n. sp.

Sikkim? No history; only one specimen, in the collection of Mr. Sylvanus Hanley.

Shell sinistral, depressedly conoid, openly umbilicated, probably hirsute when young. Sculpture coarse, irregular, transverse ridges. Colour uniform ochraceous. Spire conoidal; apex blunt, smooth. Suture well marked. Whorls six, close-wound, convex. Aperture semicircular, diagonal; peristome somewhat thickened, white, with a thin callus on the parietal margin, not to the extent of a ridge.

Size—major diam. 5·5, minor diam. 5·0, alt. 3·0 millims.

Parietal vertical lamina simple; palatal plicæ in two rows, four long in front, four short behind, and one basal long.

This shell is very distinct; it has somewhat the form of *P. plectostoma*, but is not so angular on the periphery, while the internal plication is quite different, besides being so very much smaller in size.

XX.—*On the Occurrence of* Neomenia (Solenopus) *in the British Seas.* By the Rev. A. M. Norman.

The translation of Koren and Danielssen's paper on *Solenopus*, in the 'Annals' for May, relates to a very remarkable new order of Mollusca. It will be of interest to your readers to learn that the type species has long been known to me as an inhabitant of the British Seas; and though at this moment

I cannot recall to mind with certainty other localities, I have undoubtedly met with it in the Shetland seas. Last year I also dredged it in the neighbourhood of Bergen, Norway, whence also Koren's and Danielssen's specimens came. The genus and species must in justice bear the name bestowed upon it by Tullberg, who published an accurate description, illustrated by two plates of figures of the animal and its anatomy, in 1875, at a time when M. Sars had only given the MS. name. The synonymy of the British species will be :—

Subclass OPISTHOBRANCHIATA, Milne-Edwards, 1848.

Order *Telobranchiata*, Koren and Danielssen.

Genus Neomenia, Tullberg, 1875.

(=*Solenopus* (Sars, MS.), Koren and Danielssen, 1878.)

1. *Neomenia carinata*, Tullberg.

1868. *Solenopus nitidulus*, M. Sars, Forhand. i Videnskabs-Selsk. Christ. p. 257 (name only, no description).
1875. *Neomenia carinata*, T. Tullberg, "*Neomenia*, a new Genus of Invertebrate Animals," Bihang til Svenska Vet.-Akad. Handl. Band iii. no. 13, pls. i. & ii.
1877. *Solenopus nitidulus*, Koren & Danielssen, Archiv for Mathematik og Naturvidenskab. Christiania, p. 6, and translated Ann. & Mag. Nat. Hist. ser. 5, vol. iii. p. 324.

Habitat. Norway (*Sars, Norman, &c.*); Sweden (*Lovén*); Shetland (*Norman*).

2. *Neomenia Dalyelli*, Kor. & Dan.

1877. *Solenopus Dalyellii*, Kor. & Dan. *l. c.* p. 10, and in Ann. & Mag. Nat. Hist. *l. c.* p. 327.
?1853. *Vermiculus crassus*, Dalyell, Powers of the Creator, vol. ii. p. 88, pl. x. fig. 11.

Habitat. Norway (*Sars, Koren*); North Atlantic, lat. 64° 9′ N., long. 6° 6′ E. (?), 157 fathoms (*Koren*); Scotland? (*Dalyell*).

It will be seen from Koren and Danielssen's paper that they regard this curious animal as a mollusk, though so much differing from previously known mollusks that it could not be included in any of the established orders. It may be interesting if I add here for comparison Tullberg's concluding remarks, after he has previously gone carefully into the anatomy; he says :—

"As regards the systematic position of this curious animal, some few remarks offer themselves; but it seems safer to defer all detailed discussion on this subject until more complete investigation shall have been made. As elsewhere, embryology will give the best clue to its affinities. At present the type of Mollusca and that of Vermes seem both to claim *Neomenia* as a distant relation, the latter perhaps with more right than the former. *Neomenia*, however, presents considerable deviations from both, in the absence of a radula, in the structure of the alimentary canal and of the nervous system, as also in other respects, as the form of the body and the spines of the skin."

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

March 12, 1879.—Henry Clifton Sorby, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "On Conodonts from the Chazy and Cincinnati groups of the Cambro-Silurian, and from the Hamilton and Genesee-Shale divisions of the Devonian, in Canada and the United States." By G. Jennings Hinde, Esq., F.G.S.

After a sketch of the bibliography of the subject, the author described the occurrence of Conodonts. In the Chazy beds they are associated with numerous *Leperditiæ*, some Trilobites, and Gasteropods; in the Cincinnati group with various fossils; and in the Devonian strata principally with fish-remains; but there is no clue to their nature from these associated fossils. They possess the same microscopic lamellar structure as the Russian Conodonts described by Pander. The various affinities exhibited by the fossil Conodonts were discussed; and the author is of opinion that though they most resemble the teeth of Myxinoid fishes, their true zoological relationship is very uncertain. The paper concluded with a classification of the Conodonts from the above deposits.

2. "On Annelid Jaws from the Cambro-Silurian, Silurian, and Devonian Formations in Canada, and from the Lower Carboniferous in Scotland." By G. Jennings Hinde, Esq., F.G.S.

After referring to the very few recorded instances of the discovery of any portions of the organism of errant Annelids as distinct from their trails and impressions in the rocks, the author noticed the characters of the strata, principally shallow-water deposits, in which the Annelid jaws described by him are imbedded. A description was given of the principal varieties of form and of the structure of the jaws. They were classified from their resemblances to existing forms under seven genera, five of which are included in the family Eunicea, one in the family Lycoridea, and one among the Glycerea. The author enumerated fifty-five different forms, the greater proportion of which are from the Cincinnati group.

April 30, 1879.—Henry Clifton Sorby, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "*Vectisaurus valdensis*, a New Wealden Dinosaur." By J. W. Hulke, Esq., F.R.S., F.G.S.

The author described some fossil remains, obtained by him in Brixton Bay, Isle of Wight, in 1871, consisting of an ilium, several pre-sacral, and one post-sacral vertebra. He established the Dinosaurian nature of the animal represented by them, and offered proof of its distinctness from already-known forms. He proposes for it the name *Vectisaurus valdensis*, a name descriptive of the locality and formation in which the remains were found by him. The characters presented by the genus *Vectisaurus* were stated to be as follows:—Ilium with a long compressed antacetabular process, having its greatest transverse extent in a vertical plane, and strengthened by a strong ridge produced from the sacral crest. Vertebræ in anterior dorsal region having opisthocœlous centres, their lateral surfaces longitudinally concave, transversely gently convex, meeting below in a blunt keel.

2. "On the Occurrence of the Genus *Dithyrocaris* in the Lower Carboniferous, or Calciferous Sandstone, Series of Scotland; and on that of a second Species of *Anthrapalæmon* in these Beds." By R. Etheridge, Esq., Jun., F.G.S.

The author, in the first place, referred to the extension of the range in time of the genus *Dithyrocaris*, by the discovery of numerous fragmentary remains of *D. testudineus*, Scouler, in the Calciferous Sandstone or Lower Carboniferous Series of the south of Scotland, about the horizon of the Wardie Shales near Edinburgh, and in the Cement-stone group of Roxburghshire.

A further and more complete description of *Anthrapalæmon Woodwardi*, Eth., jun., was then given, in which the characters of some of the appendages were more particularly alluded to, such as the eyes, inner and outer antennæ, and first pair of ciliate appendages, thus placing the stability of the species beyond a doubt.

The paper concluded with the description of a second species of *Anthrapalæmon*, from the Lower Carboniferous rocks of Roxburghshire, for which the author proposed the name of *A. Macconochii*, after the discoverer of the specimen. This remarkable species, of which the carapace is at present the only portion known, differs essentially in the characters of this part of the body from all the other described species of the genus.

MISCELLANEOUS.

Notice of a new Jurassic Mammal. By Prof. O. C. Marsh.

During a recent visit to the Rocky Mountains the writer spent some time in examining the deposits known as the Atlantosaurusbeds, and was rewarded by the discovery of several interesting fossils, among them the lower jaw of a small mammal. This specimen indicates a diminutive marsupial, quite distinct from the one previously described by the writer from the same horizon (*Dryolestes priscus*)*, which has hitherto been the only mammal known from the Jurassic of this country.

The present specimen, which is from the left side, has the larger part of the ramus preserved, with a number of perfect teeth in position. Most of the symphysial portion is lost, and the posterior part is missing or only faintly indicated. The jaw was remarkably long and slender. The horizontal portion is of nearly equal depth throughout, and the lower margin nearly straight. The form of the coronoid process, condyle, and angle of the jaw cannot be determined from this specimen.

The remarkable feature in this jaw is the series of premolar and molar teeth. These were very numerous, apparently as many as twelve in all, and possibly more. The premolars had their crowns more or less compressed and recurved; and some of them were supported by two fangs. These had a small posterior tubercle at the base of the crown, but none in front. The molar teeth were all single-fanged, with elevated conical crowns; those preserved have a distinct cingulum. The molars increase in size from the first to the fifth. All the teeth preserved have the crowns raised considerably above the upper margin of the jaw, and thus appear to be loosely inserted. A large pointed tooth lying near the jaw appears to be a canine.

The principal dimensions of this specimen are as follows:—

	millim.
Length of portion of jaw preserved	11·5
Extent of five molar teeth	4·0
Extent of entire molar series	5·0
Height of fifth true molar above jaw	2·0
Depth of jaw below fifth molar	1·75
Depth of jaw below last premolar	1·5
Depth of jaw below first premolar	1·4

In comparing this interesting fossil with the forms already known, it is at once evident that it differs widely from any living type. Its nearest affinities are clearly with the genus *Stylodon* of Owen, from the Purbeck beds of England †; and in many respects the correspondence is close.

This specimen clearly indicates a new genus, which may be called *Stylacodon*, and the species represented *Stylacodon gracilis*. With the genus *Stylodon*, this form evidently constitutes a distinct family, which may appropriately be termed the Stylodontidæ. The present specimen indicates an animal somewhat smaller than a weasel, and probably insectivorous in habit.—*Amer. Journ. Sci. & Arts*, July 1879.

* 'Annals,' July 1878, p. 108.

† Geological Magazine, vol. iii. p. 199 (1866), and Palæontographical Society, vol. xxiv. p. 45 (1871).

Alleged Evidence of the Moa from feathered Ornaments of Maori Weapons.

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

Gentlemen,—I have been favoured by a letter from Dr. Hector, F.R.S., dated "Wellington, New Zealand, 20th May, 1879," informing me that the paragraph from the 'Otago Daily Times' quoted in my 'Memoirs on the Extinct Wingless Birds of New Zealand,' vol. i. p. 448, relating to Dr. Hector's examination of weapons alleged to have been brought by Capt. Cook from New Zealand, is incorrect, and that the editor's remark, "strange that this evidence should have reposed in the cellars of the British Museum for a century," is quite unfounded, and that Dr. Hector "never made any statement that could possibly bear such construction as is implied by the writer of the paragraph in question."—R. Owen.

On the Metamorphoses of the Blister-beetle (Lytta vesicatoria). By M. J. Lichtenstein.

During the first warm days at the end of May or the beginning of June, Blister-beetles in copulation are common on ashes, privets, lilacs, &c., and when placed under a bell glass the females soon make an excavation in the earth and deposit in it a mass of some hundreds of rather elongated whitish and transparent eggs. In a fortnight these eggs hatch and furnish the larvæ long since known as *Triungulini*, and figured by Ratzeburg and others. They are scaly, dark brown, with the meso- and metathorax and first abdominal segment white. This larva has very acute jaws, black prominent eyes, and two long caudal setæ.

After several fruitless trials the author got them to feed at first upon the stomachs of honey-bees, and then upon eggs and young larvæ of various species of bees, especially *Osmiæ* and *Ceratina chalcites*. Care must be taken to add honey to the eggs or young larvæ, because animal food is only fitted for this first larval form, and the little *Triungulinus* seems to have an instinctive knowledge that it must not touch the egg or larva unless there is beside it sufficient honey to feed the form which is to succeed it. But when this condition is fulfilled the little animal at once attacks the egg or the larva, and is seen to increase in size rapidly.

On the fifth or sixth day it changes its skin. It loses its caudal setæ and its brown colour, and becomes a small hexapod worm; its jaws become obtuse, its eyes much less brilliant; it quits the animal food and begins upon the honey. Five days later there is a fresh change of skin, and the first modifications become still more strongly marked; the jaws become still broader, and the eyes more and more obliterated.

Five days later there is another moult, when the eyes entirely disappear, the feet and the jaws become brown and horny at the extremity, the insect acquires the aspect of a small larva of a Lamellicorn, and is evidently destined to burrow in the ground.

Up to this point the author reared the larvæ in small glass tubes like thimbles, corked and turned bottom upwards; and it was upon the surface of the cork that the above changes took place. He now employed a glass tube about 4 inches long and 1 inch in diameter, stopped at the bottom with a piece of sponge, and filled with earth, upon which he placed the Scarabæoid larva (as Riley has called the same stage in *Epicauta*). The larva immediately buried itself and formed, a little above the sponge, against the wall of the tube, a small chamber or cavity. In five days more a fresh change of skin took place, producing a pupa like that of a Muscide, having four small mamillæ at the apex, and three pairs of small mamillæ at the part where the legs were. Its colour is horny white; and it is motionless, looking exactly like a chrysalis. This state lasts through the winter, the only sign of life being the issuing from its pores, from time to time, of a transparent colourless liquid, which remains for some days at the surface of the body.

On the 15th April this pupa burst its envelope, and gave issue to a white grub, very like the Scarabæoid larva, but without its robust claws and jaws, only presenting rudimentary feet, each composed of three short and thick pieces. This grub moves slowly in its cell, but does not go out of it or eat. On the 30th April there is a fresh change, producing a nympha of the regular coleopterous type, having all the limbs recognizable. It is at first white, but soon becomes coloured; on the 17th May it was already very dark; and on the 19th the beetle was visible in the cell ready to make its appearance. The complete development of the insect thus occupies a year. The author believes that in nature the insect preys upon burrowing bees, such as *Halictus* and *Andrena*.—*Comptes Rendus*, May 26, 1879, p. 1089.

On the Systematic Position of the Volvocineæ, and on the Limits of the Vegetable and Animal Kingdoms. By M. E. Maupas.

Since the publication of the memoirs of F. Cohn upon the Volvocineæ, it seemed that the old debates respecting the systematic position of those Microphytes were closed for ever. Every one, in fact, had adopted the opinions of this naturalist; and in all the general treatises the Volvocineæ are arranged with the Algæ. Stein, in his fine volumes recently published upon the Flagellate Infusoria, recurs to the old view of Ehrenberg, and reclaims the Volvocineæ for the animal kingdom, placing them among the Infusoria. As this question affects important problems of cellular morphology and goes to the very heart of the controversy on the limits of the two organic kingdoms, I have thought it useful to make known to the Academy some observations and considerations opposed to the conclusions of the learned professor of Prague.

With Stein, the true criterion which enables a Protozoon to be distinguished from a Protophyte is the simultaneous presence of vibratile cilia or flagella, of contractile vacuoles, and of a nucleus in one and the same creature. The Protozoa alone, according to him, combine these three organs; no well-characterized plant possesses them together. He insists repeatedly upon this character, especially at pp. 37, 47, and 51 of the work above cited. It is on account of the simultaneous existence of these three organs, ascertained by all observers, and particularly by F. Cohn, in the Volvocineæ, that Stein has excluded them from the vegetable kingdom, and placed them among the Flagellate Infusoria. We shall find that this character is of no importance, and that it occurs in Algæ, upon the vegetable nature of which Stein himself would not venture to cast a doubt.

In the first place, it is useless to dwell upon vibratile cilia; every one knows that all zoospores are furnished with them.

I pass to the contractile vacuole. And here I cannot refrain from expressing my astonishment to see a naturalist so exact, and generally so well informed, as Stein still denying the existence of this organ (p. 47) in well-characterized plants. It has been seen by Leitgeb, De Bary, Fresenius, Strasburger, Dodel-Port, and Cienkowski in the zoospores of Saprolegnieæ, of *Cystopus*, of Myxomycetes, of Palmellaceæ, of *Ulothrix*, of *Hydrurus*, of *Chætophora*, &c.; I have myself indicated it in *Microspora floccosa* and *Stigeoclonium tenue*; and I am convinced that it will be found in many other zoospores if it is sought with high magnifying-powers and under good conditions of observation. At any rate, the numerous facts already ascertained are sufficient to refute the assertion of the celebrated professor of Prague.

There remains the nucleus; and Stein, in denying its existence in the zoospores of the Algæ, is in accord with everybody. All the observers who, since Thuret, have studied these organisms have been unable to discover a nucleus in them; and Strasburger, quite recently ('Botan. Zeitung,' April 25, p. 274), assumes that the nucleus of the zoospores of *Ulothrix* does not exist during its wandering period, and is reconstructed afresh at the moment of germination. I have tried to verify these assertions by the aid of very precise methods of observation, which I have long employed in the investigation of the nucleus and nucleolus of the Infusoria; and in the zoospores of *Microspora floccosa* and of an undetermined *Œdogonium* I have found a very distinctly characterized nucleus.

I placed upon the glass plate a small drop full of zoospores of *Microspora*, covered it with the thin glass, and drew away the water by aspiration, so that the zoospores were slightly compressed and rendered nearly motionless. I then cemented two of the opposite edges of the covering-glass with paraffin; and when it was well fixed I caused a drop of alcohol to penetrate beneath it by drawing off the water with bibulous paper. The zoospores were quickly killed, and retained by compression between the two plates of glass. I then replaced the alcohol with water, and the latter with saturated picrocarminate. In a few minutes, the action of the reagent being sufficient, I drew it off and replaced it by water, always by means of bibulous paper, and then replaced the latter by crystallizable acetic acid. This last reagent immediately clears the object; and there is then seen, in the rostral region of the zoospores, a small spherical nucleus of an intense red colour and very distinctly defined, the rest of the body remaining very pale. As the acetic acid is very volatile, one has only to place at the edge of the covering-glass a drop of glycerine, which penetrates and replaces the evaporated acid, preserving the form of the zoospores. We thus obtain a preparation which only requires luting to be rendered permanent.

With the zoospores of *Œdogonium*, of which I had only a small number, I followed a rather different method. I killed them by exposing the drop of water for a minute to the vapours of osmic acid of 1 per cent.; I then cemented them under the covering-glass by means of paraffin, coloured them with the picrocarminate, and afterwards cleared them with the acetic acid and glycerine. The action of the picrocarminate requires to be continued longer than in the method with alcohol. The nucleus, situated in the middle of the body, rather a little behind than in front, appears like a small red sphere.

These zoospores were killed during their period of mobility. The nuclei could not be confounded with the amylaceous corpuscles which are met with in many Volvocineæ besides the true nucleus. The amylaceous corpuscles never acquire a red colour in preparations made in accordance with the methods here employed. We have therefore to do with true nuclei, combined with vibratile cilia and with contractile vacuoles, in zoospores of Algæ. The two Algæ studied have zoospores belonging to two different types, those of *Microspora* being flagellate, and those of *Œdogonium* furnished with a circlet of vibratile cilia. I am persuaded that if the zoospores of the other Algæ are suitably investigated a nucleus will be found in in all of them.

The new criterion proposed by Stein for distinguishing the two organic kingdoms is therefore of no value. Moreover, to seek a well-defined boundary between plants and animals seems to me to be a search very little in harmony with all the recent progress of biological studies. The latest works all tend more and more to demonstrate that all the barriers which it had been attempted to raise between these two groups have nothing fundamental or real in them. From the physiological point of view, Claude Bernard has established incontestably the biological unity of the living world. The same conclusion springs from all the morphological results that we have attained. At present neither physiology nor morphology furnish any exclusive character belonging to one or the other of the two kingdoms. When we study the amphibiological creatures which swarm in the lower grades of the living world we may therefore sometimes be puzzled where to class them. It is necessary then to consider the totality of the characters; and, without having recourse to a third kingdom, we may almost always succeed in finding in them tendencies and affinities which enable us to assign them a place in the existing categories. It is by the consideration of these general characters that I am in complete accord with Cohn and other writers in classing the Volvocineæ among the Algæ, side by side with the Palmellaceæ, the Conjugatæ, and the Zoosporeæ.—*Comptes Rendus*, June 16, 1879, p. 1274.

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[FIFTH SERIES.]

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XXI.—*Remarks on the Recent* Eryontidæ. By the Rev. A. M. Norman, M.A.

I am sorry that Mr. Spence Bate's reply to my inquiries respecting the Crustacea described by him in a paper "On the *Willemoesia* group of Crustacea," which appeared in the 'Annals' of December last, has remained so long unnoticed by me. Unfortunately I have been so occupied by duties that I have had no time for writing since the commencement of the year.

Mr. Spence Bate's paper just referred to was on a subject of the greatest interest. In it were described a number of Crustacea discovered by the 'Challenger' in the abyss of the ocean, extremely closely related to a group of animals which, until recently, were believed to have been extinct for countless ages; for they had only been met with in old fossiliferous strata. The recent forms which have now been found are so closely the counterparts of their ancient brethren, that they mimic even minute details of sculpture in the several segments of the body. Yet, at the same time, I found conclusions drawn that were totally at variance with those at which I had arrived from the examination of two specimens of these animals which were dredged off the coast of Spain by the 'Porcupine' expedition of 1870.

Mr. Bate's conclusions were to me startling; but I did not venture to say that they were wrong, since, with the mass of material at his command, he had advantages in arriving at a definite opinion which I had not myself enjoyed. The matter, however, was of too great interest to pass by—of so much interest, not to myself only, but to many others, that it seemed the best way to ask Mr. Bate to give us further information upon the points in question.

I am well aware that the style of my writing was terse. I adopted the form of abrupt questions for brevity's sake; for I was compelled to compress my observations into the small space of three pages, which had been kindly accorded to me by the Editors of the 'Annals' at a late period, when the matter for the issue of the next month's number had already been determined on. I regret that it would seem that this brevity savoured to Mr. Spence Bate of discourtesy.

Whether he is in the right or I am right in the views which we respectively hold is a matter of no moment to myself, if only the discussion of the points in question tends to throw more light upon the subject.

My first and most important question was, "Are his genera *Pentacheles* and *Willemoesia* any thing more than the other sex of *Polycheles*?" The first words of the reply are, "Having just given a paper to prove that they are distinct and not one and the same species, I beg to repeat that *Pentacheles* and *Willemoesia* are not the other sex of *Polycheles*, and to refer to my paper for details." I have referred again to his paper, only to find, as before, that there was not one single allusion to sex throughout it. It was this very omission which, on first reading his paper, had led me to the suspicion that Mr. Bate had fallen into the error of regarding certain modifications of structure as of generic value, which really were dependent on and characteristic of the sex of individuals of the same species. The information, however, upon the question of sex which was wanting in the first paper has, in the second, been supplied. I will now state the grounds on which my own views were arrived at previously to the publication of Mr. Spence Bate's paper.

1. *The known examples with the last pereiopods simple* (Polycheles, *Bate*) *were males, while those which had the last pereiopods chelate or subchelate* (Pentacheles *and* Willemoesia, *Bate*) *were females*; *thus* :—

A. Males, with last pereiopods simple.

a. *Polycheles typhlops*, Heller. The type specimen was a male, and has the last pereiopods simple.

b. *Willemoesia crucifera*, Suhm, a male; last pereiopods simple.

c. *Polycheles typhlops*, Heller. A male from the 'Porcupine' expedition, which I had examined, is characterized by the last pereiopods being simple.

B. Females; last pereiopods chelate.

d. *Polycheles typhlops*, Heller. A specimen dredged by the 'Porcupine' expedition.

e. *Willemoesia leptodactyla*, Suhm. A female, having the last pereiopods chelate. This specimen is said by Suhm to be a male; but it is clear that he fell into an error as regards the sex; for he says "at the coxal joint of the third pereiopod are the genital openings," which statement, together with his figure (pl. xiii. fig. 2) of the first pleopod, clearly prove that the type specimen was a female.

It will thus be seen that before the publication of Mr. Bate's paper all known specimens which had simple last pereiopods were males, while such as had those limbs terminated by chelæ were females.

2. *That the male* (c) *and the female* (d) *represent the two sexes of one and the same species, and that therefore the achelate or chelate character of the last pereiopods is a modification dependent upon sex.*

I stated in my former note that I considered the two specimens taken by the 'Porcupine' expedition (see Proc. Roy. Soc. 1870, p. 154) to be male and female of *Polycheles typhlops*, adding, "my conclusion that their difference is sexual may be wrong." Mr. Bate has commented on these words as though I did not know the sex of the individuals examined; but to any one who reads the whole passage it will be at once obvious that my argument was that those structural differences which he regarded as generic I found to accompany difference of sex, and regarded as sexual. The following detailed description of this male and female will enable other carcinologists in some degree to form their own opinions.

Polycheles typhlops, Heller *.

1862. *Polycheles typhlops*, Heller, Beiträge zur nähern Kenntniss der Macrouren, Sitzungsberichte der Akad. der Wissensch. math.-nat. Cl. Bd. xl. Abth. 1, p. 389, pl. i. figs. 1–6.

1863. *Polycheles typhlops*, Heller, Crustaceen des südlichen Europa's, p. 211, pl. vii. figs. 1, 2.

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* If Heller's figures are absolutely correct, the form here described is a different species; but with present knowledge I do not feel justified in giving it a different name to that under which I recorded it in the 'Porcupine' Report (Proc. Roy. Soc. 1870, no. 125, p. 154).

Male. Anterior margin of carapace with a strong central spine, flanked on each side with another spine; *lateral margin* bearing seven spines on anterior (hepatic) portion, five spines on the middle division, and about twenty on the branchial portion; *central dorsal line* spined, spines arranged in single or double files, thus—1 (the rostral), 1, 1, 2, 2, 2, 2*; *hinder margin* bearing six spines—the median pair, and on each side of these two spines; a curved row of five spines passes backward from the ocular notch; and a ridge crowned with about fourteen minute spines runs along the branchial region parallel with the lateral margin; still more minute spines are also present on the ridges which divide the gastric from the cardiac and branchial regions and other parts of the carapace. The *pleon* has the first five segments centrally carinated, with a large forwardly curving spine at the anterior end of the carina of each segment; this spine attains its greatest development on the fourth and fifth segments; sixth segment bicarinated, the carinæ nodulous; the sides of all the segments ornamented with small rounded tubercles. *Telson* gradually tapering to an acute termination, its anterior portion with a central carina, while the hinder portion is bicarinate, the carinæ slightly serrulate. *Gnathopods* imperfect; the base of one remains as far as the middle of the meros, the outer margin of portion of the meros which remains bears several small spines. *Last pereiopods* with the extremity simple, styliform, much shorter and more slender than the preceding pair. *First pleopods* one-branched, simple, spoon-shaped, the expanded portion thin and transparent, with a central rib. Length 60 millims.

Female in all its general characters and the structure of its limbs closely resembling the male just described, but differs as follows:—*Cephalothorax* bearing on front margin a pair of central spines (instead of a single spine); lateral margin with the spines 6, 3, 8; central dorsal row 2 (rostral), 1, 2, 1, 2, 2, 2; no spines on hinder margin, except the central pair; five spines on hepatic and gastric regions as in male; ridge on branchial region with only five spines; the smaller spines present on the carapace of the male are absent or evanescent. The *pleon* is carinated and armed exactly as in male, and only differs in the minute tubercles on the sides not being developed. *Ocular notch* deeper than in male. *First pereiopods* with two spines on the outer margin of the meros, and a

* These are only the more prominent spines; the intermediate spaces between them are furnished, as are all other parts of the carapace, with minute spines, any one of which, a little more developed, would make such a spine as would be counted in the row.

single distal spine on meros, carpus, and manus; lower margin of manus spinulated, edge of finger minutely and exquisitely serrated. *Last pereiopods* much smaller than the others, chelate, the finger longer than the thumb. *First pleopods* with the terminal portion styliform. Length 50 millims.

Male taken off Portuguese coast in 220 fathoms, 'Porcupine' Exped. 1870, Station 13, lat. 40° 16′ N., long. 9° 37′ W.; female in 257 fathoms (Station 8, lat. 48° 13′ N., long. 9° 11′ W.) on the Channel slope.

Now these two crustaceans show a very close resemblance to each other in all general characters, while the points of divergence are only such as might reasonably be expected to result from difference of sex and of size; and I cannot feel myself justified in regarding them as belonging to two species; and still less am I prepared to place them in two genera. The female is much smaller than the male; and this fact and the difference of sex may well account for the less-pronounced character of the spinous adornment of the carapace in the former: it will be observed that the arrangement of the lines of spines is the same in both. I have gone into very minute detail as to the number of spines which compose the rows, because it is only here that any difference can be detected; but no species-splitter has yet gone so far as to base character on such minutiæ as these. The male before us, indeed, proves from its own carapace that stress must not be laid on such points; for while one lateral margin has seven spines on the hepatic region, the other has eight. The one important point of distinction between the two 'Porcupine' *Polycheles* is the character of the last pereiopods. Is, then, the achelate or chelate structure of these limbs a difference resulting from genus or sex?

3. *Sexual diversity in the last pereiopods of the male is a common feature among the Crustacea.*

The male sexual organs are situated at the base of the last pereiopods; and while many organs, both of the cephalothorax and pleon, undergo frequently the most remarkable modifications, as indirectly subservient to the sexual functions, in few organs are these modifications more general or more remarkable than in the last pereiopods. Many instances might be cited among the higher Crustacea, while among the Copepoda the varied and peculiar modifications of these limbs in the male are found to be of no small importance in the diagnosis both of genera and of species.

4. *Male Crustacea are constantly found to differ from their females by structural differences which, in the aggregate, are far*

more remarkable than those upon which specific and even generic characters are usually based.

This is now so fully proved that it may be laid down plainly as an axiom. As instances of extraordinary divergence in form and structure between the sexes it will suffice to name the order Cumacea, the Isopoda (*Bopyrus*, *Phryxus*, *Gyge*, *Ione*, *Cryptotheria*, *Anceus*, *Tanais*, *Apseudes*, *Næsa*, &c.), the parasitic Copepoda (*Chondracanthus*, *Brachiella*, *Lernanthropus*, *Lernæopoda*, *Anchorella*, *Strabax*, *Medisecaste*, *Diocus*, and their allies), the Cirripedia (*Ibla* and *Scalpellum*). It would be a long task to attempt to enumerate the multitude of instances in which the different sexes of Crustacea have been described as different species, very often belonging to different genera.

These are the grounds on which the conclusion was arrived at that the chelate or achelate character of the last legs of those recent Eryontidæ which I had seen and of those which had been described was indicative of the sex to which the individual belonged and had no further importance.

Have Mr. Spence Bate's papers changed my views? In his first paper, I repeat, there was not a statement to make me modify it in the slightest degree, inasmuch as the sex of the specimens described was in no case given, while forms were described which apparently closely corresponded in all particulars save in those which he regarded as generic, but which I took to be sexual. I therefore considered that his paper, so far from weakening, gave strength to the opinion which I entertained.

In his second paper, however, in which he was good enough to reply to my inquiries, Mr. Bate has given us the sexes of the species he has examined; and a first glance at the list might seem to argue that he had completely proved his point, and that the divergences were generic and not sexual.

To those, however, who know much of the life-history of the Crustacea the statement will not seem *necessarily* to be quite conclusive.

There are certain rules which should be borne in mind in the study of the Crustacea which seem now to be fully established, and which I will proceed to lay down.

a. *Among the Crustacea, for every female we must be prepared to find, and shall often find, two forms of males.*

b. *One of these males may be expected to resemble the females more or less closely, and will perhaps only be distinguishable by examination of the sexual organs themselves; the other form will exhibit varied and very marked points of divergence from* *the female, sometimes in general contour, but more especially in the structure of the limbs.*

c. *Different limbs will be thus sexually modified in different groups or in different genera; and these modifications become valuable for the classification of families and genera, while the exact mode of the modification of the particular limb is of much use as specific character.*

d. *In the case of dimorphous males, the males most closely resembling the females are either immature or, in some instances perhaps, where the males are as large as the adult females, sterile. The second form of male, which is widely divergent from its female, is the fully developed sexual individual*; and the alterations of structure are exhibited sometimes in a very different form of carapace, but always in specialized development of certain appendages, which may be either antennæ, mouth-organs, gnathopods, pereiopods, pleopods, or uropods, which become indirectly subservient to the discharge of the function of the impregnation of the female. It is often only at the final moult of the male that these peculiar specialized characters of sex are assumed.

e. *From the time of the assumption of the complete sexual character, in some (rare) cases the discharge of the sexual office would seem to be the only thing remaining for the life of the individual, the function of alimentation in part or even wholly ceasing.* This extreme case, however, has, I believe, as yet been observed only among the order Isopoda, where we find instances in *Anceus* (Hesse and others), *Tanais* (F. Müller and A. M. N.), *Apseudes* (G. O. Sars, in *Aspeudes anomalus*).

Dimorphous males are known to us in genera of Macrura, Cumacea, Isopoda, Amphipoda, Copepoda, Ostracoda, and perhaps Cirripedia ("complemental male," Darwin).

One instance may now be referred to, because it has reference to that group of genera, the Astacidæ, to which it was stated, in my former notes, that I agree with Heller in considering *Polycheles* to be perhaps most nearly related.

The freshwater crayfish, *Astacus*, of Europe has its closely allied counterpart in North America in the genus *Cambarus*. In this genus, though not as far as is known in *Astacus*, two forms of the male occur.

The following passage from Hagen will speak for itself:—
"The discovery that every species of *Cambarus* possesses two different forms of males was made by Prof. L. Agassiz, and kindly communicated to me.

"The existence of a second form of the male, if it were no more than a passage or metamorphic form, would not be extraordinary. But the great number of full-grown second-form specimens in every species, which are often even larger than the first-form males, seems to prove that they are individuals which have remained in a sexual stage that does not agree with their corporal development—in short, that they are perhaps sterile.

"The objection that these second-form males may be individuals shortly before or shortly after the casting of the skin, I can surely refute, as I have seen many specimens at this stage of growth, the museum collections exhibiting the animal in all the different phases of its existence.

"Another objection, that the males of the second form, or perhaps those of the first form, are abnormally developed individuals, is refuted by the great number of the two forms existing and living together.

"The conjecture, on the other hand, that the second-form males may be sterile, is really supported by the anatomical examination of the two forms in the principal groups of *Cambarus*" *.

Not only so, but Hagen tells us of two forms of the other sex, and that in certain abnormal females he finds "a tendency to a more masculine development, as in the aforesaid males a tendency to a feminine development" †.

Mr. Bate informs us that he has females of six species of *Willemoesia* and *Pentacheles* (that is, with chelate last pereipods) and males of two, and that he has males of three species of *Polycheles* with simple last pereiopods, and females of two. As far as members go (but, of course, numbers are of little or no value), this gives 9 to 4 in favour of my view.

The exceptions are that he has males of *Willemoesia leptodactyla* and *Pentacheles Suhmi* with chelate last feet. I have hinted in this paper, from what we know to occur among other Crustacea, that these males may be either immature, and, not yet having attained their full sexual characters, exhibit still the female form of the limb, or that they may be instances of dimorphous (sterile) males. Indeed it would seem that Mr. Spence Bate is not without doubts as to the location of some of the forms he has described as species; for immediately after the list he adds, "For some time I was hesitating where several species of *Pentacheles* should be placed, as there is a regular gradation from the imperfect to the perfect chelate character of the fifth pereipod; but as I found *Polycheles*, both male and female, with the simple non-chelate foot,

* Hagen, 'Monograph North-American Astacidæ,' 1870, p. 22.
† Hagen, *l. c.* p. 17.

at present it appears to me that there is no arrangement so constant as that which I propose."

The other exceptions occur in *Polycheles* (as that genus is defined by Bate), in two species out of three of which he has females with styliform last feet. On examining the figure of *Polycheles crucifer* which accompanies Suhm's paper, it would seem that the inner antennæ are without the scale which is characteristic of *Polycheles* of Heller, and which I stated in my former notes to be the chief character that seemed to separate *Polycheles* from the supposed extinct genus *Eryon*. Can it be that *Polycheles*, as defined by Bate, with simple last pereiopods in both sexes, has the inner antennæ without a scale, and is in reality *Eryon*? It would be of especial interest should it prove so; but I am not sure that Bate's fig. 6 does not show the antennal scale to the left of the figure; but in that case it is very remarkable from having a deeply serrated edge.

It seems necessary that I should add a few words respecting the homologues of the eyes in these Crustacea. Mr. Spence Bate has very kindly sent me a copy of plate xiii., in which he has lettered what he considers to be the eyes in the several figures. They are not the same organs which Heller took to be the rudiments of the eyes; and I venture to think that Bate is right and Heller wrong in his homology. But that these organs are used for vision I cannot conceive to be possible. It will be found among the stalk-eyed Crustacea that loss of vision and consequent change of function in what would ordinarily be the eye is accompanied by one or other, or by both, of the following modifications:—1st, *that the eyestalk is no longer movable, but becomes firmly fixed in the socket*; 2nd, *that the eye assumes a difference of form, and is either* (a) *narrower and pointed, instead of club-shaped at the extremity*, and so employed (in some instances at any rate) as an organ of offence, as in *Ethusa granulata*, Norman, or *Cambarus pellucidus*, Tellkampf, *or* (b), *on the other hand, becomes expanded and flattened into a plate*, examples of which may be found in the genera *Pseudomma*, G. O. Sars, *Amblyopsis*, G. O. Sars, and *Petalophthalmus*, Suhm.

Now, in the Crustacea which we are considering, Mr. Bate says, the "eyes" are "immovably lodged," and "the peduncle throughout the group is reduced to a minimum and fixed as a rigid part of the dermal structure;" and with respect to form in *Willemoesia leptodactyla* they would seem, from the figure given, to be not unlike those of *Calocaris McAndrei*, Bell; while in *Pentacheles enthrix* and *Polycheles crucifer*, instead of being club-shaped as in veritable eyes, they terminate in a long acute point in the one case, and in a "long obtuse point" in the other. The reason why, in my former note, I was not in a position to deny positively that these extremely rudimentary organs had lenses, was because, although the 'Porcupine' specimens showed not the slightest trace of lenses, yet, as they had been preserved in glycerine and subsequently transferred to spirit, it was possible that this treatment might have destroyed lenses which had existed.

Mr. Bate inquired whether I could say there were eye-stalks in the young of "*Astacus? zaleucus*, Willemoes-Suhm, *Nephropsis Stewartii*, Wood-Mason, and the blind prawns of the North-American caves." Of the first two only the type specimens are known. It is hardly likely, therefore, that I should be acquainted with their young. With respect to the "blind prawns of the North-American caves," I know of no such Crustacea; and suppose that "prawns" was a slip for "crayfish," and that he refers to the *Cambarus pellucidus* of the Mammoth Cave of Kentucky. That crustacean has eyestalks not only when it is young but in maturity also. "Like the other animals living in caves, it is blind. The eyes are atrophied, smaller at the base, conical, instead of cylindical and elongated as in the other species. The cornea exists, but is small, circular, and not faceted; the optic fibres and the dark-coloured pigments surrounding them in all other species are not developed"*.

XXII.—*Notes on the Palæozoic Bivalved Entomostraca.* No. XIII. Entomis serratostriata *and others of the so-called* "Cypridinen" *of the Devonian Schists of Germany.* By Prof. T. Rupert Jones, F.R.S., F.G.S.

[Plate XI.†]

Introduction.—In the 'Annals and Magazine of Natural History' for June 1873, pp. 413–416, is a list of the species of *Entomis* with which I was acquainted at that date. These included several *Devonian* species from Germany, and *Silurian* species from Bohemia, known to me from figures only, as well as some British *Silurian*‡ and *Carboniferous* species which

* Hagen, *l. c.* p. 33.

† This Plate has been drawn under a grant from the Royal Society for the illustration of fossil Bivalved Entomostraca.

‡ *Entomis aciculata*, op. cit. p. 416, was from Peeblesshire, not the "Pentland Hills."

had come under my notice. Having expressed a difficulty* in mastering the description of figures of the so-called "Cypridinen," published in 1856 ('Beitr. Pal. Thür. Waldes') by my friend Dr. Richter, of Saalfeld, I was most courteously favoured by him with a good set of specimens for examination early in 1874. Some, indeed, of these were types of species published in 1869, in his paper on the Devonian Entomostraca of Thuringia†, which memoir had escaped my observation until after my "Notes on *Entomis*," &c. were printed in 1873. In the meantime, before Dr. Richter's specimens reached me, I was so much struck with the peculiarity of the Entomostracan structures figured in the 'Zeitschrift' of 1869, that I could not but believe some peculiar generic form, occurring in the Thuringian strata, had been elaborated by my friend; and I suggested, in the 'Neues Jahrbuch für Min.' &c. 1874, 2. Heft, p. 180, that his name should be associated with it in the term *Richteria*.

After a long study of Dr. Richter's specimens, having taken them up again and again during the last four years, as new information on analogous and collateral materials become available, I cannot find any reason to support the establishment of my proposed genus "*Richteria*;" for the typical specimens show merely the conformation and characters of *Entomis*; and lately Dr. Richter has informed me that he now refers his so-called "Cypridinen" to that genus.

Description.—Two separable valves, oblong-ovate in outline, ornamented with longitudinal and subconcentric riblets, and impressed externally with a more or less pronounced nuchal or dorsal furrow, ending in a small and often obscure pit at about the middle of the valve, constitute the best preserved remains of the Devonian *Entomides* under notice.

The pressure, both vertical and lateral, to which the Devonian schists have been subjected very rarely leaves these little fossils in their original shape; and the material of the valves has almost always disappeared, leaving hollow external moulds and convex internal casts. The former show the delicate costulation of the valves; the latter are usually smooth and rarely bear any of the external ornament. Flattened by perpendicular pressure, and lengthened, shortened, or otherwise distorted by lateral pressure in different directions, the natural ovate form is seldom preserved, but is replaced by every modification from subcylindrical to circular and oblique-oval

* *Op. cit.* p. 415, note.

† 'Zeitschrift deutsch. geol. Gesellsch.' Jahrgang 1869, pp. 757–776, pls. xx. & xxi.

shapes. In some cases the dorsal notch is nearly obliterated by vertical pressure; and in other instances it is exaggerated by horizontal squeezing, when the valve becomes shortened to a small subglobular mass, and the two ends of the valve are made to approach each other.

The real outside of a valve is very rare. The convex costulate specimen (fig. 8), even, may be destitute of the external coating. Hollow impressions of the surface, sometimes with remains (or mineral replacements) of the test adhering thereto, are common; and the interior of these moulds usually has the ridge and knob, or some indication of them, which are due to the nuchal incurving of the test. It is possible that on the exterior this feature was not nearly so strong as within, being due as much to a local internal thickening of the substance as to a bending-in of the shell. It was, however, always sufficiently defined to form a weak line when the valves were shortened by being squeezed endwise (see figs. 3, 15, 16).

The convex casts of interiors are destitute of riblets, and sometimes (in the Saalfeld specimens) bear only a central pit, corresponding with the central knoblet of the hollow ribleted moulds. Thus these insides of valves appear to have been smooth, with a small central tubercle, and no definite trace of the external nuchal sulcus, which, however, gives a distinct mark on internal casts of valves bent and shortened by terminal pressure, as mentioned above. In specimens from other localities the smooth convex casts bear the nuchal furrow and no definite central pit.

None of the smooth convex casts with a pit only are figured here, but are recognizable in some of the published illustrations, as in Richter's 'Beitrag' &c. pl. ii. fig. 2.

Many similar smooth convex casts, but bearing the nuchal furrow, are present in a drab mudstone of the "Cypridinen-Schiefer" from Nassau (formerly in Mr. Daniel Sharpe's collection), and are oblong-oval, narrow, oblique, or quite round*, according to the direction of the lateral (horizontal) pressure to which they have been subjected.

The longitudinal wrinkling of the surface of the valves varies in the number, arrangement, smoothness, and thickness of the riblets or costulæ. They may be quite even and smooth (fig. 18 *b*), slightly roughened (figs. 6 *b*, 7 *b*, and 8 *b*), crenulated (figs. 1 *b* and 5 *b*), and even serrated (fig. 4 *b*; see also 'Zeitschr.' 1869, pl. xx. fig. 10). The indentations are sufficiently coarse and defined in some specimens of these hollow moulds

* Such as are figured by Richter, 'Beitrag' &c. pl. ii. figs. 28, 31, and 'Zeitschr.' 1869, pl. xx. fig. 7. See also our figs. 3, 15, 16.

to appear as minute pits, like the bases of hollow spines* (fig. 4 *a*). In the Nassau specimen, referred to above, these little pits are, in many of the hollow casts, very numerous, strong, and regular.

In thickness the riblets vary considerably; so that we may count 36 on some valves (figs. 2, 6)—and on others, of about the same size, 30 (fig. 4), 28 (fig. 9), 22 (fig. 8), 20 (fig. 18), 18 (fig. 11), 16 (fig. 12). On smaller valves, with the *thin riblets*, we find 22 (fig. 5), 18 (fig. 14), 16 (fig. 13); and on a small valve of the *thick-wrinkled* kind there are 18 (fig. 10).

As to the arrangement of the riblets, the typical pattern is a parallel longitudinal folding, with turns of the middle riblets (either backwards and forwards, or irregularly concentric) near the ends of the valves, and a continuous concentric wrinkling at the margins. There are usually two terminal centres of curves or folds; but they may be modified or obliterated by pressure. The whole series of riblets in some cases appears to be naturally subcircular and concentric (figs. 2, 6, 9).

The differences in *essential* characters among these Devonian *Entomides* cannot be regarded as very great. The modifications of shape can be recognized as distinctive only in so far as some specimens (such as figs. 1, 2, 5, 7, 13, 14) are more elongate and almond-like than others. Pressure in several directions has interfered with the outlines, often to a puzzling extent. The sculpturing has many gradations of pattern. Perhaps the only tangible distinctions are:—(1) between the valves with strong (figs. 4, 8, 10, 11, 12, 18), and those with feebler riblets—the former kind usually accompanying the oblong, and the latter the almond-like shape of valve; (2) among the latter, between the parallel (figs. 1, 5, 7, 13, 14) and the concentric arrangement of the costulation; (3) among the last, between the almost simple concentric (figs. 2, 6) and the more labyrinthic (fig. 9) pattern.

I have not been able to make out the intimate structure of the valves as described and figured by Dr. Richter in the 'Zeitschr.' 1869; nor can I agree with the determination there given of their parts and features. The "back-views" of the test are to me the side-views of individual valves, not showing the nuchal furrow, either because it is wanting on the outside of the valve (?), or because it is obsolete or obliterated by pressure. The suborbicular forms, shortened by pressure from end to end, were referred to in the memoir as "female" individuals, and the nuchal or dorsal furrow as a transverse

* Such a spinous surface, indeed, is indicated in Richter's 'Beitr. Pal. Thür. W.' pl. ii. f. 34; *C. gyrata*, p. 36.

ventral slit (like the opening of the hood in some Phyllopods), crossed by a bridge of shell-matter. Dr. Richter's views of the relationship of the so-called "Cypridinen," described and figured in the 'Zeitschrift' for 1869 are there given with some doubt; and we now know (see above, p. 183) that he refers them to *Entomis*.

EXPLANATION OF PLATE XI.

Fig. 1. Concave cast, with faint knob and ridge (the latter extended by pressure). Furrow-casts interrupted by slight indentations due to the serrulation of the riblets. Richter's pl. xx. fig. 10 (Zeitschr. 1869) makes the nearest approach to the typical interruption of the furrow-casts. This specimen (referred by Dr. Richter to "*C. serratostriata*"), is in a red schist, with many casts, hollow and raised, elongate, oval, and round.

Fig. 2. Concave cast, squeezed so as to give the furrow-casts a lozenge-shape arrangement. On similar schist to that of fig. 1, and referred to the same species. It may be the same as fig. 6 ("*tenella*"), or possibly fig. 9 ("*labyrinthica*").

Fig. 3. Convex smooth cast (marked with sand-granules only) of a valve squeezed up endways on itself, with the nuchal depression exaggerated by the pressure, and a mark below of the test broken across. With fig. 1, and referred to the same species.

Fig. 4. Shallow concave cast, with faint irregular knob and ridge. The furrow-casts are much interrupted by what seem to be the bases of external spines, along the internal lines. On reddish-grey schist. This is referred by Dr. Richter to "*C. gyrata*."

Fig. 5. Small hollow cast, with ridge and slight knob. On red schist, with numerous casts, both raised and sunken, long, oval, and round. On this hand-specimen occur such smooth convex casts, with central pit, as that shown in Richter's 'Beitrag,' pl. ii. fig. 27. Referred to "*C. scrobiculata*, Richter," but probably *E. serratostriata*.

Fig. 6. Hollow casts of a pair of opened valves, with ridges within, which represent the nuchal furrow of each valve. In dull purplish-red schist. Referred to "*C. tenella*, Richter," but corresponding in some respects with "*C. labyrinthica*," Richter (see fig. 9). The smoothness of the delicate costulæ and their circular arrangement may be distinctive features; but, on the other hand, these may possibly be modifications from pressure. The figured "*tenella*" ('Zeitschr.' 1869, pl. xx. fig. 11) has concentric riblets; but they are pitted.

Fig. 7. Hollow cast (somewhat crushed) with ridge and knob. In dark-grey schist, with both concave and convex casts, variously squeezed. Referred to "*C. tæniata*, Richter," but probably *E. serratostriata*.

Fig. 8. Convex, somewhat flattened, cast; in purplish-grey schist, with both raised and hollow casts, but low and shallow. Riblets strong and slightly serrulate. Referred to "*C. gyrata*, Richter."

Fig. 9. Shallow hollow cast, with the furrow-casts much modified by pressure. In pale purplish-grey schist, with a few shallow and imperfect casts. Referred to "*C. labyrinthica*, Richter," with the figure of which (in 'Zeitschr.' 1869, pl. xx. fig. 12) it agrees as to the branching and anastomosing of the concentric costulæ.

Fig. 10. Small, oblong, hollow, cast, with ridge reaching all across, owing to unequal pressure. Furrow-casts broad; internal lines here and there showing indications of bases of spines. On reddish schist, with many modified casts. Referred to "*C. tæniata*," and somewhat corresponding with 'Zeitschr.' 1869, pl. xxi. fig. 1, but unlike our fig. 7, which is referred to the same.

Figs. 11, 12. Hollow casts, with ridges and knobs faint; furrow-casts broad; costulæ thin and slightly irregular. In dark purplish-red schist, with similar casts, variously modified as to shape by pressure, and with numerous inner and outer moulds of annulated Tentaculites. Fig. 11 shows a specimen somewhat shortened by pressure. These are referred to "*C. serratostriata*," but apparently belong to the more oblong form, with coarser furrows, which more nearly corresponds with *Entomis gyrata* (Richter).

Figs. 13, 14. Small, almond-shaped, hollow casts, much like fig. 5, and on the same hand-specimen. Referred to "*C. scrobiculata*," but probably belonging to *E. serratostriata*.

Fig. 15. Outline of a small smooth cast of a shortened valve; others of a larger size occur on the same slab, which bears also the specimens figs. 5, 13, 14, 16. Referred to "*C. scrobiculata*," but probably belonging to *E. serratostriata*.

Fig. 16. Small, convex, smooth, subglobular cast, of a squeezed-up and shortened valve, with central pit and furrow, exaggerated by terminal pressure. On the same piece of red schist as that yielding figs. 5, 13, 14, 15. Referred to "*C. scrobiculata*;" probably *E. serratostriata*.

Fig. 17. Outline of a broken hollow cast of the dorsal edge of two united valves, with a slightly raised seam along the junction of the valves, and a very faint cross ridge. In reddish-grey schist, weathering brown, with Tentaculites, and numerous casts, both raised and hollow, of *E. serratostriata*. The specimen is marked "Ventralseite von *C. tenella*;" but it is the dorsal, and not the ventral, edge of the closed carapace of the common *Entomis*.

Fig. 18. Shallow hollow cast, with remains of the test; furrow-casts and lines quite smooth and sharp. In dark schist, with scattered portions of other similar copper-red tests, or their replacement by mineral matter (iron oxide?). Marked "*C. costata*," but differing considerably from pl. xx. fig. 15, 'Zeitschr.' 1869. It is not very distinct from our figs. 4, 8, 10, 11, 12, except that the costulæ are smoother and make two folds near one end of the valve, a pattern obscurely traceable in fig. 4.

Conclusion. We may conclude, as far as the present evidence permits, that figs. 1, 3, 5, 7, 13, 14, 15, 16, and 17 belong to *Entomis serratostriata* (Sandberger), figs. 2 and 6 to *E. tenella* (Richter), fig. 9 to *E. labyrinthica* (Richter), figs. 4, 8, 10, 11, 12, and 18 to *E. gyrata* (Richter).

XXIII.—*On the Natural Term of Life and of its chief Periods in the Hippopotamus* (Hippopotamus amphibius, *Linn.*). By Prof. Owen, C.B., F.R.S., F.Z.S.

It may be interesting to note, in relation to the longevity of wild mammals (a constant in the determination of which it is difficult to get facts), that the hippopotamus the capture of which, shortly after birth, is noted in the 'Annals & Magazine of Natural History' for June 1850 as having occurred in August 1849, died at the Zoological Gardens in March 1878. The conditions under which this animal lived to the age of twenty-eight years and eight or nine months, were such as to support an inference that it died of old age, and that the natural term of life of *Hippopotamus amphibius* may be set down at thirty years or thereabouts.

No special morbid appearance was discovered to suggest that death from old age had been anticipated. The worn state of the teeth was that of a vegetable feeder at the close of natural life. It may be thought that some allowance should be made for the artificial conditions under which this male hippopotamus lived; yet its health and vigour were such as to enable him to procreate.

The first offspring was a male, which was born February 22, 1871; it died on the 23rd of the same month*.

The father had attained a size in 1854 indicative of the procreative period; but the exercise of the faculty was delayed both by the later acquisition of the female and the state of their abode.

Mr. Bartlett informs me:—"I believe the reason she did not breed sooner was the fault of the construction of the water-tank. I had the tank made to slope gradually at the side; and this form of tank enabled the animals to copulate, whereas the sudden drop of 2 feet was unsuited to the purpose" †.

The pregnant state of the female was suggested by "a considerable change in her habits and appearance." The coitus had been noted as on June 29, 1870, giving a period of gestation of 7 months 22 days, =237 days.

The periods of gestation of the *Hippopotamus amphibius* determined at the Zoological Gardens of Amsterdam are from 7 months and 21 days to 7 months 25 days.

The second offspring of the same parents at the London

* 'Proceedings of the Zoological Society,' March 1871, "Notes on the Birth of a Hippopotamus in the Society's Gardens," by A. D. Bartlett, Superintendent.

† Letter, July 17, 1879.

Zoological Gardens was born January 7, 1872 *, and was begotten May 27, 1871. It was a female, and died on the 10th January, 1872; the gestation was 227 days, being 10 days shorter than in the case of the male offspring.

On November 5, 1872, the Secretary reports "the birth of a third hippopotamus (*Hippopotamus amphibius*), which had taken place that day in the Society's Gardens at 7 A.M. The period of gestation in the present instance had been eight calendar months less four days, according to the keeper's observations" †.

The coitus here is noted as on March 9, 1872‡. The offspring was a male; and the gestation was five days longer than in the case of the first male, and fifteen days longer than in the case of the female offspring.

Since this birth the mother has ceased to breed; she is four years younger than the male. The female hippopotamus in the menagerie at Amsterdam produced young as soon as she was full-grown.

The term of growth of the hippopotamus appears to be about five years; it extended, in the instance of the male born in midsummer 1849, as to length, to the year 1854; but the well-fed animal gained in bulk during some following years. The procreative period, commencing probably in 1854, was continued up to the year 1872, and perhaps a few years later, say to 1875, when the animal had attained the age of 26 years; this would leave a period of four years for old age.

An approximate conclusion as to the natural term of life in mammals may be made upon knowledge of the duration of one of the well-marked periods of existence. These are three, viz. the "preprocreative," the "procreative," and the "postprocreative" periods. In the human subject the first is modified to a small extent by latitude and climate. Taking an average as at 18 years, the procreative period may be set down as at three times that extent, carrying on the life-term to 72 years. If the postprocreative equals the preprocreative, life will extend to 90 years.

If the first period of life be characterized by the acquisition of full growth, then a man might survive as long after the procreative period, ending say at 75 in the male, as he had lived to acquire maturity and complete ossification, say at 30 years, and so reach the rare term of 105 years.

* See "Notes on the Visceral Anatomy of the Hippopotamus," by J. W. Clark, F.R.S., Proc. Zool. Soc. 1872, p. 185.

† Report on the additions to the Society's Menagerie, by the Secretary, Proc. Zool. Soc. 1872, p. 795.

‡ Ibid. p. 819.

The ascertained relative duration of the three periods above defined in the artiodactyle mammals most nearly approaching the *Hippopotamus amphibius* in size, supports the conclusion here endeavoured to be drawn from what could be ascertained of these periods in the captive male in the Gardens of the Zoological Society of London, viz. that the duration of its life under these circumstances must be that, or nearly that, of the individuals of the species in their native land and wild state, which may accordingly be set down at or about 30 years.

It is but due to the responsible officers in charge of the exotic animals in that noble establishment, to bear grateful testimony to their successful treatment, and to their exact observations and records of phenomena essential to the advancement of the science of Natural History.

British Museum, July 20, 1879.

XXIV.—*On some new and rare British Spiders, with Characters of a new Genus.* By the Rev. O. P. CAMBRIDGE, M.A., C.M.Z.S., &c.

[Plate XII.]

SINCE my last communication on British Spiders (Ann. & Mag. Nat. Hist. Feb. 1878, ser. 5, vol. i. p. 105, pl. xi.) I have been enabled, through my own researches and the kind assistance of several friends and relatives, to add thirty-nine species to the list of those then known to Great Britain and Ireland. Fifteen out of the thirty-nine appear still to be undescribed; twelve others have not hitherto been recorded as British, though known on the continent of Europe; and the twelve remaining species have lately been described, either as new to science or to Britain, in Part I. of "The Spiders of Dorset," published in the 'Transactions of the Dorset Natural-History and Antiquarian Field Club' for 1879. The fifteen new species, above referred to, are described in the following pages; and several of them are figured in the accompanying Plate. A list is also appended of those spiders not before recorded as British, and of the others mentioned above as described and recorded in "The Spiders of Dorset."

Several of the species included in the total (484) of British spiders recorded up to the time of the publication of my last communication (February 1878) have since been ascertained to be synonymous with others previously known. The number now considered to be British, so far as they are known up to the present time (Aug. 7, 1879), is 519; and, of these, 364 have been met with in the county of Dorset.

On one of the spiders now described a new genus is founded. This little spider (*Theridiosoma argenteolum*) is of great interest as well as beauty, and forms a link between *Theridion* and *Epeïra*. The snare, however, of a very closely allied species* is (as described by Dr. Ludwig Koch) decidedly of the type belonging to the *Theridiides*, in which family the present spider must therefore be included.

Order Araneidea.

Fam. **Drassides.**

Genus Gnaphosa, Latr.

Gnaphosa suspecta, sp. n.

Length of an immature female 2 lines.

This spider is of a rather flatter form than *Gnaphosa anglica*, Cambr. The legs are stronger, and the cephalothorax is devoid of the strong, dark, V-shaped marking characteristic of that species. The colour of the cephalothorax is pale yellow-brown, thickly mottled and suffused with a deeper hue, and edged with a brown-black marginal line. The legs are pale yellow-brown, more or less suffused with a darker colour. There are no spines, apparently, on those of the first two pairs, excepting two of a strong bristly nature on the upperside of the femora. All the tibiæ, tarsi, and metatarsi are furnished above with a few long, erect, slender hairs.

Relative length of the legs 4, 1, 2, 3; but the difference between those of the first and fourth pairs is slight.

The palpi, falces, and maxillæ are similar in colour to the legs, while the colour of the sternum is like that of the cephalothorax.

The eyes, though very similar in general size and position to those of *G. anglica*, are more closely grouped and form a more rectangular area, whose transverse diameter is also shorter in proportion to the longitudinal.

The abdomen is rather broad, and of an oblong-oval form truncate before; it is of a dull brown colour, the slightly reddish-yellow adpressed pubescence being mixed with longer, stronger, prominent, black bristly hairs.

The example above described was found under a stone near Sherborne, in the spring of 1878, by my nephew, Frederick Octavius Pickard-Cambridge. Although, owing to its not

* *Theridion gemmosum*, L. Koch, Nuremberg, 1878.

being adult, its best specific characters are not developed, I have ventured to describe it as a new species; it is, at any rate, distinct from *G. anglica*, Cambr., and *G. lugubris*, C. L. Koch, the only other British forms of the genus yet discovered.

Genus Drassus.

Drassus minor, sp. n. (Pl. XII. fig. 1.)

Adult female, length 2 lines.

Cephalothorax elongate-oval; lateral constrictions at caput slight; the profile line forms an even, but not strong, curve; clypeus not exceeding in height the diameter of the fore-central eyes. Colour pale dull yellow-brown, some dark veinings indicating the normal indentations.

Eyes rather large and closely grouped, in the ordinary two curved transverse lines, but not very different in size; the hind-central pair oval and oblique, their most proximate points separated from each other by less than their narrowest diameter, and each is separated by only a very slightly greater interval from the hind-lateral next to it. Fore-central pair large, separated by a very small interval, and about equally distant from the fore laterals.

Legs not very long, but strong; relative length 4, 1, 2, 3, rather paler in colour than the cephalothorax, and furnished with a few spines, chiefly on the tibiæ and metatarsi of the third and fourth pairs of legs.

Falces moderately long, tolerably strong, and rather darker in hue than the legs.

Maxillæ strong, of ordinary form, curved and inclined towards the labium, but with a very slight impression across the middle; colour darker than that of the cephalothorax.

Labium oblong-oval, longer than broad, apex rather rounded, and rather darker than the maxillæ.

Abdomen elongate-oval, rather truncate before; colour dull sooty brown, with a somewhat deeper longitudinal central stripe on the fore half of the upperside; on each side of this are faintly visible the usual three elongate pale spots in a curved longitudinal line, followed by a very faint indication of the usual transverse angular lines. The underside is paler than the upper, and the whole is clothed with very short pale hairs. The genital aperture is tolerably large, of characteristic and distinctive form, with a red-brown corneous margin; and immediately behind it are two red-brown, shining, circular, convex spots close to each other in a transverse line. The whole is surrounded by coarse, dark, converging hairs.

An adult and two immature females of this species were found at the roots of coarse grass and herbage on the Weymouth side of the Chesil Beach, near the Portland Station, on the 6th of June, 1879. It is allied to *Drassus criminalis*, Cambr., and *D. infuscatus*, Westr., but is very much smaller and differs totally in the form of the genital aperture, as well as in the relative position of the eyes, though resembling them a good deal in general form and colouring.

Fam. **Theridiides.**

Genus Steatoda, Sund.

Steatoda Clarkii, sp. n.

Length of an immature female, 2 lines.

Cephalothorax constricted laterally on the margins at caput, and of a yellow-brown colour.

Eyes rather large and closely grouped in a transverse-oval figure; those of the hind-central and lateral pairs nearly equal in size and pearly white; those of fore-central pair dark-coloured, further apart than those of hind-central pair, but forming a line of nearly equal length; those of the hinder row equidistant from each other, and separated by intervals of less than an eye's diameter; the four centrals form a square.

Legs short, 1, 4, 2, 3, tolerably strong, and of a brownish-yellow colour.

Abdomen oval, tolerably convex above and projecting a good deal over the base of cephalothorax. Colour brownish yellow-white on the upperside, with a broadish submarginal bordering band of red-brown, interrupted at the fore extremity and at three other places on each side by transverse brownish-yellow distinct lines; sides and underpart brownish yellow, the former marked and spotted with reddish brown near the posterior extremity.

Sternum dark yellow-brown.

A single example of this very distinct species was received some years ago, among many other spiders, from the late Rev. Hamlet Clark, by whom it was found near Torquay. Owing to its having been accidentally mislaid until very lately, it has hitherto escaped notice.

Theridiosoma, g. n.

Cephalothorax short; thorax round-oval, gradually rising in a curve to the ocular area; caput strongly constricted on the lateral margins, and deeply indented on each side near the thoracic junction.

Eyes of tolerable size, subequal and closely grouped, in two rows, the posterior row much the most strongly curved; those of the fore-central pair placed on a tubercular prominence. Four central eyes form a trapezoid whose anterior side is shortest.

Legs short, moderately strong; relative length 1, 2, 4, 3, or 1, 4, 2, 3, furnished with coarse hairs and a few strong bristles only.

Maxillæ short, strong, and straight, convex in front, broad at their extremities, where the outer side is well rounded, and the inner side rather less so.

Labium short and somewhat semicircular.

Abdomen large and globular.

This is a genus of very great interest, and appears to be a connecting link between *Theridion* and *Epeïra*. Dr. L. Koch includes a very closely allied species, found near Nuremberg, in the genus *Theridion* (*T. gemmosum*); but the form of the maxillæ and the stronger legs seem to exclude it entirely from that group, and to necessitate a new genus for its reception. Dr. Koch describes the snare as consisting simply of a few lines spun from plant to plant. This habit, together with some structural considerations, exclude it from the *Epeïrides*, which, however, it resembles in the form of the maxillæ. The egg-cocoon is described as pear-shaped; it is suspended by a slender footstalk, and is apparently very like that of *Ero thoracica*.

Theridiosoma argenteolum, sp. n. (Pl. XII. fig. 8.)

Adult female, length very slightly over 1 line.

The colour of the *cephalothorax* is yellow, the caput suffused with sooty black, especially on the sides near the occiput; a few hairs are directed forwards from the ocular area, with some others disposed in a central longitudinal line running backwards.

The *eyes* occupy the whole width of the caput at its rather produced extremity; those of the hind-central pair are of a bluish-grey hue, and are nearer together than each is to the hind-lateral eye on its side; the interval being about half an eye's diameter. Those of each lateral pair are placed slightly obliquely on a tubercle, the hinder one being the smallest and of a pearly-white hue; the fore-laterals are pale greyish; the fore-centrals are seated on a rather strong tubercular prominence, and are dark-coloured and not easily seen; the hinder row is much more strongly curved than the anterior one; the eyes of the latter are near together, but not contiguous, the interval between the fore-centrals being very small, while that between each and the fore-lateral on its side is a little greater.

The *legs* are short, moderately strong, 1, 2, 4, 3; but the difference between 2 and 4 is very slight. Their colour is yellow, the tibiæ tinged with brownish orange, and much stronger than the metatarsi; the extreme point of the metatarsi and the fore half of the tarsi are black. Their armature consists of hairs and a very few prominent and rather strong bristles only, none of the latter, however, being sufficiently strong to be called a spine; the tarsal claws are rather weak.

The *palpi* are slender, short, of a yellowish colour, tipped with blackish, and furnished with coarse bristles.

The *falces* are moderate in length and strength, vertical, and similar to the legs in colour, the denticulations being very minute.

The *maxillæ* are of a dull yellowish hue; and the *labium* is rather darker-coloured.

The *sternum* is of a somewhat subtriangular form, yellow along the middle, with a broad dark yellowish-brown border.

The *abdomen* is very large, globular, and projects greatly over the base of the cephalothorax. It is very thinly clothed with hairs, and is of a shining silvery-white colour, with a golden tinge on the middle of the upperside, and clouded in parts with a pale brownish-claret hue, forming a definite though not a very strongly marked pattern; and the whole surface is covered with an irregular network of fine dusky lines. On the fore part of the upperside is a ring formed by a band of a pale claret colour; the enclosed space bears a blackish cruciform marking; this is followed by a somewhat dagger-shaped marking of a similar hue, which runs into a large, quadrate, dull claret-coloured area; this area is rather the palest along the middle and at the fore extremity, but reaches quite to the spinners, on each side a little above which there is a rather large silvery blotch, with another, smaller one still nearer to the spinners. The sides are marked with a strong oblique claret-coloured stripe or band. The underside is reddish brown. The spinners are short and compact, the four outer ones equal in length. The genital aperture is rather large, of a transverse somewhat oval form, and placed behind a strong shining black prominence.

A single example of this very pretty and distinct little spider was found among low herbage on the edge of a watery swamp near Bloxworth, on the 30th of June, 1879. It is closely allied to *Theridion gemmosum*, L. K.; but on comparison with types of that species received from Dr. L. Koch, I think it is of a distinct species. The colouring and pattern are different, the tibiæ of the first pair of legs are rather longer and stouter, and the interval between the eyes of the hind-central pair is greater.

Genus Neriene, Blackw.

Neriene reproba, sp. n. (Pl. XII. fig. 2.)

Length of the adult male very nearly $1\frac{1}{2}$ line.

The *cephalothorax* is of a dusky yellow-brown colour, marked with converging lateral indistinct markings of a deeper hue; its convexity is moderate; the lateral marginal compression at the caput is scarcely visible; and the profile line forms a gradual and pretty even curve from the hinder extremity to the eyes. The height of the clypeus slightly exceeds half that of the facial space.

The *eyes* are in the usual position, placed on black tubercular spots, and form an area whose transverse measurement is about double that of the longitudinal diameter. They are of moderate size, and do not differ greatly from each other in that respect; and the curves of the two rows (of which the anterior is the shortest, and the convexities of which are directed away from each other) are as nearly as possible equal. The eyes of the hind-central pair are separated by rather more than a diameter's interval; and their distance from the hind-laterals is considerably greater; those of the fore-central pair are rather the smallest of the eight, contiguous to each other, and separated by a diameter's interval from the fore-laterals; those of each lateral pair are contiguous to each other, and seated obliquely on a strong tubercle.

The *legs* are moderate in length and strength, 4, 1, 2, 3, tapering regularly to their extremities, well furnished with coarse, rather prominent hairs, and a few slender erect bristles and hairs; they are of a pale dull yellow-brown colour, rather deepening in hue towards their extremities.

The *palpi* are rather short, similar in colour to the legs, excepting the fore part of the radial joint, which is blackish red-brown, and the digital joint, which is of a dark yellow-brown hue. The radial is rather shorter but stronger than the cubital joint; its fore extremity on the upperside is produced, and strongly emarginate or indented in a circular form, leaving two cusps, of which that on the inner side is slightly curved, pointed, and of a corneous appearance; this joint is furnished with coarse hairs and black bristles, of which those on the outer side are most numerous and strongest. The digital joint is of moderate size, oval, with a large roundish lobe at the base on the outer side tinged with red-brown; and at the middle of the hinder extremity is a short red-brown, somewhat tooth-like, pointed prominence, whose point is directed outwards. The palpal organs are highly developed and complex; a strong somewhat pointed process, with its inner edge minutely serrated, projects prominently downwards from near their centre; and at their fore extremity on the outer side is another short strong one, of a black hue, whose extremity appears to be subdivided into several short divergent projections.

The *falces* are similar in colour to the cephalothorax, moderately long, powerful, vertical, slightly divergent at their extremities; and each falx has a strong, sharp-pointed, tooth-like process in front, towards the fore extremity on the inner side.

The *maxillæ* are strong, especially at their base on the outer side, where the palpi are inserted, obliquely truncated at their extremity on the outer side, and strongly inclined towards the labium; the latter is short, and of a somewhat semicircular form.

The *abdomen* is oval, rounded before, pointed behind, and moderately convex above; it is of a dull sooty yellowish-brown hue, clothed thinly with coarse blackish hairs.

This spider is allied to *Neriene livida*, Bl., but may easily be distinguished by the tooth-like process on the falces, and the absence of the red-brown impressed spots on the upper-side of the abdomen, as well as by the totally different structure of the palpi and palpal organs. It is also allied to *Neriene* (*Drepanodus*) *albipunctata*, Cambr.; but the bifid termination of the tooth-like process on the falces of the latter, the armature of the tibiæ of the first and second pairs of legs, and the wide separation of the fore-central eyes, will, with some other important differences, distinguish the present species at once from that spider.

A single example of the adult male was found under a stone at Ringstead (on the coast between Weymouth and Whitenose), in April 1879, by my nephew, Frederick O. P.-Cambridge.

Neriene rudis, sp. n.

Length of the adult female rather more than $1\frac{1}{2}$ line.

The profile of the upper part of the caput of this spider forms a strong curve, the occipital region being considerably convex; the lateral constrictions on the lower margins of the caput are but slight.

The colour of the *cephalothorax* is a bright shining yellow-brown; the *legs* (which are tolerably long, rather slender, and furnished with hairs and a few fine bristles) being a little lighter in hue, while the falces, maxillæ, labium, and sternum are darker. The falces are long, powerful, vertical, and prominent near their base in front, being also armed with a row of five strongish teeth on the inner side of the extremity of each falx.

The *eyes* are in the ordinary position and placed on dark tubercles; they are rather small, and do not differ very greatly in size. Those of the hind-central pair are much nearer to each other than each is to the hind-lateral eye on its side, the interval between them being equal to a little more than an eye's diameter; those of the fore-central pair are almost contiguous to each other. The clypeus projects evenly forwards; and its height rather exceeds half that of the facial space.

The *palpi* are tolerably long, similar in colour to the legs; the radial and digital joints are of a deeper tinge, and devoid of any terminal claw.

The *abdomen* is of an oblong, somewhat cylindric-ovate form, rather broadest at its hinder extremity; its colour is black; and it is thinly clothed with hairs. The genital aperture is large, prominent, of characteristic form, and of a dark blackish and red-brown colour.

A damaged example of the male appeared to show but little difference from the female in general character and appearance. The falces, however, are less powerful; and the abdomen is shorter and less cylindric in form. The palpi have the cubital and radial joints short; the latter is considerably produced at its fore extremity on the upperside, the termination being obtusely pointed and directed slightly outwards; and on the outer margin of the radial joint is a rather dense tuft of strong black hairs. The digital joint is large and of a short roundish-oval form; the palpal organs are prominent and complex; near their extremity, on the inner side, is a strong, tapering, sharp-pointed, black spine, which curves round in a nearly circular form underneath the fore extremity of the digital joint, and has its hair-like point in contact with the outer side of the palpal organs, at whose extremity there are also several other prominent corneous processes and spines. At the base of the palpal organs, on the outer side, is a strong curved process, somewhat obscured by the tuft of hairs on the outside of the radial joint.

Examples of this spider, which I believe to be hitherto undescribed, were contained in a collection made by Mr. H. C. Young of Glasgow, near that city, and kindly sent to me for determination.

Neriene exhilarans, sp. n. (Pl. XII. fig. 3.)

Adult male, length 1 line.

Cephalothorax oval, with little or no lateral marginal impression at the caput; the profile line forms an even slope, with the slightest possible curve, from the hinder extremity to the occiput, which is a little gibbous; the ocular area slopes forwards; and the clypeus (the height of which exceeds half that of the facial space) is rather prominent at its lower margin; immediately behind each lateral pair of eyes is a small, slightly elongate, but rather deep indentation, on the inner side of which is a distinct triangular black spot. The colour of the cephalothorax is a deep rich brown; and its whole surface is very finely and thickly punctuose. Along the central line of the caput is a single row of four or five bristles directed forwards; and a few others occupy the ocular area.

The *eyes* are not very large, nor do they differ greatly in size; they are in the usual position—rather closely grouped together, the two rows being near to each other. Those of the hind-central pair are separated from each other by rather less than a diameter's interval, and from the laterals by rather more than a diameter; those of each lateral pair are seated slightly obliquely on a strong tubercle.

The *legs* are slender, tolerably long, of an orange-yellow colour, furnished with hairs, and with two or three very slender erect bristles on the genual and tibial joints; relative length 1, 4, 2, 3.

The *palpi* are slender, moderately long, of a pale orange-yellow colour, the digital joints brown. The radial and cubital joints are of the same length; the former is the strongest, and has, at the inner side of its fore extremity, a slightly tapering, curved, and obtusely-pointed reddish-brown apophysis, rather less in length than the joint itself. The digital joint is rather large, and has a strong lobe or protuberance on the outer side. The palpal organs are not very prominent, or very complex. A slender, black, filiform spine issues from their base on the outer side, crosses over to the inner side of their fore extremity, which it encircles, passing close beneath the point of the digital joint, and forming a sinuous coil at their fore extremity rather on the outer side, in contact with some semitransparent membrane.

The *falces* are strong, divergent, prominent in front, and the extremities rather attenuated. Their colour is like that of the cephalothorax; towards their outer margins, and more sparingly in front, they are furnished with some minute tubercles, each terminating with a fine hair; and on their inner sides are some sharp teeth, the longest and strongest of which is placed in front of the rest, just at the point where the attenuation begins.

The *maxillæ* are strong, much bent and inclined to the labium, and furnished on their outer sides with some dentiform tubercles, each of which ends with a bristle.

The *labium* is very short, truncated at its apex, and (with the maxillæ) of the same colour as the falces.

The *sternum* is large, heart-shaped, very finely punctuose, and of a deep blackish-brown colour.

The *abdomen* is oval, moderately convex above, and projects a little over the base of the cephalothorax; it is of a dark blackish olive-green hue, thickly covered (when seen through spirit) with pale yellowish lines and spots, and clothed with short hairs. The spinners are short, of a pale colour, and placed in a sort of sunken hollow, or pit, of a circular form. A little way in front of them, beneath the abdomen, are two parallel transverse folds in the epidermis, within which I conceive there may be the external orifices to some supernumerary breathing-organs.

A single example of this very distinct spider was found by myself among moss in a fir-plantation near Bloxworth, on the 17th of May, 1879. It is evidently closely allied to *Neriene sulcata*, Bl., a spider I have never seen; but as Mr. Blackwall does not mention the very remarkable and easily-observed characters furnished by the tubercles on the falces and maxillæ, I think there can be no doubt of its specific difference.

Neriene nefaria, sp. n. (Pl. XII. fig. 4.)

Length of the adult male 1 line.

The *cephalothorax* is of ordinary form; the lateral constriction on the lateral margins of the caput is slight, the occiput a little rounded, and with only a slight depression between it and the thoracic indentation. The oblique indentations marking the junction of the caput and thorax are strong, and, together with those on the thorax, are marked by dusky black converging lines, the general ground-colour being dull greenish olive yellow-brown, with a black marginal line. The height of the clypeus, which is a little gibbous or rounded in profile, is rather more than half that of the facial space.

The *eyes* are in two curved rows, well separated from each other, and occupying the whole width of the upper part of the caput, the curve of the posterior row being the strongest. The length of the anterior row is but very slightly shorter than that of the posterior one; the eyes of each of the lateral pairs are contiguous to each other, and seated on tubercles, being thus but very slightly oblique in their position. The eyes of the posterior row are of equal size, and separated by equal intervals of no more than a diameter's extent. Those of the fore-central pair are nearer together, but not quite contiguous to each other; the fore-laterals are the largest of the eight, and are distant from the fore-centrals by about the diameter of the latter. The four central eyes form a narrow trapezoid, the anterior side of which is shorter than the posterior.

The *legs* are rather short, tolerably strong, their relative length 4, 1, 2, 3; they are of a clear yellow colour, furnished with coarse hairs and a fair number of short, erect, fine bristles, mostly on the tibiæ and metatarsi of the first two pairs; a single stronger bristle also springs from the anterior extremity of the genual joints.

The *palpi* are similar in colour and armature to the legs.

The *falces* are vertical, moderate in length and strength, divergent at their extremities, and similar in colour to the cephalothorax.

The *maxillæ* are strong and a little inclined to the labium, which is broad but short; these parts are similar in colour to the falces.

The *sternum* is heart-shaped and of a deeper hue.

The *abdomen* is of moderate size, and of a broadish oviform shape; it is of a dull blackish colour, palest underneath, and pretty thickly clothed with coarse hairs. The process connected with the genital aperture is rather prominent, of a red-brown hue, and of characteristic form. A little way in front of the spinners, beneath the extremity of the abdomen, is a very distinct transverse slit, or narrow opening, of considerable length; this, without a doubt, is the orifice of an additional spiracular organ, and forms a very strong specific character in the present spider, even if it be of no greater systematic significance.

A single example was found at the roots of herbage on the edge of the low cliffs bordering the Smallmouth Sands, near Weymouth, on the occasion of the meeting of the Dorset Natural-History and Antiquarian Field Club, on the 2nd July, 1879.

Neriene mystica, sp. n. (Pl. XII. fig. 5.)

Adult female, length 1 line.

The *cephalothorax* is of an elongate-oval form somewhat drawn out at the fore extremity, the clypeus projecting, and equal in height to half that of the facial space. It is of a dull greenish yellow-brown colour; the margins and some vein-like converging lines blackish, and the fore part slightly suffused with a sooty hue. The hinder slope has a very large, deepish, extended indentation, giving it a hollow appearance in profile, with a prominence at the thoracic junction, and a correspondingly deep depression directly behind the occiput, which is a very little gibbous; the ocular area slopes forwards; and the clypeus (seen in profile) projects in a slightly upturned form: the whole profile line is thus characteristically, but unusually, irregular.

Behind each lateral pair of eyes is a slight longitudinal indentation running backwards. The ocular area is of a broadish transverse-oval shape; and the eyes are rather closely grouped together: those of the hind-central pair, which are the largest, are further from each other than each is from the lateral on its side, the interval being about equal to an eye's diameter; the interval between the fore-centrals is very small, and each is contiguous to the fore lateral next to it; the lateral pairs are placed very slightly obliquely.

The *legs* are slender, rather short, of a pale orange-yellow colour, furnished with hairs and, chiefly on the tibial joints, with a few erect slender bristles.

The *falces* are small, straight, slightly inclined backwards, and (with the maxillæ, labium, and sternum) similar in colour to the cephalothorax.

The *abdomen* is large, tolerably convex above, of a somewhat oblong-oval form, and projects, though not greatly, over the base of the thorax; it is of a dull black hue tinged with olive, glossy, and very sparingly clothed with hairs. A very broad strong prominent process is connected with the genital aperture, the extremity being of a somewhat recurved form.

A single example of this spider was received about the middle of June 1879 from my cousin, Colonel Pickard, R.A., by whom it was found at Balmoral Castle, Scotland. The very peculiar and irregular profile line of the cephalothorax, the projecting clypeus, and prominent genital process will serve to distinguish this species from all its congeners known to me.

Neriene improba, sp. n. (Pl. XII. fig. 6.)

Length of the adult male, $\frac{1}{14}$ of an inch.

Cephalothorax dark black-brown tinged with an olive-greenish hue. Ocular area somewhat produced forwards, but with no eminence or elevation on the caput; profile level, the dip between the caput and thorax very slight.

The *eyes* are at the extremity of the caput. The fore-centrals describe a square whose posterior side is longer than the rest. The position of the fore-central and lateral pairs is rather difficult to make out, owing to their indistinctness; but the interval between the eyes of the former considerably exceeds a diameter.

Legs moderately long, slender, yellow.

Palpi short; digital joint and palpal organs very large, the rest very slender. The cubital joint is very short; the radial stronger and considerably produced in front, in a somewhat curved form, over the base of the digital joint, pointing outwards, its extremity being deeply cleft, or bifid; the posterior portion of the bifid part is prominent and tipped with a small reddish-brown point, the anterior portion is obtuse, and adheres more closely to the digital joint. The palpal organs are complex, but tolerably compact; and at their extremity is a very small, fine, brown spine, curved in a circular form, but almost concealed in a membranous substance.

Abdomen black and glossy.

A single example was received in 1878 from Mr. T. Workman of Belfast, by whom it was found near that city, and kindly sent to me among some other spiders taken in the same locality. Subsequently (May 15, 1879) an adult and immature males were found at Bloxworth, under some bricks in the Rectory yard. In the form and structure of the palpi and palpal organs this spider bears much general resemblance to *Walckenaëra erythropus*, Westr. (Cambr. 'Spiders of Dorset,' p. 165); but the entire absence of any elevation on the caput distinguishes it at a glance from that species. The portion of structure also, in the palpus of that spider, corresponding to the posterior part of the bifid extremity of the radial apophysis in the present species, emerges very distinctly from *beneath the joint*, while in the present spider it appears to form part of *the upperside* of it.

Walckenaëra minutissima, sp. n. (Pl. XII. fig. 7.)

Adult female length $\frac{1}{2}$ line ($\frac{1}{24}$ of an inch).

The cephalothorax, legs, palpi, falces, maxillæ, labium, and sternum of this exceedingly minute spider are of a not very deep brown colour, the genual joints of the legs being much paler than the rest.

The *abdomen* is large, of a globular form, and projects greatly over the thorax, its colour being of a dull olive-green strongly suffused with a sooty hue, and its surface thinly clothed with short hairs.

In its general form this little spider is very like *Walckena-*

ëra brevipes, Westr., resembling it in the short broad cephalothorax, short legs, and round abdomen. It is, however, a smaller spider, and of a paler hue; and although the eyes are in a very similar general position, they are larger and more closely grouped together. The interval, also, between those of the central pair of the hinder row is greater, being double that which separates each of them from the lateral eye on its side; whereas in *W. brevipes* the eyes of the hinder row are separated by equal intervals. In the present spider the position of the eyes approaches very nearly to that of *Pholcomma gibbum*, Westr. The height of the clypeus, also, in *W. minutissima* is greater than in *W. brevipes*, being very nearly equal to two thirds of the height of the ocular area, while in *W. brevipes* it is only a little more than one half of the height of that area. In the male (when discovered) the height of the clypeus will probably be found to *exceed* two thirds that of the ocular area. The legs are slender, short, and furnished with hairs, one or two being erect.

From *Walckenaëra brevis*, Wid., the present spider may be distinguished, not only by the same characters in respect of the eyes which distinguish it from *W. brevipes*, but by its much smaller size, paler colour, and the still greater proportional height of the clypeus, which in *W. brevis* is no more than half that of the ocular area.

Two adult females were received from Colonel Pickard, R.A., by whom they were found at Balmoral Castle, Scotland, about the middle of June 1879.

Genus Linyphia, Latr.

Linyphia subnigripes, sp. n.

Length of an adult female, $1\frac{3}{4}$ line.

The *cephalothorax* is of ordinary form; its colour is yellow-brown, marked with a dusky brown marginal line and indistinct converging bars, following the course of the normal indentations. There is also a central longitudinal line of the same colour.

The *eyes* are seated on black spots, those of the posterior row forming a transverse straight line, the interval between those of the hind-central pair being greater than that between each and the hind-lateral eye on its side; the fore-central pair are placed on a prominence, which brings them rather considerably in advance of the rest.

The *legs* are long, slender, and tapering, furnished with hairs, and distinct, prominent, but not very strong spines; they are similar in colour to the cephalothorax, excepting the tibiæ and metatarsi of the first, second, and fourth pairs, and part of the metatarsi of the third pair, which are of a deep blackish-brown hue. The lengths of the second and fourth pairs differ but little if any thing; the first pair is the longest, and the third shortest.

The *palpi* are, like the legs, furnished with hairs and spines, and of a yellow-brown colour, the radial and digital joints black-brown.

The *abdomen* is oviform, and projects a little over the hinder part of the thorax; it is of a dull yellowish-brown hue, marked (especially above) with numerous irregularly shaped, yellowish white, somewhat shining, cretaceous spots, whose disposition leaves an indistinctly defined, longitudinal, central, yellowish-brown stripe on the fore half of the upperside, and some oblique lateral ones. The genital aperture is small, not very prominent, but of characteristic form and dark red-brown colour.

A single example of this spider was kindly sent to me by Mr. T. Workman, by whom it was found near Belfast in the autumn of 1878. It is allied to *Linyphia luteola*, Blackw.; but the dark brown portions of the legs and palpi distinguish it at once from that and from all other species known to me.

Linyphia relativa, sp. n.

Length of an adult male, slightly over 1 line.

Cephalothorax broadish oval, a very little constricted on the lateral margins at the caput, of a yellowish colour slightly tinged with brown, and with some lateral converging lines of a deeper hue. The hinder slope is rather abrupt, deeply and broadly indented; and the profile line of the upper part of the thorax and caput is level, with a very slight impression behind the occiput. The ocular area is a little prominent, and, as well as the upper part of the caput, which is rather rounded, is thinly furnished with bristly hairs directed forwards. The height of the clypeus exceeds half that of the facial space.

The *eyes* are on black spots; those of the posterior row are removed from each other by rather less than an eye's diameter; those of each lateral pair are placed obliquely; those of the fore-central pair are the smallest of the eight, and contiguous to each other. The four central eyes form a square, whose anterior side, however, is much shorter than the rest.

The *legs* are long, slender, 1, 2, 4, 3, similar in colour to the cephalothorax, furnished with hairs and armed with long, rather slender, but distinct black spines: three of these on each of the tibiæ of the second, third, and fourth pairs, one on the genua, and one on the inner side of the fore extremity of the femora of the first pair only, the tibiæ of this pair having four; there is a single spine also on each of the metatarsi.

The *palpi* are rather short, and similar to the legs in colour. The radial and cubital joints are of equal length: the former is much the stronger, and is a little produced at its fore extremity on the upperside; it is furnished with black bristles and hairs; four of the strongest of the former are curved and tapering, and form nearly a straight line from the base to the extremity of the joint, the line being also continued backwards by another similar bristle at the middle of the fore extremity of the cubital joint; these bristles are all about the same length and strength. The digital joints are of good size, and have their convex sides directed inwards to each other; each has a large lobe on the outer side, and two small subconical prominences at its posterior extremity. The palpal organs are prominent and complex, with a strong, subangularly curved process at their base on the outer side; the posterior extremity of this process is the largest and most prominent; and there are some bristly hairs issuing from near the other (or anterior) extremity.

The *falces* are moderately strong, rather long, divergent, a little bent outwards near their fore extremity, and directed backwards, towards the sternum; their colour is a little browner than that of the cephalothorax.

The colour of the *maxillæ* is dull yellowish, and the *labium* and *sternum* are strongly suffused with brown.

The *abdomen* is short oviform, considerably convex above, and projects a little over the base of the cephalothorax; it is of a dull brown hue, broken up into blotches, or reticulated by pale irregular lines on the upper part and sides, the underside being dark brown.

An example of this spider was found among moss in Berewood, adjoining the Bloxworth woods, on the 2nd of May, 1879. It is allied to *Linyphia alacris*, Bl., but may be distinguished easily, by the different pattern of the cephalothorax and abdomen, and by the absence of the very long, strong, single bristle which projects from the fore side of each of the cubital and radial joints of the palpus of that species—the bristles on those joints of the present spider being (as above described) more numerous, and, as nearly as possible, equal in length and strength.

Linyphia turbatrix, sp. n.

Adult male, length 1 line, or a little over.

The whole of this spider is of a yellow-brown colour, the cephalothorax being the palest and clearest, and the abdomen the darkest, with a sooty hue. The caput and thorax are about level as far as the thoracic junction, whence the posterior slope is distinct but not very abrupt; between the occiput, which is rather rounded, and the thoracic junction is a very slight shallow depression. The clypeus is almost vertical, and its height is less than half that of the facial space; on the fore part of the caput, and along the central line backwards, are a few strong bristly hairs.

The *eyes* are of tolerable size, seated on black spots, and occupy the whole width of the fore extremity of the caput; the interval between those of the hind-central pair is distinctly greater than that between each of them and the hind-lateral eye on its side, being about equal to a diameter; those of the fore-central pair are contiguous to each other, and each is separated from the fore-lateral on its side by less than its own diameter; the direction of the lateral pairs is slightly oblique. The four central eyes form a square, whose anterior side is rather shorter than the rest.

The *legs* are rather long, slender, 4, 1, 2, 3, and furnished with hairs and a few spine-like bristles.

The *palpi* are short and slender; the radial and cubital joints equal in length; the former is very slightly produced and rounded at the fore extremity on the upperside, and furnished with bristly hairs; the latter has a single prominent, tapering, slightly sinuous bristle at the fore extremity of its upperside. The digital joint is small, and of a narrow or somewhat oblong-oval form, rather exceeding in length the radial and cubital joints together, and clothed with bristly hairs, especially at the fore extremity. The palpal organs are not very complex; at their base on the outer side is a strong, bent, somewhat crescent-shaped corneous process, the fore part being strongly emarginate; and at their extremity is a small, straight, sharp, black, thorn-like spine, in contact with some semitransparent membrane.

The *falces* are vertical, tolerably long, but rather weak, and divergent.

The *sternum* is similar in colour to the abdomen, which last is clothed with strong bristly hairs.

The female resembles the male in general form and colours, but is larger. The genital process is characteristic but not conspicuously prominent.

Two males and a female of this spider were found in a swamp near Bloxworth, at the end of June 1879. The male may easily be distinguished from *Linyphia oblivia*, Cambr., *L. oblita*, Cambr., and some other allied and rather obscure species, by the very narrow form of the digital joints of the palpi.

Genus Diæa, Thor.

Diœa devoniensis, sp. n.

Length of an immature female, nearly $2\frac{1}{2}$ lines.

The *cephalothorax*, *legs*, *palpi*, and other fore parts are of a brownish-yellow colour, tinged with reddish; a rather radiated area at the thoracic junction suffused with whitish. The metatarsi, and the larger portion of the tibiæ of the first two pairs, are armed beneath with two parallel longitudinal rows of spines.

The *eyes* of the hind-central pair are nearer to each other than each is to the lateral eye next to it. The four central eyes form a square, the anterior side being a little shorter than the posterior one.

The *abdomen* is oval, of a pale dull brownish-yellow colour mottled with yellowish-white, and with some pale transverse lines along the middle of the upperside.

The spider above described was received some years ago from the late Rev. Hamlet Clark, by whom it was found near Torquay. It has been mislaid, and so overlooked until recently. M. Simon, who has examined this specimen, is of opinion that it belongs to an undescribed species. It is certainly very distinct from any other British Thomisid; probably, however, the colours have faded since it was caught.

The following spiders are now for the first time recorded as British :—

Genus Gnaphosa, Latr.

Gnaphosa lugubris.

Gnaphosa lugubris, C. L. Koch, Die Arachn. vi. p. 60, Taf. cxcv. fig. 473; E. Simon, Arachn. d. France, iv. p. 174.

I have met with the female in the adult state in the months of September 1878 and April 1879, under old turves on Bloxworth Heath, together with numerous immature individuals of both sexes. It is nearly allied to *Gnaphosa anglica*, Cambr., but is larger and differs in the structure of the genital aperture, although resembling that species very closely in general form and colours.

Genus Drassus, Walck.

Drassus infuscatus.

Drassus infuscatus, Westr. Ar. Suec. p. 347.

An adult female occurred among dead leaves and moss in a wood at Bloxworth at the end of September 1878. It is closely allied to *Drassus troglodytes*, C. Koch, and to *Drassus criminalis*, Cambr., but differs from both in the form and structure of the genital aperture.

Genus Prosthesima, L. Koch.

Prosthesima Latreillii.

Prosthesima Latreillii, Sim. Arachn. d. France, iv. p. 62.
Melanophora atra, C. Koch, Die Arachn. vi. p. 88, Taf. cci. fig. 493.

Two adult examples (one of each sex) of this spider were found on Bloxworth Heath in May 1877, but were at the time mistaken for *Prosthesima nigrita*, Fabr. (*Drassus pusillus*, Bl.). An adult female was received in the spring of 1876 from Ventnor, and an adult male from Balmoral, where it was found in June 1879 by Col. Pickard, R.A. I also met with a female and its egg-cocoon under a stone at Poxwell, near Weymouth, at the beginning of July 1879. The egg-cocoon is of a lenticular form and of a dark yellowish red-brown colour.

Although very similar in general appearance to *P. nigrita*, the male may be distinguished at once by the structure of the palpi; and the female by the form and structure of the genital aperture.

Prosthesima longipes.

Melanophora longipes, L. Koch, Die Arachn.-Fam. der Drassiden, p. 147, pl. vi. figs. 88, 89.

Adult and immature examples of both sexes of this spider were found on Bloxworth Heath, under old turves and among moss and heather, in September 1878. It may be distinguished from its congeners by the much longer and more slender legs, as well as by the structure of the palpi of the male, and the genital aperture of the female.

Prosthesima latitans.

Melanophora latitans, L. Koch, E. Simon, Arachn. d. France, iv. p. 70.

An adult male of this species was found near Lulworth Cove, Dorsetshire, on the 26th of June, 1878. It is closely allied to *Prosthesima Petiverii*, Scop. (*Drassus ater*, Bl.), but is of a more completely jet-black colour, and the palpal organs are quite different in their structure.

Prosthesima lutetiana.

Melanophora lutetiana, L. Koch, Die Arachn.-Fam. der Drassiden, p. 157, Taf. vi. fig. 100; and E. Simon, Arachn. de France, iv. p. 78.

Closely allied to *Prosthesima nigrita*, Fabr., but larger, and differs in the structure of the genital aperture. An adult female, found at Dunmore in Scotland, was received in 1878 from Mr. H. C. Young of Glasgow. Several immature examples, which I believe to be also of this species, were received some years ago from Mr. W. Farren, by whom they were found in Wicken Fen, Cambridgeshire.

Genus Dictyna, Sund.

Dictyna viridissima.

Aranea viridissima, Walck. Faune Par. ii. p. 212.
Drassus viridissimus, Walck. Ins. Apt. i. p. 231.

Examples of the adult male of this spider, found at Box Hill, Surrey, were sent to me in March 1879, by Mr. T. Workman of Belfast. These examples were in bad condition and had lost their colour, but have been identified for me by Mons. Eugène Simon.

Genus Neriene, Bl.

Neriene viva.

Neriene viva, Cambr. Proc. Zool. Soc. 1875, p. 330, pl. xliv. fig. 5.

Two adult males of this very distinct little spider were found among rushes and sedgy grass in a swamp near Bloxworth in May 1879.

Neriene barbata.

Neriene barbata, Thor. Tijds. Ent. xviii. p. 89; and Sv. Akad. Handl. xiii. no. 5.

An adult male was kindly sent to me in March 1879 from Glasgow by Mr. H. C. Young, by whom it was found in the neighbourhood of that city.

Genus Walckenaëra, Bl.

Walckenaëra prominula.

Erigone prominula, Cambr. Proc. Zool. Soc. 1872, p. 750, pl. xlv. fig. 4.

Examples of this spider were found at Newhaven, Sussex, on furze bushes in bloom, in the months of May and June

1871, by myself and Mons. Eugène Simon. I have also received it from Bavaria and other parts of Germany.

Genus PHILODROMUS, Walck.

Philodromus constellatus.

Philodromus constellatus, Sim. Arachn. de France, ii. p. 298.

Closely allied to *Philodromus aureolus*, Clk., but easily distinguished, among other characters, by the large, radiating, stellate, brownish-yellow marking at the thoracic junction.

A single example of the female was found several years ago at Bloxworth, but has hitherto been overlooked among numerous specimens of *P. aureolus*.

Philodromus emarginatus.

Philodromus emarginatus, Schr.; Simon, Arachn. de France, ii. p. 277.

A single example of the female was found at Bloxworth some years ago, but, like the preceding species, was overlooked among specimens of *Philodromus aureolus* and *P. cespiticolis*. It is closely allied to *P. lineatipes*, Cambr., of which I have, in the course of the year 1878, received adults of both sexes from Mr. H. C. Young of Glasgow; but on a comparison of these with adults of *P. emarginatus*, sent to me from France by Mons. Eugène Simon, I believe the two to be distinct species.

Species lately described in 'Spiders of Dorset,' Pt. I., *as either new to science or not before recorded as British.*

Genus SEGESTRIA, Latr.

Segestria bavarica, C. Koch; O. P. Cambridge, Spiders of Dorset, pt. i. p. 8. Isle of Portland.

Genus LIOCRANUM, L. Koch.

Liocranum celere, Cambr. *l. c.* p. 40. Bloxworth, Dorset.

Genus HAHNIA.

Hahnia candida, Sim.; Cambr. *l. c.* p. 71. Portland.

Hahnia helveola, Sim.; Cambr. *l. c.* p. 72. Bloxworth and North Wales.

Genus ROBERTUS, Cambr.

Robertus astutus, Cambr. *l. c.* p. 103. Bloxworth.

Genus Neriene, Bl.

Neriene dolosa, Cambr. *l. c.* p. 126. Bloxworth.
Neriene jugulans, Cambr. *l. c.* p. 138. Sherborne, Dorset.

Genus Walckenaëra, Bl.

Walckenaëra crassiceps, Westr.; Cambr. *l.c.* p. 151. Bloxworth.

Genus Linyphia, Latr.

Linyphia Frederici, Cambr. *l. c.* p. 186. Warmwell and Sherborne.
Linyphia decipiens, Cambr. *l. c.* p. 208. Bloxworth.
Linyphia pholcommoides, Cambr. *l. c.* p. 212. Sherborne.

Genus Ero, C. L. Koch.

Ero tuberculata, C. L. Koch; Cambr. *l.c.* p. 235. Wokingham and Bloxworth.

Notes on some other Spiders; with correction of errors in "Notes on British Spiders" (Ann. & Mag. Nat. Hist. Feb. 1878, ser. 5, vol. i. pp. 105–128).

Lethia patula.

Lethia patula, Cambr. *l. c.* p. 108.

I had inadvertently overlooked the fact that at the time my notes on this spider were written (*l. c.*) it had already been described by M. Simon as a *Dictyna* (Arachn. de France, i. p. 197. It appears, however, to be undeniably a *Lethia.*

Lethia albispiraculis.

Lethia albispiraculis, Cambr. Spiders of Dorset, p. 53; and Ann. & Mag. Nat. Hist. Feb. 1878, p. 109, pl. xi. fig. 1.

Adults of both sexes were again found at Portland on the 6th of June, 1879. The male resembles the female in general colours and appearance; but it is rather darker, and the spiracular plates are devoid of the shining white hue observable (but, I find now, not invariably) in the female. This species is closely allied to *Lethia subnigra*, Cambr., but is, I think, distinct from it.

Cryphœca mœrens.

Cryphœca mœrens, Cambr. Spiders of Dorset, p. 59.

An adult female was found by myself on iron railings at Bloxworth in April 1879. This example conclusively proves it to be a *Cryphœca*, allied to *C. silvicola*, Hahn, but smaller, and differing not only in colour and markings, but in the structure of the genital aperture. The length of the adult female is barely over 1 line, while that of this sex of *C. silvicola* is from $1\frac{1}{2}$–$1\frac{3}{4}$. It is stated (*l. c.*) that the inferior spinners of the very young and minute type specimen were longer than the superior pair. As this is not borne out by the adult example now recorded, I conclude that the extra length observed in the type specimen must have arisen from an accidental elongation, which occasionally happens to the spinners of many spiders when preserved in spirit of wine.

Drassus braccatus, L. Koch.

Drassus bulbifer, Cambr. *l. c.* p. 111.

I was unaware until lately that this spider is identical with *Drassus braccatus*, L. Koch. The name *bulbifer* therefore becomes a synonym, and that conferred by Dr. Koch has priority.

Clubiona neglecta, Cambr.

An adult male and female of this rare spider were lately received from Belfast, where they had been found by Mr. T. Workman during the past spring.

Liocranum gracilipes, Bl.

Liocranum gracilipes, Bl.; O. P. Cambridge, Spiders of Dorset, p. 39.
Liocranum prælongipes, Cambr. (sub *Drassus*), Ann. & Mag. Nat. Hist. June 1861.

I have come to the conclusion, after careful examination and consideration, that the two spiders above mentioned are of the same species.

Phyllonethis instabilis.

Phyllonethis instabilis, Cambr. Spiders of Dorset, p. 95.

Adults of both sexes have been found during this last May near the same locality in which it was originally discovered about seventeen years ago.

Steatoda coracina, C. L. Koch.

Steatoda coracina, C. L. Koch, Cambr. Spiders of Dorset, p. 98.

An immature male was found on Bloxworth Heath in April last, an adult female under a stone on the 30th of last June, and an adult male on heather on the 15th of last July in the same locality. A single example only, found in May 1863, had been previously recorded in Britain. When running, the male has a more decidedly ant-like appearance than almost any other spider I am acquainted with.

Walckenaëra erythropus, Westr.

Walckenaëra erythropus, Westr.; Cambr. Ann. & Mag. Nat. Hist. Feb. 1878, p. 116; Spiders of Dorset, p. 165.

I have found numerous examples of this little spider among brickbats and in other situations at Bloxworth rectory during this last spring and early summer; and have also received several specimens from Windsor Castle, where it was found by Col. Pickard, R.A. Hitherto this has been a very rare spider; and it is difficult to account for its being thus abundant during the present season, in which spiders, generally speaking, have been very scarce.

Walckenaëra parallela, Bl.

Walckenaëra parallela, Bl.; Cambr. Spiders of Dorset, p. 156.

I have not met with a single example of this spider during the past spring, though it has frequently been searched for in places where it was found in some abundance in the spring of 1878.

Epeira acalypha, Walck.

Epeira acalypha, Walck.; O. P. Cambridge, Ann. & Mag. Nat. Hist. Feb. 1878, p. 119 (sub *Zilla*).

By an inadvertence a striking variety of this spider was recorded (*l. c.*) under the genus *Zilla*. It is, however, undoubtedly an *Epeira*.

Philodromus lineatipes.

Philodromus lineatipes, Cambr. Ann. & Mag. Nat. Hist. Feb. 1878, p. 122, pl. xi. fig. 5.

The expectations expressed (*l. c.*) that the specific distinctness of this spider would be confirmed by the discovery of the adult form, has been fulfilled by the reception, from Mr. H. C. Young of Glasgow, of adults of both sexes. It is very nearly allied to, but, I think, distinct from *Philodromus emarginatus*, Schrank.

List of the Spiders noted and described.

EXPLANATION OF PLATE XII.

Fig. 1. *Drassus minor*, sp. n. *a*, profile, without legs or palpi; *b*, genital aperture; *c*, eyes, from in front; *d*, natural length of spider.

Fig. 2. *Neriene reproba*, sp. n. *a*, front view of eyes and falces; *b*, left palpus, from outer side, rather in front; *c*, right palpus, from above and behind; *d*, natural length of spider.

Fig. 3. *Neriene exhilarans*, sp. n. *a*, profile, without legs or palpi; *b*, front view of eyes and falces; *c*, eyes in slightly different position; *d*, portion of caput in profile; *e*, cubital and radial joints of right palpus, from in front; *f*, natural length of spider.

Fig. 4. *Neriene nefaria*, sp. n. *a*, profile, without legs or palpi; *b*, underside of abdomen; *x*, transverse slit near spinners of ditto; *c*, genital aperture; *d*, natural length of spider.

Fig. 5. *Neriene mystica*, sp. n. *a*, profile, without legs or palpi; *b*, portion of caput, and eyes, from above and behind; *c*, genital aperture; *d*, ditto, in profile; *e*, natural length of spider.

Fig. 6. *Neriene improba*, sp. n. *a*, eyes, from above and behind; *b*, right palpus, from inner side; *c*, ditto, from above and behind; *d*, natural length of spider.

Fig. 7. *Walckenaëra minutissima*, sp. n. *a*, profile without legs or palpi; *b*, fore part of caput and eyes, from in front; *c*, ditto, from above and behind; *d*, genital aperture; *e*, natural length of spider.

Fig. 8. *Theridiosoma* (gen. nov.) *argenteolum*, sp. n. *a*, profile, without legs or palpi; *b*, genital aperture; *c*, ditto, in profile; *d*, outline of spider, of natural size; *e*, eyes, and falces from in front; *f*, natural length of spider; *g*, maxillæ and labium.

XXV.—*Descriptions of Palæozoic Corals from Northern Queensland, with Observations on the Genus* Stenopora.

By H. A. Nicholson, M.D., D.Sc., F.G.S., &c., Professor of Natural History in the University of St. Andrews, and R. Etheridge, Jun., F.G.S., of the British Museum.

[Plate XIV.]

1. *Introduction.*

The corals about to be described are derived from two sources, viz. a collection from the limestone of the Broken River, made by the late Mr. Richard Daintree, C.M.G., F.G.S., and a second from several localities, made by Mr. R. L. Jack, F.R.G.S., F.G.S., at present Government Geologist for North Queensland.

At the time the "Daintree collection" of Queensland fossils (animal remains) was described by Mr. R. Etheridge, F.R.S.*, the corals were not included in Mr. Etheridge's report, but, having been placed in our hands for description, are now in the British Museum.

The collection made by Mr. Jack has only reached this country within the last few months; and as a portion of it and of that made by Mr. Daintree are from one district and, in all probability, from the same limestone, or at any rate from a limestone in the same series, the present appeared to us a favourable opportunity for working out the two collections in connexion with one another.

Many of Mr. Daintree's corals are in travelled blocks of limestone, in all probability taken from the bed of the Broken River near the outcrop of the limestone yielding them. In this respect Mr. Jack's collection becomes of essential service, because the corals comprised in it have all been obtained *in situ*, and, in addition to enabling us to show the above supposition to be correct, further indicate that the blocks cannot have travelled far.

The Australian Palæozoic corals have not been investigated to any great extent. The most important memoirs on the subject are:—an appendix to Dr. C. Darwin's 'Geological Observations on Volcanic Islands'†, by the late Mr. Lonsdale, in which the genus *Stenopora* was first enunciated; the remarks by the same author contained in Count P. de Strzelecki's work 'Physical Description of New South Wales &c.'‡; descriptions by Prof. J. D. Dana in the 'Geology of the

* Quart. Journ. Geol. Soc. 1872, xxviii. pp. 317-350.
† London, 1844, 8vo, App. pp. 161-163.
‡ London, 1845, 8vo, p. 262 *et seq.*

United-States Exploring Expedition, under Capt. Wilkes, U.S.N.'*; Prof. F. M'Coy's paper "On the Fauna and Flora of the Rocks associated with the Coal of New South Wales" †, containing descriptions of *Cladochonus tenuicollis* and *Strombodes australis*. These, with Prof. de Koninck's 'Recherches sur les Fossiles paléozoïques de la Nouvelle-Galles du Sud' ‡, comprise the more important publications bearing on Australian Palæozoic corals, although there are a number of minor papers which need not now be referred to.

2. *Geological Notes.*

The published information in connexion with the localities or horizons from which the corals about to be described come may be summed up as follows:—

The Broken-River Limestone, represented by the specimens collected by Mr. Daintree, is considered by Mr. R. Etheridge, F.R.S., as the lowest fossiliferous deposit in Queensland. He says, "There cannot now be any doubt that the Broken-River Limestone beds, containing *Favosites* &c. &c., are the lowest fossiliferous deposits in the Queensland area; and their age is undoubtedly Lower Devonian or 'Siluro-Devonian'" §. On this subject Mr. Daintree, who probably had the best knowledge of North-Australian geology, says, "In the limestone bands which form the lower portion of the series" (*i. e.* the Devonian) "corals are very numerous; in fact the limestones, where little alteration has taken place, are a mass of aggregated corals" ‖. In addition to these remarks, Mr. Daintree gives a woodcut view of a "Section of Devonian Coral Limestone, Terrible Creek, near Messrs. Cunningham's Cattle Station, Burdekin River, Northern Queensland" ¶, in all probability the very locality from which his corals came.

Two specimens in the Daintree collection are from the Gympie gold-field, in the characteristic green chloritic rock of that district. These beds are also considered by Mr. Etheridge to be of Devonian age**; but Prof. M'Coy is more inclined to regard them as Carboniferous ††.

We now come in due course to the specimens forwarded by Mr. R. L. Jack. From the Bowen-River coal-field there are two species of *Stenopora* from beds which have been shown

* New York, 4to, pp. 711, 712.

† Ann. & Mag. Nat. Hist. 1847, xx. p. 227.

‡ Bruxelles, 1876, pts. 1 and 2, pp. 140 and 133; 1877, pt. 3, pp. 143–157.

§ Quart. Journ. Geol. Soc. 1872, xxviii. p. 324. ‖ Ibid. p. 290.

¶ *Loc. cit.* p. 290, fig. 12. ** Ibid. p. 324.

†† Prodromus Pal. Victoria, 1874, i. p. 38.

by one of us* to possess strong *Permo-Carboniferous* affinities. The Fanning-River Limestone has in the same manner been shown to be of Devonian age, by means of the Mollusca there associated with the corals. The age of the Arthur's-Creek Limestone, a new locality, will be commented on at the close of this paper.

3. *Lithological Characters of the Specimens.*

We are indebted to our friend Mr. T. Davies, F.G.S., of the British Museum, for the following notes on the lithological characters of some of the matrices containing certain of the corals about to be described.

The fossiliferous rock of Coral Creek consists of an ochreous, concretionary or nodular ironstone, resembling, in a remarkable degree, some forms of bog-iron-ore. In this, in addition to a copious molluscan fauna, occurs *Stenopora Jackii* (nobis). Other nodules occur associated with this, formed of detrital matter, which varies according to the derivative rock, in some cases being more felspathic and quartzose with scales of mica, suggesting a gneissic or granitic rock as the source. These nodules contain *Stenopora ovata*, Lonsdale, in abundance.

The fossiliferous rock of the Gympie gold-field, containing many fossil *Spiriferæ*, *Stenopora?* sp., &c., is of aqueous origin, and consists of the detritus of preexisting metamorphic shales and limestones. Large angular and subangular fragments of a fine-grained chloritic slate occur in a conglomerate of small oval pebbles of limestone, dolomitic limestone, and a siliceous rock. The cementing material consists of the fine-grained comminuted detritus of chloritic schist. Chlorite alone occurs as an incrustation on the contained fossils, more especially upon the remains of the Mollusca.

4. *Descriptions of the Species.*

Spongida (Stromatoporoidea).

Before proceeding to a detailed description of the corals, we may mention the presence of the genera *Stromatopora* and *Caunopora* in the Queensland limestones—a fact not hitherto recorded, so far as we are aware.

Stromatopora occurs amongst Mr. Daintree's fossils from the Broken-River Limestone, but in so highly silicified a state that we have not been able to make a satisfactory examination of the specimen. Another example has been forwarded by Mr. Jack from the Arthur's-Creek limestone,

* In a paper lately read before the Geological Society of London.

which is very like some of the Devonian species of Devonshire and the Eifel.

The *Caunopora* is also from the limestone of Arthur's Creek, and is apparently distinct specifically from *Caunopora placenta*, Phillips, the characteristic Devonian form from Devonshire.

Pending a detailed and proper description of the Eifel and Devonshire forms of *Stromatopora* and *Caunopora*, we refrain from entering into details concerning these specimens, and hope to be able to do so, with more satisfactory material in our hands, at some future date.

Class ACTINOZOA.

Genus Favosites (pars), Lamarck, 1816.

(Hist. des Anim. sans Vertèb. ii. p. 204.)

Obs. The Silurian rocks of New South Wales have yielded no less than five species of this genus, and one doubtful one, to the researches of Prof. de Koninck*, viz.:—*Favosites aspera*, D'Orb.; *F. cristata*, Blumenbach; *F. fibrosa*, Goldf.; *F. Forbesi*, Edw. & H.; and *F. gothlandica*, Fougt. The same author likewise mentions as occurring in the Devonian rocks of New South Wales:—*F. alveolaris*, Goldf.; *F. basaltica*, Goldf.; *F. fibrosa*, Goldf.; *F. polymorpha*, Goldf.; and *F. reticulata*, Blainville. In addition to these, *Favosites gothlandica* was long ago shown to be present in New South Wales rocks by Mr. Lonsdale †; and its existence (as *F. Goldfussi*, Edw. & H.) in the Devonian rocks of Buchan, Victoria, has been pointed out by Prof. M'Coy ‡.

Amongst the Queensland corals are two forms of *Favosites* only separable by the size of the corallites composing the respective colonies. We refer these as follows:—

Favosites gothlandica (Fougt), Lamarck.

Favosites gothlandica, Lamarck, Hist. Anim. sans Vertèb. 1816, ii. p. 206.
Calamopora gothlandica, Goldfuss, Petr. Germ. 1829, i. p. 78, t. 26. fig. 3, *a–c*.
Favosites gothlandica, Edwards and Haime, Polyp. foss. Terr. Pal. 1851, p. 232.
Favosites Goldfussi, Edw. & H. ibid. p. 235, t. 20. fig. 3, *a, b*.

Obs. It will be convenient to consider the form with the smallest corallites as the typical *F. gothlandica*, whilst that

* Foss. Pal. Nouv.-Galles du Sud, 1876, pts. 1, 2, pp. 20–23.
† Strzelecki's Phys. Descr. New South Wales, 1845, p. 266.
‡ Prod. Pal. Victoria, dec. iv. 1876, p. 15.

with the larger calices may be looked upon as the variety *Goldfussi*. Edwards and Haime regarded *F. gothlandica* as an essentially Silurian species; and the corresponding Devonian form was separated by them under the name of *F. Goldfussi*. The latter is stated by its authors to be distinguished from the former by its larger corallites and more closely set mural pores. The size of the tubes (1½ line), however, is frequently exceeded by typical Upper Silurian examples of *F. gothlandica*, notwithstanding their more commonly smaller size. Under any circumstances the size of the corallites merely cannot be regarded as a character of the smallest specific value, while the mural pores exhibit an at least equal variability. Upon the whole, therefore, *F. Goldfussi*, Edw. & H., cannot be satisfactorily separated from *F. gothlandica*, except as a mere variety.

In the specimens here referred to *F. gothlandica*, var. *Goldfussi*, the diameter of the calices, as before stated, is about 1½ line, in extreme cases reaching as much as 2¼ lines. In one example there are four tabulæ in the space of two lines vertical, whilst in another specimen the same number are contained in a space a little exceeding this. The examples collected by the late Mr. Daintree appear to be only portions of colonies; but, notwithstanding this, one of the specimens, a very fine one, measures 9½ inches by 4½, forming a more or less elongated depressed parallelogram. This form of *F. gothlandica* corresponds in a striking manner with that met with in the Corniferous Limestone of North America, a careful comparison having been made with colonies of the latter coral in the cabinet of one of us.

We now come to four specimens, and possibly a fifth, which we look upon as referable to *Favosites gothlandica* proper, as understood by Messrs. Edwards and Haime. They also bear a close resemblance to *F. epidermata*, Rominger, from the Corniferous Limestone of North America, which is probably, after all, only another variety of the widely spread and typical *F. gothlandica*. In the colonies in question the calices are much smaller, scarcely ever exceeding 1 line in diameter, and frequently less, whilst four tabulæ appear, on an average, to be comprised within the space of 1½ line vertical. We say on an average, because we find, on the examination of a sufficiently large number of specimens gathered from various quarters, and including those from Australia, that there is every gradation between these two conditions in the size of the corallites and disposition of the tabulæ. It is on these grounds, combined with the variable disposition of the mural pores, that we propose to consider *F. gothlandica* in the wide sense understood by Goldfuss, before its subdivision by Edwards and Haime.

In the fifth example, previously referred to as probably identical with the other form, the septal spines are well developed.

Locality and Horizon. Broken River, a tributary of the Burdekin River, North Queensland. Specimens obtained *in situ* and in partially rounded blocks. Devonian Limestone.

Collector. The late Richard Daintree, Esq., C.M.G., F.G.S., &c.

Genus Alveolites, Lamarck, 1801.

(Système des Anim. sans Vertèb. p. 375.)

Obs. We have before endeavoured to point out* the chaotic condition in which the genus *Alveolites* at present rests. The conclusion at which we arrived, after a very careful examination of a large series of corals referable to the *Alveolites-Chætetes* section of the Tabulata, was:—"Not only does it appear to be evident that the name *Alveolites* covers a number of forms which are not always united by relations of genuine affinity, but even those forms which may be regarded as types of *Alveolites* are only separable from certain allied groups by characters difficult to define or discover, and sometimes of dubious value and uncertain interpretation." Since these remarks were made, *Alveolites* has been the subject of further research by one of us; and in a forthcoming work † it will be shown that this name must be restricted to a small group of species, while many forms which have been indiscriminately assigned to it will have to be distributed amongst other genera.

We have before us two corals from Queensland, which we have not been able to submit to as complete an examination as we should like. One of them is a ramose form of *Alveolites*, accepting that genus as *formerly understood*, with affinities to *Pachypora*; the other is an expanded or lobate species of so-called *Alveolites*.

Under this name there have been described from the Palæozoic rocks of Australia the following species:—The Upper Silurian series of Burrowang has yielded to the researches of Prof. de Koninck ‡ *Alveolites repens*, Fougt, and *A. rapa*, De Kon. The Lower Devonian rocks of the same colony have yielded *Alveolites subæqualis*, Edw. & H., and *A. ob-*

* Journ. Linn. Soc. Zool. xiii. p. 353.

† H. A. Nicholson 'On the "Tabulate Corals" of the Palæozoic Rocks, with Critical Descriptions of Illustrative Species.'

‡ Foss. Pal. Nouv.-Galles du Sud, 1876, pt. 1, pp. 17, 18, and 77.

scurus, De Kon. We may at once state that the Queensland *Alveolites* forwarded by Mr. Jack in no way correspond to any of these; indeed the two new species described by Prof. de Koninck appear to us to be very unsatisfactorily established, and nothing is known of their microscopic structure.

Alveolites (*Pachypora*?), sp. ind.

Obs. A ramose species, with affinities to *Pachypora*, and possibly really referable to this latter genus. It is very like *A.* (*Cladopora*) *robusta*, Rominger *, from the Corniferous Limestone of North America. The surface-characters are much destroyed by weathering; and as its internal structure shows nothing but mural pores and tabulæ, with no special features of interest, little further can be said about it. The coral may at once be distinguished from our *Pachypora meridionalis* by its very oblique tubes and calices.

The largest of the specimens before us (by no means a perfect specimen) is 3½ inches in length. The distance between two points of bifurcation or dichotomization of the branches is 1 inch 3 lines.

Locality and Horizon. Arthur's Creek, Burdekin Downs, Devonian Limestone.

Collector. R. L. Jack, Esq.

Alveolites, sp. ind.

Obs. An expanded, lobate, or palmate form, which, in the present unsatisfactory and chaotic state of *Alveolites*, is very difficult to determine, although, specifically speaking, we do not know any thing precisely like it. Sections show that the corallites were thin-walled and irregular, with mural pores and plenty of tabulæ. With the material before us we feel we should be only unnecessarily increasing nomenclature by bestowing a name, and therefore refrain.

Locality and Horizon. Arthur's Creek, Burdekin Downs, North Queensland. Limestone of Devonian age.

Collector. R. L. Jack, Esq.

Genus Heliolites, Dana, 1846 (?).

(Zoophytes, Wilkes's U.S. Expl. Exped. p. 541.)

Obs. The Silurian and Devonian rocks of one or other of the Australian colonies have yielded four species of this genus, so far as present researches have gone; and to these we have to add a fifth and sixth.

* Foss. Corals of Michigan, p. 54, t. 22. figs. 1, 2.

Heliolites interstinctus, Linn., has been met with, according to Prof M'Coy*, in the Upper Silurian Limestone of Waratah Bay, Victoria. The researches of Prof. de Koninck have shown the existence of *H. megastoma*, M'Coy, and *H. Murchisoni* in the Upper Silurian rocks (probably Ludlow or Wenlock) of New South Wales, at Burrowang†, whilst the Devonian of the same colony has yielded *H. porosa*, Goldf. ‡

Heliolites porosa, Goldfuss.

Astræa porosa, Goldfuss, Petr. Germ. 1826, i. p. 61, t. 21. fig. 7.
Heliolites porosa, M.-Edwards and Haime, Polyp. foss. Terr. Pal. 1851, p. 218; Mon. Brit. Foss. Corals, 1853, pt. 4, p. 212, t. 47. fig. 1, *a–f*; De Koninck, Foss. Pal. Nouv.-Galles du Sud, 1876, pt. 1, p. 81; Etheridge, jun., Cat. Australian Foss. 1878, p. 37.

Obs. Under this name we have assembled a series of specimens from three localities in North Queensland, varying more or less slightly in their characters amongst themselves, but which we think are all referable to *Heliolites porosa*, Goldf. The composite corallum in these corals is massive, with a flat under surface or base, having few and faintly marked concentric ridges. The calices in all the specimens are circular, pretty equally developed in the same individual, and separated by unequal interspaces occupied by cœnenchymal tubes§; each calice varies from $\frac{1}{2}$–$\frac{2}{3}$ of a line in diameter. The tubes of the cœnenchyma are rather small and polygonal, and constitute somewhat large interspaces between the corallites. The septa are only visible here and there.

Upon comparing a series of specimens of *H. porosa* from German and British Devonian rocks we find that considerable variation takes place,—1st, in the diameter of the corallites themselves; 2nd, in the size of the cœnenchymal tubuli; 3rd, in the amount of intercalicular space occupied by the latter; and 4th, in the length of the septa. These variations are, indeed, shown in the figures given by MM. Milne-Edwards and J. Haime. So far as we are able to judge, the Queensland examples appear to occupy a median place in the above scale; the diameter of the corallites and cœnenchymal

* As *Palæopora*, in Progress Report for 1876, no. iv. Geol. Survey Vict., by T. Couchmann, pp. 156, 158 (Melbourne, 8vo, 1877).

† Foss. Pal. Nouv.-Galles du Sud, 1876, pt. i. pp. 24, 25.

‡ Ibid. p. 81.

§ In this and in the following descriptions of species of *Heliolites* we use the terms "cœnenchyma" and "cœnenchymal tubes" simply in accordance with previous custom, and for the sake of convenience. There is, of course, no true "cœnenchyma" in *Heliolites* and its allies; and the so-called "cœnenchymal tubes" are really a specialized series of small corallites.

tubuli is greater than in some European examples and less than in others. On the whole the interspaces occupied by the tubuli are perhaps greater in the Queensland examples.

In vertical sections we can distinguish with ease the tabulæ as described by Edwards and Haime, horizontal, but sometimes oblique. These authors describe the cœnenchymal tubuli as "nearly regularly hexagonal." Certainly this is the case with some of the tubes on various parts of the Queensland specimens; but we find by far the commoner form is the polygonal.

Locality and Horizon. Broken River, North Queensland, in rolled blocks (*Daintree*); Limestone of the Fanning River, Burdekin Downs, N. Q., *in situ* (*Jack*); Limestone of Arthur's Creek, Burdekin Downs, *in situ* (*Jack*). Devonian.

Collectors. The late R. Daintree, Esq., and R. L. Jack, Esq. (*Coll.* Geol. Survey of North Queensland and Brit. Mus.)

Heliolites Daintreei, Eth., Jun., and Nicholson.
(Pl. XIII. figs. 3, 3*a*.)

Spec. char. Corallum compound, discoid or flattened; upper surface a little convex; under surface more or less flattened, concentrically wrinkled round the edges. Calices large, equal in size, with a diameter of $\frac{3}{4}$ line, or at times almost 1 line, closely set; calicular edge deeply scalloped. Septa numerous and well-marked, certainly fourteen and sometimes more, unequal in size. Cœnenchyma composed of large and well-developed tubes separating the corallites by irregular interspaces, often of small extent. A specimen measures $3\frac{1}{2}$ inches by nearly 4.

Obs. We have separated from the foregoing specimens one which appears to us to possess characters sufficiently worthy of specific distinction.

It may be distinguished by the size and contiguity of the large corallites, with their strongly scalloped margins. The cœnenchymal tubuli are irregularly developed; for between neighbouring calices we occasionally see only one row of tubes, but more commonly the number is increased to two. The latter number varies up to three or four, beyond which we have not observed them to be increased.

In the contiguity of its calices and frequent diminution of the tubuli, *H. Daintreei* resembles *H. megastoma*, M'Coy, of the British Silurian rocks, but is at once distinguished by the prominent scalloped edges of the calices, and the flat or little-convex form of the corallum.

In the contiguity of the corallites one to the other there is a good deal of resemblance between our *H. Daintreei* and *H. pyriformis*, Lonsdale, as figured by Hall from American specimens; but the other characters are quite dissimilar.

Locality and Horizon. Broken River, North Queensland, as a rolled block.

Collector. The late R. Daintree, Esq.

Heliolites, sp. ind.

Obs. A third and small species of *Heliolites* is represented by a single example nestling in the middle of a large block of *Favosites.* The calices and cœnenchymal tubuli are very small, the latter so much so that the use of a lens is required for their detection. The corallites are circular and possess very thin and thread-like margins, and they are separated from one another by intervals of cœnenchyma of some extent. The tubes of the latter are very small and almost microscopic, hexagonal or polygonal.

In a vertical section the structure is characteristically Heliolitiform. In the interspaces between the corallites the small square cells, making up the cœnenchyma, are quite apparent, but rather unequal in size. The tabulæ in the corallites are moderately close and horizontal.

We have observed traces of very small septa remaining in one or two of the corallites; but their structure is so delicate and minute that their preservation is surprising. We think it very probable that this is an undescribed minute *Heliolites*; but as we have only one example before us, we refrain from committing ourselves to a name. It appears to be smaller in general than any of the commoner species of *Heliolites* known to us, especially as regards the size of the cœnenchymal tubes.

Locality and Horizon. Broken River, North Queensland, in a large block of *Favosites.* Limestone of Devonian age.

Collector. The late R. Daintree, Esq.

Heliolites plasmoporoides, Eth. Jun., and Nicholson, sp. nov.
(Pl. XIII. figs. 2, 2 *b*.)

Spec. char. Corallum irregularly ovate; upper surface convex. Calices circular, with a thin thread-like margin, average diameter $1\frac{1}{2}$ line, contiguous, but separated from one another by small interspaces of cœnenchymal tubuli. The latter are large and of very irregular form: some are elongate, with one axis much longer than the other; others are polygonal; and, again, others are without definite outline. Between contiguous corallites there is usually but one row of large oblong interstitial tubes, reaching from calice to calice;

or, where the corallites become a little separated from one another, these may be increased in number. Septa almost obsolete, thread-like. A specimen measures 5 inches by 4.

Obs. The form and arrangement of the cœnenchymal tubuli render the present species a very interesting one. If horizontal sections in the mass are examined only with the naked eye or ordinary lens, the species will be pronounced a *Plasmopora;* and this it at first appeared to us to be. It has all the general appearance of this genus, especially in the fact that there is often but a single row of oblong interstitial tubes between every two corallites. In such sections the walls of these tubes have quite the appearance of thread-like costæ radiating from corallite to corallite, or bifurcating at various angles where their number is increased between the corallites, as in *Plasmopora.* When, however, vertical microscopic sections are examined, the true affinities of this peculiar coral at once become apparent. In the first place, the arched and vesicular tabulæ of *Plasmopora* are wanting, and we find in their place the straight horizontal diaphragms of *Heliolites.* Secondly, in similar sections the interstitial or cœnenchymal structure is found not to consist of vertical canaliculi formed by the irregularly-developed walls of the tubuli, and subdivided by horizontal or convex dissepiments into irregularly formed cells, as in *Plasmopora,* but of a series of small regular and well-developed cells formed by the intersection of the vertical tubuli and their horizontal tabulæ, which are usually placed on the same level and correspond with one another, precisely as seen in vertical sections of *Heliolites megastoma*, M'Coy.

In working out this interesting coral we have made a series of microscopic sections of *Plasmopora petaliformis* and *Heliolites megastoma,* for comparison with those of the Queensland fossil; and these have enabled us to indicate *Heliolites* as the proper resting-place for this otherwise very *Plasmopora*-like coral.

So far as our investigations enable us to form an opinion, *H. plasmoporoides* is most nearly allied to *H. megastoma*, M'Coy; indeed, in the figure of this species given by Edwards and Haime we notice the one-celled disposition of the cœnenchyma in places, similar to that seen in the present species. The latter, however, is clearly distinguished from *H. megastoma.*

Locality and Horizon. Broken River, a tributary of the Burdekin River, North Queensland. Devonian Limestone.

Collector. The late R. Daintree, Esq.

[To be continued.]

XXVI.—*Descriptions of new Species of Lepidoptera from Madagascar, with Notes on some of the Forms already described.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

THE following species have recently been added to the collection of the British Museum.

Nymphalidæ.

SATYRINÆ.

STRABENA, Mabille.

So far as I have been able to ascertain, this genus has not hitherto been characterized, unless the description of *S. Smithii* (in which the truncato-angulated form of the primaries and dentate character of the secondaries is mentioned) be regarded as a sufficient indication of the generic peculiarities. The aspect of the species here described, and which I believe to be another representative of *Strabena*, is not unlike that of *Dædalma*, the arrangement of the ocelli on the under surface being very similar to that of *Neope*.

1. *Strabena Mabillei*, sp. n.

♂. Alæ supra piceo-fuscæ, areis costali et apicali anticarum nigrescentibus, margine nigro lineam albidam vel pallido fuscescentem includente; anticæ ocello magno, in spatii primi mediani medio posito, nigro, albo pupillato, castaneo cincto; posticæ ocellis duobus minoribus, interiore majore, fascia submarginali pallida, intus fusco limitata: corpus nigro-fuscum. Alæ subtus fuscæ, lituris numerosis nigris ornatæ, marginibus fere velut supra: anticæ costa nigra, lituris albis interrupta, area interna lituris nigris inconspicuis, litura subapicali costali obliqua maculaque ad marginem externum flavis, ocello parvo subapicali nigro, albo pupillato, olivaceo cincto, fusco circumcincto, lilacino zonato, ocello superno iride multo latiore; posticæ maculis nonnullis sparsis flavis, fascia obliqua a lineis irregularibus nigro-fuscis limitata; ocellis septem nigris, cæruleo-albido pupillatis, flavo-cinctis, fusco circumcinctis, lilacino zonatis, primo, quarto et quinto duplo majoribus: corpus olivaceum. Alar. exp. unc. 2.

Antananarivo (*Kingdon*).

Specimens nearly agreeing with that here described were regarded by the late Mr. Hewitson as a variety of "*Mycalesis antahala*" of Ward; the species, however, is apparently more nearly allied to the "*M. avelona*" of the same author.

2. *Culapa parva*, n. sp.

Olivaceo-fusca: alæ anticæ supra ocello magno nigro, albo pupillato, fulvo late cincto, in spatio primo mediano posito: posticæ ocello apud angulum ani parvo : corpus nigrescens. Alæ subtus lilacinæ olivaceo transversim lituratæ, fascia lata media flavido-olivacea, fascia ejusdem coloris marginali ; anticæ ocello superno iride antice obliterata ; posticæ ocello superno minore : corpus olivaceum. Alar. exp. unc. 1, lin. 9.

Antananarivo (*Kingdon*).

The type of *Culapa* of Moore, is "*Mycalesis mnasicles*," Hewitson.

3. *Pseudonympha subsimilis*, n. sp.

Alæ supra fere velut in "*Mycalesi iboina*" sed minores et paululum pallidiores ; anticæ subtus lineis ocellisque similibus, linea autem submarginali alternatim angulata : posticæ arenoso-albidæ fusco lituratæ, lineis mediis velut in "*M. ankova* ;" ocello apud apicem costali et duobus apud angulum analem valde inæqualibus, linea submarginali alternatim angulata et duabus marginalibus velut in anticis olivaceo-fuscis : corpus griseum. Alar. exp. unc. 1, lin. 7.

Fianarantsoa (*Shaw*).

4. *Pseudonympha angulifascia*, n. sp.

Alæ supra fere velut in "*M. iboina*" sed minores ; anticæ subtus obscuriores ; posticæ flavæ, area basali, fascia valde irregulari media (ferrugineo limitata), nebula discali, apice, lineis duabus submarginalibus ciliisque fuscis ; macula subcostali apud apicem nivea ; ocellis duobus apud angulum ani nigris, albo pupillatis flavo cinctis, interiore magno, exteriore minimo : corpus fuscum, pedibus pallide olivaceis. Alar. exp. unc. 1, lin. 6.

Antananarivo.

We have also received from this locality what I suppose to be the "*Mycalesis anganavo*" of Ward, a little species much resembling a small *Pedaliodes* or *Steroma* in form and in the marking of the under surface : it cannot well be placed either in *Mycalesis*, *Pseudonympha*, or *Strabena*. For this form, which seems to unite the characters of several distinct genera, I propose the name of *Henotesia*.

HENOTESIA, gen. nov. (ἑνοτήσιος).

Alarum forma velut in *Pedaliodi*, palpis autem brevioribus venisque *Strabenæ* (a *Pseudonympha* nervulis secundo et tertio alarum posticarum medianis latius separatis).

5. *Henotesia anganavo* ?, Ward.

Olivaceo-fusca : alæ anticæ supra ocello magno, nigro, albo pupillato, castaneo cincto ; posticæ ocello multo minore apud marginem externum, linea submarginali undulata nigra. Alæ subtus fuscæ nigro lituratæ: anticæ ocello superno et linea submarginali indistincta nigra, area externa paululum pallidiore: posticæ fascia valde irregulari media nigro-fusco limitata et extrorsum flavo limbata, area externa dilute fusca, nigro indistincte liturata: ocellis duobus analibus inæqualibus nigris, albo pupillatis, late ferrugineo cinctis, linea undulata submarginali fusca, linea ante marginem ciliisque nigrescentibus. Alar. exp. unc. 1, lin. 6.

Antananarivo.

As I am not by any means certain that this is the species intended by Mr. Ward's very brief description, and as, moreover, I consider the name *anganavo* by far too barbarous to be countenanced by the naturalists of the future, I would propose that, in the event of the type of *Henotesia* proving distinct, it should receive the name of *H. Wardii.* The only means of deciding the question will be by examining either the type or a figure made from it, as the description might apply to half-a-dozen species.

6. *Ypthima Vinsonii*, Guénée.

Now that we have received this species (from Antananarivo), I strongly suspect it to be conspecific with "*Erebia rakoto*," Ward. The example received is certainly very distinct from *Y. Batesii*, being considerably larger and altogether different on the underside. *Satyrus mopsus* of Mabille seems to be allied to *Y. Vinsonii*; the latter cannot, surely, be a *Strabena*, as hinted by M. Mabille.

7. *Ypthima niveata*, n. sp.

♀. *Y. Batesii* affinis: supra olivaceo-fusca, areis alarum discalibus albicantibus, marginibus autem fundi colore; anticæ ocello magno subapicali nigro, lilacino bipupillato, fulvo cincto; posticæ ocellis duobus subapicali et subanali unipupillatis. Anticæ subtus disco albo; posticæ albæ, costæ basi, angulo anali, striga submarginali, linea fere marginali ciliisque fuscis, ocellis supernis fusco zonatis, ocello parvo anali duplici: corpus nigrescens. Alar. exp. unc. 1, lin. 7.

Antananarivo (*Toy*).

It is barely possible that this can be the female of *Y. Batesii*; it differs from it so much more than do the opposite sexes of any other species in the genus.

Nymphalinæ.

M. Mabille appears to mistake my *Panopea Drucii* for the common *Panopea dubia*, Pal. de Beauv.; it is, however, a constant and distinct species.

8. *Salamis definita*, sp. n.

Magnitudine speciei cui nomen *S. aglatonice*, signationibus autem velut in *S. Duprei*, caudis alarum posticarum elongatis, marginibus autem velut in *S. aglatonice* infuscatis; area basali alarum omnium distincte cinerea; alæ subtus fundo niveo, areis obscurioribus subcinereis; ocello subanali posticarum magno. Alar. exp. unc. 2, lin. 6–11.

Fianarantsoa and Antananarivo.

This species is evidently quite common. It is much smaller than *S. Dupréi*, with less falcated primaries, the bases of the wings and the border of the secondaries grey; the under surface also usually shows no trace of the sandy yellowish tint so frequently found in *S. Dupréi*. From *S. aglatonice*, with which it agrees in size, it differs in its more falcate primaries, the greater extent of the black apical border of these wings, the almost entire absence of the rose-coloured shot and of the large black spot on the first median interspace of primaries, and in the caudate character of the anal angle of secondaries.

Acræinæ.

9. *Acræa fornax*, sp. n.

Alæ anticæ rufo-fulvæ strigulis duabus basalibus, costa, dimidio fere apicali et margine lato externo nigerrimis, costæ basi rufa, punctis duobus minutissimis in marginis postici sinibus positis, fasciola trifida subapicali alba; posticæ rufo-fulvæ margine externo late nigro, punctis paucis ad marginem rufis, macula irregulari ad cellulæ basin, serie subbasali macularum quinque, plaga cellulam terminante et serie macularum octo inæqualium omnibus nigris: corpus nigrum fulvo alboque punctatum. Alæ subtus multo pallidiores quam supra; anticæ maculis triangularibus marginalibus fulvis, ad apicem elongatis; posticæ subroseæ, area basali obscuriore, maculis nigris fere velut supra, margine externo late nigro maculis ad marginem triangularibus fulvis, venis ferrugineis: corpus nigrum, palpis, pedibus anticis femoribusque aureo-flavis, ventre longitudinaliter albo strigoso. Alar. exp. unc. 2.

Fianarantsoa (*Shaw*).

This very distinct species is probably most nearly allied to *A. Sganzini*; but in form it more nearly agrees with *A. pseudolycia*.

Lycænidæ.

10. *Castalius azureus*, sp. n.

Alæ supra cæruleæ apud margines saturatiores; anticæ margine costali et basi nigrescentibus, venula superiore discocellulari nigra, margine externo latius nigro, area statim pone cellulam subpellucida, albicante; posticæ basi nigrescente, linea marginali punctisque submarginalibus nigris, macula apicali, a lunula cæruleo-cinerea interrupta, nivea, ciliis albis nigro persectis, cauda nigra: corpus nigrescens, oculis albo cinctis, palpis lateraliter albis. Alæ subtus cretaceo-albæ, linea tenui marginali, serie macularum apud marginem externum virgulisque submarginalibus nigris; anticæ macula discocellulari serieque angulari macularum quinque discalium, tribus quarum superioribus confluentibus: posticæ ad basin sordidæ, macula oblonga discocellulari, tribus apud basin in serie obliqua positis, octo discalibus, tertia et quarta in serie angulata connectis, unaque subanali nigris; maculis duabus seriei marginali analibus smaragdino bracteatis virgulisque submarginalibus croceis; ciliis velut supra: pectus cinereo-albidum; venter sordide albidus. Alar. exp. unc. 1, lin. 7.

Antananarivo (*Kingdon*), Fianarantsoa (*Shaw*).

Two collections contained a single example of this very distinct and beautiful little species. In the specimen from Fianarantsoa several of the submarginal black spots on the upper surface of the secondaries are wanting.

11. *Iolaus argentarius*, sp. n.

♀. Anticæ supra area interno-basali argenteo-cærulea, area media plagam magnam sericeo-albam formante, costæ basi nitide fusca, area apicali et margine externo late nigris; posticæ sordide albæ apud basin argenteo-cæruleæ, fascia lata subcostali nigrescente, in medio nigra, linea marginali maculisque submarginalibus nigris albo limbatis, macula autem subanali maxima extrorsum vivide cæruleo limbata, caudis nigris albo terminatis: corpus fuscescens, cinereo-hirtum. Alæ subtus albæ; anticæ virgula discocellulari, striga obliqua discali, lunulis septem submarginalibus et linea marginali nigris; posticæ maculis duabus apud basin nigris, linea valde irregulari a costa ad marginem internum errante, apud aream analem trisinuata, partim fusca cæteroquin nigra, macula costali subapicali nigra, strigis duabus margini apicali subparallelis pallide fuscis, macula rotundata in area prima mediana sita plagaque adhærente fulvis, lunulis duabus margini anali parallelis nigris, macula submarginali apud angulum analem cinerea, macula anali nigra maculaque adhærente alba, introrsum smaragdino, extrorsum aureo zonatis: ventre fuscescente. Alar. exp. unc. 1, lin. 5.

Antananarivo (*Kingdon*).

Papilionidæ.

Pierinæ.

12. *Nychitona sylvicola*, Boisd.

A specimen of this species now received agrees in all points with the description; the small spot which Dr. Boisduval mentions as usually present is, however, very indistinct; on the under surface it agrees well with Cramer's figure of *N. medusa*, said to come from Bengal. We have an example agreeing in all respects with the figure and with *N. sylvicola*, from the Congo, but none from any part of India. The specimens previously received, and supposed to be *N. sylvicola*, agree in all respects with *N. nupta*. With regard to the latter species, which Mr. Kirby supposes to be the female of *N. alcesta*, I may mention that the sexes are identical, the upper surface being pure white in both; in *N. alcesta*, on the other hand, both sexes have a well-defined black spot on the disk and at apex of primaries.

13. *Belenois albipennis*, sp. n.

♀. *B. helcidæ* simillima, margine autem nigro minus profunde exciso; posticæ subtus niveæ, haud croceæ. Alar. exp. unc. 2, lin. 7.

Antananarivo (*Kingdon*).

If this should prove to be no more than a variety, it will throw doubt upon the value of several other species in the genus.

Papilioninæ.

An example of *Papilio endochus* received with Mr. Kingdon's series differs from the typical form in the absence of the second black costal patch on the primaries.

Hesperiidæ.

14. *Trapezites? Kingdoni*, sp. n.

Alæ anticæ supra velut in *T. jaccho* (*T. eliena*, Hewits.); posticæ nigro-fuscæ plaga magna diffusa media ochracea, ciliis sordide aurantiacis: corpus nigrescens; thorace lateraliter viridi piloso. Anticæ subtus costa late ferruginea, margine externo late lilacino, maculis hyalinis velut supra; posticæ rufo-fuscæ plaga obliqua media et fascia lata marginali lilacinis, margine abdominali roseo-fusco, ciliis sordide aurantiacis: corpus pallide fuscum, pectore albido-hirto, palpis albis. Alar. exp. unc. 1, lin. 4.

Antananarivo (*Kingdon*).

It is possible, as the secondaries of this species are rather shorter than in the Australian insects composing the genus *Trapezites*, that it may have to be separated as the type of a distinct genus; the pattern and general coloration, the antennæ, form of primaries, and appearance are, however, so exactly like *Trapezites* that I have hesitated to separate it. '*Pamphila*' *gillias* of Mabille (Pet. Nouv. ii. p. 285, 1878) seems to be an allied species *.

15. *Cyclopides pardalina*, sp. n.

Nigra; anticæ supra linea subcostali basali, striga securiformi media, macula subcostali media, duabus subapicalibus oblique positis et quarta bifida discali croceis; posticæ plaga permagna subpyriformi media crocea, ciliis extrorsum croceis. Alæ subtus apice costaque sordide flavis, maculis supernis majoribus croceis; posticæ citrinæ maculis subcostalibus submarginalibusque septem et striga interno-mediana cinereo-fuscis: pectus viridi-cinereum, antico flavescens, ventre citrino. Alar. exp. unc. 1.

Antananarivo (*Kingdon*).

Allied to *C. paniscus* and *C. malgacha*.

Sphingidæ.

Chœrocampinæ.

16. *Gnathostypsis laticornis*, sp. n.

Alæ supra roseo-ferrugineæ vel rufo-fuscæ, tertia parte externa anticarum dilutiore, linea valde indistincta aream externam introrsum limitante, linea regulari discali margini parallela fusca, costa et margine interno cinerascentibus, ciliis testaceis; posticæ margine externo cinereo-fusco introrsum sinuato, ciliis albis fusco hic illuc punctatis: corpus ferrugineum vel rufo-fuscum; oculis albido cinctis. Alæ subtus ferrugineæ fusco striolatæ, marginibus externis cinereo-fuscis paululum roseo tinctis: corpus rufescens, pedibus albicantibus, ventris segmentis testaceo et albo marginatis. Alar. exp. unc. 1, lin. 6–7.

Antananarivo and Fianarantsoa.

Although I have not seen the type of *Gnathostypsis*, this species answers so well to the characters given by Dr. Wallengren that I have little doubt of its being a second species of that genus.

* Five species of Hesperidæ are described in this number of the 'Petites Nouvelles:' for my part I do not think that naturalists' advertisement sheets ought to be used as media for describing new species. Publication even in newspapers should, in my opinion, be ignored, much more in two- to four-page advertising pamphlets.

17. *Diodosida Grandidieri*, sp. n.

Affinis *D. murinæ*, corpore alisque anticis cinereis ferrugineo lineatis: alæ anticæ fere velut in *D. murina* lineis subparallelis scriptæ, plaga subapicali marginali, margine apud angulum externum punctisque lineas terminantibus nigro-fuscis, macula interno-basali unaque diffusa pone cellulam fuscis; posticæ nigro-fuscæ, striga margini parallela indistincta rufescente, plaga marginali apud angulum analem cinereo-albida, ciliis albis: corpus linea dorsali longitudinali fusca; antennis pallide testaceis. Anticæ subtus cinereæ, disco pallide carneo-fusco a linea undulata in venis nigro punctata limitato; posticæ carneo-albidæ lineis tribus subparallelis cinereis, linea quarum externa nigro punctata, margine latius cinereo introrsum dentato, ciliis albis. Alar. exp. unc. 1, lin. 11.

Antananarivo (*Kingdon*).

18. *Chœrocampa humilis*, sp. n.

Alæ supra cupreo-fuscæ, sericeæ; anticæ area basali costaque subcinereis, area externa saturatiore a linea regulari obliqua, ad apicem currente, introrsum limitata; posticæ margine externo latius obscuro: corpus alis obscurius. Alæ subtus testaceæ marginibus paululum obscurioribus; anticæ minime rufescentes: corpus subtus pallide testaceum, ventre roseo tincto. Alar. exp. unc. 2, lin. 1.

Antananarivo (*Kingdon*).

Possibly the male of *C. Batschii*, but differing from the figure in form, and considerably smaller.

Other Sphingidæ received from Mr. Kingdon are:—*Ambulyx Coquerilii* ♂, Boisd.; *Chœrocampa gracilis*, Butl. (a South-African species); *Protoparce lingens* ♀, Butl.; and *Diludia chromapteris*, Butl. Of the last-mentioned species (hitherto unique, so far as I am aware, in the Museum collection) there was a very fair series, exhibiting slight variations in the intensity of the coloration, but not in any of the markings. I consider this rather important evidence in favour of its distinctness from the allied *D. jasmini*, Boisd., since that species is described as having "whitish grey upper wings and ash-coloured stigma," no mention also being made of the parallel discal series of whitish spots common to *D. chromapteris*; the lower wings moreover are said to be "black, with the base broadly of a beautiful orange-yellow, and the anal angle marked by a little patch of ashy grey;" in *D. chromapteris* they are greyish brown, with the basal half bright ochreous, with two transverse central blackish bands, the inner one quite black, the outer one dentate and dividing a series of grey dashes between the veins; instead of a grey patch, there is a snow-white spot near the anal angle placed upon a longitudinal black dash *.

Agaristidæ.

19. *Rothia micropales*, sp. n.

R. pali affinis, multo minor, nigro-fusca; alæ anticæ fascia obliqua pallide flava pone medium sita, costam angulumve externum haud attingente; posticæ plaga media rotundata flava cyaneo zonata, oculis flavo cinctis: abdomen lateribus croceis. Alæ subtus paulo pallidiores; anticæ nigro-fuscæ, basi crocea, fascia superna flavida, ciliis apicalibus albis; posticæ croceæ areis apicali et externa nigro-fuscis: corpus sordide croceum, palpis nigro-fuscis albo maculatis, pedibus supra fuscis. Alar. exp. unc. 1, lin. 8.

Antananarivo (*Kingdon*).

Professor Westwood places *R. pales* first in his list of the species of *Rothia*; yet he refers to this genus two *Eusemiæ* (*E. agrius* and *pedasus* of Herrich-Schäffer). In this matter he is manifestly in error, *E. agrius* being closely allied to *E. zea* of the same author, and *E. pedasus* being allied to *E. hypopyrrha*.

In the British Museum we have specimens of *E. zea* and *E. hypopyrrha*. They both have the greater part of the secondaries carmine upon the under surface, and form a group, with *E. agrius* and *pedasus*, which cannot be separated generically from *Eusemia*, unless, indeed, the more robust body of *E. hypopyrrha*, and its slightly more pointed primaries in the male, should be considered sufficient reasons for regarding it alone as the type of a new genus.

20. *Rothia Westwoodii*, sp. n.

Nigra; alæ anticæ fasciola pone medium abbreviata flava, antice coarctata; posticæ plaga permagna dimidium basale fere implente flava; abdominis lateribus ochreis. Alæ subtus ad basin ochreæ; corpus ochreum, palpis nigris flavo punctatis. Alar. exp. unc. 1, lin. 5.

Antananarivo (*Kingdon*).

This seems to be a common species.

The female of *Eusemia hypopyrrha*, obtained by Mr. Shaw at Fianarantsoa, only differs from the male in its browner ground-colour and rather broader wings.

* The type being slightly rubbed, I have corrected one or two points in the original description.

Zygænidæ.

21. *Pseudonaclia? trimacula*, Mabille.

We have received a female of this species from Fianarantsoa.

22. *Pseudonaclia simplex*, sp. n.

Alæ anticæ nigro-fuscæ immaculatæ; posticæ aurantiacæ margine externo late nigro: corpus nigro-fuscum. Anticæ subtus et margo externus alarum posticarum purpureo-fusca, aliter velut supra. Alar. exp. unc. 8.

Fianarantsoa.

A third species in the same collection appears to have the outer half of the primaries rubbed until quite denuded of scales; I therefore hesitate to describe it before seeing other examples to determine whether or not these wings are naturally semihyaline.

Lithosiidæ and Arctiidæ.

Sozuza argentea, *S. Kingdoni*, and *Areas virginalis* have been received from Fianarantsoa.

Nyctemeridæ.

Nyctemera insularis, Boisd., and *N. biformis* ♀, Mab., have come from Fianarantsoa.

23. *Hylemera puella*, sp. n.

♂. Sericeo-nivea; alæ semihyalinæ; anticæ area apicali et margine externo late nigro-fuscis angulum introrsum formantibus, basi paululum fulva: corpus cinereo-albidum, collo tegulisque fulvis, antennis nigris. Alæ subtus velut supra: corpus lateraliter fuscescens, pedibus palpisque flavescentibus. Alar. exp. unc. 1, lin. 2.

Fianarantsoa (*Shaw*).

24. *Hylemera fragilis*, sp. n.

♂. Præcedenti persimilis, sed margine interno, areis apicali et externa alarum anticarum abrupte et profunde apud ramos medianos excisis. Alar. exp. unc. 1, lin. 2.

Antananarivo (*Kingdon*).

Liparidæ.

25. *Leucoma pruinosa*, sp. n.

♀. Nivea, nitens; alæ semihyalinæ; abdomen testaceum niveo squamosum: subtus alba, oculis fuscis, tarsis nigrescentibus ad basin albis. Alar. exp. unc. 2, lin. 11.

Antananarivo (*Kingdon*).

Size of *L. auripes*, ♀, but with more elongated wings.

26. *Gogane turbata*, sp. n.

Alæ anticæ ferruginosæ, strigis duabus obliquis sinuosis pallidioribus, virgula discocellulari nigra, margine latius testaceo lituris ferrugineis intersecto, introrsum squamis nigris limitato, venis in disci medio nigris, margine interno squamis consuetis mediis elongatis, partim nigris instructo; posticæ ochraceæ area submarginali, præsertim ad apicem nigro-squamosa: thorax ferrugineus squamis elongatis sparsis nigris instructus, lateribus pallidioribus; abdomen ochraceum. Alæ subtus ochreæ, anticæ maculis submarginalibus et puncto discocellulari nigris, posticæ macula subapicali nigra; corpus sordide aurantiacum. Alar. exp. unc. 1, lin. 9.

Antananarivo (*Kingdon*).

The characteristic projecting patch of scales from the inner margin of the primaries seems to satisfactorily establish the generic position of this species.

We have received from Antananarivo what I believe to be the male of my *Gogane ochrea*. If so, the species would be better placed in *Chærotriche*, as the form of the male and its broadly pectinate antennæ agree with that genus rather than with *Gogane*: the males of *Gogane* correspond in form and antennæ with the females of *Chærotriche*; the females of *Gogane* have the antennæ as in the males. The male of *C. ochrea* may be characterized thus:—Smaller than the female, with shorter wings, the primaries decidedly more orange in colour; an abbreviated longitudinal black dash and two dots just above the origin of the median branches, and a black-edged rounded grey spot near the middle of the inner margin; a few black scales on the internal fringe below this spot.

27. *Euproctis titania*, sp. n.

♂. Lacteo-alba, sericea, macula ad angulum cellulæ superiorem flava, costa sordide alba; alæ posticæ paululum flavescentes; capite, prothorace et abdomine (basi excepta) ochreis; antennis ferrugineo pectinatis: alæ subtus lacteo-albæ, nitentes, costis paululum ochraceis; anticæ macula superna cum area costali confluente; palpis, pectore antice et ventre lateraliter ochreis. Alar. exp. unc. 2.

♀. Multo major, ochrea; alæ pallidæ, magis forsitan stramineæ quam ochreæ, nitentes, anticæ puncto ad angulum cellulæ ochreo; capite et prothorace læte ochreis; abdomine sordide ochreo, maculis dorsalibus pilosis obscurioribus; cauda perlata, ad basin pilis crassis nitide aureis instructa, aliter lanosa fusca: subtus pallide ochrea, alæ nitentes, anticæ costa lætius ochrea; palpis, pectore antice et ventre lateraliter subaurantiacis; pedibus crinitis, ano sericeo sordido. Alar. exp. unc. 2, lin. 5.

Antananarivo (*Kingdon*).

LÆLAPIA, gen. nov. (λαῖλαψ, απος).

Loperæ, Wlk. (*Cataphractes*, Fld.) affinis, alis autem elongatis, anticis margine interno rotundato, corpore robustiore, antennis longis tenuibus, palpis porrectis nudis, pedibus crinitis. Gen. typ. *L. notata.*

28. *Lælapia notata*, sp. n.

Alæ anticæ cinereo-fuscæ pallidæ roseo tinctæ, in medio nebulosæ, plaga magna fere triangulari ad costæ medium sordide alba, in cellula discoidali autem nivea et puncto nigro utrinque limitata, puncto interiore in serie punctorum angulata alam transerrante sito, litura subbasali costali nigra, serie punctorum nigrorum discali curvata; posticæ læte ochreæ: thorax cinereo-fuscus roseo tinctus, collo nigro maculato antice ochreo; palpi antennæque nigrescentes; abdomen ochreum. Alæ anticæ subtus cinereæ, area magna costali cellulam partim implente ochrea, macula discocellulari et altera costali nigris, area interna late ochracea sericea; posticæ ochreæ, macula discocellulari et altera costali nigris: corpus antice purpureo-fuscum, aliter ochraceum, tarsis pedibusque anticis fuscis. Alar. exp. unc. 1, lin. 7.

Antananarivo (*Kingdon*).

In pattern this singular species agrees almost better with the little species of the genus *Lacipa* than with *Lopera*; in the form of the wings it is more like *Euproctis.*

NUMENOIDES, gen. nov.

Numeni affinis, fœmina autem antennis late pectinatis. Gen. typ. *N. grandis.*

29. *Numenoides grandis*, sp. n.

♀. Statura *N. patranæ* ♀. Alæ anticæ fasciis roseis stramineo limbatis fasciisque alternatis irregularibus ferrugineis ornatæ, serie irregulari lunularum ferruginearum nigro limbatarum discali, area apicali et margine externo late ferrugineis; posticæ ochreæ fascia interrupta media et macula discocellulari nigrescentibus, macula obliqua subapicali et altera subanali nigris: thorax roseus, a tergo ochreus; abdomen læte ochreum maculis lateralibus nigris; antennis albidis testaceo pectinatis. Alæ subtus ochreæ, anticæ costa rufo-ferrugineo maculata, fascia pone medium angulata antice ferruginoso-fusca, maculis duabus costalibus oblique positis fuscis albido cinctis, areis apicali et externa velut supra ferrugineis fulvo notatis; posticæ dimidio costali rufo squamoso, ferrugineo oblique fasciato (fasciis ochreo limbatis), fascia valde irregulari pone medium fusca, linea irregulari ferruginea discali, plaga elongata marginali in dimidio apicali posita rufo-ferruginea fulvo notata: pectus ochreum, roseo hirtum, genibus nigrescentibus, palpis nigro maculatis; venter sordide roseus maculis tribus semicircularibus fulvis, serie macularum utrinque ejusdem coloris rotundatarum, ano fulvo. Alar. exp. unc. 2, lin. 10.

Antananarivo (*Kingdon*).

Evidently a very handsome insect when fresh from the pupa.

30. *Lymantria rosea*, sp. n.

Roseo-alba; alæ sericeæ, anticæ basi albo punctatæ, area basali nigro maculata, striga angulata undulata submedia nigrescente, linea angulata regulariter undulata discali fusca, linea submarginali undulata fusca; posticæ macula discocellulari et fascia squamosa submarginali fuscis: corpus album, antennis fuscis; abdomen roseo tinctum. Subtus roseo-alba; alæ anticæ cellula discoidali nigro strigata, maculis apud angulum externum nigris; posticæ macula discocellulari nigra. Alar. exp. unc. 1, lin. 7.

Fianarantsoa (*Shaw*).

Unfortunately not in very good condition; nevertheless I think I have not overlooked any of the markings.

31. *Dasychira vibicipennis*, sp. n.

D. fascelinæ affinis, multo major: alæ anticæ maris cinereo-fuscæ albo sparsæ, feminæ cinereo-albidæ, venis albis, fasciola basali, fasciis duabus undatis lunulatis, virgulis duabus discocellularibus, maculis duabus subapicalibus plus minusve distinctis oblique positis punctisque marginalibus ferrugineis, ciliis pallide fuscis; posticæ pallide testaceæ, area externa feminæ sordida, ciliis albidis: thorax testaceus, capite tegulisque plus minusve albidis, antennis fusco pectinatis; abdomen testaceum, segmentis albicantibus. Alæ subtus fusco-albidæ, venis discocellularibus late obscuratis; anticæ feminæ striga discali diffuse fusca; posticæ virgula ejusdem coloris costali: corpus subtus fusco-albidum, maris fere testaceum; pedes tarsis nigris albo fasciatis. Alar. exp. ♂, unc. 2, lin. 2; ♀, unc. 3, lin. 1.

Antananarivo (*Kingdon*).

32. *Dasychira gentilis*, sp. n.

♀. Præcedenti affinis: alæ anticæ cretaceo-albæ et, area externa excepta, nigro dense punctata, fasciis aream basalem transerrantibus tribus macularibus, maculis quinque difformibus apud venas discocellulares confertis, fascia angulata maculari discali, maculis quinque sparsis ei parallelis maculisque marginalibus rufis; posticæ stramineæ: corpus ochraceum, antennis nigro-fusco pectinatis. Alæ corpusque subtus ochracea immaculata. Alar. exp. unc. 2, lin. 9.

Antananarivo (*Kingdon*).

33. *Mardara viola*, sp. n.

Alæ anticæ purpureo-cinereæ, plaga interna fasciam postmediam partim implente alba, area basali virescente, nigro notata, margine externo latius pallido, subviridi, introrsum irregulariter nigro limitato, lineis duabus postmediis denticulatis viridi-albo marginatis nigris, externa undata, macula lunulari discocellulari nigra; posticæ albæ, areis costali et externa testaceis, striga submarginali venisque discocellularibus fuscescentibus: corpus testaceo-albidum, antennis fuscis, testaceo pectinatis. Alæ subtus albidæ, area costali late rufo-fuscescente, striga anticarum discali, posticarum submarginali fuscescentibus, maculis lunatis discocellularibus nigris: corpus testaceum. Alar. exp. unc. 1, lin. 7.

Antananarivo (*Kingdon*).
This is the first extra-Indian representative of the genus.

34. *Mardara peculiaris*, sp. n.

Alæ anticæ nigro-fuscæ, signatura ʊ-formi nigra albido partim marginata aream basalem fere includente, linea albido marginata interna, fascia obliqua statim pone signaturam basalem sita testacea, apud marginem internum expandente, a linea nigra intersecta, serie lunularum nigrarum sinuosa discali, maculis introrsum nigris extrorsum testaceis submarginalibus, ciliis nigrescentibus linea basali albida; posticæ albæ, area costali, area apicali et margine postico fuscescentibus: corpus fuscum, antennis nigro pectinatis. Alæ subtus multo pallidiores, anticæ cinereo-fuscescentes area interna albida, virgula discocellulari, linea curvata discali ciliisque fuscis; posticæ maculis squamosis discalibus fuscis, margine postico fuscescente: corpus subtus fuscescens, tarsis albido fasciolatis. Alar. exp. unc. 1, lin. 5.

Antananarivo (*Kingdon*).
A singularly marked species.

Notodontidæ.

Chrysotypus, nov. gen. (χρυσότυπος).

Pygæræ affinis, alæ anticæ autem magis productæ, cellula discoidali multo longiore, venæ subcostalis ramis magis divergentibus, vena mediana quadriramosa (vena inferiore discoidali ramum quartum formante); posticæ breviores, margine costali magis convexo, cellula discoidali latiore, ramis subcostalibus separatim emissis, vena mediana quadriramosa (vena discoidali ramum quartum formante): corpus paululum gracilius, pedibus longioribus subnudis. Gen. typ. *C. dives*.

35. *Chrysotypus dives*, sp. n.

Aureo-fuscus: alæ nitentes, ferrugineo lituratæ, lineis duabus transversis ferrugineis; anticæ linea tertia subapicali obliqua, costa ferruginea ad basin purpureo tincta; cilia alarum omnium ad angulum analem ferruginea: corpus cinereo-fuscum, squamis sparsis ochreis, capite colloque aurantiacis. Alæ subtus pallidiores: corpus pallide fuscum, pedibus rufescentibus. Alar. exp. unc. 2, lin. 1.

Antananarivo (*Kingdon*).

This species resembles *Siculodes* in coloration and pattern.

Another new genus, allied to *Ceira*, was obtained by Mr. Kingdon; but the specimen is not in sufficiently good condition for me to make out a good generic diagnosis from it.

Argyrotypus, gen. nov.

Præcedenti simillimus, alæ posticæ autem angustiores, apice acuminato, antennis latius pectinatis, palpis longioribus, pedibus tenuioribus. Gen. typ. *A. locuples.*

36. *Argyrotypus locuples*, sp. n.

Alæ anticæ supra rufo-fuscæ, maculis rotundatis nitide argenteis fere obtectæ (vel argenteæ fusco reticulatæ venisque fuscis); posticæ nitide argenteæ, angulo anali rufo-fusco reticulato: thorax rufo-fuscus, antennarum basi, macula tegularum humerali, ciliis internis et metathoracis lateribus argenteis; abdomen argenteum linea dorsali punctisque lateralibus rufo-fuscis. Alæ subtus argenteæ ferrugineo reticulatæ: corpus argenteum, ventre ferrugineo seriatim maculato, pedibus (palpisque plerumque) ferrugineis. Alar. exp. unc. 1, lin. 9.

Antananarivo (*Kingdon*).

In some respects allied to the genus *Harpyia.*

37. *Nioda lignea*, sp. n.

N. basivittæ subaffinis: alæ anticæ rubro-fuscæ, pallidæ, dimidio interno cinerescente, costa viridi maculata, striga longitudinali ad venam medianam adhærente picea, vitta ad venam discoidalem adhærente nigra, strigulis inter venas apud marginem externum nigris, macula apicali, altera subapicali, lineola ad marginis externi medium et macula apud angulum externum triangulari marginalibus albis nigro extrorsum tenuissime limbatis, ciliis fusco-albidis a linea nigra intersectis; posticæ fusco-albidæ, striga submarginali indistincta fusca, linea marginali alteraque cilia percurrente fuscis: corpus testaceum, thorace, tegulis et metathorace albido pilosis. Subtus pallide cinereo-fusca: alæ maculis discocellularibus, striga indistincta curvata discali maculisque submarginalibus fuscis, linea marginali alteraque cilia percurrente obscurius fuscis; anticæ vittis tribus brevibus apicalibus nigris. Alar. exp. unc. 1, lin. 5.

Fianarantsoa (*Shaw*).

Lasiocampidæ.

Mr. Shaw obtained the male of *Anchirithra insignis* at Fianarantsoa. It chiefly differs from the female in having a longer body, with well-developed anal tuft; the antennæ are equally plumose in both sexes.

Limacodidæ.

38. *Parasa valida*, sp. n.

Alæ anticæ supra virides, basi purpureo-fusca, extrorsum tenuiter albo ex parte limbata, margine costali ochraceo, area externa lato rufo-fusca, introrsum a linea curvata obscuriore limbata, fascia indistincta diffuse cinerea, ciliis subcinereis; posticæ ochreæ, sericeæ, area externa sordida, venis apud marginem ciliisque rufo-fuscis: thorax viridis, fronte, palpis antennisque rufo-fuscis obscuris; abdomen ochreum, ano nigrescente. Alæ subtus ochraceæ, anticæ disco flavescente, area costali ad alæ medium fusca, area externa fere velut supra sed paululum pallidiore; posticæ area costali præsertim apud apicem fusco squamosa: corpus subtus piceum. Alar. exp. unc. 1, lin. 7.

Antananarivo (*Kingdon*).

More nearly allied to *P. latistriga* of South Africa than any other described species.

Bombycidæ.

SYNCLYSMUS, gen. nov. (συγκλυσμός).

Forma, colore signaturisque supra fere velut in *Hypochroma*, structura autem venarum corporis antennarumque velut in *Bombyce* et generibus ei affinibus, venis medianis triramosis; alæ anticæ breves latæ, vena subcostali quinqueramosa, discoidalibus simplicibus; posticæ elongatæ subpyriformes, vena subcostali biramosa: antennæ breves, late pectinatæ; pedes breves crassi; tibiæ posticæ dilatatæ, compressæ. Gen. typ. *S. niveus*.

39. *Synclysmus niveus*, sp. n.

Sericeo-albus: alæ linea discali regulariter undata squamosa nigra, punctis marginalibus nigris; anticæ marginibus sordidis fusco nigroque irroratis, area basali a linea nigra squamosa oblique fœdata, a linea distincta angulata nigra oblique extrorsum limitata: antennæ fusco pectinatæ. Alæ subtus punctis marginalibus nigris, area costali nigro irrorata; anticæ puncto costali apud apicem nigrescente, aliter omnino albæ. Alarum exp. unc. 1, lin. 6.

Fianarantsoa (*Shaw*).

This genus must, I think, be regarded as a link between *Bombyx* and *Asthenia.*

Caradrinidæ.

40. *Caradrina spælotidia*, sp. n.

Spæloti fimbriolæ simillima, structura autem *Caradrinæ*: alæ anticæ supra olivaceo-fuscæ nitentes, litura basali, linea sinuosa aream basalem extrorsum limitante, fascia obscure marginata sinuosa media, linea trisinuata submarginali, macula adhærente costali punctisque marginalibus nigrescentibus; posticæ multo pallidiores, ad basin albidæ, area externa obscuriore, ciliis albidis: corpus fuscum. Alæ anticæ subtus fuscæ, nitentes, margine costali pallida nigro pone medium oblique notata, punctis marginalibus nigris, ciliis albidis; posticæ albidæ, sericeæ, macula discocellulari, litura discali arcuata plagaque apicali squamosa fuscis, punctis marginalibus nigris: corpus subtus fusco-albidum. Alar. exp. unc. 1, lin. 3.

Fianarantsoa (*Shaw*).

Orthosiidæ.

41. *Panolis notabilis*, sp. n.

Alæ anticæ supra coloribus fere *P. piniperdæ*, signaturis autem omnino distantes, area basali rosea lilacino tincta, nigro notata, marginibus omnibus roseis, plaga permagna media, antice obliqua, excisa, lacteo-flavida, ochraceo maculata, extrorsum a fascia curvata (rufescente, purpureo punctata) limbata, lineis duabus submarginalibus curvatis aureo-fulvis, ciliis fulvis rufo-fusco acuminatis; posticæ lacteæ roseo paululum tinctæ, ciliis fulvis ad apicem fusco acuminatis: corpus pallide fuscum, capite colloque testaceis ferrugineo notatis, prothorace cinerescente, abdomine roseo hirto. Alæ subtus sericeo-lacteæ, ciliis citrinis, linea discali vix distinguenda fundo obscuriore curvata, punctis discocellularibus fuscis; anticæ area subcostali sordide rosea; posticæ margine costali roseo squamosa: pectus nigrescens, lateribus albicantibus; abdomen sordide roseum, ano testaceo; pedes purpureo-fuscæ, fulvo fasciolatæ. Alar. exp. unc. 1, lin. 5.

Antananarivo (*Kingdon*).

Hadenidæ.

42. *Eremobia virescens*, sp. n.

Alæ anticæ supra flavo-virides fusco nigroque maculatæ, serie punctorum trium alborum subbasali, lineis duabus valde irregularibus fasciam latam mediam formantibus albis, macula discocellulari alba, serie virgularum <-formium submarginalium albarum maculisque connatis nigris; alæ posticæ albidæ, area externo-apicali punctoque discocellulari pallide fuscis: thorax aureo-viridis, tegulis nigro bimaculatis, abdomine pallide fusco, antennis fuscis. Alæ subtus lacteæ sericeæ, anticæ area discoidali fuscescente; posticæ maculis duabus subapicalibus squamisque sparsis costalibus ferrugineis, puncto discocellulari nigro: corpus subtus albidum, capite coxisque anticis fuscis. Alar. exp. unc. 1, lin. 2.

Antananarivo (*Kingdon*).

43. *Euplexia debilis*, sp. n.

E. luciparæ affinis, omnino autem pallidior fasciis maculisque male conspicuis: alæ anticæ plaga permagna maculam reniformem includente subapicali albida, limbo externo angustiore, linea pallida submarginali regulari; alæ posticæ vix infuscatæ albidæ. Alar. exp. unc. 1, lin. 3.

Antananarivo (*Kingdon*).

One example, rather worn: although most nearly allied to the European species, it bears a greater general resemblance to *E. discisignata* of India.

Ennomidæ.

Crocinis, gen. nov. (κρόκος, ἶνις).

Pyriniæ affine, distat autem antennis pectinatis palpisque longioribus. Gen. typ. *C. fenestrata*.

44. *Crocinis fenestrata*, sp. n.

♂. *Pyrinæ martiatæ* persimilis, crocea: alæ anticæ area externa, angulo externo excepto, latius ferruginea, apud apicem fuscescente, maculis sex mediis albo-hyalinis congregatis; posticæ lineis duabus abbreviatis abdominalibus mediis rufis; antennæ nigræ. Alæ subtus stramineæ, anticæ area externa indistincte lilacina, maculis supernis mediis: corpus lacteo-albidum, pedibus stramineis. Alar. exp. unc. 1.

Antananarivo (*Kingdon*).

45. *Crocinis ochracea*, sp. n.

♂. Pallide crocea: alæ anticæ costa paululum saturatiore squamisque argenteis sparsa, margine externo irregulariter ferruginoso, punctis minimis marginalibus nigris, ciliis aureo-fuscis, litura apud angulum externum angulata ferruginea extrorsum plumbeo limbata, punctis nonnullis plus minusve distinctis subapicalibus ferrugineis, lineis duabus irregularibus duplicatis ferrugineis, interiore subbasali indistincta, exteriore media, puncto discocellulari nigro; posticæ lineis tribus æquidistantibus duplicatis indistinctis ferrugineis, punctisque duobus tribusve ejusdem coloris marginalibus: caput obscurum, antennis nigris. Subtus pallidior, sericea, lineis obsoletis punctisque inconspicuis. Alar. exp. lin. 11.

Antananarivo (*Kingdon*).

46. *Crocinis plana*, sp. n.

♂. Crocea: alæ anticæ apice et macula triangulari marginali cum eo confluente nigro-fuscis lilacino tinctis, puncto discocellulari, lituris tribus abbreviatis apud angulum externum internis squamisque nonnullis subbasalibus sparsis nigro-fuscis: corpus antennis nigris, abdomine pallido. Alæ subtus punctis discocellularibus nigro-fuscis, anticæ macula marginali elongata lilacina fusco limbata, squamis nonnullis subapicalibus costalibus fuscis. Alar. exp. lin. $11\frac{1}{2}$.

Antananarivo (*Kingdon*).

The genus *Crocinis* appears to replace *Pyrinia* (*Crocypteryx*, Guén.) in Madagascar.

Euboliidæ.

47. *Eubolia dulcis*, sp. n.

Alæ anticæ cinereæ, lineis tribus transversis nigro-fuscis, prima subbasali apud costam inangulata, secunda aream basalem limitante extrorsum a vena mediana ad marginem internum cinereo-fusco limbata, tertia discali subangulata introrsum cinereo-fusco limbata, extrorsum albo marginata, macula discocellulari nigra, margine externo ciliisque obscuris; posticæ rufo-testaceæ, immaculatæ: corpus cinereum. Subtus rufo-testacea: alæ anticæ macula superna discocellulari nigra. Alar. exp. unc. 1.

Antananarivo (*Kingdon*).

A pretty little species, quite distinct from any known form.

The following genus is placed by Walker at the end of the *Noctuites*, among the Pseudo-Deltoids; it may, however, have to be referred to the true Deltoids.

48. *Singara hypsoides*, sp. n.

Alæ anticæ supra lacteo-stramineæ, sericeæ, area costali, striga curvata discali diffusa ciliisque ochraceis, macula discocellulari punctisque duobus obliquis subapicalibus nigris, costa nigro irrorata; posticæ ochreæ, fascia vix distinguenda pallidiore discali ad marginem abdominalem introrsum virgula nigricante squamosa marginata: thorax lacteo-stramineus, capite palpisque nigris albo sparsis; abdomen ochreum. Subtus ochrea: alæ maculis magnis discocellularibus nigris; tarsi nigro-fusci. Alar. exp. unc. 1, lin. 11.

Fianarantsoa (*Shaw*).

Botydidæ.

49. *Botys Kingdoni*, sp. n.

B. marginali affinis: alæ subhyalinæ, aureo-albidæ, margine externo ciliisque aureis, anticæ apice costaque cupreis, fasciola obliqua subapicali, macula apud venas discocellulares triangulari strigaque subcostali basali purpureo-nigris, puncto apud angulum externum purpureo-fusco; posticæ macula subapicali et puncto apud angulum analem purpureo-nigris: thorax purpureo-fuscus; abdomen rufescens, segmento basali flavo albo marginato, segmentis secundo et tertio lateraliter argenteo maculatis. Alæ subtus pallidiores: corpus argenteum, genibus tibiisque aureis. Alar. exp. unc. 1, lin. 1.

Antananarivo (*Kingdon*).

A very beautiful species, smaller than *B. marginalis*, with darker and differently formed border to the primaries, and with differently coloured body.

The only representative of the Tineina now received is one of the *Crambites*, which I believe to be *Ancylolomia? anticella* of Walker.

The difficulty of obtaining papers published in recent French publications is so great that I have been almost inclined to doubt whether the authors desire the English public to see them. I have consulted three of the largest libraries accessible to me, to none of which the French Entomological Society has sent the complete volume of its 'Annales' for 1878.

XXVII.—*Description of a new Species of Chamæleon from Madagascar.* By Dr. A. Günther, F.R.S.

[Plate XIII.]

A small collection, made by the Rev. G. A. Shaw, at Fianarantsoa, Betsileo, Madagascar, contained three species of Chamæleons, viz. *Ch. lateralis* (Gray), *Ch. gularis* (Gthr.), and an undescribed species, which may be named

Chamæleon minor.

This species is allied to *Chamæleon bifurcus*, but considerably smaller, and also differing from it in several other respects.

Snout of the adult male produced into two flat compressed horns, slightly divergent in front, and covered with large scutes; they are much approximated at their base, and connected by a transverse scute, which also, in the female, is persistent, although this sex, as usual, is destitute of horns. Occipital region flat, slanting from behind forwards, with a rounded margin behind, and without lateral flaps. The dorsal crest is low, composed of a few isolated tubercles, and ceases towards the middle of the back. No distinct gular or ventral median series of tubercles, the median tubercles differing so slightly from those on the side as to scarcely deserve the designation of crest. The scutes on the upperside of the head and on the cheek are rather large and irregular. No larger tubercles on the body or limbs; heel without spur or prominence.

Dark greenish, with a white streak along the median line of the throat and belly; female, besides, with a similar white band along the hinder side of the hind leg, and continued for a short distance on each side of the tail.

Four specimens were collected, three adult males and one female; the largest of the males is $8\frac{3}{4}$ inches long, the tail measuring $4\frac{1}{2}$. The smallest male (which has the horns fully developed) is $7\frac{1}{4}$ inches long, the tail measuring 4 inches. The female is the smallest of all; yet it must be adult, as it is full of mature eggs. It is only $5\frac{1}{4}$ inches long, the tail measuring 3 inches.

XXVIII.—*Description of a new Species of* Cetonia *from the Island of Formosa.* By Charles O. Waterhouse.

Cetonia (*Protætia*) *culta.*

Olivaceo-ochraceo furfurosa, opaca; thorace crebre punctato, lineis duabus interruptis guttisque nonnullis lateralibus pallidis, scutello elongato, impunctato; elytris crebre punctatis, guttis parvis irregulariter dispositis, macula laterali pone medium fasciaque communi flexuosa ante apicem pallidis, sutura ad apicem haud producta; sterno et abdomine in medio pedibusque (plus minusve) denudatis, purpureo-cupreis. ♀.

Long. 8 lin.

A very distinct species, perhaps most resembling *P. intricata*, Saund., but rather broader, and with distinct, moderately fine, rather close punctuation on the thorax and elytra, the latter very obtuse at the apex and without any prolongation of the suture. The general colour is brownish yellow slightly tinted with olive, dull, resembling some varieties of *Gymnetis pantherina.* The thorax has two interrupted lines above, and three or four spots at the sides, pale sandy; the posterior angles are much rounded, the base is very slightly sinuate before the scutellum. Scutellum long and rather narrow. Elytra rather short, with the single sublateral costa scarcely visible, the sutural angle not prolonged, with small round, pale sandy spots scattered over the surface, more closely on the disk; there are four or five slightly larger spots on the margins, one of which is particularly noticeable rather behind the middle; towards the apex of each elytron is a flexuous mark. The middle of the sternum and the middle of the abdomen are denuded, shining; the legs are more or less denuded. The pygidium is densely strigose-punctate, with some pale spots on each side. The anterior tibiæ have two not very sharp teeth.

Hab. Takow, South Formosa.

Presented to the British Museum by H. E. Hobson, Esq.

MISCELLANEOUS.

On the Oviposition of the Amblystomes at the Museum of Natural History. By M. L. Vaillant.

At the meeting of the Academy of the 27th March, 1876*, the oviposition of the Amblystomes produced from Axolotls born in the menagerie of the Museum was noticed by Prof. Blanchard. Since that period those animals have been carefully observed, and have given occasion to some observations the results of which, I think, it may be useful to indicate.

These ova, deposited about the 19th March, have been regularly developed in accordance with the mode already known in the case of the Axolotls. The tadpoles passed the winter in the form of branchiferous larvæ; and about forty individuals were successfully preserved. In February 1877 (that is to say, at the end of ten months) one of them became converted into an Amblystome. The others were divided into two parts. Some (the first series) were placed in an aquarium full of water and thus kept completely immersed; the others (second series) were placed, on the contrary, in a receiver, in which the level of the liquid never rose above 0·03–0·04 metre; a portion of dry ground also enabled the animals to issue from the water with facility. As a term of comparison, other individuals proceeding from a laying of ordinary Axolotls were divided in nearly equal numbers into two corresponding series, and placed in the same conditions.

The subjoined Table shows the present state of the experiment,

* Comptes Rendus, tome lxxxii. p. 916; 'Annals,' May 1876, p. 414. A note on the same subject was also published in the 'Bulletin de la Société Philomathique de Paris,' 6e série, tome xi. p. 13.

which has been prosecuted for a little more than three years. In each series it makes known the number of individuals transformed, the number of those remaining in the state of Axolotl, and, lastly, the number of dead.

Oviposition of Amblystomes.

	Amblystomes.	Axolotls.	Dead.
First series........	1	16	3
Second series	2	14	4

Oviposition of Axolotls.

	Amblystomes.	Axolotls.	Dead.
First series........	2	4	10
Second series	1	4	11

Since 1876 the reproduction of the Amblystomes could not be again obtained; but on the 13th and 14th April last these animals presented modifications which enabled approaching oviposition to be foreseen. The abdomen of the females had attained a considerable development: in the males the labia of the cloaca were inflated; the tail, usually rounded, had acquired an elevated form, in consequence of the development of a vertical crest, which was particularly marked at the upper part of the organ, upon which it considerably exceeded the level of the dorsal line. M. Desguez, attendant in the menagerie, was even a witness of the copulation at this period. The first oviposition, which commenced on the 17th April, continued on the two or three following days; a second took place on the 12th May; and at present there exist in the menagerie about from seventy to eighty very lively and well-developed tadpoles. Some of the first hatched have even acquired, in less than three months, a comparatively considerable size; they do not measure less than 0·10–0·12 metre; their integument is marbled with green, with whitish spots more apparent than in the adult Axolotls, of which, however, they present all the external characters.

The fecundity of the transformed Axolotls being no longer contestable, one is led to recognize that they must be regarded not as an aberrant form, resulting, to some extent, from a pathological modification (an opinion maintained by a certain number of authors and still accepted by some foreign naturalists), but as a normal metamorphosis conformable to the commonly known cycle among the Urodela. These animals, under certain biological conditions which have still to be determined, may, it is true, reproduce in two states—the larval state, and the state of complete development; nevertheless this is a fact which is not without its analogues among the lower Vertebrata and certain Articulata, according to a remark made as long ago as 1868 by Prof. Blanchard *.—*Comptes Rendus*, July 14, 1879, p. 108.

* Comptes Rendus de la réunion de la Société Helvétique, à Einsiedeln.

On the Organization of Batrachobdella (B. Latasti, *C. Vig.*). By M. C. Viguier.

This little Hirudinean lived parasitically upon an Algerian Batrachian, *Diploglossus pictus*, which, combined with a certain external resemblance, led to its being taken for *Glossiphonia algira*. Like the latter animal, it presents only two eyes, but is in other respects distinguished therefrom, even externally, by its smaller size, its more regular form, not attenuated in front, its greener colour, and its proportionally larger posterior sucking-disk. The following are the results of its anatomical examination.

Generative organs.—The genital orifices are situated, the male on the twenty-first ring, and the female between the twenty-third and twenty-fourth. There is no regular penis, but a mere button, as in the *Glossiphoniæ*; this button is generally placed a little to the right of the median line, when the animal is looked at from the lower surface. The epididymi are very large; and, after a certain number of folds, each of them gradually narrows into a very delicate deferent canal. Twelve testes of comparatively large size are arranged in two regular and parallel series. The female apparatus consists of two very small pyriform ovaries, from which start delicate oviducts, opening into a very small matrix situated immediately above the vulva. The latter is transverse and always exactly median.

Digestive apparatus.—There is, as in the *Glossiphoniæ*, an exsertile trunk, behind which the œsophagus has the aspect of a muscular tube with longitudinal and annular fibres. Above the genital apertures there is a large pyriform brownish inflation, visible by transparence in the living animal, and which is constituted, from without inwards, by rather voluminous brownish cells, and by larger clear cells with a brilliant nucleus, arranged all round the lumen of the digestive tube. Immediately behind this inflation, which, no doubt, performs the function of the liver, are the first lateral cæca, which pass in front of the first testes; five other cæca on each side pass between the testes of each row. Lastly, a seventh pair of narrow cæca comes behind the last pair of testes. The axial portion of the digestive tube between the cæca presents small turbid cells, which also perhaps have the function of hepatic cells. Behind the seven pairs of narrow cæca, and where the cavity of the body is no longer occupied by the testes, come four pairs of large cæca—the first two pairs directed slightly forward, the third nearly transverse, the fourth directed backward. The terminal portion of the digestive tube makes a small loop to the left, and is then directed in a straight line to the anus.

Circulatory apparatus.—The circulatory apparatus much resembles that described by Budge in *Clepsine*; one may even say that it is nearly identical, at least so far as I have been able to discover. The vascular loops of the head, however, advance in front of the eyes further than is figured by that author. The cardiac vessel is exactly similar.

Nervous system.—The nervous system is nearly as described by Baudelot in *Clepsine*. It consists of twenty-one ganglia, not including the collar and the posterior mass. In one type the subœsophageal portion of the collar results from a more considerable grouping, and the terminal mass of the chain from a smaller grouping than in *Clepsine*. The number of large cells contained in the vesicles appended to the ganglion is less than is figured in Baudelot's memoir.

To sum up:—*Batrachobdella* approaches the *Glossiphoniæ* or *Clepsinæ* by its nervous system and its circulatory apparatus, while the general arrangement of the generative organs is rather that which occurs in the *Ponbdellæ* or *Pontobdellæ*; and the digestive apparatus, although presenting a trunk as in *Clepsine*, differs from what is seen in all other Hirudineæ by the arrangement of the cæca and presence of an hepatic inflation.—*Comptes Rendus*, July 14, 1879, p. 110.

Description of a new Species of Chirocephalus. By John A. Ryder.

The genus *Chirocephalus* does not seem to have been noticed up to the present time in North America; I therefore take much pleasure in announcing the discovery of a hitherto undescribed species of the genus in the vicinity of Woodbury, New Jersey, where it was found in abundance in the ditches by Mr. W. P. Seal, a resident of the place, and an indefatigable collector of the minute life of his neighbourhood.

The genus, as characterized by Dr. Wm. Baird*, has been found in Switzerland, France, England, Russia, and Siberia. The species *C. lacunæ*, most nearly like the one I am about to describe, is figured and described by Guérin, in his 'Iconog. Règne Animale,' as being found at Fontainebleau, France. The differences between our species and Guérin's are, however, sufficiently striking and constant to characterize a well-marked specific type; and I accordingly propose the following specific characterization of the American form:—

Chirocephalus Holmanii, nov. sp.

Claspers moderately robust; second joint forked, longest branch longer than first joint and curved inwards, its tip crossing that of its fellow of the opposite side when in repose; shorter branch less curved, slightly swollen, and rough on the inner surface of its tip, about half as long as the longer branch. Two long fleshy proboscis-like prehensile organs arise from the bases of the claspers, and are coiled up between the latter; muscular fibres pass throughout their length; near their origin and for the first third they are expanded inferiorly into a thin margin with about seven papilliform processes; they then gradually contract, becoming cylindrical at their second third, where about seven well-marked

* Monograph of the Family Branchipodidæ, Ann. & Mag. Nat. Hist. 2nd ser. vol. xiv. 1854, pp. 216-229.

digitiform processes are found, the longest of which are about as long as twice the diameter of the proboscis at this point; the remaining third gradually contracts, and is thickly studded with half-rings of small papillæ, which seem to mark indistinctly the segments of the organ. Total length of the proboscis, when extended, about three times that of the claspers. Total length 12–14 millims. Habitat, Woodbury, New Jersey.

I name the above species in honour of Mr. D. S. Holman, actuary of the Franklin Institute, in recognition of the services he has rendered in devising methods for studying living objects, both large and small, under the microscope, and to whom I am also indebted for the specimens from which the above description has been taken.

The detection of a member of the genus in this country is very interesting, but less so than the detection of *Pauropus Huxleyi*, Lubbock, in the vicinity of Philadelphia, without any difference, as far as Sir John Lubbock's excellent plates of English specimens would enable one to judge, that would make it even a variety, although removed by more than 3000 miles of ocean from its congeners. It has been suggested, however, that, inasmuch as Philadelphia is an old English settlement, *Pauropus* may have been introduced; but in the case of *Chirocephalus* such an explanation is less open to acceptance.—*Proc. Acad. Nat. Sci. Philad.*, April 29, 1879.

Note on the Adoption of an Ant-Queen.

Mr. McCook reported the following case of the adoption of a fertile queen of *Crematogaster lineolata*, a small black ant, by a colony of the same species. The queen was taken in Fairmount Park, April 16, and on May 14 following was introduced to workers of a nest taken the same day. The queen was alone within an artificial glass formicary; and several workers were introduced. One of these soon found the queen, exhibited much excitement, but no hostility, and immediately ran to her sister workers, all of whom were presently clustered upon the queen. As other workers were gradually introduced they joined their comrades until the body of the queen (who is much larger than the workers) was nearly covered with them. They appeared to be holding on by their mandibles to the delicate hairs upon the female's body, and continually moved their antennæ caressingly. This sort of attention continued until the queen, escorted by workers, disappeared in one of the galleries. She was entirely adopted, and thereafter was often seen moving freely, or attended by guards, about the nest, at times engaged in attending the larvæ and nymphs which had been introduced with the workers of the strange colony. The workers were fresh from their own natural home; and the queen had been in an artificial home for a month. As among ants the workers of different nests are usually hostile to each other, this adoption of an alien queen is an example of the strong instinct which controls for preservation of the species.—*Proc. Acad. Nat. Sci. Philad.*, April 1, 1879.

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XXIX.—*On the Structure of* Stromatopora.

By H. J. Carter, F.R.S. &c.

[Plate XV.]

Having published an article "On the Probable Nature of the Animal of *Stromatopora*," and another "On the Mode of Growth of *Stromatopora*, including the Commensalism of *Caunopora*," in which some errors of the former are corrected, I now propose to communicate a third, "On the Structure of *Stromatopora*."

By adopting the "commensalism of *Caunopora*," first noticed by C. F. Roemer, the structure of *Stromatopora* becomes much simplified, and the general features of the whole group more easily defined; but it must not be supposed that this structure can be seen with the unassisted eye, although higher powers than simple lenses of ½-inch to 2-inch focus are detrimental to it, like most other minute fossilizations when in limestone; nor can it be obtained without much sectioning and as minute dissection as the lapidification will permit. Hence nothing of this kind can be done in the quarry, and much must be obtained from the polished specimens of lapidaries; so that when the collector, previously unprepared in this way, visits the quarry where there may be abundance of specimens, he will be very likely to come away disappointed.

STROMATOPORA, Goldfuss.

Gen. char. Corallum concentrically laminar, massive, incrusting; curve of the lamina large, simple, and expanded, or small, short, and abruptly undulating, following one or several axes, directed in the same or several ways in accordance with the number and direction of the undulations, composed of cœnenchyma formed of rectilinear or curvilinear fibre, and presenting in the course of the lamina isolated spots of stellate venation, whose flexuous rays, becoming divided and subdivided into branches, finally terminate by anastomosing with those of the neighbouring stellations and cœnosarcal cavities respectively (Pl. XV. fig. 1).

Laminæ.—Variable in thickness according to the fineness or coarseness of the specimen or species; in some not more than 1-144th inch, in others wider; but this measurement must not be confounded with the coarse yet characteristic lamination of "weathering" in the mass, where a variable number of the thin laminæ may be left together; again varying in the undulating structure, which frequently resembles the "gnarly grain" of an oak panel, in contradistinction to the less wavy condition of the layer in the "straighter grain," well illustrated in the horizontal section of a tree, where the same lines are sometimes close together and sometimes wide apart in the same concentricity.

Rectilinear and Curvilinear Structure of the Cœnenchyma.—Baron Rosen in his 'Thesis,' to which I have before alluded, clearly describes and illustrates these two structures ('Ueber die Natur der Stromatoporen,' 1867, pp. 6, 7, and tabb. 1, 6) in his *S. typica* and *S. Schmidtii* respectively, which in a general way holds good throughout, but, of course, is subject to modifications which more particularly belong to the descriptions of the *species* respectively.

Considering the "rectilinear structure" first (Pl. XV. fig. 2), this may be divided into a horizontal and a vertical facies—in which the former presents a number of triangular or polygonal (fig. 2, *a*), and the latter a number of rectangular spaces (fig. 3, *d d*). In the horizontal section (fig. 2) the triangular spaces are formed by the extension of straight lines between a number of more decided puncta (fig. 2, *d d*), which are the truncated ends of the vertical lines or rods that form the most striking part of the rectangular structure in the vertical section (fig. 3, *a a*). Thus, as this structure is repeated in each lamina, the triangular spaces appear on the upper and under side of it respectively, while the interval, now filled with transparent calcite (fig. 2, *e e*, and fig. 3, *d d*), was occupied by the fleshy part of the animal, and thus was the cœnosarcal cavity of the cœnenchyma; but, although the horizontal lineation forming the triangular spaces was only *impressed* upon the cœnosarc, it nevertheless alone formed the upper and under lines of the rectangular spaces in the vertical section (fig. 3, *b b*); while such laminæ being successively formed, at last produced the great corallum. That the horizontal lineation was only impressed upon the cœnosarc is evidenced by the *decomposed* fossil structure, in which the parts occupied by the cœnosarc, *i. e.* the transparent, have become opaque calcite, while all the rest have disappeared or only left a brown stain. Thus the white calcite, bearing merely the impressions of the horizontal lines, would remain continuous throughout the lamina in other respects, but for the intervention of the vertical lines or rods—finding its openings only through the triangular spaces in the surface. All this is further confirmed by the structure of the *undecomposed* lapidification, where the reverse of colour is the case, and the horizontal lines and vertical rods are composed of opaque white, while the intervening portion is filled with transparent calcite, presenting, from its transparency, a dark colour. When, from the undulating form of the layer or other causes, the horizontal section is slightly oblique, the pattern of the triangular lineation is not so complete, while where it is entirely absent the ends of the rods of the vertical structure *alone* come into view (Pl. XV. fig. 2, *b*), and *vice versâ*.

The size of the triangular spaces varies slightly with the structure of the cœnenchyma, which may be finer or coarser according to the specimen or species, or from the variable size of the polyps which had to protrude through them; but while they slightly vary among themselves, perhaps the average diameter of the largest may be from 1-180th to 1-120th inch. Those of *Hydractinia pliocena** are only 1-360th inch, of *H. calcarea* 1-600th inch, and of *H. echinata* about 1-266th inch in diameter, the smaller triangular spaces being for younger polypites and other appendages that might have existed in *Stromtopora*, as seen in the living *Hydractinia echinata*, or when it has been preserved in spirit with the polyps still exserted.

The size of the rectangular spaces in the vertical section

* *Hydractinia pliocena*, Allman, should, as Dr. G. Steinmann has stated ('Neues Jahrbuch f. Min., Geol. u. Paleontologie,' 1879, Heft v.–viii. p. 733), be now *Hydractinia incrustans*, Goldfuss, from a gigantic specimen over 50 centims. in extent, at the Strasburg Museum, called by Goldfuss "*Stromatopora incrustans*" (Bronn, Ind. Pal. p. 1203).

(Pl. XV. fig. 3, *d d*) would, of course, be influenced by the thickness of the layers &c., as stated under "*Laminæ.*"

On the other hand, the "curvilinear structure" (Pl. XV. figs. 4, 5), although also divisible into a horizontal (fig. 4) and vertical (fig. 5) facies, is not so strongly differentiated as the rectilinear one; for the curvilinear element enters into the vertical lineation sufficiently to give it a mixed character of vertical and inflected lines (fig. 5), while the triangular lineation is quite excluded from the vertical section in the rectilinear structure. Still, while the curvilinear structure is *alone* seen in the horizontal section (fig. 4) and the mixed form in the vertical one (fig. 5), the difference is sufficiently marked to obviate confusion; besides, there is an indistinct horizontal lineation in the vertical which is never seen in the horizontal section, arising not from actual lines, but from structural arrangement influenced by the laminar growth.

In the horizontal section the curvilinear structure is represented by a vermicular fibre or thread (Pl. XV. fig. 4, *aaaa*), which, branching and anastomosing repeatedly, is not confined to the surface as the triangular lineation in the rectilinear form, but, descending perpendicularly (fig. 5, *c c c*), gives rise to the straighter curvilinear structure observed in the vertical section (fig. 5, *a a a a*); so that, in short, the curvilinear thread is horizontal in the horizontal and somewhat verticalized in the vertical section of the layer, which, being repeated concentrically, leads at last to the production of the general mass of this kind of *Stromatopora*, as the rectilinear does to its corallum.

Here the intervening cavities (Pl. XV. figs. 4 and 5, *bb*, *bb*, respectively, now filled with transparent calcite), which held the cœnosarc, are, of course, as vermicular in form as the curvilinear thread of the cœnenchyma, so that, in the *decomposed* fossil, where the same change takes place as that mentioned in the rectilinear structure, a vermicular form makes its appearance in opaque white calcite, which in the *undecomposed* lapidification was transparent, while hardly any thing but a brown stain remains of the *formerly* white curvilinear structure; in short, as before stated, the colouring is reversed.

While, however, as also before stated, these are the extreme forms of the cœnenchymal structure of *Stromatopora*, there are intermediate and modified forms (always remembering, of course, the influence that various kinds of lapidification may produce)—such, for instance, as a condensation of the horizontal layer of the rectilinear structure in the finer species, wherein the ends of the rods are so expanded that the straight lines between them can hardly be seen, and the interstices indicative of the holes of the polyps, being thus reduced to various diameters below 1-600th inch, causes them to look like apertures in the midst of a layer composed of the puncta (*i. e.* ends of the rods alone). Or, in the curvilinear structure, the interspaces representing the cœnosarcal cavities become so uniformly contracted that both the horizontal and vertical sections indicate a composition of vertical tubes *alone*, in juxtaposition like those of *Favosites gothlandicus*, but *with* the stellate venation to be mentioned hereafter and *without* the *tabulæ*, though still communicating with each other as freely as the cœnosarcal cavities in the more typical form.

Again, although the differences between the rectilinear and curvilinear structures are so marked, they are very analogous in their growth, inasmuch as the end-to-end anastomosis of the old fibre with the new in both instances leads to a continuity of structure in the mass, differentiated only by the characters above mentioned.

Lastly, the "vertical rods" may be thick or thin; and although *par excellence* confined to the rectilinear (Pl. XV. fig. 3, *a a*), similar ones also occur in the curvilinear structure *but not always*, and therefore are not inserted in the illustrations; they are, however, just as much in connexion with the curvilinear structure, which they simply pierce, as they are with the triangulated layers of the rectilinear structure, which they as simply unite together. They may also present the same appearance of original hollowness. Mr. Champernowne informs me that he has several specimens bearing these "rods" both with and without the presence of the *tubes* which characterize the specimens called "*Caunopora*;" so that the rods do not depend upon the presence of the tubes. In my own small collection the only specimens of curvilinear structure (viz. two) which bear the "rods," happen to be accompanied by the tubes of *Caunopora*. But the most remarkable feature in them is that their axial structure, as well as the connecting fibre being transparent, indicates that they were originally hollow (figs. 2 and 3, *e e e*).

How far this hollowness was in connexion with the cœnosarcal cavities of the cœnenchyma or with the axial portions of the rectilinear and curvilinear fibre respectively, which, as just stated, also gives evidence of similar hollowness, I am not able to say; but hereafter I shall show that the rods were probably closed where they projected beyond the free or natural surface.

The composition of all the fibre in the cœnenchyma, too, always appears to be granular, and so open in some parts that it appears almost cribriform. For this I have endeavoured to account by the fact that the calcareous fibre in *Millepora alcicornis*, as the horny fibre in *Hydractinia echinata*, appears first in small increments, which afterwards become continuous in both instances; but in vain do we look for the granular appearance in the fresh fibre of *Millepora alcicornis* after it is fully formed; so that it is just possible that lapidification may have had a hand in this appearance.

Stellate Venation.—The stellate venation consists of points in the cœnenchyma more or less uniformly distant from each other, from which flexuous rays, now represented by transparent calcite, radiate in all directions, becoming branched and subdivided as they go, until finally they terminate in anastomosing with those of the neighbouring stellations and in the cœnosarcal cavities of the cœnenchyma respectively (Pl. XV. fig. 1). They appear to come into existence with each lamina, as testified by the larger masses of rectilinear cœnenchyma produced by the prevailing species of *Stromatopora* in Pit-Park Quarry at Dartington, wherein the lamina may not be more than 1-96th inch in thickness; hence the least abrasion in making a section of such specimens may take them away or bring them into view. The flexuous ray and its branches may vary from 2 lines or less to 2 inches, chiefly according to the species, with a diameter at its origin generally proportionate to its length, that of the latter being 1-24th inch *. The rays appear to be generally centred in an elevation, and to descend, branching as they go, over the sides of it to the plane surface of the species, following the layer, whose undulation may be in proportion to the mamillary projections on the free or natural surface, being greatest in species like *S. polymorpha*, Goldf., while in others there may be hardly any elevation perceptible, yet still the stellate venations exist. Generally, too, they are centred in a special enlargement like a cell, which may in some species have more or less vertical extension; but, whatever the centre may be, it does not appear to have had an *external* opening, as shown by Rosen's magnified illustration of a stellate venation from *Stromatopora astroites* (see tracing fig. 6, from tab. ii. fig. 7), which had *not even a central enlargement*. How far the extension of the flexuous ray may be confined to the

* This is the largest that I have seen, and occurs in a species apparently peculiar to Pit-Park Quarry, Dartington, of which Mr. Champernowne has a specimen wherein the flexuous ray even exceeds these dimensions. The largest seen by Baron Rosen is that of *Stromatopora astroites*, of which I have given a tracing (fig. 1) of the natural size.

lamina in which it is developed I am not prepared to state; but it often appears to descend through several layers in the mass when this is merely owing to the undulation of the layer; while in flat species a horizontal shave more or less, as before stated, may bring it into view or take it away altogether, showing that in this instance it is confined to the layer. Still, as the cavities of the cœnosarc become continuous by extension upwards, so the branches of the flexuous ray of the stellate venation may be more or less extended vertically. Hence also, as the form presented by the free surface of *Stromatopora* cannot be generic but must be specific, so this must be given, together with the other peculiarities of structure, in the descriptions of the respective species.

We have now to consider the import of the parts that have been enumerated, and see if this can be elucidated by reference to existing species.

It is true that no species of *Stromatopora* is known to exist at the present day; but still there may be organisms of a like nature that reflect back a light which may lead us to a right understanding of what *Stromatopora* was.

That *Millepora alcicornis*, although not growing into such thick masses as *Stromatopora*, does produce a corallum which is composed of a curvilinear cœnenchyma, increasing by lamination, and spreading over or enveloping every hard object with which it comes into contact, like *Stromatopora*, is incontestable.

That the fossil species, viz. *Hydractinia pliocena* (originally and significantly called *Stromatopora incrustans* by Goldfuss, as before stated), was produced by a like organism to that of *Millepora* is equally true.

And, lastly, we have species of *Hydractiniæ* at the present day producing respectively horny and calcareous polyparies analogous to these coralla.

Nor does any one doubt that all these were produced by Hydroid Polyps issuing from holes smaller even than those indicated by the triangular spaces in the rectilinear structure of *Stromatopora*. In short, when we look at a whelk-shell covered with living *Hydractinia echinata* in its natural element, or after having suddenly been plunged from it into spirit and water for preservation, we do not wonder that such an exuberant growth of polyps of all sizes, such as must also be present in *Millepora alcicornis*, could easily produce the coralla of either *Hydractinia pliocena* or any of the *Stromatoporæ*.

So far, then, we can account for the corallum of *Stromatopora* and the animal which produced it.

What part, then, did the "stellate venation" perform? and is there any thing analogous to it in the organisms just mentioned?

From what has been stated of the stellate venation, it does not appear that it had an *external* opening in the fresh state, as will be shown hereafter, whether with or without a central cell or inflation, such as that, in the latter instance, figured by Baron Rosen (*op. et l. c.*)—and therefore that its functions were not excretory like those of the canal-systems of sponges, which, possessing a stellate form like that of the stellate venation of *Stromatopora*, are present on the surface of some species. Again, the stellate venation in *Stromatopora* appears in every layer however thin, which, in some specimens of the rectilinear species from the Pit-Park Quarry at Dartington, split off individually, each bearing its own centres of stellate venation, which are generally situated one over another as they are on the summits of the gentle elevations which characterize the growth of the species. This, too, is not like the character of the stelliform excretory canal-systems of sponges, which are confined to the surface of the few species that present them. We therefore, however like the latter may be to the stellate venations of *Stromatopora*, may dismiss this speculation from our conjecture.

Next, as to any thing like the stellate venation in any of the recent or fossil specimens of organisms apparently allied to *Stromatopora*.

Here we must first advert to what takes place in the development of the *polypary* of *Hydractinia echinata* and *H. calcarea* respectively, all of which may be found detailed and illustrated *in extenso* in my communications on the subject published in the 'Annals' (vol. xi. p. 1 &c. pl. i., 1873; and vol. xix. p. 46 &c. pl. viii., 1877), but which will be briefly repeated here for our present purpose—that is, to show that there is a grooved venation in dried specimens of the recent species to which I have alluded, previously formed by, and afterwards supporting in the living state, a stoloniferous branched tubulation whose office is similar to that of the *hydrorhiza* of the Hydroid Zoophytes, viz. to produce the rudiments upon which the whole of the rest of the *polypary* is erected. This tubulation may be first observed in the proliferous membrane of *Hydractinia echinata*, as well as in that of *H. calcarea*, and is easily recognized by the presence of horny or calcareous points, as the case may be, upon its *external* surface, which are not only the rudiments of the *polypary*, but those of the grooved venation, as before stated, in which the stoloniferous tubulation is afterwards to be lodged, but which, disappearing in the dried state, leave the latter in the form so beautifully displayed in the surface of the branched species of *Hydractinia* (*H. arborescens*, Ann. 1878, vol. i. p. 298, pl. xvii. fig. 4). The same kind of grooved venation exists in *Millepora alcicornis* either in the surface or immediately beneath the last or outer layer, according to the degree of development to which the layer has arrived, since, as may be gathered from what has been stated of the stoloniferous tubulation in *Hydractinia*, the tubulation soon obscures itself by the development of the *polypary* around and above it. The same grooved venation may be beautifully seen on the surface of the fossil species, viz. *Hydractinia pliocena*, Allman, = *Stromatopora incrustans*, Goldfuss, *ut anteà*, and not only on the surface but in the subjacent layers as they are split off from the fossilized polypary or corallum.

Now no naturalist or comparative anatomist (for it is essential that a palæontologist should be one) could ever confound this structure with that of the excretory canal-system of sponges, however like the latter may be to it; if so, I must refer him to Mr. Moseley's description of it in the living species under the name of "hydrophyton" (Phil. Trans. 1877, vol. clxvii. p. 125, pl. iii. fig. 16, &c.), wherein it will be found to be "lined, and in many places filled with cellular elements" (p. 128, pl. iii. fig. 17), and not hollow like the canal of sponges; while I myself cannot see any difference, except in form, between this grooved venation and the stellate venation—which in the lapidified state of *Stromatopora* in the horizontal section is filled with transparent calcite, but which, of course, when in the interior of the corallum becomes tubular, and in the larger forms of Pit-Park Quarry, to which I have alluded, filled (when under decomposition) with a mould of opaque white calcite, following the same mineral changes as before mentioned under similar circumstances, and thus contrasting strongly, in its branching form, with the dark remains of the decomposed corallum in which it is thus imbedded.

Nature frequently repeats herself in form, although not in function, as if there were a unity of design. Thus there is a specimen of a polyzoon in the Liverpool Free Museum, which was brought to my notice by Mr. T. H. Higgin, F.L.S., where the cœnobium is identical with the general form of the siliceous hexactinellid sponge called *Eurete farreopsis*, which I have figured in the 'Annals' (vol. xix. pl. ix. fig. 1); and I possess the calcareous cormus of a Synascidian still larger, where the general structure is similar, *i. e.* composed of a branched anastomosing tubulation in which the latter is one third of an inch in diameter, and thus forms a clathrous mass. (By "calcareous" I mean charged with globular spined spicules of carbonate of lime, like those of the *Didemnida*, Giard.) Now all these are built upon the same design, and in all the oral orifices of the organisms respectively producing them are on the *outer* side of the tubulation; yet no naturalist would assert that a polyzoon, a spongozoon, and an ascidian were one and the same organism. Hence the form may be the same, but the function different; and so the stellate venation of *Stromatopora* may be like the stellate excretory canal-system of sponges presenting this form, with a totally different function; on the other hand, in *Hydractinia* and *Stromatopora* respectively, the form of the venation may be different and the function the same.

Lastly, we come to the "vertical rods" of *Stromatopora*, to which I have alluded as always existing in the rectilinear and only sometimes in the curvilinear cœnenchyma, presenting an axial transparency indicative of their having once been *hollow* in the whole of their length, except probably at the surface, where the hollow is closed; and that this was probably the case we arrive at in the following way, viz. that the spines in both *Hydractinia echinata* and *H. calcarea* which pass up through the whole layer of the polypary are respectively hollow throughout, but closed at the apex (Ann. 1877, vol. xix. pl. viii. figs. 1 and 4)—also that the spines on the surface of the fossil species, viz. *H. pliocena*, are the same, and appear to be continuous with the vertical tubes in the stroma or corallum, while *Labechia conferta* of the Silurian Formation (which was a species of *Hydractinia*, and to which I shall allude more particularly hereafter) presents the same kind of axial transparency in its vertical rods or columns, which terminate in opaque (closed) conical points respectively on the surface, indicative of their also having been in like manner otherwise hollow (fig. 8, *a*, *b*). Hence too, perhaps, we may account for the axial transparency, indicating original hollowness, in the "vertical rods" of *Stromatopora*.

Further, if we compare *Favosites gothlandicus* (fig. 7) with *Labechia conferta* (fig. 8—both fossils of the Silurian Formation), both will be found to be composed of vertical spaces tabulated; but while the former was composed of tubes in juxtaposition with horizontal tabulæ (fig. 7, *b*), the latter was composed of thick hollow columns between which the tabulæ were extended in a much less regular manner (fig. 8, *a*, *b*);

and thus in *Labechia* we have a transitional form from *Favosites gothlandicus* to the *rectilinear* structure of *Stromatopora*, which, in the horizontal section (fig. 2, *a*, and fig. 8, *a*), it closely resembles—accounting for Lindström's statement that G. Eisen had pointed out to him "that there are specimens found in Gothland combining the peculiar features of *Labechia* with those of *Cœnostroma*" = *Stromatopora* (Ann. 1876, vol. xviii. p. 5).

That *Labechia* was a species of *Hydractinia* is evident from its structure and mode of growth—*i.e.* more or less laminiform, enveloping small shells and corals in its course of increase. I make this statement from two large specimens now before me, in which there are a number of layers of *Labechia* varying in thickness under one third of an inch, heaped irregularly upon each other with shells, corals, and sand between them, some of the former of which have not only become united to and imbedded in the layers, but also, after the manner of *Hydractinia*, appear to have become partly absorbed into their structure; so that, under this form, *Labechia*, contrary to Messrs. Nicholson and Murie's statement (Journ. Linn. Soc. vol. xiv. p. 235), *is* closely allied to *Hydractinia*, which seems to show that the assertion was made upon a single specimen in which this did not occur.

There is a species of *Stromatopora*, viz. *S. elegans*, Rosen (the well-known "staghorn variety"), among those in the possession of the lapidaries hereabouts, which in the presence and position of the stellate venation has puzzled both Mr. Champernowne and myself; for the pattern in the cœnenchyma exactly represents the stellate venation in the horizontal section, but in its branches will be found to end not like that of the usual venation, namely in the cœnosarcal cavities, but in the fibre of the cœnenchyma itself; and yet the branches of the stellate venation, when it happens by the section to have come into view, follow the course of the cœnenchymal stellation. The stellate figure in the cœnenchyma (however much, in the horizontal section, it may look like the cylindrical branches of the stellate venation) has a *vertical* extension, as well as a horizontal one, in the cœnenchyma, so that the horizontal section might cut off several thin slices and still leave the same figure; while the stellate venation is probably confined to only one part of it, and therefore only now and then, in small fragments, is seen, but, of course, must somewhere become continuous with the cœnosarcal cavities. Hence I should be inclined to infer that the "stellate venation" maintains its horizontal position, however much *vertically* the stellate figure assumed by the cœnenchyma may be extended. But this, again, although desirable to notice here, is a point which chiefly belongs to a particularization of the structure in connexion with a description of this species.

Budleigh-Salterton,
July 29, 1879.

EXPLANATION OF PLATE XV.

Fig. 1. *Stromatopora astroites*, Rosen, natural size, showing spots of "stellate venation." (After Rosen, tab. ii. fig. 6.)

Fig. 2. *Stromatopora*, sp. (Pit-Park Quarry, Darlington). Illustrating the rectilinear structure in a horizontal section of the cœnenchyma. *a*, ends of vertical rods, with the rectilinear lines between them forming the triangular spaces; *b*, the same, with the rectilinear lines removed; *c*, dark shade to represent the transparent calcite indicative of original hollowness; *d d*, ends of rods; *e e*, cavity of cœnosarc.

Fig. 3. The same. Illustrating the rectilinear structure in the vertical section of a little more than a single lamina. *a a*, the rods; *b b*, the horizontal lines limiting the lamina above and below, being produced by the edge of the layer (*a*, fig. 2); *c c*, inflated ends of the rods uniting respectively with those of the next laminæ both above and below; *d d*, rectangular or quadrilateral spaces, forming part of the cœnosarcal cavity; the dark shade represents the transparent calcite, indicating original hollowness both in the rods and horizontal lines.

Fig. 4. *Stromatopora*, sp. (Pit-Park Quarry, Dartington). Illustrating the curvilinear structure in the horizontal section of the cœnenchyma. *a a a*, vermiculated thread or fibre cut through on the surface; *b b b*, vermicular cavities of cœnosarc; *c c c*, descending portions of vermiculated thread of cœnenchyma.

Fig. 5. The same. Illustrating the curvilinear structure in the vertical section. *a a a*, vermiculated thread or fibre cut through vertically, showing a tendency to vertical elongation; *b b b*, vermicular cavities of cœnosarc; *c c c c*, descending portions of vermiculated fibre.

N.B. Figures 2–5 inclusive are drawn to the scale of about 1-96th to 1-1800th inch. As the structures vary in size in different species, and, indeed, in different specimens of the same species, so here the rectilinear appears smaller than the curvilinear, but, from what has been stated, it might have been the reverse.

Fig. 6. *Stromatopora astroites*, Rosen. One star of stellate venation, magnified five diameters. (After Rosen, tab. ii. fig. 7.) The unfinished state of the ultimate branches here is to indicate that they are sunk into the cœnenchyma of the *Stromatopora*, and, therefore, that the centre is elevated.

N.B. The fact of the structure of the cœnenchyma being much smaller than the stellate venation is evidenced by fig. 1 (viz. *Stromatopora astroites*), wherein the former is too minute to be represented of its natural size, while the latter can be easily seen with the unassisted eye. Hence it must not be expected that the stellate venation can be represented here upon the same scale as the rectilinear and curvilinear structures of the cœnenchyma respectively (figs. 2–5); but when magnified, as in fig. 6, on a much lower scale, being smaller, it might, without this explanation, lead to the idea that the stellate venation was much smaller than the general cœnenchymal structure, while it is greatly the reverse.

Fig. 7. *Favosites gothlandicus.* *a*, portion of surface, to show the hexagonal form of the cells; *b*, portion of vertical section, to show the *vertical* septa or walls of the cylinders traversed by the *tabulæ*.

Fig. 8. *Labechia conferta.* *a*, horizontal section, to show the arrangement of the rods or pillars, and the lines (*tabulæ*) traversing their interspaces—also that they were hollow, as indicated by the white centre now filled with transparent calcite; *b*, vertical section, to show the same, but with closure of the pointed free extremities.

N.B. These figures (viz. 7 and 8) are all magnified upon the same scale, viz. two diameters, and are slightly diagrammatic, to show how the rods and tabulæ of *Labechia*, replacing the cylinders and tabulæ of *Favosites*, present an analogous structure to the rectilinear cœnenchyma of *Stromatopora* (figs. 2 and 3).

XXX.—*Descriptions of Palæozoic Corals from Northern Queensland, with Observations on the Genus* Stenopora. By H. A. Nicholson, M.D., D.Sc., F.G.S., &c., Professor of Natural History in the University of St. Andrews, and R. Etheridge, Jun., F.G.S., of the British Museum.

[Plate XIV.]

[Continued from p. 226.]

Genus Stenopora, Lonsdale, 1844.

Stenopora, Lonsdale, Darwin's Geol. Obs. Volc. Islands, 1844, p. 161 (note).
Stenopora, Lonsdale, Strzelecki's Phys. Descr. New South Wales &c., 1845, p. 262.
Tubuliclidia, Lonsdale, Bull. Soc. Géol. de France, 1844, 2nd ser. i. p. 497.
Tubuliclidia, Lonsdale, Murchison's Geol. Russia, 1845, vol. i. pp. 221 and 631 (note).

Gen. char. Corallum ramose or sublobate, rarely massive, rooted below, and composed of tubular corallites, which are nearly vertical in the centre of the branches, and radiate outwards, from an imaginary axis, to open on all points of the free surface. Corallites polygonal, thin-walled, and more or less completely in contact in the centre of the branches; but in the outer curved portion of their course more or less cylindrical, and annulated by periodical ring-shaped thickenings, which are placed at corresponding levels in contiguous tubes, in such a manner as to leave vacant spaces between the intervening unthickened portions. Visceral chamber in the outer portion of the tubes alternately contracted and dilated in correspondence with the periodic thickening of the walls just spoken of, but open and subpolygonal in the axial portion of the corallum. Septa obsolete. Tabulæ remote, usually placed at corresponding levels in contiguous tubes. Mural pores of small size, not numerous, and irregularly distributed.

History. The genus *Stenopora* was proposed and partially described by the late Mr. Lonsdale in an appendix, entitled "Description of six Species of Corals from the Palæozoic Formation of Van Diemen's Land," to Dr. C. Darwin's work 'Geological Observations on the Volcanic Islands' *. Of the few characters assigned to it, the only one which can be at all seized upon as of generic value is the so-called periodical constriction of the tubes. Two species were described in detail, *Stenopora tasmaniensis* and *S. ovata*. From the remarks made by Mr. Lonsdale on the former we gather that the branches sometimes become hollow, and that the tubes in the body of each branch are angular, but after deflection towards the surface they become oval. No tabulæ were observed. Some peculiar changes in the surface of the colony were observed by Mr. Lonsdale: for instance, where the mouths of contiguous corallites are not in contact they were seen to be separated by foraminated grooves, the latter becoming, as growth progressed, gradually filled up; the walls then thickened, and a row of tubercles were developed along the crests so formed. The mouth afterwards became closed by a lamina projecting from the inner wall.

In Count P. de Strzelecki's work 'Physical Description of New South Wales, &c.' †, Mr. Lonsdale further described *Stenopora*, gave additional notes on the two species already mentioned, and added two others, *S. informis* and *S. crinita*, both massive forms, the two previously described species being ramose. In the generic description now given the contraction of the corallites "at irregular distances, but in planes parallel to the surface of the specimen," is mentioned, and also the existence of additional interpolated tubes. We may here remark that in this final definition of *Stenopora* by Lonsdale there is no character which would now be regarded as of generic importance.

The structure of *Stenopora ovata* is described at greater length than in the previous notice of this species. In the centre of the branches the tubes are in contact and polygonal,

* London, 1844, pp. 161–169. † London, 1845, pp. 262–266.

and the tubular "constrictions" are very numerous and strongly marked; but no satisfactory evidence was forthcoming of the ultimate closing of the tube-mouth in *S. ovata*, as described in *S. tasmaniensis*.

In the form described under the name of *Stenopora crinita*, Mr. Lonsdale observed that the additional or interpolated tubes sometimes sprang "from the lines of contraction, but sometimes commenced in the spaces between them."

In a table of fossils attached to a paper by Murchison and De Verneuil on the Permian System of Russia*, the name *Tubuliclidia* (Lonsdale) is used instead of *Stenopora*, and two additional species are there mentioned, *S. spinigera* and *S. crassa*.

In Murchison's 'Geology of Russia' the name *Tubuliclidia* is retained† in a similar table of fossils; but in an appendix ‡ to this work the name *Stenopora* is again made use of, and *Tubuliclidia* relegated to the synonymic list. The two species previously mentioned are here described and figured; and although Lonsdale says nothing about the presence of tabulæ, if we mistake not, they are distinctly figured in one of the illustrations of *S. crassa* §.

In 1848 Prof. J. D. Dana ‖ pointed out that the diagnosis of *Stenopora* by Lonsdale was insufficient, and redefined it as follows:—"Internal structure of corallum fine, prismatic; cells of surface minute, subangular, contiguous; zoophytes glomerate or ramose; surface often small-verrucose." This definition adds nothing to our knowledge of the genus as worked out by Lonsdale.

In 1849 the same author referred¶ all Lonsdale's species of *Stenopora* to the genus *Chætetes*; but, at the same time, he did not fail to notice the peculiar tube-accretions, termed by Lonsdale "constrictions;" and he likewise confirmed the latter's observation on the occasionally hollow nature of the branches in the ramose species. Dana, in addition, described a new species as *Chætetes gracilis* **, which appears to be congeneric with *S. tasmaniensis* and *S. ovata*.

Messrs. Milne-Edwards and Haime, in their memoir on the Perforate and Tabulate Zoantharia††, define *Stenopora* as a *Chætetes* with small styliform processes at the angles of the calices, and give as their type *S. spinigera*, Lonsdale. This definition was repeated in their Introduction to their

* Bull. Soc. Géol. de France, 1844, ser. 2, i. p. 475.
† Vol. i. 1845, p. 221. ‡ P. 631. § Tab. A. fig. 12, *a*.
‖ Wilkes's U.S. Explor. Exped. Zoophytes, p. 537.
¶ Ibid. Geology, pp. 711, 712. ** P. 712, t. 10. fig. 15.
†† Comptes Rendus Hebd. 1849, xxix. p. 261.

'Monograph of the British Fossil Corals' *; whilst in their more extended work 'Polypiers Fossiles &c.' they placed the whole of the Australian species described by Lonsdale doubtfully in the genus *Chætetes* †, and noticed the presence of tabulæ in *S. crinita*.

It has already been pointed out by one of us ‡ that "they (*i. e.* Edwards and Haime) thus do not notice the characters relied upon by Lonsdale and M'Coy as separating *Stenopora* and *Chætetes*, whilst they introduce a feature not mentioned by either of these observers. In other words, they break up Lonsdale's genus into two portions, one of which, typified by *Stenopora spinigera*, Lonsd., they retain under *Stenopora*; whilst the other, comprising all the (so called) species enumerated by M'Coy, King, Geinitz, and Howse, they place under *Chætetes* and *Favosites*."

In 1851 Prof. M'Coy gave a diagnosis of *Stenopora* derived from the study of so-called British species. He described the presence of lateral gemmation, the absence of connecting tubuli or foramina in the tubes, and the presence of "imperfect diaphragms perforated in the middle" §.

This would have been a real advance in our knowledge of *Stenopora*, because Lonsdale said no trace of transverse diaphragms had been noticed ‖, were there any evidence to show that M'Coy's definition was based upon corals really belonging to this genus ¶, or possessing a structure at all similar to that exhibited by either of the typical forms, *S. tasmaniensis* or *S. ovata*. M'Coy's "*Stenopora fibrosa*, Goldf.," which is the first species described after his definition, is a Silurian form, and is almost certainly a *Monticulipora*. Any appearance of "perforated diaphragms" in *Stenopora* can only be due to the periodic contractions of the visceral chamber by the annular thickenings of the walls of the corallites, the true tabulæ being thin, horizontal, and complete, as we shall show hereafter.

* 1850, p. lxi. † 1851, pp. 273, 274.

‡ Quart. Journ. Geol. Soc. xxx. p. 499.

§ Brit. Pal. Foss. fasc. i. p. 24.

‖ Darwin's Geol. Observations, p. 162.

¶ We have carefully examined specimens and thin sections of *Monticulipora* (*Chætetes*) *tumida*, Phill., which M'Coy described as a *Stenopora*; and we find this form to very closely approach the type species of *Stenopora* in internal structure, with which, in fact, it agrees in most features of importance. The thickening of the tubes towards their mouths, however, appears to be not so distinctly a periodical and annular thickening, and mural pores have not been yet detected, while several Silurian *Monticuliporæ* exhibit similar features in a less marked form. Under these circumstances, therefore, we have not felt ourselves justified in actually removing *Monticulipora* (*Chætetes*) *tumida*, Phill., to *Stenopora*.

Fromentel, in his 'Introduction à l'étude des Polypiers Fossiles' *, follows Edwards and Haime in referring the *Stenoporæ* to *Chætetes*, with a note of interrogation; indeed this reference is adopted by Milne-Edwards even in his most extended and latest work on this subject, 'Histoire naturelle des Coralliaires' †.

Prof. de Koninck has, to us, made a most inexplicable reference ‡ in placing *S. tasmaniensis* and *S. ovata* as synonyms of *Monticulipora tumida*, Phill. (*Chætetes tumidus* auctt.). They have no specific connection with this characteristic European Carboniferous species.

In the Cambridge 'Catalogue of Cambrian and Silurian Fossils' §, the late Mr. J. W. Salter adopted *Stenopora* nearly in the same sense in which it was employed by Prof. M'Coy.

In 1874 a paper by one of the present writers ("Descriptions of Species of *Chætetes* from the Lower Silurian Rocks of North America)" was published ||, in which the relations of *Stenopora* to other genera were touched on. One very important point is here brought forward, viz. that in all the American Devonian and Silurian species of *Monticulipora* examined by the author the outer walls of the corallites were exposed by fracture, as in *Stenopora*, although in every other respect the characters were those usually ascribed to *Chætetes*. The confusion which has arisen by the indiscriminate use of the terms *Favosites*, *Chætetes*, *Monticulipora*, and *Stenopora* by various authors is again commented on by the same writer in his 'Report upon the Palæontology of the Province of Ontario' ¶. The difficulty formerly experienced in separating *Chætetes* from *Stenopora* is here alluded to; and the author considers that the forms referred to the latter by palæontologists who have written since Lonsdale cannot be separated from *Chætetes*.

In a paper "On the Affinities of the Anthozoa Tabulata" **, Dr. G. Lindström has proposed the elimination of *Stenopora* from amongst the Tabulate corals, and the placing of it with the Polyzoa.

The last reference we have to make in the history of this interesting genus is an important one. In his recent work, "Recherches sur les Fossiles paléozoïques de la Nouvelle-

* Paris, 1858–61, pp. 274, 275. † Vol. iii. 1860, p. 272.

‡ Nouvelle Recherches sur les Animaux foss. &c. pt. i. 1872, p. 143.

§ Cambridge, 1873, pp. 29, 108.

|| Quart. Journ. Geol. Soc. 1874, xxx. pp. 499–515.

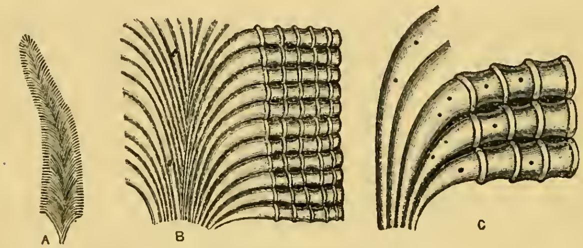
¶ Toronto, 1874, pt. i. p. 60, 1875, pt. 2, p. 29.

** Ann. & Mag. Nat. Hist. 1876, xviii. p. 9.

Galles du Sud,' Prof. L. G. de Koninck has shown the existence in *Stenopora ovata* of mural pores or perforations *, and, in consequence, has referred it to the genus *Favosites*. The pores in question are described as irregular in disposition, some on the faces of the walls themselves, others on the angles of the corallites. The presence of tabulæ, first figured by Lonsdale in *Stenopora*, is recorded in this species.

Obs. Taking *S. ovata*, Lonsd., as the foundation of the following remarks, the corallum in *Stenopora* is usually more or less branched; but the branches may be so thick, or may so extensively coalesce, that its general form becomes that of a lobate mass. The corallites (fig. 1, A) radiate in all directions from an imaginary axis, and present very different appearances in the central and circumferential portions of the corallum respectively. In the axial portion of the branches the tubes are nearly vertical, are essentially polygonal or prismatic in shape, have thin walls, and are nearly or quite in contact with one another throughout. As they pass upwards the tubes gradually diverge, coming, at last, to be nearly horizontal, and preserving this direction for a considerable distance, till they at last open upon the surface. There is thus an exterior zone of the corallum, in which the corallites are nearly transverse to the axis of the branches; and in this region (fig. 1, B) they have a generally cylindrical appearance, owing to the fact that their walls are thickened at very short intervals by annular accretions of growth, the portions of the tube between them retaining their normal diameter. As these thickened portions are placed at corre-

Fig. 1.



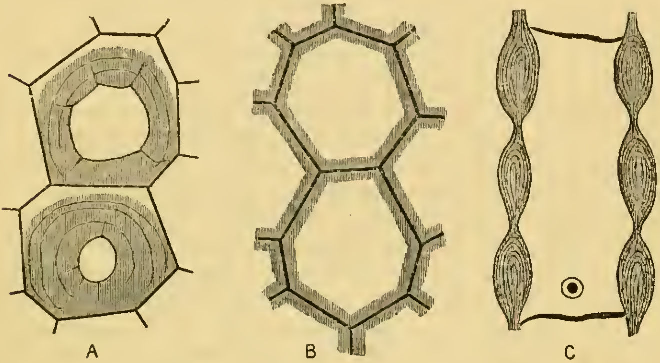
A. Portion of a branch of *Stenopora Jackii*, Nich. & Eth., Jun., split open, of the natural size. B. Portion of the same, enlarged, showing the annulation of the tubes in their outer portions. C. A few of the tubes of the same, still further enlarged, showing the mural pores. Permo-Carboniferous, Queensland.

* Bruxelles, 1877, pt. 3, pp. 156, 157.

sponding levels in all the corallites, it follows that the tubes are in actual contact with one another at these points only, and that they are separated by ring-like spaces corresponding with all the unthickened segments of the tubes.

Thin sections of the corallum show different appearances in different portions. Thus, in a transverse section across a branch, the axial corallites are seen to differ in no essential feature of their structure from those of *Monticulipora* or *Favosites*. Each possesses its own wall, which is not abnormally thickened (fig. 2, B), the boundary between contiguous tubes being

Fig. 2.



A. Two tubes of *Stenopora ovata*, Lonsd., cut transversely across their thickened portions, and showing the contraction of the visceral chamber by an annular deposit of sclerenchyma, which is not in contact with the wall on one side. B. Two tubes of the same from the centre of a branch, cut across, and showing the thin walls and polygonal form. C. Portion of a tube of the same cut longitudinally, showing the thickening of the wall, the tabulæ, and one of the mural pores. Enlarged twenty-five times. Permo-Carboniferous, Queensland.

clearly indicated by a distinct dark line. The tubes in this portion of the corallum are also regularly polygonal, and are certainly, as a rule, in close contact. On the other hand, in sections tangential to the branch and taken a little below the surface, the tubes are cut across in their outer portions, where they are periodically thickened. The tubes still appear to be polygonal and in contact, each being bounded externally by a well-marked dark line; but the appearances presented by the area within this boundary-line are very puzzling, apparently varying according as the section traverses the tubes at the level of their thickened portions or at that of the unthickened intervals between the latter. In the former case the visceral chamber (fig. 2, A) is seen to be greatly contracted, and to be reduced to a comparatively small rounded or subpolygonal central tube, which is in turn surrounded by a thickened ring of sclerenchyma, which usually shows distinct traces of its being composed of successively-deposited concentric laminæ. In the latter case there is still a ring of sclerenchyma within the dark outer polygonal boundary; but this ring is of small thickness comparatively, and the central tube is wide and open. Further, in both cases alike there are two phenomena observable which we are at present unable to account for. One of these consists in the fact that the ring of sclerenchyma within the corallite is never in contact with the outer polygonal wall for more than one half or two thirds of its circumference, being separated from the latter throughout the remaining part of the tube by a distinct and conspicuous interspace, which is filled in the fossil with transparent calcite. Not only is this partial interspace between the inner ring and the outer wall apparently always present (fig. 2, A), but it seems to be always situated upon the same side of all the corallites in any particular section. The other inexplicable feature is, that the outer dark walls of the corallites appear to be always in close contact, whereas an examination of the exterior of the tubes shows them to be only in contact along the planes where thickenings of the wall are developed, while they are separated by distinct intervals in the spaces between them.

Moreover, in many parts of tangential sections the corallites exhibit few features that would satisfactorily separate them from similar sections of certain *Monticuliporæ*—though they usually have exceptionally thick walls, and also often exhibit a thin dark ring a little within the true wall and concentric with the latter. There are also some other phenomena occasionally observable which it is extremely difficult to explain; and we must admit that there are various points as to the anatomy of this curious genus which must remain obscure until a large series of specimens can be microscopically investigated.

Longitudinal sections of the corallites (fig. 2, C) show the periodical annular thickenings of the tubes in a very instructive manner, and demonstrate that these are really *thickenings of the wall*, projecting both externally and internally; so that it is not correct to regard the corallites as being "periodically constricted," this phrase applying only to the visceral chamber In fact the longitudinal section of the wall has a regularly moniliform appearance, owing to its successively traversing thickened and unthickened segments. Sections of this kind also show that there exist remote and complete tabulæ, which are usually placed at approximately corresponding levels in all the corallites of a single colony. Lastly, these sections occasionally show mural pores, though these structures can best be made out by a microscopic examination of the exterior of the tubes, when they are found to have the form of small, circular, irregularly-distributed apertures. It may be added that long sections show the same puzzling feature as do tangential slices—namely, that the corallites are apparently in contact throughout their entire length, whereas macroscopic examination shows them to be clearly free over the unthickened segments of the tube.

Our specimens are not in such a condition as to justify our making any definite statements as to the characters exhibited by the surface, except that the calices are certainly not oblique. The exterior of the mouths, according to Lonsdale, are round or slightly oval, and the dividing ridges sharp, with a large tubercle at the interspace between every four mouths. So far as we can judge, the general aspect of the calices is very similar to that of either *Monticulipora* or *Chætetes*; and we should therefore doubt if a simple inspection of the exterior would enable an observer to certainly separate an example of *Stenopora* from one of either of the latter genera. At any rate, it is probable that the presence of spines or tubercles in the lips of the calices (even if a constant character) cannot be supposed to have more than a mere specific significance.

As to the affinities and systematic position of *Stenopora*, Lonsd., the discovery by Prof. de Koninck of mural pores, and the existence of these in other forms, as demonstrated by us, are quite conclusive as to the propriety of referring the genus to the Favositidæ; and it is thus widely removed from *Chætetes*, Fischer, and *Monticulipora*, D'Orb., to which it bears a striking superficial likeness, and from which it has usually been supposed to be hardly, or not at all, separable. Within the family of the Favositidæ the genus holds an entirely unique position, and possesses no close ally with which it need be compared in detail.

In making specific determinations of *Stenoporæ* we labour under a certain disadvantage; for it has already been pointed out by one of us that the collection containing two of the types (*S. tasmaniensis*, Lonsd., and *S. ovata*, Lonsd.) has been lost; but this is partly counterbalanced by the existence of the fine specimens of the same species described by Mr. Lonsdale in the Strzelecki collection.

Geological Position. So far as can be at present stated, the species of *Stenopora*, Lonsd., are confined to the Carboniferous or Permo-Carboniferous formation of Australia and Tasmania. There is, indeed, some uncertainty as to the precise geological horizon of some of the deposits which have yielded *Stenopora*; but there is no reason to think that any of these are of Silurian age, and all the corals of this formation which have been at various times referred to *Stenopora* must, pending their complete examination by microscopic methods, be placed under *Chætetes* or *Monticulipora*.

Addendum.—The preceding description of the genus *Stenopora* was founded entirely upon an examination of *S. ovata*, Lonsd., and of the undoubtedly congeneric *S. Jackii*, nobis. Since this was written, however, we have been enabled to examine *S. tasmaniensis*, Lonsd., *S. crinita*, Lonsd.; and a third form, which may be *S. informis*, Lonsd., and we have thereby gained some additional information, and at the same time, in some respects, materially augmented the difficulty which we have experienced in our endeavour to interpret the structure of this extraordinary genus. So many points, indeed, have presented themselves for solution, that we think it best to postpone our remarks upon this subject till we can devote a memoir especially to the elucidation of this genus. In the meanwhile, therefore, we will only say here that *S. tasmaniensis*, Lonsd., is in all its essential details similar to *S. ovata* and *S. Jackii*, whereas *S. crinita* and *S. informis* differ in important respects from the species just mentioned, and show a curious approximation to certain of the so-called *Monticuliporæ*.

Stenopora ovata, Lonsdale.

(Pl. XIV. figs. 1–1 *c*; and woodcut, fig. 2.)

Stenopora ovata, Lonsdale, in Darwin's Geol. Obs. Volc. Islands, p. 163 (1844), and in Strzelecki's Phys. Descr. N. S. Wales, p. 263, pl. viii. figs. 3 *a* & 3 *b* (1845).

Chætetes (?) *ovatus*, Milne-Edwards & Haime, Pol. Foss. des Terr. Pal. p. 273 (1851).

Monticulipora tumida (pars), De Koninck, Nouv. Rech. Terr. Carb. Belgique, p. 143 (1872).

Favosites ovata, De Koninck, Pal. Nouv.-Galles du Sud, pt. iii. p. 156, pl. iii. fig. 5 (1877); Etheridge, jun., Cat. Australian Foss. p. 36 (1878).

Spec. char. Corallum sublobate or submassive, of cylindrical or flattened branches, which have a diameter of from half an inch to an inch and a half or more. Corallites vertical, or nearly so, in the centre of the branches, but finally bending outwards nearly at right angles, and being continued for some distance in this direction before reaching the surface. Corallites in the central portions of the corallum thin-walled, polygonal, and closely contiguous; but in the horizontal portion of their course thickened by annular accretions, by which the tubes are placed in contact, the intervening unthickened segments being free. Corallites on an average from $\frac{1}{70}$ to $\frac{1}{80}$ inch in diameter, tubes of smaller size being here and there intercalated among the larger ones. In the outer portion of the tubes about six of the annular thickenings of the tubes and as many unthickened segments occupy the space of one line. Tabulæ horizontal, complete, remote from one another as a general rule, and, for the most part, placed at corresponding levels in contiguous tubes, these levels having no evident relation to the annular thickenings of the tubes.

Obs. Having already given a full account, so far as our materials permit, of the internal structure of the genus, we need not go into details as to the minute internal structure of the present species. Our specimens, moreover, do not exhibit the surface in any manner that would enable us to give the external characters of the species. That our specimens are referable to *Stenopora* is proved beyond a shadow of doubt by their microscopic structure; and in identifying them with *S. ovata*, Lonsd., we have relied chiefly upon the rapid divergence of the tubes from the central bundle, and the great number and close arrangement of the annular thickenings of the corallites in the horizontal portion of their course, these being sometimes so much developed as to give to the exterior of the tubes a regularly crenulated appearance. The annular thickenings are also unusually broad; and many smaller tubes are interpolated among the larger ones as the surface is approached.

Our determination is the more to be relied on as we have made a direct comparison between Mr. Jack's specimens and Mr. Lonsdale's Strzeleckian type*, although, for reasons previously explained, we have not had the advantage of examining the specimens upon which the species was originally based by Mr. Lonsdale, and which were collected in Tasmania by Dr. Charles Darwin, F.R.S.

Locality and Horizon. Permo-Carboniferous, Coral Creek, Bowen-River Coal-field, Queensland.

Collector. R. L. Jack, Esq., F.R.G.S., F.G.S., &c.

Stenopora Jackii, Nich. & Eth., Jun. (Woodcut, fig. 1.)

Spec. char. Corallum ramose, dividing at wide intervals, the branches cylindrical, averaging about two lines in dia-

* Phys. Descript. N. S. Wales, &c., 1845, t. 8. f. 3 (coll. Brit. Mus.).

meter, and gradually tapering to their free extremities. The corallites are nearly vertical in the axial portion of their course, but ultimately bend outwards nearly at right angles to the imaginary axis of the branches, and open on the surface by rounded calices which are free from any obliquity. As the terminations of the branches are approached the angle of deflection of the corallites becomes less and less, and the horizontal portion becomes shorter and shorter; until at the extremity the whole of the corallites are nearly vertical. Average diameter of the corallites from $\frac{1}{70}$ to $\frac{1}{80}$ inch, smaller tubes being intercalated among those of average size as the surface is approached. Annular thickenings of the horizontal portions of the tubes narrow and ring-like, about five occupying one line, this being the total length, in general, of the annulated portions of the corallites. Mural pores minute, irregularly distributed. Surface not observed.

Obs. This is a graceful and well-marked species, easily distinguished from *S. ovata* and *S. tasmaniensis* of Lonsdale by its habit and general proportions. We should have been inclined to refer it to *Stenopora* (*Chætetes*) *gracilis*, Dana, had it not been for the fact that Dana lays stress upon the length of the tubes in the latter species, as well as upon the remarkable paucity of annulations in the same.

In the present species, on the other hand, the annulations of the tubes in the horizontal portions of their course are much more numerous than in *S. tasmaniensis*, Lonsd., while it differs conspicuously from *S. ovata*, Lonsd., in its size and general proportions. The presence of minute irregularly placed mural pores can be readily made out in specimens which are longitudinally fractured, by an examination of the exterior of the tubes under low powers of the microscope.

Locality and Horizon. Permo-Carboniferous, Coral Creek, Bowen-River Coal-field, N. Queensland.

Collector. R. L. Jack, Esq., F.G.S.

Stenopora ? sp.

Obs. Among our specimens from the Daintree collection we have numerous examples of a ramose coral which, from its *general appearance*, can only be regarded as a species of *Stenopora*, but which, so far as we can make out, does not exhibit the peculiar internal structure of this genus as typified by *S. ovata*, and which we, therefore, think may possibly be a *Monticulipora*, D'Orb. The specimens in question occur abundantly in a curious chloritic conglomerate (of Devonian or Carboniferous age?), which is largely impregnated with a grass-green chloritic or serpentinous mineral; and none of them exhibit the characters of the surface. Moreover, though the coralla are calcareous, and are themselves permeated by crystalline calcite, their more delicate structures seem to have been destroyed during the process of fossilization, and microscopic sections fail to show the internal structure in a thoroughly satisfactory manner.

The corallum in this form is ramose, the branches from two to five lines in diameter, diverging from a main stem obliquely or at right angles, the terminal portions always bifurcating, and the apices of the branches rounded or lobate. The corallites, after a short vertical course in the axis of the branches, are abruptly deflected nearly at right angles; and after holding this latter course for a space of from half a line to a line or more, they open by direct apertures upon the surface. As examined by a lens, the outer horizontal portions of the corallites appear to be thickened at intervals, as in *Stenopora*; but thin sections do not confirm this view of their structure. On the contrary, their walls seem to be uniformly thickened, the thickening increasing in amount as the calices are approached, and sections at right angles to the tubes appear to give clear indications of the existence here and there of a series of interstitial tubuli. Neither tabulæ nor mural pores are recognizable with any certainty.

When fractured surfaces of this coral are examined, the appearance presented is so *Stenopora*-like, that we feel ourselves obliged to refer the species to *Stenopora* rather than to *Monticulipora*, notwithstanding the absence of the more detailed characteristic internal structure of the former genus. It is, of course, just possible that this may be due to the mode of preservation. The general aspect of this species is quite that of Dana's *Stenopora* (*Chætetes*) *gracilis*, especially in the lobate bifurcation of the terminal branches; but the internal structure, so far as known to us, does not altogether correspond with the latter. Our *Stenopora* disagrees with Dana's species in the same way as *S. ovata* does; viz. the periodical thickenings, although faintly marked, are much too numerous for *S. gracilis*.

Locality and Horizon. In a fine conglomerate containing much chloritic matter, Gympie Gold-field. Devonian or Carboniferous (?).

Collector. The late Richard Daintree, Esq., C.M.G., F.G.S. (*Coll.* Brit. Mus.)

Genus Aræopora, Nich. & Eth., Jun., gen. nov.

Gen. char. Corallum massive, resembling that of *Favosites*, of polygonal corallites, which radiate outwards from an imaginary axis to open upon the upper surface of the colony. Under surface covered with an epitheca (?). The corallites are firmly united by their walls, which are extensively pierced by apertures, placing the visceral tubes in direct communication. Septa trabecular, often irregularly divided, or anastomosing at their free ends. Tabulæ rudimentary, represented by occasional horizonal trabeculæ. No columella nor cœnenchyma.

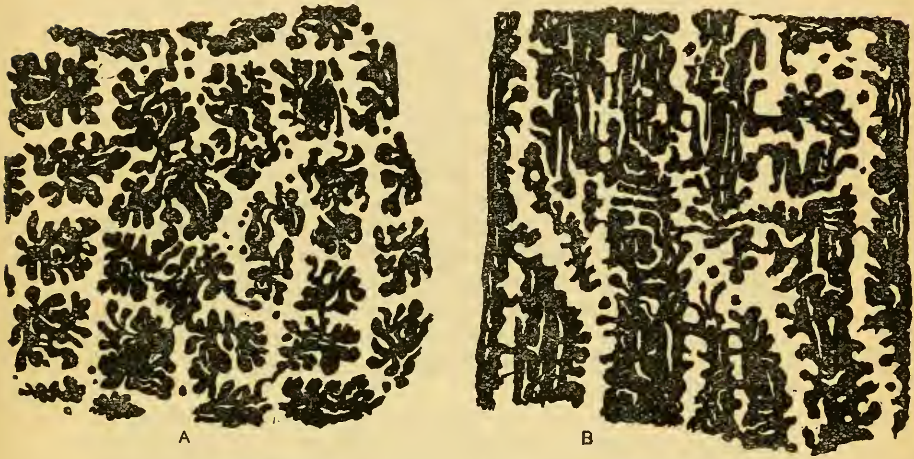
Obs. This genus is founded upon a single remarkable specimen belonging to the "Daintree collection," from the Devonian or Carboniferous deposits of Queensland, which we propose to distinguish specifically by the name of *Aræopora australis*, and of which we subjoin a brief description.

Aræopora australis, Nich. & Eth., Jun.

Spec. char. Corallum massive, pyriform, of considerable size, composed of polygonal or prismatic corallites which radiate outwards from an imaginary axis to open on the upper surface of the colony. Average diameter of the corallites from two thirds to three fourths of a line, no very small tubes being intercalated amongst those of ordinary dimensions. Walls amalgamated, irregularly cribriform. Septa variable in number, spiniform, or irregularly divided. Tabulæ rudimentary.

Obs. The corallum of *A. australis* might at first sight be readily taken for that of any of the larger and more massive species of *Favosites* (such as *F. hemisphæricus*, Yand. & Shum.), though even to the naked eye the absence of distinct tabulæ and the cribriform or porous condition of the walls are striking features. Our only specimen is not perfect, and is not only completely silicified, but is thoroughly infiltrated with silica tinged with oxide of iron. Its height is rather more than three inches, and its greatest width something over four inches. Its form is pyriform, the narrow base having evidently been attached to some foreign body, while the under surface was almost certainly covered by an epitheca, of which no traces now remain. The calices must have opened over the whole of the upper surface; but none of them are preserved in the specimen now before us. The corallites radiate with a graduated divergence from the imaginary axis of the colony; and their form is regularly prismatic or polygonal, as in *Favosites*. This character, however, is much more perceptible by the eye, or when the surface is examined with a lens, than it is when thin sections are investigated under the microscope, as it is to some extent masked in the latter case by the broken and cribriform structure of the walls. Thin sections (fig. 3, A & B), whether transverse or vertical, show that the walls of the tubes are extensively porous and cribriform, being pierced by numerous apertures, which place the visceral chambers in direct communication. Transverse sections also serve admirably to show the character of the irregular trabecular septa, some of which are simply spiniform, while others divide towards their inner extremities, or even unite with their neighbours by their free ends. Vertical sections show that the septa are, upon the whole, placed in longitudinal rows; and they exhibit occasionally horizontal trabeculæ (fig. 3, B), which may be regarded as of the nature of rudimentary tabulæ.

Fig. 3.



A. Part of a transverse section of *Aræopora australis*, Nich. & Eth., Jun., enlarged eight times, showing the trabecular septa and porous walls. B. Part of a vertical section of the same, similarly enlarged, showing the cribriform character of the walls, the septa, and the rudimentary tabulæ. Devonian, Queensland (Daintree collection).

From a consideration of the above characters it cannot be doubted that we have to deal in *Aræopora* with a genuine "Perforate" Coral, which, however, is closely related to the Favositidæ, and may be best placed in this family rather than in any of the more regular groups of the Perforata. By the characters of its walls and septa the genus presents certain alliances with the Poritidæ; but its general form and aspect are those of a *Favosites*; and the presence of rudimentary tabulæ would further confirm the view here taken. Among the genera of the Favositidæ its nearest ally is to be found in the Lower Silurian genus *Columnopora*, Nich., which it nearly resembles in form and habit. It is distinguished from the latter, however, by the less regularly perforate character of its walls, by the rudimentary condition of its tabulæ, and by the irregularly dividing and trabecular septa. We are unable to institute any comparison between *Aræopora* and the Cretaceous genus *Koninckia*, E. & H.; but the septa of the latter seem to be merely spiniform (six in number), and the tabulæ are said to be well developed and complete.

Locality and Horizon. Limestone of the Burdekin River, N. Queensland. Devonian.

Collector. The late R. Daintree, Esq.

Genus Pachypora, Lindström.

Pachypora meridionalis, Nich. & Eth., Jun.

Spec. char. Corallum ramose, of cylindrical branches, about two lines and a half or three lines in diameter, dividing dichotomously at comparatively remote intervals. Corallites not regularly polygonal, with very thick walls, the diameter of which increases as the mouth is approached. Calices hardly at all oblique, about a third of a line, or sometimes rather more, in diameter, oval, rounded, or irregular in shape, often opening into one another, surrounded by thick obtuse margins, which exhibit no traces of the original polygonal wall of the corallite. Mural pores few, very large, and irregularly placed. Tabulæ few and remote.

Obs. This species is unquestionably very closely allied to *Pachypora* (*Favosites*) *cervicornis*, De Blainv., of the European Devonian; and we have felt some hesitation in giving it a distinct specific designation. Both belong to that section of *Favosites* in which the walls are thickened by the secondary deposition of sclerenchyma in successive laminæ, the amount of this thickening being increased as the mouth is approached; and both are therefore referable to Lindström's genus *Pachypora*. Both are alike in form and general habit, and have singularly large, sparse, and irregular mural pores. After a comparison, however, of the Australian specimens with examples from the Eifel, both macroscopically and microscopically, we have come to the conclusion that the former must in the meanwhile be regarded as specifically distinct, upon the following grounds:—

a. *Pachypora meridionalis*, nobis, is, on the whole, a much smaller species than *P. cervicornis*, De Blainv., the branches in the latter often reaching 8 or 10 lines in diameter.

b. The corallites in *P. cervicornis* can always be shown, by thin sections, to preserve their polygonal outline, in spite of the thickening to which they are subjected; in the axis of the branches they are regularly polygonal; and even the thickened lips of the calices show more or less distinctly a polygonal line placed at a little distance from the mouth of the tube, which represents the original wall. On the other hand, in *P. meridionalis* the polygonal form of the corallites is more or less completely obliterated, even in the axis of the branches the originally prismatic wall cannot be detected, and the thickened lips of the calices are simply rounded and obtuse.

c. In *P. cervicornis* the calices are about half a line in diameter, rounded or subpolygonal, and only occasionally opening into one another. In *P. meridionalis*, on the contrary, the calices are mostly only about a third of a line in diameter (counting in, as before, the wall around them), their shape is very irregular, and they open into one another so frequently, and to such an extent, that they sometimes become almost vermiculate in character.

Upon the whole, therefore, we consider the present species to be sufficiently distinct from *P. cervicornis*, De Blainv., to deserve a separate name; and we know of no other adequately characterized species with which it is necessary to compare it in detail. We may add that the differences between *P. meridionalis* and *P. cervicornis*, which we have above alluded to, are much more conspicuous if we take specimens of the form usually known by the latter name in the Devonian Limestones of Devonshire, and figured as such by Milne-Edwards and Haime (Brit. Foss. Cor. pl. xlviii. fig. 2).

Locality and Horizon. In Devonian Limestone (apparently abundant), Fanning River, Burdekin, N. Queensland; Limestone of Arthur's Creek, Burdekin Downs, N. Queensland.

Collector. R. L. Jack, Esq., F.G.S.

Pachypora? sp. ind.

Obs. A second and ramose form, in all probability referable to this genus, occurs in the Fanning-River Limestone; but the state of preservation did not permit of our making thin sections; so that we can do no more than simply record the occurrence of it. The same form is also met with at Reid.

Collector. R. L. Jack, Esq.

Genus Trachypora, Edw. & Haime, 1851.

(Polyp. Foss. Terr. Pal. p. 305.)

Trachypora, sp. ind.

Obs. So far as we are aware, *Trachypora* has not been hitherto recognized as an Australian genus of Palæozoic Corals. Mr. Jack has forwarded to us a single and badly preserved example, which, although sufficiently good for generic identification, is in too ill-preserved a condition to warrant us in attaching to it a specific description and name.

The specimen is seated on the weathered surface of a piece of limestone, and exhibits the vermiculate surface and non-septate calices characteristic of *Trachypora*.

Horizon and Locality. Arthur's Creek, Burdekin Downs, N. Queensland. Devonian Limestone.

Collector. R. L. Jack, Esq.

Genus Aulopora, Goldfuss, 1826.

(Petrefacta Germaniæ, i. p. 82.)

Obs. Without at present entering into the question of the extent to which *Aulopora*, *Syringopora*, and *Cladochonus* may be regarded as distinct, it may be simply stated that only one species of *Aulopora* has been described from the Palæozoic rocks of Australia, viz. *Aulopora fasciculata*, De Koninck*, from the Upper Silurian of Bell River, New South Wales. We have now to place on record the presence, in the Arthur's Creek Limestone, of a form possessing all the characters of the European Devonian *Aulopora repens*.

Aulopora repens (Knorr & Walch.), Edwards & Haime.

Aulopora serpens, Goldfuss, Pet. Germ. i. p. 82, t. 29, f. 1.
Aulopora repens, Edwards & Haime, Pol. foss. Ter. Pal. 1851, p. 312.

Obs. We have an example of this interesting coral creeping over the surface of a specimen of *Heliolites porosus*. The weathering of the surface of the coral has removed the epitheca and exposed wall of the *Aulopora*, and laid bare the interiors of the ramifying or stolon-like corallites.

The spaces enclosed by the union of the corallites are irregular in shape, some polygonal, others elongated. The corallites either occur along the course of the creeping network, or are thrown off as a small projection at each bifurcation. There is no regularity in their disposition: at one point they succeed one another very rapidly along the creeping tubes, and are much crowded; but on other portions they are scattered and separated by much greater interspaces. On the edge of the corallum, where the reticulation becomes of a more open nature, the zigzag appearance given to the corallites by frequent dichotomization becomes very apparent. There are no septa visible in our example.

* Foss. pal. Nouv.-Galles du Sud, 1876, p. 14, t. 1. f. 1.

Horizon and Locality. Arthur's Creek, Burdekin Downs, North Queensland. Devonian Limestone.

Collector. R. L. Jack, Esq.

In addition to the corals which we have now described, the Arthur's-Creek Limestone has yielded a colony of *Lithostrotion* or *Lonsdaleia*, enveloped in a mass of *Stromatopora*, and partly silicified. In all probability it is a species of the former genus.

5. *Distribution of the Species and Age of the Beds.*

1. The fossiliferous beds of Coral Creek, at a point below the Sonoma road-crossing, in the Bowen-River Coal-field, have yielded

Stenopora ovata, *Lonsdale.*
—— Jackii, *nobis.*

2. The Fanning-River Limestone has also afforded the following two species, although there are indications of other corals not determinable :—

Heliolites porosus, *Goldfuss.*
Pachypora meridionalis, *nobis.*

3. The green fossiliferous chloritic rock of the Gympie goldfield is crowded with a pretty coral, which may be a *Monticulipora*, but which we place provisionally as

Stenopora ? sp. ind.

4. The limestone of the Broken River, a tributary of the Burdekin River, contains :—

Favosites gothlandicus (*Fougt*), *Lamk.*, vars.
Heliolites porosus, *Goldfuss.*
—— plasmoporoides, *nobis.*
—— Daintreei, *nobis.*
——, sp. ind.
Aræopora australis, *nobis.*

5. The Arthur's-Creek Limestone, Burdekin Downs, has yielded the largest number of species, viz. :—

Caunopora.
Stromatopora.
Alveolites (Pachypora), sp. near A. robustus, *Röm.*
—— (lobate form), sp.
Aulopora repens, *Ed. & H.*
Heliolites porosus, *Goldfuss.*
—— ——, vars.
Lithostrotion, sp. ind.
Pachypora meridionalis, *nobis.*
Trachypora, sp. ind.

With regard to the first locality, we would simply point out here that evidence has been elsewhere adduced by one of us to show that in all probability certain of the beds of the Bowen-River Coal-field, including those of Coral Creek, are of Permo-Carboniferous age, with a strong leaning towards the Permian aspect—and that the detailed examination of the *Stenoporæ* in no way invalidates this view, but, on the contrary, lends colour to it.

The Gympie series, from which the coral we have noticed as *Stenopora?* (or perhaps *Monticulipora*) is derived, is considered by Mr. R. Etheridge, F.R.S., to be of Devonian age. We are not in a position either to confirm or disprove this opinion, as the material examined by us throws no fresh light upon the subject.

The Fanning-River Limestone and its associated shale have been shown, in the paper just referred to (as before the Geological Society), to possess a strong claim to be considered Devonian. We have determined only two corals satisfactorily from this horizon, *Heliolites porosus* and *Pachypora meridionalis* (nobis). The former, a typical Devonian coral in Devonshire and the Eifel, supports the evidence afforded by the Mollusca in a marked degree; that of the *Pachypora* will be considered immediately.

We now come to the two last localities, both in the Burdekin district—a limestone developed on the Broken River and Arthur's Creek, Burdekin Downs. The first point to be noticed in connexion with these localities is the presence of massive *Favosites*, of the Devonian type, quite undistinguishable from the *F. gothlandicus* and its variety *F. Goldfussi*, of the Devonian of Europe and North America. Secondly, we note the presence of numerous large colonies of *Heliolites*, including *Heliolites porosus* in abundance.

Again, strong evidence of a Devonian age is afforded by the appearance here of a coral which we cannot distinguish from *Aulopora repens*, Edw. & H., a very characteristic Devonian species, and of the equally characteristic Devonian genus *Trachypora*, while species of *Alveolites* of a Devonian type are also present. Hardly less characteristic is the *Pachypora* to which we have given the name of *P. meridionalis*, and which is most intimately allied to the *P. cervicornis*, De Blainv. sp., of the Devonian of Europe, and to similar or identical forms in the Devonian of North America. Upon the whole, therefore, putting to the evidence afforded by the corals that derived from such characteristic forms as *Stromatopora* and *Caunopora*, we cannot doubt that the deposits now under consideration are of Devonian age. So far as we are acquainted with their fauna, they would seem to correspond very closely with the Middle Devonian Limestones of the Eifel, or perhaps with the somewhat older series of the Corniferous Limestone of North America; but we do not doubt that large additions will yet be made to the list of fossils from these beds, when it will be possible to compare them more closely with the corresponding deposits in Europe and North America.

In conclusion, we may at once state that our investigations amongst the corals of the Broken-River and Arthur's-Creek Limestones of North Queensland quite enable us to confirm, in a general way, Mr. Etheridge's opinion of the former series, that "their age is undoubtedly Lower Devonian or 'Siluro-Devonian.'"

EXPLANATION OF PLATE XIV.

Fig. 1. A fragment of *Stenopora ovata*, Lonsd., of the natural size. 1 *a*. Side view of three corallites of the same, in the outer portion of their course, enlarged, showing the periodic thickenings of the tubes. 1 *b*. Part of a tangential section of the same, taken just below the surface, and enlarged twenty-five times, showing the hexagonal corallites and the ring-like deposit of sclerenchyma in the interior of many of the tubes. 1 *c*. Part of a vertical section of the same, enlarged twenty-five times, showing the periodical thickenings of the tubes, the remote tabulæ, placed at corresponding levels in contiguous tubes, and the mural pores. 1 *d*. Part of a transverse section of *Stenopora crinita*, Lonsd., enlarged ten times, showing the ring-like sclerenchymatous deposit in the tubes, introduced for comparison with 1 *b*.

Fig. 2. A small portion of a transverse section of *Heliolites plasmoporoides*, nobis, of the natural size. 2 *a*. Part of the same section, enlarged five times. 2 *b*. Part of a vertical section of the same, enlarged five times, showing that the tabulæ of the smaller tubes have the characters of those of *Heliolites* and not of those of *Plasmopora*.

Fig. 3. Part of the surface of *Heliolites Daintreei*, nobis, of the natural size, showing the proportions and relative positions of the large corallites. 3 *a*. Part of a transverse section of the same, enlarged five times.

Fig. 4. A small fragment of *Pachypora meridionalis*, nobis, of the natural size. 4 *a*. Portion of the surface of the same, enlarged five times. 4 *b*. Tangential section of the same, enlarged ten times, showing the thickened walls of the corallites. 4 *c*. Part of a longitudinal section of the same, enlarged ten times, showing the thickening of the tubes near their mouths. In the portion of the section represented, the visceral chambers of the corallites are filled with matrix, rendering it impossible to recognize the tabulæ or mural pores.

XXXI.—*Observations on the Genus* Macropis. By W. H. Patton*.

Hermann Müller found the females of the European *Macropis labiata*, Panz., upon the flowers of *Lysimachia vulgaris* only, while the males occurred also upon the flowers of *Œnanthe fistulosa*, *Rhamnus frangula*, and *Rubus fruticosus*†. This is the basis upon which Sir John Lubbock has made and repeated the statement, that "the species visits exclusively *Lysimachia vulgaris*"‡. Yet Dufour had previously taken both sexes upon *Alisma Plantago*, and Schenck had taken either one or both sexes upon *Bryonia*, *Rubus cæsius*, *Circium arvense*, and *Picris*. Subsequently Mr. John B. Bridgman has taken the male upon *Cirsium arvense*§ and upon *Lysimachia*, Mint and Marsh Potentilla, and the female upon *Circium arvense* and *Lysimachia*‖. I have taken the female of the American species upon *Lysimachia ciliata*¶, *Rhus glabra* and *R. typhina*, and *Archangelica hirsuta*, and the male upon *Rubus villosus* and *Cornus paniculata*.

Yet there appears to be some peculiar relationship between the *Macropis* and the *Lysimachia*. Collecting in 1874 and 1875, I observed that the *females taken upon other flowers had no pollen masses* upon their legs, and were indeed upon another quest. Mr. Bridgman (*l. c.* 1878, p. 22) observed that the females taken on *Cirsium arvense* had no pollen. Can it be that the young live upon the pollen of *Lysimachia* only, just as other insects are restricted to the foliage of particular plants?

Hermann Müller (*l. c.* p. 248), observing that the pollen was collected upon the tibiæ of these bees in thick *moist* balls, and unable to find any honey in the flowers of *Lysimachia*

* From Silliman's 'American Journal,' Sept. 1879, pp. 211–214.

† 'Die Befruchtung der Blumen durch Insecten,' pp. 348 and 463 (1873).

‡ Belfast Address, 1874; 'Nature,' vol. x. p. 425, and 'British Wild Flowers in Relation to Insects,' p. 21. The inconsistency of his statement appears when he says ('British Wild Flowers,' p. 126) that "*Lysimachia vulgaris* produces no honey;" and the question arises in the mind of the reader, where do the bees get the honey upon which they must live?

§ Newman's 'Entomologist,' Aug. 1876, p. 158.

‖ Ibid., Jan. 1878, vol. xi. p. 22.

¶ The group of Lysimachias containing *L. ciliata* has recently been set apart as a distinct genus, *Steironema*, Raf., by Prof. Gray (Proc. Am. Acad. vol. xii. p. 62) because of differences in the æstivation of the corolla; but for our present purposes, *Tridynia* (containing *stricta* and *quadrifolia*), *Lysimachia* (containing *vulgaris*), and *Steironema* may be treated together under the name *Lysimachia*.

vulgaris, was led to believe that the bees pierced the cellular tissue of the flowers with the *ligula* for the juices with which to moisten the pollen. This act of the bee seems to me both impossible and unnecessary. The ligula is too weak; and if we are to look to the *Lysimachia* for a solution of the problem, it is well to ask whether the glands with which the filaments and base of the corolla are beset may not furnish the nectar. In the American *L. ciliata*, *L. quadrifolia*, and *L. stricta*, and on the filaments at least of the European *L. vulgaris* the glands are very numerous. But upon the flowers of *stricta* and *quadrifolia* the *Macropis* has not yet been found, although the flowers have been often watched; it seems, therefore, that the glands afford no attraction. We must conclude that it is with nectar that the pollen is moistened; and as it has been my good fortune to distinctly observe a female *Macropis* sucking nectar from the flowers of *Rhus glabra*, it is evidently from these and other flowers that the *Macropis* obtains the honey for the food both of itself and its young.

But why does the *Macropis* moisten the pollen as it is collected? this is an unusual habit. The social bees moisten it in order that it may be retained on the pollen plates. The Scopulipede and Gastrilege bees retain the dry pollen with the hairs forming the pollen-brushes. The *Lysimachia* pollen is not of so dry a nature that hairs would not hold it. An altogether new interest was given to the genus *Macropis* by Hermann Müller's observation that it alone of all the solitary bees of Germany moistened the pollen as collected, thus economizing the expanse of hairs upon the legs*. The retaining-hairs upon the posterior legs of *Macropis* are unusually short. By moistening the pollen they are enabled to retain much larger masses than they otherwise could. Such, also, is the habit, as I have observed, of the allied American genera *Scrapter*, *Calliopsis*, and *Perdita* (*P. 8-maculata*, Say); and Fritz Müller has recorded the same habit for *Centris*, *Tetrapedia*, and *Epicharis* in Brazil †, although in these latter genera the scopa is long.

On account of the close resemblance which *Macropis* bears to the higher bees, Shuckard ('British Bees') was led to believe that it would be found to agree with them in their noisy

* *L. c.* p. 47, and Anw. d. Darw. Lehre auf Bienen, p. 22 (1872).

† 'Nature,' vol. x. p. 103. These observations by Fritz Müller are open to doubt. In *Centris*, as in our native genera *Diadasia* (n. g.) and *Melissodes*, the hairs of the scopa are conspicuously plumose, and the pollen would have a matted appearance even when dry. It can be stated with confidence that, even if the pollen is slightly moistened by these bees, it is not formed into a paste, as it is by the social bees.

flight also. But repeated observations in the field, under the most favourable circumstances, have satisfied me that their flight is perfectly silent. Yet Shuckard is not correct when he says the other Andrenidæ are mute; for I have observed that certain species of *Colletes*, *C. armata*, mihi, and *C. compacta*, Cress., and possibly some of the larger species of *Andrena*, make, during flight, a distinct hum, much like that of the honey-bee.

Up to the present time no French* or English author has questioned the validity and naturalness of the two groups *Abeille* and *Proabeille*, into which Réaumur divided all the bees. Kirby adopted this classification, employing the names *Apis* and *Melitta*; Latreille adopted it under the names *Apiariæ* and *Andrenetæ*; and all subsequent authors have employed the same classification, either under these names or under Leach's family names Apidæ and Andrenidæ. Yet the only characters given for separating the Apidæ and Andrenidæ which are not entirely erroneous are:—

Apidæ: labium longer than mentum, basal joints of labial palpi elongate, labium slender and not flattened.

Andrenidæ: labium shorter than mentum, basal joints of labial palpi not unlike the following joints, labium flattened.

But in the genus *Scrapter* (placed among the Andrenidæ) the palpi are precisely as in *Calliopsis* (placed among the Apidæ), and, as I have observed, the labium in repose is of precisely the same length—in both extending to the tip of the basal joint of the palpi. The greater breadth of the labium in *Scrapter* can alone determine to which family it belongs; and this difference in breadth is imaginary rather than real. Moreover, in the genera *Megalopta* and *Oxistoglossa*, and some groups of the genus *Nomia* (genera placed among the Andrenidæ), the labium is as slender as in the Apidæ; and in the genus *Hyleoides* (placed among the Andrenidæ) the joints of the labial palpi are proportioned just as in certain of the Apidæ.

Rejecting, therefore, the families Andrenidæ and Apidæ, and without proposing, at present, a more natural classification for the ANTHOPHILA, *Macropis* may be removed from connexion with the short-tongued bees and placed between the *Andrenoides* and *Scopulipedes*. In the greater number of its characters it is allied to the *Andrenoides*; but in single characters of great value it bears relationship to other very

* As Lepeletier failed to recognize the *Bees* as a natural group, he cannot be said to have presented any classification of them.

diverse groups. With the *Andrenoides* it agrees in the venation of the anterior wings, which differs from that of *Scrapter* and *Calliopsis* in the pointed marginal cell only, in the cleft claws of the female, and in the habit of moistening the pollen as collected. With *Andrena* it agrees in the form of the tongue and palpi. With the *Scopulipedes* it agrees in the short anal lobe of the posterior wings and in general appearance. In the form of the basal joint of the posterior tarsi of the female it agrees with none but the social bees, which also have the habit of moistening the pollen as collected.

Macropis, Panz. (1809).

Ocelli in a slight curve; face slightly narrowed beneath; clypeus not elevated, yellow in the male; labium transverse, entire; mandibles stout, obtusely bidentate; maxillary palpi 6-jointed, the sixth and one half of the fifth joints extending beyond the apical lobe of the maxillæ; labium lanceolate, one third the length of the mentum, the latter narrowing toward the base, the paraglossæ small; joints of the labial palpi decreasing in length successively, the basal joint equal in length to the second and third taken together. The flagellum in the female subclavate, the first joint ovate, the second narrowed toward the base and one third longer than the first joint, the third and fourth joints equal and when taken together shorter than the second joint, the apical joint obliquely truncate; in the male the first joint of the flagellum is globose, the second scarcely longer than the first, the third scarcely one half as long as the second, the fourth about equal in length to each of the following joints, the flagellum not clavate, but longer than in the female. The anterior wings have two submarginal cells, the second receiving both recurrent nervures, the origin of the first recurrent nervure far beyond the origin of the cubital nervure; the stigma of good size; submarginal bullæ six, two on the first transverse nervure, one on the second, one on the first recurrent nervure, two on the second; basal lobe of the posterior wings extending beyond the middle of the submedian cell. Both sexes have the tarsal claws cleft, and a distinct enclosure at the base of the posterior tibiæ. Posterior femora of the male swollen; posterior tibiæ in both sexes robust; basal joint of the posterior tarsi of the female quadrate, flattened, the upper angle not produced, the second joint attached at the lower angle; the posterior tibiæ and the basal joint of the posterior tarsi of the female clothed with a short dense pubescence, upon which the pollen is collected in moist masses; basal joint of the posterior tarsi of the male armed with a regular comb of long teeth projecting from the inner margin of the lower face. Sixth segment of the abdomen of the female with a smooth enclosure on the disk. The seventh segment in the male with a triangular pyramidal projection on the disk, the apex of the projection obtuse, the anterior and longest side polished.

XXXII.—Tintinnus semiciliatus, *a new Species of Infusoria.* By Dr. V. Sterki *.

There are so many "new species" of Infusoria that it is hardly fair to publish separately the discovery of a single one. As regards the present species this course is taken because it appears specially adapted to interest us, with regard to the establishment of certain morphological characters.

The body of the animal is of the same form as that of *Tintinnus fluviatilis*, St.,—elongated, usually drawn out at the hinder end into a peduncle, by which it is fixed in a tube formed and inhabited by it. This peduncle is thin, but not abruptly marked, the body passing gradually into it. The mode of contraction is characteristic, and differs both from that of the Vorticellinæ and of the Stentorinæ; the peduncle simply shortens until it almost disappears, but without the body essentially changing its form. The animals were frequently to be met with outside the above-mentioned tubes. Whether they had fallen out, or, in other words, had been torn out, or whether they occur so normally, I am unable to say. The latter is the more probable supposition from the analogy of *T. fluviatilis*; only it may be remarked that even after the lapse of considerable time they had not commenced the formation of new tubes. In this "free" state they were entirely destitute of a peduncle, an indication of which was frequently to be seen only as a little stump; otherwise the body was perfectly rounded behind. In some cases a portion was half-constricted off behind; this state was probably produced traumatically by pressure. Even when observed for a long time this constriction went no further; so that in this case there could be no question of division. The length of the body (without cilia) is 0·04–0·06, with the peduncle 0·1–0·12, and the diameter about 0·03 millim.

At the anterior end the body is somewhat narrowed, truncated transversely, with a portion of firmer substance pro-

* Translated by W. S. Dallas, F.L.S., from the 'Zeitschrift für wissensch. Zoologie,' Bd. xxxii. (1879) p. 460.

jecting like a wall all round (external parenchyma), which bears, at its free margin, a closed circlet of 15–20 larger "cilia," which will be more particularly described hereafter. Within, at the base of the wall, there is a series of smaller finer cilia, about half the length of the former. The middle part, which projects upwards like a hill, consists of softer material, and possesses spontaneous movement. On one side of this part, within the above-mentioned wall, there opens a somewhat irregular peristomial cavity penetrating into the soft sarcode as a simple sac-like depression. No separate œsophagus or mouth is observable in it; but this is easily intelligible, because this part of the body is not enclosed by any cortical layer, and the nutritive masses can consequently get easily into the interior. In like manner neither cilia nor an undulating membrane are to be observed on the peristome. Here, as in *Tintinnus fluviatilis*, all these structures are functionally replaced by the portion situated between the peristome and the middle line, which moves alternately forward, and at the same time sideways, and then back again, constantly oscillating to and fro, and thus acting like a cushion-like lip or tongue-like organ. In this case it is a very interesting and remarkable fact that we have here evidence of the possibility of a spontaneous and voluntary movement of the soft internal parenchyma, of which this part may well be said to consist.

The substance of the body is colourless or scarcely tinged with pale yellow, transparent, with a few granules and food-masses. Myophane bands, such as occur in the Stentorinæ, were not to be detected, any more than a serial arrangement of the oil-drops in the external parenchyma. In the peduncle also no differentiation into various parts was recognizable.

In the interior of the body there is, near the posterior end (leaving the peduncle out of consideration), a single distinctly recognizable elongate nucleus on the side opposite to the peristome. In its posterior extremity, in many cases, a well-marked, spherical, strongly refractive part was distinguishable, probably the nucleolus—which is rendered more probable because I could detect nothing of the kind in the vicinity of the nucleus. A contractile vesicle, apparently rather variable in position and dimensions, occurs in the neighbourhood of the peristome. In the anterior half of one specimen there were, moreover, several rather large roundish "serous" spaces, between which many smaller ones could be recognized—a phenomenon which, as is well known, occasionally occurs in many other species.

I was unable to ascertain the position of the anus.

The ciliation is of remarkably peculiar character. The anterior part of the body, from one third to nearly the half, bears scattered, short, fine cilia, like those of the Stentorinæ, but not so close together, while the hinder part and the peduncle remain perfectly naked. These cilia are usually directed rather forward; their movements, at least according to my observations, are slow and not very effective, and certainly incapable of taking any essential part in the locomotion of the animal. According to Claparède and Lachmann the species of *Tintinnus* living in the sea have the body entirely ciliated; while *T. fluviatilis*, which I only observed closely after *T. semiciliatus*, is entirely destitute of the fine body-cilia. The species now under consideration consequently holds a middle place in this respect.

It was particularly interesting to me to be able to ascertain exactly, in *T. semiciliatus*, the position and form of the so-called adoral cilia. Here these are not simple setæ or styles, any more than in the Oxytrichinæ *, Euplotinæ, Stentorinæ, &c., but flat membranes with a long insertion. There are about 15–20 of them, which, however, do not stand transversely, *i. e.* perpendicular to the series, as in the above-mentioned groups, but obliquely, thus forming, in this respect, a very interesting intermediate step between the "Heterotricha," such as *Stentor*, and the "Peritricha," although most nearly related to the former.

It has been elsewhere † stated that the adoral membranellæ of the Oxytrichinæ &c. originate as small lists, rising one after the other, which gradually, by continued growth, attain their normal size and form. In the Vorticellinæ, on the contrary, according to my observations, a single, closed, annular (*i. e.* spiral) border rises, and in its further growth becomes a single membrane. It is only when this has attained a considerable breadth (representing about half the length of the future cilia) that it begins to become fibrous at its free margin, so that, while growth still continues in the direction of length, a splitting at the same time extends more and more backward. In the species of *Tintinnus*, therefore, we have, to a certain extent, a middle form; the series is from the first broken up into pieces, which, however, are not placed at right angles, but obliquely to the series. Or might the course of development have followed the opposite direction?

From its insertion each membrane widens outwards, at first slowly, then more rapidly. From about the middle it is cleft,

* Zeitschr. für wiss. Zool. Bd. xxxi. pp. 44 *et seq.*
† Zeitschr. für wiss. Zool. Bd. xxxi. p. 46.

like a hand, into about six divisions. I have seen this structure clearly and repeatedly and in different positions of the animal; so that there can be no doubt about it. Moreover the observations were made on perfectly fresh and lively specimens, so that any division superinduced by pathological conditions is excluded. In the sequel I had the opportunity of observing nearly the same structure in *Tintinnus fluviatilis*, St., only it appeared to me that the points were rather more numerous and also finer and smaller. Each of these "cilia" gradually turns a little upon its axis, so that the surface approximates to the circular zone of insertion. In repose they all stand straight out, or still more bent in towards the axis of the body, forming a dense tuft; but they do not appear so much curved, or even almost angularly bent, as those of *T. fluviatilis*.

As already indicated there is within the cilia just described, at the base of the wall-like supporter of the latter, a second series of short fine cilia, which, so far as can be seen, are neither particularly flattened nor divided into filaments. They may perhaps be homologous with the paroral cilia of the Oxytrichinæ*. Whether *T. fluviatilis* possesses the second inner row of cilia I do not know; at any rate I have not yet seen them.

In general the movement of the animal is but small, and is limited in the case of the specimens inhabiting tubes to a rather slow protrusion and a by no means rapid retraction, by the elongation or abridgment of the peduncle, which may be entirely withdrawn into the body. The forward movement is of such an extent that the anterior large cilia protrude from the tube and can move; but they never separate widely from each other. Frequently we meet with specimens of our species without tubes, which attach themselves to the object-bearer (or to any object upon it) without a peduncle, and, indeed, very often with the anterior part turned upwards. Here, as in a lateral view, the animals may be observed very conveniently, as they usually remain quite quiet. Frequently no cilium moves for a long time; then a single one slowly bends outwards (peripherally), and strikes rapidly and, as it were, convulsively inwards; then one or another in different parts will act in the same manner. Simultaneous movement of all the cilia, or of a considerable portion of the series, is more rarely observed; and especially there are no simultaneous or undulatory movements passing through the series. In the open water the animals swim pretty rapidly by means of the

* *Loc. cit.* pp. 37, 38.

large anterior cilia, with the anterior part forwards. Nothing was to be observed of a newly formed posterior circlet of cilia, as in the Vorticellinæ and other Peritricha.

I have several times seen indubitable commencements of transverse division, in the form of a second, smaller, circlet of cilia placed laterally on the body, which could not be interpreted as any thing else. Unfortunately I had not the opportunity of observing its development further.

It remains to say a word or two with regard to the tube mentioned at the commencement of this paper. It is about 0·035 millim. in diameter, and becomes as much as 0·40 millim. long. Composed of the remains of macerated parts of plants, small fungoid and algoid filaments, &c., it is formed in the same way as the similar but shorter and less distinct tube of *Stichotricha*, by the accumulation of the masses brought together by the stream of water set up by the animal around its body, which are then pressed together, and as it were felted by pressure and the movement of the body in the interior. A rusty-red colour appears to be only accidentally caused by the material which happens to be present. The tubes were of equal width from one end to the other, and not closed behind, or only by masses which had accidentally fallen in. As they are generally much longer than the animal, and the latter is always seated near the extremity, it is evident that it must detach itself from time to time, and again attach itself more towards the end.

I observed *Tintinnus semiciliatus* here in Schleitheim in January and February 1878. I obtained some dozens of specimens. They occurred in long-stagnant water containing Algæ, on the surface of which a covering of fungoid and algoid filaments had been formed; the animals occurred principally in these masses.

Postscript.

I have the opportunity of adding on the proof that I observed some specimens of this species in February of the present year (1879). They occurred on plants in the aquarium, sometimes without a tube, sometimes with a short one, which now did not show the yellowish colour. All the essential characters just described were exhibited in the same manner; so that the species may be regarded as confirmed.

XXXIII.—*Descriptions of new Species of Lizards in the Collection of the British Museum.* By A. W. E. O'Shaughnessy, Assistant in the Natural History Departments.

The present paper contains descriptions of four new species of Cercosauridæ, one of them being the type, apparently, of a new genus. I have also taken this opportunity to publish descriptions of some new species of lizards belonging to the genera *Gongylus*, *Mocoa*, and *Leiocephalus*.

Neusticurus ecpleopus, Cope.

Neusticurus ecpleopus, Cope, Journ. Ac. Nat. Sc. Philadelphia (n. s.) viii. 1876, p. 161.

In the course of recent examinations of lizards in the British-Museum collection I have been able to recognize and separate this species from *N.* (*Custa*) *bicarinatus*, L., having previously labelled it as a new species before seeing Prof. Cope's description. M. F. Bocourt informs me, in reply to a communication which I addressed to him on the subject, that he has found two very small specimens in the Paris Museum, collected by MM. Castelnau and Deville (Cat. Méthod. 1851, p. 112), exhibiting all the characters by which this species is distinguished from the larger one. In the British-Museum collection it is represented by three full-grown examples and one young, while of the *N. bicarinatus* we possess two adults and one young individual. From this series I am enabled to state that the internasal plate is not always entire in *N. ecpleopus*, two of the specimens showing it cleft longitudinally as in *N. bicarinatus*. The other points of difference, however, are very well marked. The carinæ of the dorsal scales are much stronger and more prominent; the scales on the nape are granular, with rows of convex ones, much as in *Lepidophyma*; moreover the ventral plates are quadrangular and in six longitudinal series, whereas in *N. bicarinatus* they are always rounded and in eight or ten series. I may further add that in *N. bicarinatus* there is a small quadrangular prefrontal plate wedged in between the internasal and the two large fronto-nasals; in *N. ecpleopus* this extra plate is absent, even when the internasal is bisected.

Emphrassotis, gen. nov. (Cercosaurid.).

Head broad, somewhat flattened above; snout short, rounded. Ear indistinct. Nostril in a single large nasal plate; no frenal; no supranasals; no fronto-parietals; no fronto-nasals.

Scales of back narrow, elongate, smooth, in transverse rings; of belly smooth, square, in longitudinal series. A slight fold along the side of the body, but without smaller scales.

Emphrassotis simoterus, sp. n.

Head broad, flattened above; snout short, rounded. Ear indistinct. Nostril in a single large nasal plate; no separate frenal plate, there being an oblique superficial groove, not amounting to a division, in the middle of the nasal plate above the small præocular. A large anterior supraocular. Internasal longer than broad; no fronto-nasals or fronto-parietals; frontal broad, scarcely longer than internasal, not touching the point of the narrow wedge-shaped interparietal, from which it is separated by the slight anterior junction of the two very large parietals, which are followed by two rather large, transverse, postparietals; a series of small occipitals behind the inter- and postparietals. Only two pairs of postmental shields behind the large single submental.

A slight fold along each side, but without smaller scales.

Scales of the back elongate, narrow, quadrangular, in transverse series, not keeled; those of the belly square, in ten longitudinal series. Præanal scutes 2, 5.

In other respects this lizard resembles *Proctoporus pachyurus*, Tsch., and *Riama unicolor*, Gray. From the first it differs in the absence of a frenal plate, agreeing in that character, and in having only two pairs of postmentals in contact after the submental, with Gray's species. The absence of fronto-parietals, however, separates it from both.

Above light brown, thickly variegated with darker; entire ventral surface bluish.

One specimen, $4\frac{1}{2}$ inches in length, from Intac, Ecuador, collected by Mr. Buckley, is in the collection of the British Museum.

This lizard seems to constitute a link between the Cercosauridæ and *Gerrhonotus*.

	millim.
Distance of snout from eye	5
" " fore limb	27
" " vent	70
Length of fore limb	13
" third front toe	4
" hind limb	18
" fourth hind toe	5

Ecpleopus (*Proctoporus*) *Fraseri*, sp. n.

Head somewhat elongate. Ear well developed. Nostril in the nasal shield, which is followed by a quadrangular frenal, placed obliquely over a triangular præocular. Internasal broad, longer than frontal; no fronto-nasals; a pair of fronto-parietals, each as long as the frontal; two large parietals, one interparietal, and three small occipitals. Three pairs of post-mentals in contact behind the single submental; large scutes in two series before the collar. Dorsal scales in 35 transverse rows from occiput to base of tail, quadrangular, elongate, smooth. Sides with much smaller scales, almost granular on the sides of the neck and behind the axilla. Belly with nearly square quadrangular plates, in 10 longitudinal series. Præanal scutes large, 2, 5, the central one in the hinder row very narrow. The fore limb reaches forward to the eye; the posterior, half the length of the side.

Bluish above, with black dots placed irregularly; a black lateral stripe from the eye along the side of the body. Lower surface paler bluish; round black dots numerous and distinct on inferior surface of the limbs.

The specimen in the British Museum is from Guayaquil, and was collected by Mr. Fraser, together with a number of other Cercosauridæ which have been described from time to time.

This species differs from *E. maculatus*, Tschudi, in the absence of fronto-nasals. It appears to resemble considerably *Proctoporus pachyurus*, Tschudi, but has not the small rounded convex scales on the neck of that species, in which also the number of dorsal rows of scales is 54.

	millim.
Distance of snout from eye	5
" " ear-opening	12
" " fore limb	23
" " vent	53
Length of fore limb	15
" fourth front toe	5
" hind limb	20
" fourth hind toe	8

Ecpleopus oculatus, sp. n.

Head rather long and narrow. Ear distinct. Internasal and frontal plates equal, the suture between them straight; no fronto-nasals; a pair of fronto-parietals, nearly as long as the frontal, in contact throughout their length; interparietal large, broad; parietals large, pentagonal; two postparietals. Nostril in middle of a large nasal plate, which is followed by a quadrangular frenal. An elongate plate at the angle of the mouth, and five supralabials; temporals large, polygonal. Submental elongate, followed by only two pairs of contiguous postmentals; a third pair are widely separated by a group of wedge-shaped and pentagonal plates, which occupy the rest of the space as far as the first gular row of scales, of which there are three small and three large before the collar.

Dorsal scales narrow, elongate, each scale elevated into a ridge in the middle, in 36 transverse series between the occiput and the root of the tail; scales of the sides much smaller, round, convex or granular on side of neck and axillary region; of belly in 10 longitudinal series, the middle ones square, the outer ones narrower. Tail with scales like the back and the belly. Præanal scutes 2, 4.

The fore limb reaches to the middle of the eye, the hind limb two thirds the length of the side.

Brown above; a longitudinal stripe of lighter brown edged with black on each side of the back from the occiput to the tail. Ten or eleven conspicuous ocelli, white in the centre, and surrounded by a black ring, along the side of the body; beneath each one of these a smaller white spot is visible. All the ventral scutes and those of the under surface of the limbs black in the middle, white on the edges, the black forming longitudinal stripes.

One specimen, collected by Mr. Buckley at Intac, Ecuador.

	millim.
Distance of snout from eye	5
,, ,, ear-opening	14
,, ,, fore limb	27
,, ,, vent	63
Length of fore limb	20
,, third front toe	4
,, fourth front toe	5
,, hind limb	27
,, fourth hind toe	9

The lizard here described evidently resembles closely the description given of *E.* (*Oreosaurus*) *luctuosus* by Dr. Peters in Abhandl. Ak. Berl. 1862, p. 205, with which it is perhaps identical. Dr. Peters states that there are 43 transverse series of scales between the occiput and the root of the tail, and has not given a figure of the lizard. I am inclined to think, however, that I have only redescribed that species.

Cercosaura (*Pantodactylus*) *vertebralis*, sp. n.

A single broad internasal plate, separated from the frontal by a pair of fronto-nasals; frontal very short, scarcely longer than the internasal, and only half the length of the supraorbital region; two fronto-parietals as long as the frontal, and contiguous throughout the whole of their length; an interparietal and two parietal plates, followed by three occipitals; two series of large temporals. Nostrils anteriorly in a large nasal plate, behind which are two pentagonal frenals. Lower eyelid with a transparent disk. Supralabials 6; infralabials 5; submental broad, followed by two pairs of large contiguous postmentals; a double series of very broad plates occupies the centre of the throat to the collar, the sides being granular. Scales of the back very narrow, elongate, keeled, with triangular points in front and behind, closely fitting, in 14 longitudinal and 31 transverse series from occiput to root of tail; scales similar to those of the dorsal series descend almost to the ventral plates in the middle of the body, the rest of the lateral region in front and behind being granular like the sides of the neck. Ventral shields in 6 longitudinal series, those of the 4 inner being very broad, of the two external smaller, in 22 transverse rows. Præanal scutes 2, 2, like those of the belly—a small triangular one, with the apex wedged in between the two preceding scutes, completing the præanal border. Tail with scales continued in series like those of the back and belly.

A broad bluish-white or cerulean stripe extends from the tip of the snout to the extremity of the tail, with a narrow black border on each side along its whole length. Entire upper surface on either side of the stripe and sides of the body olive-brown, taking in the supraorbital and temporal regions of the head, which are sharply defined against the central stripe. A narrow white stripe along the supralabials to the armpit. A series of small white ocelli surrounded by black rings from the ear along the whole side of the body and tail; two lower series of smaller similar ocelli between the fore and hind limbs. A conspicuous white ocellus at the junction of the forearm and the chest, another in the middle of the forearm, and a third on the elbow; some ocelli also on the hind limb. Lower surface bluish, sprinkled with blackish.

This species, remarkable for its coloration, is most closely allied to *Cercosaura* (*Pantodactylus*) *argulus*, Peters, *l.c.* p. 184. Amongst other differences the latter has only a single frenal, and the internasal is divided into two plates.

The type specimen in the British Museum is from Intac, Ecuador.

	millim.
Distance of snout from eye	3
" " ear-opening	8½
" " fore limb	15
" " vent	33
Length of fore limb	12
" third front toe	3
" fourth front toe	4½
" hind limb	16
" fourth hind toe	6

Mocoa tetradactyla, sp. n.

Head broad; snout obtuse, rounded. Internasal plate broad, its posterior point touching the short pentagonal frontal; two broad transverse fronto-nasals nearly contiguous; fronto-parietal plate very large; its greatest breadth nearly double that of the frontal, almost triangular, but furnished with a posterior projection which reduces the interparietal to the merest rudiment; two oblique transverse parietals, each followed by two broad posterior plates. Four supraorbital plates. Nostril in the hinder and lateral portion of the nasal plate, the anterior angle of which is separated from that of the opposite side by the internasal; two frenals and three præoculars, one superior and two inferior. Seven supralabials; six infralabials. Transparent disk of lower eyelid very large. Ear-opening moderate. Scales smooth, equal on the sides and belly, in 32 longitudinal series, the middle ventral series between the chin and the vent consisting of 54 scales.

Anterior limb, when stretched forward, reaching to front angle of eye; with four toes, the first shorter than the fourth, the second shorter than the third, which is the longest: hind limb reaching forward three fourths the length of the side, with five toes.

Above olive-brown; speckled with black on the head. Five longitudinal black lines on the back between the series of scales, and separated from the sides of the body by a broad unbroken stripe of the ground-colour; a bright yellowish-brown stripe extends from above the ear-opening along the side to the tail, and another similar stripe between the fore and hind limbs. Lower surface bluish.

	millim.
Distance of snout from eye	$5\frac{1}{2}$
" " ear-opening	$12\frac{1}{2}$
" " fore limb	20
" " vent	55
Length of fore limb	$15\frac{1}{2}$
" third front toe	4
" hind limb	20

The above description is drawn from a single specimen obtained from Mr. Krefft, no locality being affixed to it. As I can see no good distinction between Dr. Gray's genus *Carlia* and *Heteropus*, the typical specimen of *Carlia melanopogon* having the scales as distinctly keeled as those of *Heteropus fuscus*, I prefer leaving the present species, in which the scales are smooth, in *Mocoa*.

Mocoa mustelina, O'Shaughn.

Lygosoma lacrymans, Peters (Annali del Mus. civ. di Genova,

xiii. 1878, p. 348), is identical with the above species, described by me in Ann. Nat. Hist. (4) 1874, xiii. p. 299.

Dr. Peters has recently confirmed, in the Annali del Mus. civ. di Genova, xiii. 1878, p. 347, my statement of the identity of *Euprepes novaræ*, Steind., with *Lygosoma* (*Mocoa*) *noctua*, Less. (Ann. & Mag. Nat. Hist. (4) xii. 1873, p. 44). He further suggests as probable that *Mocoa cuprea*, Gray, should be referred to the same species. I agree with Dr. Peters that it would have been impossible to form a correct idea of this lizard from the description given of it by Dr. Gray. I am, however, able to answer his query respecting it. The specimen designated as *Mocoa cuprea* is not in a good state of preservation; it is very different from *Mocoa noctua*, being perhaps not a *Mocoa* at all.

Gongylus gastrostictus, sp. n.

All the head-shields exactly as in *G. ocellatus*, with the exception of one additional supraorbital. Lower eyelid scaly, not transparent; ear large. Scales everywhere rounded, smooth, smaller on the sides; in 32 longitudinal series; 70 transverse series between the mentals and the vent. Limbs short, the fore limb, when laid forward, reaching to the anterior margin of the ear; a postaxillary groove not well developed; toes as in *G. ocellatus*.

Uniform brown above. Sides densely variegated with blackish, passing into series of dots on all the scales of the ventral surface, the ground-colour of which is whitish; chin blotched; infralabials bordered with blackish.

	millim.
Distance of snout from eye	5
" " ear-opening	11
" " fore limb	23
" " vent	80
Length of fore limb	13½
" third front toe	3
" hind limb	20
" fourth hind toe	7½

One specimen from Madagascar in the British Museum.

This adds another to the many representatives of the genus *Gongylus* in Madagascar hitherto made known by M. Grandidier, and more recently by Dr. Günther.

Leiocephalus (*Craniopeltis*) *variegatus*, sp. n.

Head broad, flattened above; its width equal to its length from the postoccipital to the tip of the snout. Scales on the muzzle swollen, irregular. Two interorbital series of polygonal scales, which, contiguous between the supraorbital disks, diverge anteriorly, forming a group of very large scales, two on each side, on the top of the muzzle. Occipital plate large, irregularly oblong, followed by a small postoccipital; two large polygonal plates between the former and the supraorbital disk on each side. Supraorbitals composed of a central series of six large plates, with series of hexagonal small scales on each side. Supralabials 7; one exceedingly long infraocular; loreals small, in several series. Three gular folds; sides of the neck with numerous folds between the ear and the fore limb, and with bunches of projecting scales on the anterior border of the ear and on each side of the neck. A central crest of curved scales from the occiput along the middle of the back and tail. Scales of the back small, keeled; of the tail larger, keeled; of the belly intermediate in size and smooth. Tail broad, flattened at its base. Upper surface variegated with somewhat ill-defined dark brown crescentic cross bands, leaving narrow spaces of light ground-colour, and covered with irregular yellowish-white dots. Sides bluish. Lower surface yellowish; gular region clouded with darker.

	millim.
Distance of snout from eye	11
„ „ ear-opening	26
„ „ fore limb	47
„ „ vent	116
Breadth of head	24
Length of fore limb	52
„ fourth front toe	15
„ hind limb	69
„ fourth hind toe	18

This species is apparently very similar to *Aneuporus occipitalis*, Boc., referred by Cope to *Craniopeltis*, Peters. It clearly belongs to that section of the genus *Leiocephalus* as constituted by Gray which has the large occipital plate characteristic of *L. Grayii*, Bell, *L. microlepis*, Gray (a species which we are unable to identify), and the species described by Peters under the subgeneric name *Craniopeltis*, as a subdivision of *Tropidurus*, Wied.

From all the species now represented in the British Museum it differs by characters which the above description will render apparent; and the irregularly shaped occipital, rather longer than broad, is a much smaller plate than that of *Aneuporus* figured by M. Bocourt, in Miss. Scient. au Mexique, pl. xviii. fig. 1.

Two specimens, the longest of which is 11½ inches in length, were collected by Mr. E. White near Cordova.

Leiocephalus aculeatus, sp. n.

Two lateral carinæ along the upper edge of the sides as well as the median dorsal one. Supraorbitals very broad, as in *L. iridescens*, Gthr.

Head as high as broad. Nostril posteriorly in an elongate nasal shield. Scales on the top of the muzzle numerous, polygonal, becoming larger towards the frontal region, where they pass into the two series of large interorbital plates, which are closely in contact. Three occipital plates—two rather large anterior, and one small posterior; two parietals on each side, the posterior one being very large. Orbital canthus sharp. A single series of very broad supraorbitals bordered with some small scales on each side. Only one elongate scale on the canthus between the upper angle of the orbit and the nostril, there being two such scales in *L. iridescens*. Upper labials four, narrow, elongate; a row of eight small scales above them; two rows of frenals, with an elongate infraocular scale. Ear-opening about half as large as the eye. The scales are everywhere keeled, sharp and dagger-like, with projecting points. A median dorsal crest of erect triangular scales extending on the tail; a weaker lateral one on each side of the back. Tail long, compressed, nearly thrice the length of the body.

Bronzed green, brownish on the sides, with vertical streaks. A white stripe from the ear to the fore limb, and another superiorly from the ear as far as the shoulder; another white stripe descending from the lateral carina to the fore limb.

	millim.
Distance of snout from eye	10
„ „ ear	23
„ „ fore limb	45
„ „ vent	100
Length of fore limb	50
„ third and fourth front toe	16
„ hind limb	85
„ fourth hind toe	25

Five specimens of the above described species were collected by Mr. Roff; they are from Moyobamba, Peru.

XXXIV.—*On the Homologies of the Cephalopoda.* By J. F. Blake, M.A., Lecturer on Comparative Anatomy at Charing-Cross Hospital.

There are two points of interest in the relations of the Cephalopoda which cannot yet be said to be settled. The first is their relation in homology, and thereby in their ontogeny, to the other classes of Mollusca; and the second, the relations of the Dibranchiate and Tetrabranchiate orders. These are questions on which our two great anatomists Professors Owen and Huxley have expressed decided opinions, which have not, however, been accepted by all, or perhaps the majority, of foreign naturalists. Constant accumulations also of new facts, especially in relation to the embryology of the Dibranchiates, force on us a reconsideration of the ideas derived solely from older ones, and even may lead us to put a different interpretation on the latter.

In order to compare the various classes of the Mollusca, we must place them in similar positions as defined by the first part of their alimentary canal and the circumœsophageal ganglia. The primitive form will then have a straight alimentary canal, with the cerebral ganglia above, the pedal more or less below, and the heart near the other end, its afferent vessels coming from the direction of the anus, and its efferent going towards the head. From this primitive form the rest may be deduced by a bending forwards of the anal end, carrying with it the heart and its branchiæ. On the direction of this flexure of the intestine great stress has been laid by Huxley; but I have not found much notice taken of it by foreign writers. It is obvious that such a flexure *may* take place in two opposite directions; and these have been defined by Huxley, in his recent work on the Anatomy of the Invertebrated Animals, as follows:—In the first the cerebral ganglia lie within the general angle formed by the intestine; in the second it is the pedal ganglia which lie within it. Unfortunately these two directions have been called respectively the "hæmal" and "neural." Of course the flexure must in every case be neural, as tending to bring the anus nearer to the nervous centres; and it must generally be also hæmal, for the heart usually accompanies it in its changes. In particular the Cephalopoda are said to have a neural flexure. In these the intestine is bent to the side of the pedal ganglia; but yet its direction is towards the heart, which lies on the underside. In the Pulmonata the intestine bends to the side of the cerebral ganglia; and yet its direction is towards the heart, which lies on the upperside. These latter were formerly said to have a neural flexure; but it is now called hæmal*. Taking this last view, and substituting the terms "cerebral" and "pedal" for hæmal and neural, the distinction between the classes is most marked, the Pteropoda

* Huxley, 'Morphology of Ceph. Mollusca,' 1853, and 'Introduction to Classific.' p. 39, with 'Manual of Invert. Animals,' p. 514.

alone agreeing with Cephalopoda in having a pedal flexure, that of all the rest, except Nudibranchs and Tectibranchs (which have scarcely any flexure at all), being cerebral. A point of difficulty still remains respecting this. Although the heart always accompanies the intestine in its flexures, and its afferent vessels come from the direction of the anus, yet when the intestine is rectified it appears to have a different relation to it. When the intestine is naturally straight, as in the Nudibranchs &c., the heart lies on the cephalic side—I believe, without exception. It would have the same position in the Cephalopoda and Pteropoda. But in the Heteropoda (*Atlanta*) certainly, in the Pulmonata, and, I think, also in the Pectinibranchs it would lie on the *pedal* side. It is not easy to say whether the heart lies within or without the curve formed by the intestine (on which its position, when the latter is rectified, would depend) when, in point of fact, it lies at the *side*. Perhaps, however, it is all a matter of accelerated growth. In the Lamellibranchs the intestine pierces the heart, which therefore lies on both sides of it; and the branchiæ surround the anus in *Doris* &c. Both tend to develop most on the outside, while the portion lying within the body aborts. According, therefore, as the flexure is cerebral or pedal does one or the other part of the circle become persistent, under the condition of being exterior. But the original flexure itself may have been caused by the increased growth of that side which now lies outside. This does not, certainly, account for the one-sided hearts of the Nudibranchs; but it *does* account for the different direction in which the shell of a cephalopod and of a snail is coiled: the former has its convexity, and therefore its greatest growth, on the pedal, the latter on the cerebral side. In both cases the convex side of the shell is on the side of the heart. In the case of the *Spirula*, not only the convex side of the shell, but the whole last chamber of the shell lies on the side of the heart.

We should conclude from the above observations that the Cephalopoda branched off from the main molluscan stem, through the Pteropods, at an earlier period than the development of ordinary Gastropods; and, indeed, we find their remains in deposits of earlier date than those containing the latter.

The next point of importance is the homology of the foot and other non-pallial outgrowths, on which, in fact, depends the position in which we should suppose the animal placed for comparison. In Prof. Huxley's paper on the Morphology of the Cephalous Mollusca (Phil. Trans. 1853), the line along the base of the foot is taken to have a constant direction, and, the arms of the cephalopod being taken as homologous to the foot, the intestine is made to begin in a vertical direction, while in all other mollusks (except Pteropods) it is made to commence in, and have generally, a horizontal direction. It would seem, to say the least, more natural that the position of the intestine and the nervous centres should be constant, rather than that the whole animal should be displaced for the sake of the, *ex hypothese*, greatly modified foot. Prof. Owen, in a recent paper, calling the side on which the cerebral ganglia are placed in Cephalopods dorsal, and the opposite side ventral, states that this is assented to by every malacologist. It may be wrong for all that: the foot *may* be always horizontal; the animal *may* grow vertically instead of horizontally; but what is the proof? Prof. Huxley states it as follows:—"Whether we have to do with a cephalopod or with an ordinary mollusk, the first step in the development is the separation of the blastoderm into a central elevation, the mantle, and certain lateral portions. Now these portions become in the Gastropoda the head and foot; in the Cephalopoda the head and arms. It follows, therefore, that the arms of a cephalopod are homologous with the foot of a gastropod."

Now, at the earliest stage at which such organs are recognizable, we have, for example, in *Paludina vivipara* (Leydig, Zeitsch. für wiss. Zool. ii. 1850, p. 127, &c.) the alimentary canal in a straight line, a median outgrowth on one side (the foot), and on the other a raised ciliated circle (the velum); subsequently the growth of the shell and mantle near the anal end, but slightly on the foot side, displaces the anus forward by taking its place at the end of the intestinal axis. Subsequently the foot grows out behind and before, so that its main axis becomes parallel to the alimentary canal. If now we place the mantle at the top and the mouth at the bottom, we may call the velum and tentacles on one side, and the foot on the other, lateral outgrowths; but the alimentary canal will run, as in a cephalopod, straight into the mantle-cavity, which direction remains (as far as the stomach) unchanged during development, while the foot *does* change its position by its fore and hind outgrowths. In the development of the Cephalopoda the partial segmentation of the ovum and the possession of a large yelk or nutritive vitellus displace the mouth, which should arise on the underside of the mantle elevation, and causes it to appear near the circumference of the blastoderm, the anus appearing later at the opposite end of the diameter; *but there is never a straight canal between them*; their cavities both grow into the hollow of the mantle-cavity, and meet near its base. Thus the first portion of the alimentary canal, *as soon as it is formed*, has the same direction with respect to the mantle as in the Gastropods. The direction, therefore, that is normal is this one, namely direct into the mantle-cavity, and not parallel to the edges, as Huxley's diagram would make it; and we must place the Cephalopod for comparison with the Gastropod with the œsophagus in the same direction, either both horizontal or both vertical. As the line parallel to this on the cerebral side of the latter is called dorsal, and the basis of the foot ventral, so in the former the *os sepiæ* lies on the dorsal surface and the funnel along the ventral, while the shell of the *Nautilus* comes "behind."

And now as to the foot. There is this essential difference between the foot of a Gastropod and the arms of a Cephalopod, strongly insisted on by Grenacher (Zeitsch. für wiss. Zool. vol. xxiv., 1874), that the foot is an unpaired organ, being situated in the median line. It shows a tendency to spread forward and backward, but not laterally; and where it is divided the several parts succeed each other in a longitudinal direction. This character is seen even in Lamellibranchs which have a paired shell. Only the anterior portion in any mollusk shows itself slightly bilobed. The arms of the Cephalopod, an animal with a *single* shell, are, on the contrary, from their very commencement, paired; and they are thus lateral in a very different sense from that in which the foot is so. This is to me, as it is to Grenacher, conclusive against their homology. The one can only be compared (with Huxley) to the dorsal fin of a fish; the others with its paired fins. But we must seek light also on this question from the relations of the nerve-ganglia. On this point, too, there seems to be a conflict of opinion; but the testimony appears to me conclusive against the homology I am disputing. In the first place, it might be said, the pedal ganglia are paired, therefore the foot itself is in its nature paired; yet the buccal ganglia and some of the visceral ganglia are often paired; and no one will assert the alimentary canal to be any thing but a single organ. In the next place, the normal arrangement of nerves in a Gastropod consists of two cerebral ganglia above the œsophagus and two pedal ganglia below, with which may be more or less united a pair of splanchnic ganglia behind. The auditory organs are in connexion with the pedal ganglia when not directly supplied from the cerebral. There is thus but one nervous ring. Now in the *Nautilus** the ring is subdivided, and there are *two* sets

* Owen, 'Memoir on the Pearly Nautilus,' 1832; Macdonald, Phil. Trans. 1855.

of far-separated subœsophageal ganglia. The auditory organ arises at the junction of the upper and lower ganglia, but more in relation to the hinder than the front band of the latter. The hinder pair have been called the splanchnic, and the front pair the pedal; but their position in this case would be anomalous, and it is the hinder ganglia which chiefly supply the shell-muscles, which, though not homologous, are to a certain extent analogous to the foot. But if the *Nautilus* leaves us in doubt, a *Sepia**, an *Ommastrephes*†, or an *Argonaut*‡ is clear. In these there are *three* pairs of subœsophageal ganglia. The front pair supply the arms, the *middle* pair supply the funnel and the auditory organs, the hinder pair supply the viscera. If, then, we are to take any *independent* guidance from the nerves, the front pair are *not* pedal, but belong in all the Cephalopoda to organs not developed in the adult Gastropoda; the middle pair correspond to those in the latter class called pedal; and the hinder pair are the splanchnic.

To what, then, are the arms homologous? Lovén, in 1848 ('Bidrag till Kännedomen om utwecklingen af Moll. Acephala') called them a persistent velum; and to this view Grenacher gives his adhesion. There seems, however, at first sight a fundamental objection to this, as Grenacher himself points out. The velum is always developed on what will be the cerebral side of the œsophagus, while the arms of the Cephalopod arise at first on the *opposite* side, or where the *foot* should be. It is no answer to this to say, without proof, that as they are not needed for nutrition they may shift their place, or, because the œsophagus is unpaired, to make light of its relative position. Such a treatment of questions would render homology hopeless. It seems to me the true solution will be found by asking, What is the velum of a Gastropod? Huxley first, then Gegenbaur, and lastly Ray Lankester have shown how these ciliated bands may be traced from one class to another—sometimes in the larva only, and sometimes as an adult organ (see Lankester on Embryology and Classification, 1877). In the primitive condition they formed a circle round the œsophagus, and as often as not are thrown out into long processes; with a change in the direction of the intestine their uniformity is broken, and part dies away, while the other part is left, forming a circle surrounding, not the œsophagus, but a portion of the body on one side of it, the foot being on the other. Since then, in the Gastropoda, the intestine

* See Huxley, Anat. of Invertebrates, p. 526; after Garner, Trans. Linn. Soc. 1836.

† Hancock, Ann. & Mag. Nat. Hist. 1852.

‡ Beneden, Mem. Acad. Brussels, vol. xi. 1838.

turns to the cerebral side, we have the "velum" formed on that side, whereas in the Cephalopoda, the flexure being to the opposite side, we have what we may call the "antivelum" on the pedal side. Thus the arms are homologous to the opposite portion of the architroch to that which forms a velum, and merely afford another instance in which these primitive formations are retained as functional organs. Moreover, from within the circle of the embryonic velum rise up in some Gastropods two long retractile tentacles; in like manner from within the later-formed circle of the antivelum rise up the two retractile tentacles of the Decapods.

If such be the true homology of the arms, what in the Cephalopoda represents the foot of other Mollusca? When we remember that even among the Lamellibranchs the foot is sometimes wanting, that it is very variously developed in the Gastropoda, and has merely a rudimentary representative in most of the Pteropoda, we cannot make sure of its being present at all. That it should be represented by the two halves of the funnel, as Gegenbaur supposes, is as objectionable an idea as its homology with the arms, and for the same reason—though, being more closely connected with the region of the foot, they may be supplied from the pedal ganglia. I can only suggest one median unpaired outgrowth which *may* represent it; and that is the valve within the funnel, which occurs in a great number, and especially in the *Nautilus*, which is least removed from the general type. This, however, must be doubtful, as the development of this valve has not been observed.

The recognition of the two funnel-halves of the adult *Nautilus* and the embryonic Dibranchiate as part of a second outgrowth surrounding the body, to which the name of epipodium has been given by Huxley, is pretty general; and there seems to be nothing against it. Grenacher has shown that each half is originally again in two parts, one following the other longitudinally; and one of these parts only he reckons homologous to the sails of the Pteropods.

With regard to the relations of the *Nautilus* to other Cephalopoda, it is remarkable how every additional fact in the development of the latter shows the former to represent embryonic stages; and this is the more interesting as the allies of the *Nautilus* certainly preceded the Dibranchiates in their appearance on the globe. The following points, old and new, are most noticeable in this respect. In the *Nautilus* and in the embryo Dibranchiate the funnel is in two halves, but unites into a single tube in the adult of the latter. In the *Nautilus* and embryo Dibranchiate up to a late stage there is no ink-bag, which only comes in the third period of the development of the latter; and, moreover, the *Spirula*, which is most nearly allied to the *Nautilus* by its siphonated shell, has the smallest ink-bag. Again, the *Nautilus* has its eye a simple cavity, opening externally by a minute aperture; and this is one stage of the development of the eye of a Dibranchiate. In the *Nautilus* the auditory organs are found close beneath the eyes; in the Dibranchiates they are at first found in the same position, and only gradually grow closer and closer together till they come into contact with each other on the ventral side. Finally the tentacular and labial processes of the *Nautilus* are flattened more or less, and lie one within the other. In the development of the Dibranchiate the arms rise as broad flat processes also, and one pair lies within the rest.

This last point throws light upon another question which I wish to discuss—namely, whether the six or eight processes on which the tentacles of the *Nautilus* are found are homologous to the eight arms of the *Octopus*, each tentacle representing a sucker, or whether each tentacle is homologous to a whole arm of an *Octopus*, the number having been greatly reduced. The former view was propounded by Valenciennes *, but has been contested by Owen †. Though to my mind highly interesting and suggestive, it has scarcely been noticed by other writers. Prof. Owen brings forward four reasons against this homology. First, that the general order of development is from the multiple to the simple, and therefore we ought to expect more arms in the *Nautilus*. In order that this might be true of the Cephalopod's arms we ought to find in the development of the Dibranchiates that they arose in greater numbers, and ultimately grew together into the eight. But Grenacher has now shown that first three arms arise as simple broad expansions on each side, and at a later period the suckers and the other arms appear, the fourth pair being but a process of the third, while of the first three the earlier ones lie partially within the later, and the third is the largest; so that, if we accept the above homology, the *Nautilus* exactly represents an early stage in this as well as in other respects; for it also has the fourth or anterior pair but feebly developed, being represented by but one tentacle beneath the hood. The third pair are the largest, and the other two are surrounded by it. Thus development in this case is not from the multiple to the simple in Prof. Owen's sense. It is, however, so in another sense, and in one which makes for this homology.

* Annales du Musée, 1841.

† Ann. & Mag. Nat. Hist. 1843, vol. xii.

The second objection is, that the nerves of the tentacles arise independently from the ganglia, and each one is therefore homologous to a single arm, the rest having aborted. But as each sucker of the Argonaut, as shown by Beneden*, has its ganglion and nerve, it is these that are homologous with the several tentacles of *Nautilus*, which each have a single nerve arising from a ganglion, not yet separated at the base—the only difference being that each tentacle is separate, and the development being from the multiple to the simple, the suckers on the Dibranchiates are collected onto an arm whose nerve though gangliated is single. The other two objections need not be noticed, as they have been answered by implication; but there is an argument in favour of this homology derived from knowledge acquired since the time of that paper. One of the most remarkable features of the Dibranchiates is the hectocotylization of one of the arms of the male, whereby it is made an organ subservient to reproduction, though there is no constancy with respect to the particular arm which undergoes this change. Now Van der Hoeven† has shown, and Keferstein‡ has confirmed the fact, that the male *Nautilus* in like manner suffers hectocotylization, by which the organ called the spadix is produced, an organ which, like that of the Argonaut and others, has a glandular function, and is brought into relation with the spermatophores. Now if each tentacle were homologous to an arm it should be one of the tentacles, or part of one, which is so modified. But what is the case? In the female the corresponding labial process is divided into two parts, one supporting four tentacles and the other eight; and it is the corresponding *four* tentacles in the male which make up the spadix within which they may be seen in transverse section. Thus it is part of one of the processes whose tentacles are modified in the *Nautilus*, just as it is one of the arms whose suckers are modified in the Octopod; *ergo* the process is the homologue of the arm.

Again, there is a word to say about the *hood* of the *Nautilus*. On account of there being a tentacle contained in a cavity on each side within, this has been taken to represent the two foremost tentacular processes, or, as I may now call them, arms of great substance, and which have grown together; and so the eight are made out. Whether this is the right way to look at them, or whether the hood is not an independent organ which has grown to the single-tentacled arms lying immedi-

* "Mémoire sur l'Argonaute," Acad. Brussels, vol. xi. 1838.

† Wis. en Natuurk. Verh. der Koninkl. Akad. deel iii. 1856; and Ann. & Mag. Nat. Hist. 1856.

‡ Bronn's 'Klassen und Ordnungen,' Band iii. 1865.

ately beneath them, is rather difficult to say, and is one point which would be settled by a knowledge of the *Nautilus*'s development. On the one hand, as was originally suggested by Van der Hoeven, and has been expounded recently by Owen*, the hood in the extinct allies of the *Nautilus* had the power of secreting calcareous or horny matter known as the *aptychus*; and this leads us to the shell of the Argonaut, secreted by the anterior pair of arms, which would thus be homologous with the aptychus if the hood were a modified pair of arms. On the other hand, if we carefully examine the upper surface of a *Sepia* and other Decapods in front of the calcareous "bone" and just behind the eyes, we shall find two hardened plates (called neck-plates by Keferstein), whose shape and ornaments are so similar to those of the aptychus as to make us almost certain of their homology; and these, therefore, must represent the hood of *Nautilus*, with whose position they agree. Yet we do not know that these two plates are in any way connected with the arms, either in the adult or during development; but they seem to belong to the anterior part of the epipodial ring. Either homology is so interesting that one would wish to find some way of adopting them both.

Finally, is the bone of the *Sepia* homologous with the shell of the *Nautilus*? Not exactly, I think. The homologues of the latter may be seen in the shell of the *Spirula* and the phragmocone of a Belemnite; but any representative in the *Sepia* must be sought in its mucro, and not in the mass of the bone. This opinion (for at present it is little more than an opinion) seems to gain weight by a consideration of the fossil genus *Ascoceras*. This occurs in the Upper Silurian strata, a very probable date for the near approach of the Dibranchiates. In it we find two sets of septa : the one set are at the base of the shell of the ordinary kind pierced by a siphuncle; the other set are in the body-chamber. They lie on one side obliquely; they run into one another in their curves; and they are penetrated by no siphuncle. In other words, the shell presents us with the characters of the *Nautilus*-shell at its base, and with those of the *Sepia*-bone above; and from it we may perhaps perceive the true relations of these two structures. Further details on this genus cannot now be entered upon; but they will be given in my forthcoming 'Monograph of the Fossil Cephalopoda of Great Britain.'

Proc. Zool. Soc., Jan. 1879.

XXXV.—*Respecting a new Distinction between the Species of the Genus* Phrynus *of Authors.* By ARTHUR G. BUTLER, F.L.S. &c.

IN the second part of the 'Archiv für Naturgeschichte' for this year I find a paper by Dr. F. Karsch (an assistant in the Royal Zoological Museum at Berlin) entitled "Ueber eine neue Eintheilung der Tarantuliden," in which the author splits up the species of *Phrynus* into four genera by the number of the tibial joints of the fourth pair of legs. He says (pp. 196, 197), "We have now before us a series of steps without break in the increase of the tibial joints of the legs of the hindmost pair, which may easily be overlooked." He then proceeds to characterize the genera founded upon this character as follows:—

"1. All six true legs formed alike—that is to say, the fourth pair of legs without posterior tibial joint. *Phrynichus*, nob.

Spec. typ. *Phryn. reniformis* (Linn.), 1763.
Syn. *Phalangium lunatum*, Pallas (1772).

"2. The legs of the fourth pair each with one posterior tibial joint: *Damon* (C. L. Koch), 1850.

Spec. typ. *Damon medius* (Herbst), 1797.
Syn. *Phrynus variegatus*, Perty (1830–34).

"3. The legs of the fourth pair each with two posterior tibial joints, of which the anterior one is shorter. *Tarantula*, Fabr. 1793.

Spec. typ. *Tar. pumilio* (C. L. Koch), 1841.
Syn. *Phalangium reniforme*, Pallas (1772).

"4. The legs of the fourth pair each with three posterior tibial joints. *Charon*, nob.

Spec. typ. *Charon Grayi* (Gerv.), 1842.
Syn. *Phrynus medius*, Hoeven (1842).

"The genus *Phrynichus*, as it appears, has the most species of all to show, then *Tarantula*; to the Austral-Asiatic genus *Charon* two species belong—*Grayi* (Gerv.) and *australianus* (L. Koch, 1867, Verhandl. zool.-bot. Ges. Wien, xvii. pp. 231, 232), from Upolu; and the genus *Damon* appears only to consist of one species, the *medius* (Herbst)."

After reading the above I carefully examined the sixty-eight *dried* examples of *Phrynus* in the collection of the British Museum (I would not look at our spirit-specimens, because unless these animals are quite dry it is almost impossible to detect the joints in the posterior or fourth pair of legs); and having noted down the number of tibial joints in each species, and compared them with the published figures, I was forced to the conclusion either that the figures do not accurately represent the number of joints, or that they vary in different individuals of the same species. A second difficulty lies in the character given to the genus *Phrynichus* as compared with *Charon*; for either Dr. Karsch has reckoned the metatarsus as a fourth tibial joint, making three posterior tibial joints, in which case the genus *Phrynichus*, according to our specimens, exists only upon paper; or he has not reckoned the metatarsus as a tibial joint, in which case the genus *Charon* ceases to exist.

As I consider that the metatarsus is not a true tibial joint, although in *Phrynus* it often looks like one, I shall regard the genus *Charon* as non-existent, and see how far our examples confirm Dr. Karsch's statements respecting the number of species referable to each genus. Before doing this, however, I may state that I have again compared our specimens with the published figures and satisfied myself that they were correctly determined when my monographic revision of the genus was published. I have also discovered that Herbst invariably, and Koch almost invariably, figures a *Phrynus* without posterior tibial joints to the fourth pair of legs.

The examples in the Museum, then, are as follows:—

PHRYNICHUS, Karsch.

P. scaber, Walck. (Round Island).
P. lunatus, Fabr. (Natal).
P. fuscimanus, Koch (Columbia).

According to Koch's figures we should have to add *P. nigrimanus*, *P. marginemaculatus* (figure agrees with *P. lunatus*), *P. variegatus*, *P. reniformis*, *P. palmatus*, and *P. ceylonicus*; and according to Herbst, *P. medius*, *P. palmatus*, and *P. reniforme*. The only conclusion, therefore, that I can rationally arrive at with regard to Dr. Karsch's observation that "the genus *Phrynichus*, as it appears, has the most species" is, that the species have not been seen in nature, but only in the published figures, which are not correct.

DAMON, Karsch.

P. palmatus, Herbst (Mexico and Columbia).
P. annulatipes, Wood (Zulu country, Natal, Cape).
P. Grayii, Gervais (Manilla).
P. bassamensis, Lucas (West Africa, Congo).
P. medius, Herbst (Fernando Po, Sierra Leone).
P. Kochii, Butler (America).

Here, again, we have six species in place of one.

TARANTULA, Karsch (=*Phrynus*).

P. reniformis, Herbst (Haiti).

P. variegatus, Herbst (Amazons, Jamaica, Venezuela, W. coast America).

One example of *P. palmatus*, Herbst (Mexico).

P. Whitei, Gervais (Burdwan).

P. coronatus, Butler (California).

P. Batesii, Butler (Upper Amazons).

P. longicornis, Butler (Pará).

P. granulosus, Butler (South America).

P. gorgo, Wood (Pará ?).

P. cheiracanthus, Gervais (Demerara, New Granada).

Our two specimens of *P. palmatus* from Mexico are referable, according to this character, to two distinct genera, although in all other respects (excepting that one of them is slightly immature) they agree fairly well. Now although it is possible that they may be distinct, I am much more inclined to believe that the character discovered by Dr. Karsch, although interesting as not having previously been prominently brought forward, is an unreliable one even for specific distinction.

There is one point in which Dr. Karsch appears to have misunderstood my paper where he says, "Butler's Eintheilungsgrund in amerikanische, australische, asiatische und afrikanische Formen halte ich für durchaus unthunlich, da diese geographischen Grenzen nicht für das, was man unter Art versteht, existiren und auf die Bestimmung der Formen als solche gar keine Verwendung finden." If Dr. Karsch means that geographical divisions do not necessarily represent groups of subgeneric value, I am quite willing to agree with him; but if he means that they are of no use in enabling a naturalist to identify his species, I can only answer that he is the only zoological worker, with the exception of one good man who has unfortunately left this world, who ever, to my knowledge, attempted to make such a statement. For my part I believe geography to be of the greatest value in assisting the identification of species; and I should at all times name a wingless African insect, if previously wrongly identified with a tropical American one, just as I have renamed the *P. medius*, described and figured by Koch, from America, knowing by intuition, as well as by comparison of specimens and figures, that it could not be the *P. medius* of Africa.

Before writing a paper on the subdivision of a large genus, many types of which we possess, it is strange that Dr. Karsch should not have asked me to examine them and tell him how many joints there were in the hind tibiæ of the typical specimens. In the type of *P. Grayii*, upon which the genus *Charon* is founded, there is only one posterior tibial joint; so that, if a species with three joints does exist, the genus must fall, as not being founded upon the species to which it is ascribed.

XXXVI.—*Description of a new Species of Wild Dog from Demerara.* By Dr. Albert Günther, Keeper of the Zoological Department, British Museum.

At the beginning of the present year I received from the Rev. W. Y. Turner a living example of a dog from Demerara which was evidently distinct from all the other species described from South America. My esteemed correspondent informed me that the animal must be very rare, as but few of the people in his neighbourhood knew it. It had been brought up in captivity, was perfectly domesticated, and allowed to run about the house like a domestic dog. During its journey to England it lost some of its tameness; but soon became accustomed to its new home, which it never left of its own accord. It was very playful, especially towards evening, but slept during the night. It never barked or wagged its tail, but uttered a short sharp cry when left by itself, or a hiss when an attempt was made to take its food. During my temporary absence from London it was found necessary to confine it in a cage—a change which it survived for a few weeks only.

This species is allied to *Canis vetulus*, from which it differs by having longer legs, a less bushy tail, and a much darker coloration.

Body slender, with long legs and tail, pointed snout, and rather long ears. Fur harsh, brownish grey, the long hairs on the back being black, those on the side whitish; snout coloured very much like the body. Head without conspicuous markings; chin and anterior portion of the throat black; posterior part of the throat, abdomen, and inner side of the thighs dirty whitish. Legs and tail of the same greyish colour as the sides of the body; sole of the fore foot, hinder side of the hind foot, and terminal fourth of the tail black.

	in.	lin.
Total length	38	6
Length of the head	5	9
Distance of the eye from the nose	2	6
Length of the ear	3	0
Distance of the ear from the tail	21	0
Length of the tail	12	6

The skull is very similar to that of *C. vetulus*; but the third premolar is entirely in advance of the hind margin of the foramen infraorbitale, whilst it is below it in the majority of the other South-American dogs.

	in.	lin.
Length of skull	5	2
Distance of orbit from incisors	2	2
,, foramen infraorbitale from incisors	1	9
,, fourth molar from incisors	1	9
Length of nasal bone	1	9
Least width of interorbital space	1	0
Distance of incisors from hinder palatal margin	2	7
,, between the fourth molars	0	10
,, ,, fifth ,,	0	$8\frac{1}{2}$
,, between the canine and fourth molar	0	11
Length of three posterior molars	1	0
Greatest width between zygomatic arches	2	10

Number of caudal vertebræ 23; length of the series of caudal vertebræ 13 inches.

	in.	lin.
Length of humerus	4	6
,, ulna	4	11
,, radius	4	1
,, fourth metacarpal	1	11
,, femur	4	11
,, tibia	5	0
,, third metatarsal	2	3

P.S. The Zoological Society has received, through G. H. Hawtayne, Esq., C.M.Z.S., a second specimen from Demerara, which seems to be perfectly identical with the one described here.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

May 28, 1879.—Henry Clifton Sorby, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "On the Endothiodont Reptilia, with Evidence of the Species *Endothiodon uniseries*, Owen." By Prof. R. Owen, C.B., F.R.S., F.G.S., &c.

The author referred to the characters assigned by him to his *Endothiodon bathystoma*, which had the alveolar borders of both jaws toothless, perhaps covered with horn during life, as in the Chelonians; whilst within this border there were three series of teeth both in the palate and the mandible. He next described a new species, under the name of *Endothiodon uniseries*, founded upon the fore half of a skull, having only a single row of teeth in the palate, a character which may prove to be of generic importance. The author finally discussed the relationships of this genus, which he re-regarded as belonging to the order Anomodontia, and as showing, like *Oudenodon*, traces of derivation from *Dicynodon* in the presence of caniniform processes in the upper jaw. The development of teeth interior to the alveolar margins in both jaws was to be regarded as a character of family value; and the author remarked upon the interest of the continuance of a common Ichthyic and Batrachial dental character in exceptional cases among the Reptilia up to the establishment of the Crocodilian type, above which, in the vertebrate series, calcified palatal teeth no longer appear.

2. "Note (3rd) on *Eucamerotus*, Hulke, *Ornithopsis*, Seeley, = *Bothriospondylus magnus*, Owen, = *Chondrosteosaurus magnus*, Owen." By J. W. Hulke, Esq., F.R.S., F.G.S.

In this paper the author gave a description of an unusually perfect dorsal vertebral centrum of *Ornithopsis*, and some additional information respecting the cervical and anterior dorsal vertebræ. He further compared the præsacral vertebræ with those of several recently discovered Dinosaurians of the Colorado region, showing several agreements, but also such differences as to prove the generic distinctness of *Ornithopsis*. He discussed the question of the nomenclature of the species indicated in the title of his paper, and maintained that the name *Ornithopsis* ought to be adopted for the single genus to which he referred them.

3. "Description of the Species of the Ostracodous Genus *Bairdia*, M'Coy, from the Carboniferous Strata of Great Britain." By Prof. T. Rupert Jones, F.R.S., F.G.S., and James W. Kirkby, Esq.

The long persistence of the genus *Bairdia*, from the Silurian period to the present day, and its essentially *marine* character, were first noticed; also the relatively rare occurrence of any species of *Leperditia*, *Beyrichia*, and *Kirkbya* (associates of *Bairdia* in Carboniferous strata) in freshwater or estuarine beds. *Carbonia*, on the other hand, was confined to the fresh or brackish waters in which the Coal-measures were formed. The difficulty of defining the species of *Bairdia* from carapace-valves alone, without limbs and soft parts, and the possibility of several genera being grouped under this head, were mentioned. The species of *Bairdia* described and figured in this paper were, it is believed, all that have been found in the British Carboniferous rocks, with the exception of M'Coy's *B. gracilis*. Two of Count Münster's Bavarian *Bairdiæ*, from Hof, have not yet occurred with us; neither have four of Dr. D'Eichwald's Russian Carboniferous species, nor the Australian

B. affinis, Morris. Including these, there are twenty-three known Carboniferous species of *Bairdia*. Seven of these are recurrent in the overlying Permian limestones, which have yielded twelve species of this genus. With six Silurian forms, there are altogether thirty-four recorded palæozoic species of *Bairdia*.

4. "Report on a Collection of Fossils from the Bowen River Coal-field and the Limestone of the Fanning River, North Queensland." By R. Etheridge, Esq., jun., F.G.S.

The collection on which the present paper was founded had been received from Mr. R. L. Jack, F.G.S.; and the information furnished by it was supplementary to that obtained from Daintree's collection. The fossils are from three distinct horizons. The author first briefly described the geology of the formations from which the fossils were derived, and stated that the results of his investigations led him to refer those from the Fanning River Limestone to the Devonian, those of the Bowen River Coalfield to the Upper Carboniferous or Permo-Carboniferous, and those from the Tait River to the Cretaceous. Twenty-six species of animal remains, chiefly Mollusca, are described in all, twenty of which are from the Bowen River Coalfield; the latter include a fine series of *Strophalosiæ*. The new species are *Protoretepora Koninckii* from the Permo-Carboniferous of Bowen River, and *Crioceras Jackii* from the Cretaceous; also *Strophalosia Jukesii* from the Carboniferous of New South Wales. The paper included a list of the localities in which the specimens were collected, and a full bibliography of Queensland palæontology.

5. "On a Fossil *Squilla* from the London Clay of Highgate, part of the Wetherell Collection in the British Museum." By H. Woodward, Esq., LL.D., F.R.S., F.G.S.

The specimen described is preserved, as usual, in a phosphatic nodule, and exhibits five well-preserved abdominal segments (XIV.–XVIII.), a portion of the carapace, traces of the thoracic appendages, and the appendages of the twentieth segment preceding the telson. The abdominal segments increase in breadth posteriorly as in modern *Squillæ*. The species is most nearly allied to a recent Australian *Squilla* (unnamed) related to *S. Desmarestii*. The author proposed the name of *Squilla Wetherelli* for the London-clay fossil.

6. "On *Necroscilla Wilsoni*, a supposed Stomatopod Crustacean from the Middle Coal-measures, Cossall, near Ilkeston, Derbyshire." By H. Woodward, Esq., LL.D., F.R.S., F.G.S.

The specimen described was found by Mr. E. Wilson, of Nottingham, in a nodule of Clay-ironstone. It consists of the four posterior abdominal somites and the telson. The author discussed its zoological characters, which led him to regard it as approaching the Stomapoda rather than the Isopoda. He thought it probable that Dr. Dawson's *Diplostylus* is allied to this newly discovered form, for which he proposed the name of *Necroscilla Wilsoni.*

7. "On the Discovery of a fossil *Squilla* in the Cretaceous Deposits of Hâkel, in the Lebanon." By H. Woodward, Esq., LL.D., F.R.S., F.G.S.

This fossil *Squilla* occurs in a collection, chiefly consisting of fossil fish, but also including several Crustacea and some beautifully preserved Cephalopods, obtained in the Lebanon by Prof. E. R. Lewis, of Beirût. The specimens are in a compact cream-coloured limestone, most of the slabs of which contain examples of *Clupea brevissima* and *C. Bottæ*, fragments of *Eurypholis Boissieri*, and other fishes. Like the London-clay form, the species seems to be most nearly allied to the Australian species collected by Prof. Jukes, and the segments are not ornamented with spines and ridges. The author proposed for it the name of *Squilla Lewisii.*

8. "On the Occurrence of a fossil King-Crab (*Limulus*) in the Cretaceous Formation of the Lebanon." By H. Woodward, Esq., LL.D., F.R.S., F.G.S.

This was another of Prof. Lewis's discoveries, and was of much interest as helping to bridge over the interval between the Jurassic *Limuli* of Solenhofen and those now living. The author described the characters presented by the single specimen, for which he proposed the name of *Limulus syriacus.*

June 11, 1879.—Prof. Joseph Prestwich, M.A., F.R.S., Vice-President, in the Chair.

The following communications were read:—

1. "On a Mammaliferous Deposit at Barrington, near Cambridge." By the Rev. O. Fisher, M.A., F.G.S.

The gravel in which these remains were found is about 20 feet above the alluvial flat by the river Rhee, and is evidently post-glacial. The gravel contains some of the ordinary land- and fresh-water shells, but not *Cyrena* or *Unio.* Remains of the following Mammalia have been found—*Ursus spelæus*, *Meles taxus*, *Hyæna spelæa*, *Felis spelæa*, *Cervus megaceros*, *C. elaphus*, and another, *Bos primigenius*, *Bison priscus*, *Hippopotamus major*, *Rhinoceros leptorhinus*, *Elephas antiquus* and *primigenius*—with a worked flint, almost certainly from the same deposit. The author considers the abundance and admixture of these remains due to the locality having been a sort of eddy or pool in the old river. The remains are described; and the rest of the paper is occupied with a correlation of the gravel with others in the adjoining district, and a consideration of the physical conditions under which it was deposited.

2. "Further Discoveries in the Cresswell Caves." By Prof. Boyd Dawkins, M.A., F.R.S., F.G.S., and the Rev. J. M. Mello, M.A., F.G.S., with notes on the Mammalia by the former.

This paper contained the account of digging-operations carried on in one of the smaller caves of the Cresswell Crags, known as Mother Grundy's Parlour. The authors described the occurrence in the red clay and ferruginous sand of this cave of bones of Hippopotamus and the Leptorhine Rhinoceros, proving the existence of these animals in the wooded valleys of the basin of the Upper Trent at the time of the accumulation of those deposits; while at the same time, so far as the evidence goes, there was an absence of Palæolithic man, of the Reindeer, and of Horses, while Hyænas were abundant. In a subsequent period, represented in all the caves by the Red Sand, the Mammoth, Woolly Rhinoceros, Horse, and Reindeer inhabited the vicinity, and were subject to the attacks both of Hyænas and of human hunters, whose quartzite implements prove them to have belonged to the same people whose traces are found in the river-deposits. In the breccia and upper cave-earth of the larger caves the existence of the Palæolithic hunter is evidenced by flint implements resembling those of Solutré, accompanied by implements of bone and antler. Associated with these was the incised figure of a horse described in a former paper. The authors finally dwelt briefly upon the characteristics of the caves in prehistoric and historic times, and indicated some of the anthropological points of interest connected therewith.

MISCELLANEOUS.

On the Notodelphyidæ. By M. L. Kerschner.

The author describes two new genera of the curious Copepod family Notodelphyidæ, each including a single species, which he names *Paryphes longipes* and *Dorsipys uncinata* *. He prefaces his descriptions with some corrections of previous notions as to certain points in the organization of these crustaceans. He shows that the brood-chamber, which is usually regarded as contained within the body-cavity, is formed, in the majority of Notodelphyidæ, by a duplicature of the integument of the body proceeding from the dorsal surface of the fourth and from the sides of the fourth and fifth segments, but that in two genera this duplicature is inserted even upon the second thoracic segment. He further indicates that an

* The former generic name was preoccupied by Burmeister in 1835 for a genus of Rhynchota; the latter, if it has any derivation at all, is probably a mongrel compound of Latin and Greek. We hope the author will take the opportunity of changing both names before his paper is printed.

unpaired ovary is present, and that the ova pass in strings into the oviducts (formerly " ovaries ").

The author confirms a part of Thorell's observations upon the connexion of the female generative organs, and, by the discovery of the hitherto overlooked external genital aperture of the female, brings back these organs to the general type of the whole order.

In all the males observed he describes an unpaired testis, and represents the envelope of the spermatophores as secreted by the wall of the whole of the seminal duct. In the spermatophore itself he recognizes more layers than Thorell. He describes the type on which the nervous system is constructed, and, in opposition to Buchholz, asserts the presence of olfactory nodes.—*Anzeiger Akad. Wiss. in Wien*, June 13, 1879.

Notice of a new Pauropod.

Mr. J. A. Ryder described a new myriopod which he had recently discovered, and which turned out to be nearly allied to the form described by Sir John Lubbock under the name of *Pauropus*. The specimens which the speaker had obtained were five in number and had but six segments, fewer than any other known member of the group, whilst the number of pairs of legs was nine, the same as in *Pauropus*, which is very strong evidence that the specimens are adults. The following characterization of the genus and species was proposed:—

Eurypauropus spinosus, gen. et sp. nov.

Body-segments six in number, sixth exceedingly rudimentary; antennæ five-jointed; legs in nine pairs, equidistant; tergal sclerites laterally expanded so as to conceal the legs almost entirely when the animal is viewed from above, and covered with fine tubercles which are joined to each other by raised lines; appressed curved spines are scattered over their surface in less number, and also fringe their margins, being disposed at regular intervals; the spines and lines give the dorsal surface of the little creature a slightly silky lustre when viewed with reflected light. Colour a delicate light brown. Mouth-organs the same as in the first-described genus. No evidence of eyes could be detected. Length $\frac{1}{25}$ inch; width about $\frac{1}{70}$ inch. Habitat in Fairmount Park, Philadelphia, east and west of Schuylkill, under decaying wood.

The tergal sclerites are much thicker than in *Pauropus*, having the characteristic brown colour of chitin when viewed with transmitted light. The antennæ have the terminal globular hyaline body with a long pedicle, as in *Pauropus pedunculatus*. The type is the most distinct form discovered since the detection of the first known representatives in England in 1866, and also extends the geographical range of the family, and does much towards fully establishing the Pauropoda as a distinct order of myriopods.—*Proc. Acad. Nat. Sci. Philad.*, April 22, 1879.

On the Respiratory Apparatus of the Ampullariæ. By M. A. Sabatier.

In a note inserted in the 'Comptes Rendus' of the 12th of May last, M. Jourdain described the arrangement of the respiratory apparatus of the *Ampullariæ.* Having already occupied myself with this subject in 1877 *, and having pursued my researches, I am able to make known some new facts which had escaped the observations of my predecessors.

The venous blood, returning from the different parts of the body, divides into three parts :—1, one passes to the right into a cavernous sinus, which accompanies the terminal intestine; this is the *rectal sinus*, which is a diverticulum of the general cavity of the body: 2, the second part comes from the anterior region of the body (head, pharynx, stomach, anterior margin of the palatine arch) and forms on the right the *proper afferent vessel* of the lung, which it circumscribes to the left and in front; this vessel presents a double series of orifices for the afferent branches of the roof and of the floor of the pulmonary chamber: 3, the third part, which is far more important, comes together in a large deep vessel with muscular walls, which soon ramifies on the lower surface and in the thickness of the large gland, to which I have already alluded. From this network the efferent vessels take their origin, the greater part of which reunite in a large trunk with muscular walls which carries the blood to the renal organ: this is the *deep afferent vessel of the renal organ*, which is peculiar to the *Ampullariæ.* The other vessels which originate from the large gland discharge themselves successively into a superficial vessel of no great size placed on the posterior margin of the renal organ, and which is its *superficial afferent vessel*, corresponding, in all respects, to the single afferent vessel of the other Pectinibranchiata. Hence the blood which has traversed the large gland in a true portal system is not, as M. Jourdain thinks, mingled with the blood returning from the organs of respiration, to be *immediately* poured into the heart, but it does not reach this latter organ until after it has traversed the renal organ first and the respiratory organs afterwards.

From the anterior margin of the renal organ there originates, by successive roots, an efferent vessel of the renal organ, which, after having anastomosed with the afferent vessel of the same organ, continues forward on the right margin of the principal branchia, of which it constitutes the afferent vessel. This vessel receives, in passing, some affluents proceeding from the rectal sinus.

On the left margin of the branchia, between this latter and the lung, is a large trunk which terminates at the auricle, and which is not simply, as M. Jourdain thinks, an efferent vessel of the branchia and of the lung. This vessel contains, in fact, a series of fissure-like orifices, which pour into it the blood from the branchia, and two

* Assoc. française pour l'avanc. des Sciences, session du Havre, 1877, p. 623.

series of circular orifices, of which the upper are the *efferent* orifices of the pulmonary arch, and the lower are the *afferent* orifices of the floor of the lung. On this floor, in fact, the vessels which originate from these orifices ramify in a network of which the efferent branches converge into a large trunk, entirely overlooked by M. Jourdain, and which, collecting the blood of the whole of the floor of the lung, empties itself directly into the auricle. From this results the fact, entirely exceptional in the Pectinibranchiata, that the auricle receives two totally distinct afferent veins. The one is branchial and pulmonary, the other exclusively pulmonary. This is a remarkable peculiarity of the anatomy of the *Ampullariæ*, which is in connexion with the double respiration of these animals, and with the alternations in function of the double respiratory apparatus.

The afferent vessel of the branchia and the proper afferent vessel of the lung meet in front in such a manner as to form an anterior arch. The intermediate trunk meets this arcade very obliquely and under a very sharp angle open to the left. There is thus formed between the two vessels a valvular spur, which plays an important part in several respects. When, during sojourn in the water, the pulmonary respiration and circulation are suspended by the want of air and the collapse of the lung, the blood of the proper afferent vessel of the lung, being unable to traverse the pulmonary network, arrives in abundance at the level of the mouth of the intermediary trunk, to which it applies the valvule and which it thus stops. It is thus obliged to pass entirely into the afferent vessel of the branchia, and, consequently, into the branchia, of which the activity is thus greatly increased. When, on the contrary, during sojourn in the air, the collapsed branchia does not act, the blood of the afferent vessel of the branchia, arriving *en masse* on the edge of the spur, there divides into two currents, one of which penetrates into the proper afferent vessel of the lung, and the other into the intermediary trunk, of which it augments the tension, and which distributes a part of it to the floor of the lung, and reconducts the rest to the heart. By this means the activity of the pulmonary circulation is increased during the repose of the branchia. Hence results this interesting fact, that the *Ampullariæ*, which are Pectinibranchiata in which pulmonary respiration has made its appearance, have the respiratory vessels disposed in such a manner that, when this newly-introduced function suspends its activity, all the blood which should have traversed the pulmonary network is constrained to traverse the branchial system, where its hæmatosis is assured. This curious arrangement may suffice to explain the preservation of the branchia in Gasteropoda, in which the lung has attained so remarkable a development, and which might have become purely pulmonary animals.

The distribution of the vessels in the pulmonary walls merits special mention. They form a double system of portal veins; that is to say, the vessels form on their journey two successive networks separated by intermediary trunks. This arrangement, a little less accentuated on the floor than on the roof, added to the presence of a fine vibratile epithelium on the course of the pulmonary vessels, proves the active part of this apparatus as an organ of hæmatosis.—*Comptes Rendus*, June 23, 1879, p. 1325.

On the Zoantharia Malacodermata *of the Shores of Marseilles.* By M. E. Jourdan.

The anatomical plan of the Actiniadæ is well known; it may be compared to a cylindrical body, furnished at one end with a buccal aperture surrounded by a circlet of tentacles, and hollowed by a mesenteric cavity (gastric cavity of the larva), which is connected with the mouth by an œsophageal region of ectodermal origin, formed by a short and wide tube. Between the œsophageal tube and the walls of the body are the septa, which terminate freely by the lower part of their inner margin in the mesenteric cavity.

We have successively studied these different regions in the types which presented peculiarities appreciable by the naked eye, and we will here give a summary of the principal results that we have obtained.

The walls of the body contain three layers—an external cellular layer or ectoderm, a fibrous mesodermic layer, and an internal cellular layer or endoderm.

The ectoderm is formed of glandular elements, vibratile cells, epithelial elements, which are probably sensitive (analogous to those of the chromatophorous sacs of *Actinia equina*), and, lastly, neuro-muscular elements, which we have distinctly observed in the above species. In *Phellia* this cellular layer secretes a viscous mucus, which, by agglutinating fragments of all sorts, gives a peculiar aspect to the body.

In *Bunodes* the glandular elements of the ectodermic layer group themselves together and form the little organs which adorn the column of these animals.

Cerianthus is remarkable for the structure of its mesodermic layer, and thus constitutes a distinct type among the Zoantharia Malacodermata. This layer is composed of a thick muscular region included between two planes of connective tissue. The longitudinal muscular fibres composing it are smooth and arranged in radiating laminæ. Beneath the inner fibrous plane there exists another layer of circular fibres.

In the *Actiniæ* the mesoderm is represented by laminæ of connective tissue, clothed internally by a layer of circular muscular fibres, which occur throughout the height of the column. *Calliactis* possesses a fibrous layer of exceptional thickness and density, traversed by persistent pores, and sprinkled in its upper part with numerous islets of annular muscular fibres which must act after the fashion of a sphincter.

The endoderm is composed of a cellular layer, which covers the inner surface of the mesoderm and extends over the septa.

The structure of the tentacles is similar to that of the walls of the body. These organs, however, are characterized by the presence of a layer of longitudinal muscular fibres situated beneath the ectoderm.

The septa originate from the mesodermic layer of the column. Their axis is a fibrous tissue covered with a layer of longitudinal muscular fibres. Upon one of its surfaces each septum bears a series of longitudinal folds, the totality of which represents a sort of fibro-muscular bundle.

The œsophagus, resulting from the turning back of the two primitive lamellæ, necessarily presents the structure of the wall of the body. The exterior cellular layer contains peculiar glandular elements.

In *Cerianthus* and the *Actiniæ* the reproductive elements originate in a sort of doubling of the fibrous layer of the septa—that is to say, in the mesodermic region.—*Comptes Rendus*, August 25, 1879, p. 452.

Notes on the Marriage-flights of Lasius flavus *and* Myrmica lobicornis. By the Rev. H. C. McCook.

The author remarked that the first-named ant is one of the most familiar objects in nature. Its small dusky-yellow workers may be seen in every American lawn, walk, field, and yard, throwing up their fragile moundlets of sand pellets, and swarming upon particles of fruit, crumbs, bones, dead insects, and all manner of sweets. It is quite cosmopolitan in its distribution, and is well known in Europe. The following observation of the annual marriage-flight of the sexes was made September 5, 1878, in the vicinity of Philadelphia. The nests observed were located directly in and on the grassy border of a trodden path in a farmyard. At 4 P.M. the males and females were seen coming out and re-entering the gate, amid great excitement on the part of the workers. The females particularly were followed by workers who "teased" them occasionally by gently nipping them with their mandibles. The flight of the young queens was, with few exceptions, made from the top of stalks of grass, where they clung for several minutes, poising themselves, spreading their wings, and swaying up and down. Even to these elevations the workers followed them, hastening their flight by occasional "nips." When the queen rose in flight, there was no evidence of feebleness or inexperince, except, in some cases, a slight tendency to a zigzag course for the first few yards. The flight was then, and in most cases from the very first also, strong and in a straight course. The insect first rose to a height of about 20 feet, which was soon increased to 40, 50, and even 60 feet (estimated); and this latter height was maintained until the form was lost to sight. The author was able to follow the ants in several instances to a distance of more than 300 feet before they disappeared, at which time they gave no sign of alighting. Some were seen to alight at the distance of 60 and 80 feet; others flew into a large buttonwood-tree within 30 feet of the nest.

The flight was in every case solitary, and was in all directions, although generally in the direction of the breeze. The males were in the meantime continually taking flight, urged thereto by teasing workers, each separately, and wholly independent of other males and of the females, as to the time and direction of flight. This fact led Mr. McCook to infer that the pairing of the sexes must have occurred within the nest before departure therefrom. Except in the case of those individuals who lit upon the buttonwood-tree, there appeared no opportunity for a meeting after flight. There was nothing in all the facts to suggest the idea of a future consort. The same feature of independent and solitary flight of the sexes had been observed in the swarming of the shining slave-maker, *Polyergus lucidus*. This is in marked contrast with the habit of some other ants as illustrated in an observation subsequently given.

Before taking flight the *L. flavus* females spent some time in combing and cleansing themselves. A female was placed among the workers of another nest not more than a yard distant from her own, in order to test the treatment of an alien. She was immediately attacked fiercely, and would no doubt have been soon killed had she not been removed. In two formicaries from which the above marriage-flight occurred, it was observed that the doors were closed about half-past four P.M. by bits of dry grass and pellets of soil. They so remained during the night, or at least were found closed in the morning, Three days thereafter several males were found nestled under a chip by the roadside. As soon as the chip was turned up, two of these were seized by a couple of prowling ants of the species *Tetramorium cæspitum* and *Formica Schaufussi*, and carried off as prey, a suggestion of the common fate of emmet masculines.

Mr. McCook's attention had been called to an article in a Hollidaysburg (Pennsylvania) journal, which reported a remarkable swarm of ants that had crossed that town on the 13th September, 1876. He immediately wrote to the Rev. D. H. Barron, a citizen of the place, and a gentleman of intelligence and prudence, giving certain points which it was desirable to ascertain. The ants, in the course of their flight, had come into contact with the mechanics at work upon the tower of the new court-house, whom it was reported they had assaulted vigorously. Mr. Barron visited these men, and, after a careful interview communicated the following facts:—The flight actually occurred substantially as reported; the day was clear, warm.

and calm; the ants came between 10 and 11 A.M., from the direction of the Chimney Rocks, a ridge of the mountain on the south-east of the town. As to numbers, the answers of the men were as follows:—"So thick you could hardly see through them;" "swarms;" "about 30,000!" The ants struck the building at the height of about 120 or 125 feet, and certainly assaulted the men. Whether the attack was a bite or a sting they could not tell; but it was something very uncomfortable, and they would not like to have it repeated. The ants were of two sizes—some larger, some smaller. One of the men had saved some specimens, which were sent to Mr. McCook, and proved to be the males and females of *Myrmica lobicornis*, Nylander. These ants can inflict a painful sting, but probably attacked the workmen simply in self-defence; that is, the men happened to obstruct their flight, and naturally vigorously brushed off the insects who lit upon them, who, in turn becoming irate, applied their stings. Such a vast horde as this swarm contained must have been composed of the winged inmates of many formicaries on the mountain-side. This is quite in contrast with the solitary flight of the *Lasius flavus* as previously described. The pairing of the sexes was probably in the air, or after alighting, as in the case of the agricultural ant*. Mr. McCook had taken ants of the same subfamily Myrmicidæ while they were in the act of pairing in the air.

In connexion with the above notes on the queen-life of ants, he presented an observation reported to him by Mr. Jos. Wilcox. This gentleman had seen a colony of some species of *Camponotus* occupying a large dead cypress tree standing in the midst of a cypress-swamp in Florida, at least 600 feet from the shore. The tree was wholly isolated from the land and from all surrounding vegetation, except another fallen cypress tree which leaned up against it. Evidently a fertilized queen had at some time flown from the land to this tree, where she had established the colony. The fact is interesting as indicating the origin of formicaries from single queens, as myrmecologists have supposed to be frequently, if not commonly, the case—further as showing the ability of a large number of ants (this nest was reported to consist of vast numbers) to maintain active life under quite circumscribed environment. The insects sheltered in such numbers by old trees may have furnished a large portion of the food supply. The specimens brought by Mr. Wilcox were taken from a colony on the land, which he supposed to be identical with the swamp-tree nest, and were examples of *Camponotus esuriens*, Smith.—*Proc. Acad. Nat. Sci. Philad.*, April 29, 1879.

* 'Agricultural Ant of Texas,' p. 143.

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[FIFTH SERIES.]

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XXXVII.—*Additions to the Amphipodous Crustacea of New Zealand.* By George M. Thomson, Dunedin.

[Plate XVI.]

A great boon was conferred upon working naturalists in this colony by the publication, in 1876, of a Catalogue of the Stalk- and Sessile-eyed Crustacea of New Zealand, by Mr. E. J. Miers, of the British Museum, under the auspices of the Colonial Government. Information on the subject was there collected together which had previously been obtainable only by reference to expensive and difficultly obtainable works; and though the catalogue was necessarily imperfect, it gave a good starting-point to those engaged in working up this branch of the New-Zealand fauna. Naturally enough, chiefly the larger Crustacea belonging to the Brachyura and Macrura had been obtained by earlier collectors, and the list of them is tolerably complete. It is to the Isopoda and Amphipoda that additions will chiefly be made, these tribes being well represented in our seas.

Mr. Miers has enumerated fifteen species of Amphipoda in his catalogue, all of which, with the exception of *Phronima novæ-zealandiæ*, Powell, were previously described in Spence Bate's catalogue of Amphipodous Crustacea in the British Museum. Of these species, *Talitrus* (?) *novæ-zealandiæ*, Dana (*Orchestoidea* (?) *novi-zealandiæ*, Spence Bate), must be excluded, as I have already shown (in a paper published in the N.-Z.-Inst. Transactions) that it is only the female of *Talorchestia Quoyana*, Dana. In the same paper I have replaced *Paramœra tenuicornis*, Miers (*Mœra tenuicornis*, Spence Bate), in the genus in which it was originally placed by Dana, as *Melita tenuicornis*. At the same time I added fourteen species (belonging to eleven genera), of which twelve were new to science. These additions were **Nicea novæ-zealandiæ*, **N. fimbriata*, and **N. rubra*, *Lysianassa Kröyeri*, **Pherusa novæ-zealandiæ*, **Atylus Danai*†, **Dexamine pacifica*, **Calliope didactyla* and **C. fluviatilis*, **Gammarus barbimanus*, *Themisto antarcticus*, **Platyscelus intermedius* (which may prove to be the connecting-link between *P. Rissoina* and *P. serratus*, the extreme forms of one and the same species), **Caprella caudata* and **Caprellina novæ-zealandiæ*.

In the 'Annals' for December 1878, Mr. T. W. Kirk of Wellington made some additions to the local crustacean fauna, including the following Amphipods—*Caprella lobata* and **C. novæ-zealandiæ*.

I am now able to add four more species, of which three are new.

1. *Amphithonotus lævis*, sp. nov. (Pl. XVI. figs. 1–4.)

Animal quite smooth and not carinated on the back. Cephalon produced into a small falcate rostrum, which projects between the bases of the antennæ. Eyes large, subreniform. Superior antennæ slightly exceeding the inferior, about half as long as the animal; peduncle very short; flagellum long, slender, and multiarticulate. Peduncle of inferior antennæ longer than peduncle of superior. Appendage of the mandibles long, middle joint exceeding the other two. Maxillipeds having the appendages longer than their respective joints. Gnathopoda small, subequal, abundantly ciliated; propodos with a well-defined, nearly transverse palm, against which the dactylos impinges closely. Pereiopoda subequal, posterior pair the longest. Pleopoda subequal; rami lanceolate, those of the penultimate and antepenultimate pairs unequal in length. Telson tubular, notched at the apex. Length ·3 inch.

Hab. Dredged in Dunedin Harbour in 4–5 fathoms.

Though agreeing closely in generic characters, this species is very distinct in appearance from *A. Edwardsii*, as figured in the British-Museum catalogue, and also apparently from *A. spiniventris*, Costa.

* Species not before described.

† Printed "*dania*" in Trans. N.-Z. Inst. vol. xi. p. 238.

2. *Aora typica*, Kröyer.

Of this species I got one specimen in the dredge, along with the preceding. This agreed well with the characters given in Brit.-Mus. Cat. p. 161, differing only slightly in the following respects:—The superior antennæ were about as long as the animal; the propodos of the first gnathopoda, as well as the last four joints of the second gnathopoda, were very hairy; telson quite smooth.

Colour yellowish, with small black spots chiefly on the lower parts of the body and on the limbs. Length ·3 inch.

The species has evidently a wide range, having been originally described from specimens obtained at Valparaiso.

3. *Microdeutopus maculatus*, sp. nov. (Pl. XVI. figs. 5–8.)

Animal smooth, slender. Coxæ rather small. Superior antennæ considerably longer than inferior, two thirds as long as body; second joint of peduncle long and slender; third short and furnished with a 5–6-jointed appendage; flagellum very slender, many-jointed, sparingly ciliated. Inferior antennæ strong, subpediform, with a stout olfactory denticle, and furnished with numerous cilia; third joint of peduncle short, fourth and fifth very long; flagellum short, indistinctly 6–7-jointed. Mandibular appendage 2-jointed. Maxillipeds with strongly-toothed appendages. Gnathopoda moderate, covered with strong cilia: first pair rather the largest; carpus rounded on its inferior margin; propodos oblong, with a very oblique, curved palm defined by a strong spine; dactylos strong and curved, finely toothed on the inner margin: second pair similar, but with the palm transverse and without the defining spine. Third pereiopoda shorter than preceding; posterior pair very long. Antepenultimate pleopoda reaching to extremity of ultimate pair; base of the rami with a stout spine. Telson with a broad apical notch, each side with a slender spinule. Length ·35 inch.

Hab. A single specimen dredged in Dunedin Harbour in 4–5 fathoms.

Apparently a very distinct species.

4. *Cyrtophium cristatum*, sp. nov. (Pl. XVI. figs. 9–15.)

Male. Eyes prominent. Pereion wider than deep, transversely ribbed and tuberculate. Last segment of pereion and three anterior segments of pleon elevated into prominent crests. Antennæ with long cilia on their inferior margins: superior pair shorter than inferior; peduncle reaching the extremity of penultimate joint of peduncle of inferior, bearing a one-jointed appendage; flagellum very indistinctly 7–8-jointed: inferior pair very strong, about as long as body; second and third joints with spines on their anterior margins; fourth and fifth joints long; flagellum indistinctly three-jointed, the first joint being equal to the two succeeding. Mandibles with an appendage, the basal joint of which is much the shortest. Maxillipeds with appendages to the basos and ischium; dactylos spatulate. First gnathopoda with simple cilia on their inferior margins; carpus produced inferiorly into a rounded lobe; propodos narrowing anteriorly, palm very oblique, defined by three or four stout spines; dactylos strong, curved and acutely toothed on its inner margin. Second gnathopoda large and powerful, furnished with numerous plumose hairs, which are particularly abundant in two rows on each side of the palm; basos hollowed out in front so as to receive the upperside of the propodos; meros acutely produced on its infero-posterior margin; propodos articulating on the upper margin of the carpus, oblong, that of the left side slightly the larger and having the teeth more prominent on its upper margin; palm extending along the whole under surface, with two or three denticulations; dactylos long, curved, and smooth. Pereiopoda subequal, fifth pair rather the longest; setæ numerous and strong, not exceeding the diameter of the articulations to which they are attached. Telson conical, tipped with a few slender setæ.

Female differs from the above only in the greater width of the pereion, and in having the second gnathopoda relatively smaller, rounder, and wanting the plumose cilia. Length ·25 inch.

Hab. Dredged along with the preceding species in Dunedin Harbour in 4–5 fathoms, among *Sertulariæ* and seaweeds.

This species differs from the generic characters of *Cyrtophium* in possessing an appendage on the superior antennæ; but as it agrees in every other respect, I do not feel justified in placing it in a new genus. It comes nearest to *C. brasiliense*, obtained by Dana in the harbour of Rio Janeiro.

EXPLANATION OF PLATE XVI.

Fig. 1. *Amphithonotus lævis* ♀, magnified.
Fig. 2. The same: cephalon, showing the rostrum, ×14.
Fig. 3. The same: mandible, with its appendage, ×56.
Fig. 4. The same: telson, seen from above, ×14.
Fig. 5. *Microdeutopus maculatus* ♀, magnified.
Fig. 6. The same: telson and posterior pleopoda. ×28.
Fig. 7. The same: mandible and appendage, ×28.
Fig. 8. The same: maxillipeds, ×28.

Fig. 9. *Cyrtophium cristatum* ♂, magnified.
Fig. 10. The same: mandible, ×28.
Fig. 11. The same: left maxilliped, ×28.
Fig. 12. The same: first gnathopod, ×28.
Fig. 13. The same: second gnathopod, ×25.
Fig. 14. The same: single hair from palm of same, ×115.
Fig. 15. The same: telson and posterior pleopoda, three pairs, ×28.

XXXVIII.—*On the Geological Distribution of the Rhabdophora.* By CHARLES LAPWORTH, F.G.S. &c.

[Continued from vol. iii. p. 455.]

Part II. DATA.

CAMBRIAN SYSTEM.—Although the fact of the existence of Cladophora in the Upper Cambrian rocks has been admitted by palæontologists since Salter's discovery of *Dictyonema sociale* in such abundance in strata of this age in Merionethshire, it is only within the last few years that the presence of Rhabdophora or true Graptolites in these ancient deposits has been placed absolutely beyond question. Kjerulf, indeed, figured a well-marked *Dichograptus* (*Bryograptus*) from the Alum-shales of Christiania in his 'Veiviser,' as early as 1865; but its exact horizon is even yet doubtful. Its true Cambrian age, however, is rendered highly probable by Linnarsson's more recent discovery of *Dichograptus tenellus* &c. in the highest Olenus-beds of Westrogothia*, and an allied form in the Dictyonema-schists of Scania. These strata correspond to the highest portions of the Lingula-flags of Wales, and are unequivocally of true Cambrian age.

The question of the existence of Rhabdophora in the Upper Cambrian of Britain has also been satisfactorily set at rest by the interesting researches of Dr. C. Callaway. This careful observer detected Graptolites in the Shineton (Upper Cambrian) shales of Salop as early as 1873; and in the following year examples of *Bryograptus* and *Clonograptus* from these rocks were forwarded by him to me for identification; and I recognized at once their striking similarity to the forms figured from the Swedish Cambrian by Kjerulf and Linnarsson. Within the last few months Dr. Callaway has discovered fragments of the first of these genera in the Cambrian rocks of the Malvern Hills.

* Linnarsson, 'Œfversigt af Vetenskaps-Ak. Förhandlingar,' 1871, p. 794; and Geol. Mag., June 1876.

Ordovician or Lower Silurian System.—Notwithstanding the great additions made of late years to our knowledge of the fossils of the rich graptolitiferous zones of the Llandovery and Wenlock formations, Salter's well-known generalization that Murchison's Lower Silurian system is most prolific in Graptolites remains practically undisturbed. The Arenig formation also, though it can no longer be defined as the birthplace of the family, must still be acknowledged as its metropolis; for if we have respect to the abundant extra-British forms detected in this formation, it must be conceded that "nowhere else are there so many species and such complex forms" *. This may, it is true, be owing to the fact that not only in Britain, but also in Europe and America the rocks of Arenig age are essentially dark carbonaceous shales or schists more or less graptolitiferous throughout; while the succeeding formations are marked by a much greater development of sandstones and limestones, from which, as a rule, Graptolites are absent. Nevertheless, even where black shales crowded with Graptolites do occur in these more recent formations, we never find so great a variety of types as upon any single horizon in the Arenig; and it may be that the Rhabdophora (like the Cladophora) had their culmination at or near the commencement of the Arenig, the loss, especially in genera, being very rapid as we pass upwards into the Llandeilo and Bala.

Arenig Formation.

The only Welsh rocks belonging to this formation as yet carefully searched for Graptolites are the Arenig rocks of the neighbourhood of St. David's, familiar togeologists through the extended researches of Dr. H. Hicks. The three subgroups into which the strata of this age are there divisible all yield Rhabdophora in some abundance. The forms recognized by Mr. Hopkinson and myself include † :—

I. Lower Arenig.

Didymograptus extensus, *Hall.*	Phyllograptus stella, *Hopk.*
—— pennatulus, *Hall.*	Trigonograptus truncatus, *Lapw.*
—— sparsus, *Hopk.*	—— ensiformis, *Hall.*

II. Middle Arenig.

Didymograptus patulus, *Hall.*	Tetragraptus serra, *Brongn.*
Tetragraptus Halli, *Hopk.*	—— quadribrachiatus, *Hall.*
—— ? Hicksi, *Hopk.*	Clematograptus implicatus, *Hopk.*

* Quart. Journ. Geol. Soc. vol. xix. pp. 119 *et seq.*
† Hopk. & Lapw. Quart. Journ. Geol. Soc. vol. xxxi. p. 634.

III. Upper Arenig.

Didymograptus bifidus, *Hall.*	Dicellograptus divaricatus ?, *Hall.*
—— affinis, *Nich.*	Climacograptus confertus, *Lapw.*
—— indentatus, *Hall.*	Diplograptus dentatus, *Brongn.*
—— Nicholsoni, *Lapw.*	Glossograptus ciliatus, *Emm.*
—— patulus, *Hall.*	

Some of the same forms occur in the corresponding Arenig rocks of Merionethshire. In the Jermyn-Street Museum the following forms are labelled as having been collected from the Upper Arenig of Tyobry near Tan-y-Bwylch * :—

Diplograptus tricornis, *Carr.*	Glossograptus ciliatus, *Emm.*
—— bimucronatus, *Nich.*	Diplograptus foliaceus, *Murch.*
Climacograptus confertus, *Lapw.*	—— angustifolius, *Hall.*

The Arenig rocks in the neighbourhood of Shelve yield Rhabdophora in some abundance. From the lowest zones near the Bog Mine I have collected forms of *Phyllograptus*, *Didymograptus*, and *Trigonograptus*. In the Middle Arenig near Shelve church Mr. Hopkinson has detected † *Didymograptus patulus*, Hall, and *Clematograptus implicatus*, Hopk. I have found some of the same forms at Ladywell Mine, Disgwylfa &c. From the Upper Arenig of Ritton Castle I have collected *Didymograptus Nicholsoni*, Lapw., and *D. patulus*, Hall. *Didymograptus constrictus*, Hall, is not uncommon in similar strata near Snailbeach.

Lake District.—The Arenig rocks of the Lake District include the Skiddaw Slates of Sedgwick. Little is yet known with certainty with respect to their proper physical and palæontological subdivisions. At present it is only possible to regard them, with Prof. Nicholson, as forming two main groups—a *lower* group of dark flagstones and shales, and an *upper* group of black shales and mudstones. Their Graptolites have been made the subjects of special memoirs by Salter and Nicholson; but the remarkably intertwined character of the two supposed subfaunas renders it more than probable that we have yet much to learn with respect to the systematic places of the several fossiliferous horizons.

From the Lower Skiddaw Rocks the following species have been collected ‡ :—

Loganograptus Logani, *Hall.*	Schizograptus reticulatus, *Nich.*
Temnograptus multiplex, *Nich.*	Ctenograptus annulatus, *Nich.*

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* Collection, Museum, Jermyn Street, case iv. | $\frac{4}{14}$, $\frac{4}{18}$, &c. &c. Compare also Salter, Mem. Geol. Survey, vol. iii. p. 256 &c.

† Quart. Journ. Geol. Soc. vol. xxxi. p. 636.

‡ Nicholson, Ann. & Mag. Nat. Hist., October 1869; Quart. Journ. Geol. Soc. vol. xxiv. p. 125 &c.

Dichograptus octobrachiatus, *Hall.*
—— Sedgwicki, *Salter.*
Tetragraptus Headi, *Hall.*
—— quadribrachiatus, *Hall.*
—— bryonoides, *Hall.*
—— crucifer, *Hall.*
Didymograptus patulus, *Hall.*
—— gibberulus, *Nich.*
—— nitidus, *Hall.*
Didymograptus bifidus, *Hall.*
—— Nicholsoni, *Lapw.*
—— affinis, *Nich.*
Phyllograptus typus, *Hall.*
—— angustifolius, *Hall.*
Diplograptus Hopkinsoni, *Nich.*
—— mucronatus ?, *Hall.*
Azygograptus Lapworthi, *Nich.*

The various species of *Monograptus* (*Graptolithus**) quoted by Salter and others from the Skiddaw series are almost certainly merely fragments of compound genera. The *Graptolithus latus* of M'Coy † was certainly of this nature; and the *Graptolithus tenuis*, *G. Nilssoni*, and *G. sagittarius* of Salter may with safety be assumed to have had a similar origin. His *Didymograptus sextans* (*Dicellograptus?*) is equally dubious. His *Diplograptus pristis* could not have been Hisinger's species, but was possibly *Diplograptus serra* (Brongn.) or some allied biserial form.

From the Upper Arenig rocks of Ellergill &c. Professor Nicholson has collected ‡ :—

Trigonograptus lanceolatus, *Nich.*
Trichograptus fragilis, *Nich.*
Didymograptus patulus, *Hall.*
—— bifidus, *Hall.*
—— affinis, *Nich.*
Didymograptus geminus, *His.*
—— fasciculatus, *Nich.*
Glossograptus armatus, *Nich.*
Phyllograptus angustifolius, *Nich.*
Diplograptus serra, *Brongn.*

To these I have myself added

Diplograptus tricornis, *Carr.*
Azygograptus cœlebs, *Lapw.*

and species of *Climacograptus.*

Scandinavia.—The Lower Ordovician rocks of Sweden which correspond to our British Arenig are the so-called *Lower Graptolite-* or *Phyllograptus-Schists* that underlie the well-known *Orthoceras-Limestone.* Their included Rhabdophora have recently been carefully worked out by Mr. Linnarsson; but the majority of the forms he has discovered are as yet undescribed. In the various collections from these beds which I have up to this date had an opportunity of examining I have recognized § :—

Tetragraptus bryonoides, *Hall.*
—— fruticosus ?, *Hall.*
—— quadribrachiatus, *Hall.*
Didymograptus patulus, *Hall.*
Didymograptus constrictus, *Hall.*
—— strictulus, *Linnrs.*
Phyllograptus angustifolius, *Hall.*
Temnograptus multiplex ?, *Nich.*

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* Salter, Quart. Journ. Geol. Soc. vol. xix. p. 135 &c.
† Quart. Journ. Geol. Soc. vol. iv. p. 223.
‡ Nicholson, *loc. cit. suprà.*
§ Compare Linnarsson, Geol. Mag., June 1876.

Dr. Tornquist has identified, in addition, *Didymograptus extensus*, Hall, *Didymograptus affinis*, Nich., and *Phyllograptus typus*, Hall. To these Mr. Linnarsson has recently added representatives of *Didymograptus v-fractus*, Salt., *Trichograptus multiplex*, Nich., *Diplograptus Hopkinsoni*, Nich.

The dark shales that succeed to the Cambrian rocks of the neighbourhood of Christiania in Norway, and include the local representative of the Orthoceras-Limestone of Sweden, have long been known to be graptolitiferous. A few of the Rhabdophora of these beds have been figured by Boeck † and Scharenberg ‡; but the horizons of the species are unknown. The forms named below may be easily identified upon their plates. Those in all probability restricted to the higher zones I have marked with an asterisk.

Tetragraptus fruticosus, *Hall.*
Didymograptus Murchisoni, *Beck.**
—— geminus, *His.*
Phyllograptus typus, *Hall.*
—— angustifolius, *Hall.*
Climacograptus Scharenbergi*, *Lapw.*

America.—As pointed out by Professor Selwyn §, the main mass of the Point-Levis or Quebec group of the valley of the St. Lawrence lies at the very base of the Ordovician or Lower Silurian system, and is thus, broadly speaking, synchronous with the British Arenig rocks. Its Rhabdophora have been long familiar to the eyes of palæontologists in the beautiful plates of Hall's classical memoir on the Graptolites of the Quebec Group. It may be that the more ancient of the strata from which his specimens were procured may eventually be proved to be of true Cambrian age. In the meantime, however, no division of these forms can be attempted. The species figured by Hall from Point Levis include:—

Clonograptus flexilis, *Hall.*
—— rigidus, *Hall.*
—— abnormis, *Hall.*
—— ramulus, *Hall.*
Loganograptus Logani, *Hall.*
Dichograptus octobrachiatus, *Hall.*
Tetragraptus Headi, *Hall.*
—— alatus, *Hall.*
—— crucifer, *Hall.*
—— quadribrachiatus, *Hall.*
—— denticulatus, *Hall.*
—— bryonoides, *Hall.*
—— Bigsbyi, *Hall.*
Didymograptus nitidus, *Hall.*
—— patulus, *Hall.*
Didymograptus bifidus, *Hall.*
—— indentatus, *Hall.*
—— extenuatus, *Hall.*
—— constrictus, *Hall.*
—— arcuatus, *Hall.*
—— extensus, *Hall.*
—— pennatulus, *Hall.*
Phyllograptus typus, *Hall.*
—— iliciformis, *Hall.*
—— angustifolius, *Hall.*
Diplograptus dentatus, *Brongn.*
—— inutilis, *Hall.*
Climacograptus antennarius, *Hall.*
Trigonograptus ensiformis, *Hall.*
Retiograptus tentaculatus, *Hall.*

† Boeck, 'Bemærkninger angaaende Graptolitherne:' Christiania, 1851.
‡ Scharenberg, 'Ueber Graptolithen:' Breslau, 1851.
§ Selwyn, Canadian Naturalist, 1879, p. 17.

From similar beds at Orleans Island, Gros Maule, and the river St. Anne, Hall describes:—*Didymograptus similis*, H.; *Tetragraptus fruticosus*, H.; *T. Headi*, H.; *Dichograptus octonarius*, H.; *Clonograptus Richardsoni*, H.; and *Phyllograptus Anna*, H.

Of these Quebec forms *Tetragraptus Headi*, H., *T. bryonides*, H., *Phyllograptus angustifolius*, H., and *P. typus*, H., were subsequently detected in corresponding strata on the coast of Newfoundland*, where their association with Crustacea &c. of Tremadoc and Arenig types, as at Point Levis, is demonstrative of their systematic place at or near the base of the Ordovician.

Australia.—Mr. R. Etheridge, Jun., and Professor M'Coy have recently described a small collection of Rhabdophora from the lowest Ordovician rocks of Australia†, which is remarkable for its general identity in facies with that of the Arenig rocks of England and Canada. The species figured are possibly:—

Loganograptus Logani, *Hall.*	Dichograptus octobrachiatus, *Hall.*
Goniograptus Thureaui, *M'Coy.*	Phyllograptus typus, *Hall.*
Tetragraptus bryonoides, *Hall.*	Retiograptus tentaculatus?, *Hall.*
—— quadribrachiatus, *Hall.*	Didymograptus Pantonii, *M'Coy.*
—— fruticosus, *Hall.*	—— nitidus, *Hall.*

together with indeterminable species of *Climacograptus* and *Diplograptus*.

Llandeilo Formation.

Dr. Hicks breaks up the Llandeilo formation of Wales into three portions, the well-known limestones and calcareous shales of Llandewi Felfry and Llandeilo forming the central member. This arrangement, though not universally applicable, may possibly be the natural one in the southern districts. There the Lower Llandeilo consists of dark carbonaceous shales and thick beds of coarse sandstones, with occasional igneous rocks of contemporaneous age, the Middle Llandeilo of calcareous flagstones, and the so-called Upper Llandeilo of soft dark grey flags and mudstones, forming a gradual transition into, and only doubtfully separable from, the overlying Bala formation.

In the Lower Division, as seen to the west of Shelve, I have collected *Didymograptus Murchisoni*, Beck, in some abundance, and in corresponding strata below as well as

* Logan and Billings, Geology of Canada, pp. 291, 293, 872.

† R. Etheridge, Jun., Annals and Mag. Nat. Hist., July 1874; M'Coy, Prodromus Palæontology Victoria, decades i., ii., and v.

amid the volcanic rocks of the Gelli Hills near Builth. In the dark Llandeilo shales of Pwllacca near Llandeilo I have seen the smaller varieties of *Didymograptus Murchisoni* in myriads, together with *Diplograptus foliaceus*, Murch., *Climacograptus cœlatus*, Lapw., and indeterminable forms of *Didymograptus*. *Didymograptus Murchisoni*, Beck, is quite as abundant in the black shales below the Limestone of Llandewi Felfry near Whitland, associated with *Didymograptus Nicholsoni*, Lapw., *Goniograptus*, sp., *Climacograptus confertus*, Lapw., *Diplograptus tricornis*, &c. The forms recognized by Mr. Hopkinson and myself* in the Lower Llandeilo zone of Abereiddy Bay include

Didymograptus euodus, *Lapw.*
—— indentatus, *Hall.*
—— Murchisoni, *Beck.*
Diplograptus foliaceus, *Murch.*
—— tricornis, *Carr.*
Dicellograptus moffatensis ?, *Carr.*

and some others.

In the Middle Llandeilo of Abereiddy Bay are found *Dicellograptus*, *Diplograptus foliaceus*, Murch., and *D. tricornis*, Carr. In the corresponding strata of Builth Road and Wellfield, Radnorshire, I have detected

Dicellograptus patulosus, *Lapw.*
Cœnograptus gracilis ?, *Hall.*
Diplograptus foliaceus, *Murch.*
Diplograptus tricornis, *Carr.*
Climacograptus cælatus, *Lapw.*

A fine example of *Dicranograptus formosus*, Hopk., from these beds at Castell is in the Jermyn-Street collection (Case iv. $\frac{5}{23}$). Rocks of corresponding age at Meadowtown near Shelve have yielded me *Diplograptus foliaceus*, Murch., and *D. dentatus*, Brongn.

The Upper Llandeilo rocks of Abereiddy Bay have, up to this time, proved barren of Graptolites. From the Upper Llandeilo of Hagley, near Chirbury, I have collected *Diplograptus foliaceus*, Murch., and *Climacograptus Scharenbergi*, Lapw. From the Upper Llandeilo of Llandrindod Wells Mr. Hopkinson sent me, some years ago, *Climacograptus Scharenbergi*, Lapw., *C. cœlatus*, Lapw., and *Dicellograptus moffatensis*, Carr. From the same rocks near that town I have this summer collected *Diplograptus tricornis*, Carr., *D. foliaceus*, Murch., *Climacograptus cœlatus*, Lapw., *C. perexcavatus*, Lapw., *C. Scharenbergi*, Lapw., and species of *Dicellograptus* and *Lasiograptus*.

At the village of St. Clear's, near Caermarthen, the bank of the little river exposes a good section of highly fossiliferous

* Hopkinson and Lapworth, Quart. Journ. Geol. Soc. vol. xxxi. p. 634.

black shales, apparently of Upper Llandeilo age. In these I have recognized

Dicranograptus formosus, *Hopk.*	Climacograptus cælatus ?, *Lapw.*
—— sextans ?, *Hall.*	—— perexcavatus, *Lapw.*
Diplograptus foliaceus, *Murch.*	

During the progress of the Geological Survey of North Wales Mr. Salter detected Graptolites in the deep-seated schists of Tiddyn Dicwm, near Tremadoc. From their apparent stratigraphical position he assigned them to the general horizon of the Arenig formation. There can be little doubt, however, that they are actually of Llandeilo age. The specimens from this locality preserved in the Jermyn-Street Museum, or figured in the 'Geology of North Wales' *, include *Dicranograptus ramosus*, Hall, *Diplograptus tricornis*, Carr., *Climacograptus Scharenbergi*, Lapw., and *C. bicornis*, Hall. I recognized the same species in a fine collection made by Mr. Hopkinson from this locality in 1873, together with the following additional species :—

Didymograptus, sp.	Diplograptus angustifolius, *Hall.*
Glossograptus Hincksi, *Hopk.*	Dicellograptus sextans (?), *Hall.*
Diplograptus dentatus, *Brongn.*	Diplograptus Whitfieldi, *Hall.*

Ireland.—The only graptolitiferous strata in Ireland that can with certainty be assigned to the Llandeilo formation are the schists of Bellewston Hill, County Meath, whence Mr. Baily procured *Didymograptus Murchisoni*, Beck, in association with *Diplograptus foliaceus*, Murch., and other forms †.

Sweden.—The black shales that overlie the Orthoceras-Limestone of Sweden, and are known as the *Dicranograptus*- or Middle Graptolite-schists, fall into two tolerably distinct palæontological groups. The lower group (*Murchisoni*- or *geminus*-schists) is marked by the presence of *Didymograptus geminus*, His., and several allied species; and it may therefore be roughly paralleled with our British Llandeilo. According to the most recent researches of Mr. Linnarsson ‡ its lowest beds contain representatives of the British forms *Phyllograptus typus*, Hall, *Diplograptus Hopkinsoni*, Nich., and *Diplograptus tricornis*, Carr. These pass up into a group of dark shales with *Didymograptus geminus*, His.; and the Llandeilo group is terminated by beds with *Glossograptus Hincksi*, Hopk. With the above forms occur also Diplo-

* Memoirs Geol. Surv. England and Wales, vol. iii. pl. xii.

† Baily, Journ. Geol. Soc. Dublin, Jan. 1862.

‡ Linnarsson, 'Œfversigt af Vetenskaps-Akademiens Förhandlingar,' 1878.

graptidæ of the genera *Diplograptus* and *Climacograptus*, together with *Lasiograptus* and *Azygograptus* &c.

France &c.—*Didymograptus Murchisoni* and its allies occur in the inferior division of the Schiste ardoisier of Bretagne * in association with Crustacea of Llandeilo type. It is found also in similar strata near Oporto in Portugal †.

[To be continued.]

XXXIX.—*Description of a new Species of* Acme *and Varieties from the Conglomerate Beds at Menton.* By GEOFFREY NEVILL, C.M.Z.S.

Acme Foliniana.

Testa turrito-elongata, imperforata, cornea, lævis et nitida; spira subrecta, paululum prope apicem obtusum eversa; anfract. 6 aut 6½ (rarissime 7), convexiusculi, sutura distincta separati, interdum inferne linea incisa (more Eulimidarum) circumdata; apertura subverticalis, subquadrangularis, marginibus callo lævi junctis; columellaris subrecta; peristom. album, percrassum, duplex.

Typi anfr. 6·5; long. 5·5, diam. 1·75; apert. alt. 1·5, lat. 1·1 millim.

This was an exceedingly abundant form, often in a perfect state of preservation, at three different levels; a few specimens had seven well-developed whorls, the others 6 or 6½, increasing very gradually and regularly, moderately convex, the last two approximately of equal breadth; apex blunt and obtuse, the apical whorls with a slight inclination to the right (away from the axis of the shell); perfectly smooth, polished, shining, of a more or less pale horny colour, sometimes so transparent that the columella can be traced from the apex to the base; suture distinct, with a more or less obsolete incised line close below it, as in many species of *Eulima* &c.; aperture a trifle everted, subquadrate, with a remarkable, pure white, callous rib close to the peristome, imparting a duplex appearance to the latter; a thin callosity joins the margins.

I have much pleasure in naming this, the giant of its genus, after my friend the Marquis de Folin of Bayonne, whose researches connected with minute marine species are so highly valued and appreciated.

* Tromelin and Lebesconte, 'Catalogue des Fossiles Siluriens,' 1875, p. 46, &c.

† Sharpe, "Geology of Neighbourhood of Oporto," Q. J. G. S. vol. v. p. 147.

Type, Indian Museum, Calcutta; also in coll. Marquis de Folin, Mons. J. René Bourguignat, Coombe Williams, P. Joly, P. Fagot, and Colonel Godwin-Austen.

Var. *emaciata*, nov.

This is a dwarf form, apparently varying in every specimen, and of which it seems to me impossible to grasp any thoroughly constant character. Taking an extreme specimen, it is distinguished by its smaller size, by the more regularly turreted spire being quite upright, 6 whorls, of almost equal size, slightly more convex, especially the last, which is also proportionally very short; aperture smaller, a trifle more vertical and scarcely everted; callosity joining margins well developed; peristome does not present the duplex appearance of the preceding, except at the columella. Rare in middle deposit only.

Long. 4·13, diam. (vix) 1·5 millim.

Type var., Indian Museum, Calcutta; also in coll. Marquis de Folin and Mons. J. René Bourguignat.

Var. *pachystoma*, nov.

(An potius *A. pachystoma*, sp. nov. ?)

This, unlike the preceding, is an exceedingly well-marked and distinct form, unmistakable at a glance. I think it extremely probable Mons. Bourguignat is correct in regarding it as a distinct species. It can be known from the typical form by its much less distinct suture, by the shorter, less elegantly and regularly turreted spine, composed of only six more rapidly imcreasing whorls, the apical two compressed, the others scarcely convex, almost cylindrical, especially the last, which is proportionally much longer, the antepenultimate one much broader than the others (not the case in type form); the apical portion of the spire considerably more diverted from the axis of the shell, with the aperture very much everted, imparting a still stronger resemblance to certain species of *Eulima*; the thick, white peristome is surrounded by a still more callous rib, especially noticeable at its termination, about the middle of the columella, which is slightly oblique; the duplex character of this outer lip is still more distinctly and clearly marked. This form was by no means uncommon, though much less abundant than typical *A. Foliniana*, with which it was associated.

Long. 5, diam. 1·9 millim.

Type var., Indian Museum, Calcutta; also in coll. Marquis de Folin and Mons. J. René Bourguignat.

XL.—*On some new Species of Araneidea.*

By the Rev. O. P. Cambridge, M.A., C.M.Z.S., &c.

[Plate XVII.]

A small collection of spiders, chiefly of the genus *Erigone* (*Neriëne* and *Walckenaëra*, Bl.), lately received from Graf Eugen v. Keyserling of Glogau, Silesia, contained four species which appear to me to be undescribed. These, together with another very remarkable one of the same group, sent to me from Lisbon by Mr. H. O. Forbes, are described and figured in the present paper. Those received from Count Keyserling were found in different localities in Germany; and among them were also examples of the following known species:—

Dictyna viridissima, *Walck.*, Orzova.
Neriëne exhilarans, *Cambr.*, Munich.
—— livida, *Bl.*, Glogau.
—— cornuta, *Bl.*, Orzova &c.
—— graminicola, *Sund.*, Munich.
—— rufipes, *Sund.*, Lüvland &c.
—— dentipalpis, *Wid.*, loc.?
—— isabellina, *C. L. Koch*, Dux.
—— fuscipalpis, *C. L. K.*, Glogau.
—— rubripes, *Bl.*, Glogau.
Bathyphantes brevipalpis, *Menge*, Munich.
Walckenaëra Simonii, *Cambr.*, Munich.
—— elongata, *Wid.*, Munich.
Walckenaëra cucullata, *C. L. Koch*, Munich and Glogau.
—— brevis, *Wid.*, Munich.
—— pusilla, *Wid.*, Munich.
—— bifrons, *Bl.*, Orzova.
—— prominula, *Cambr.*, Glogau.
—— perforata, *Thor.*, Orzova.
—— cristata, *Bl.*, loc.?
—— pallens, *Cambr.*, Munich.
—— altifrons, *Cambr.*, Glogau and Munich.
—— antica, *Wid.*, Danzig.
Linyphia decens, *Cambr.*, loc.?
—— oblivia, *Cambr.*, Munich and Glogau.
—— pallida, *Cambr.*, Glogau.
—— nigrina, *Sund.*, Glogau.

The following are the species supposed to be new:—

Neriëne rasa, sp. n., Dux, p. 343, Pl. XVII. fig. 1.
—— Keyserlingii, sp. n., loc.?, p. 344, Pl. XVII. fig. 2.
—— iracunda, sp. n., Lüvland, p. 346, Pl. XVII. fig. 3.
Walckenaëra nasuta, sp. n., Lisbon, p. 347, Pl. XVII. fig. 4.
—— congenera, sp. n., Munich, p. 348, Pl. XVII. fig. 5.

Fam. Theridiides.

Gen. Neriëne, Bl.

Neriëne rasa, sp. n. (Pl. XVII. fig. 1.)

Adult male, length very nearly $\frac{1}{9}$ of an inch.

The colour of the *cephalothorax*, *falces*, *maxillæ*, *labium*, and *sternum* is a clear but darkish yellow-brown; the *legs* and *palpi* are of a paler hue, and the abdomen is blackish olive-brown. The general convexity of the cephalothorax is somewhat depressed; but the caput is well rounded on all sides, and the profile of the clypeus (which considerably exceeds in height half that of the facial space) continues the curve of the profile of the occiput; the profile line behind the occiput exhibits a very slight depression; on the caput and clypeus are some prominent hairs.

The *eyes* are small, and, excepting the fore-centrals, which are very small, are of equal size; those of the hind-central pair are considerably nearer together than each is to the hind-lateral eye on its side, the interval being no more than an eye's diameter, which is also the same interval as that which separates them from the fore-centrals; those of each lateral pair are placed obliquely on a tubercle; the fore-centrals are dark, indistinct, and contiguous to each other.

The *legs* are of tolerable length and rather slender; their armature had been almost entirely denuded, but it appears to have consisted of hairs only.

The *palpi* are short; the radial joint is stronger, but scarcely longer, than the cubital, both being very short; the former spreads out a little in front, but has no projection or apophysis; it is furnished with some bristly hairs, the longest and strongest of which are on the outer side; the digital joint is of moderate size, and has a strong lobe or prominence towards its hinder extremity on the outer side; the palpal organs are moderately complex; at their base on the outer side is a prominent, almost circularly curved, corneous process, and at their extremity are two or three small, blunt, projecting, corneous points.

The *falces* are long, strong, and greatly inclined backwards to the labium; they are also a little divergent at their extremities.

The *abdomen* is of tolerable size; its shape is a regular oval, its surface glossy and very sparingly clothed with hairs; and it projects a little over the base of the thorax.

This spider is allied to *Neriëne Huthwaitii*, Cambr., which it resembles very much in general colouring and appearance; but it may easily be distinguished by the much shorter radial joint and much larger digital joint of the palpus; the structure also of the palpal organs is entirely different.

A single example was sent to me for examination by Count Keyserling, by whom it was found at Dux.

Neriëne Keyserlingii, sp. n. (Pl. XVII. fig. 2.)

Adult female, length $\frac{1}{5}$ of an inch.

The whole of the fore part of this spider, including the legs and palpi (which are a little the palest), is of a clear yellow colour; and the abdomen is pale straw-coloured. The *cephalo-*

thorax is of a rather flattened form; the profile line forms a slightly curved slope to the eyes, the depression behind the occiput being exceedingly slight. The normal grooves and indentations are fairly marked, and are also indicated by converging lines of a dusky hue.

The *eyes* are of tolerable size and not very unequal; they are rather closely grouped; those of the posterior row are equidistant from each other, being separated by a central-eye's diameter, each of the central eyes being also separated by a similar space from the fore-central eye opposite to it. Those of each lateral pair are contiguous to each other, and are seated obliquely on a black tubercle; those of the fore-central pair are on a large black spot, and are separated from each other by nearly half a diameter.

The *legs* are moderate in length and strength (4, 1, 2, 3), furnished with hairs, and a very few slender prominent bristles.

The *falces* are long, strong, very prominent towards their base in front, a little divergent, and armed with strong sharp teeth on the inner sides, a row of five (the strongest) being placed along the outer edge, and three along the inner edge of the groove in which the fang lies when at rest. On the outer sides in front are some minute piliferous tubercles arranged in two or three longitudinal lines.

The *maxillæ* are long, strong, somewhat obtusely pointed on the inner extremities, and inclined towards the *labium*, which is of a semicircular form.

The *abdomen* is oval, broadest behind, and projects over the base of the cephalothorax; it is of a pale straw-yellow colour, thinly clothed with fine hairs, and marked with four small, round, red-brown, impressed spots near the middle of the upperside, forming a trapezoid, whose posterior is longer than the anterior side; a sooty-black broken stripe bisects the upperside in a longitudinal direction, the hinder part being formed of two elongate arrow-head markings, following each other in close contact, the posterior one merging in a large sooty-black patch some little distance above the spinners. It is probable that in a series of examples some variations in this pattern would be exhibited. The genital aperture is small and characteristic in form, but has no prominent process connected with it; just in front of the spinners is a curved lip-like fold in the integument, having every appearance of being the aperture leading to one or two spiracles (breathing-organs).

Two examples of this fine and distinct species were comprised in the collection of spiders received for examination from Count Keyserling, by whom they were found in Germany; but the precise locality is unknown to me.

Neriëne iracunda, sp. n. (Pl. XVII. fig. 3.)

Adult male, length slightly over 1 line.

The *cephalothorax* is of a dark yellow-brown colour, and of a somewhat oblong-oval form, broad at the fore part, and the lateral constriction on the margins, at the caput, exceedingly slight. The profile line forms a tolerably even, though very slight curve; the ocular area slopes forwards; and the clypeus, which projects a little, is less in height than half that of the facial space.

The *eyes* are all seated on tubercles; those of the lateral pairs rather strong; they are not very large or greatly different in size, those of the anterior (or fore-central) pair, which are a little the smallest, are separated by a small but distinct interval, those of the hind-central pair are divided by rather less than a diameter's interval, that which separates each of them from the hind-lateral eye on its side being about equal to a diameter. The curves of the two rows of eyes are as nearly as possible equal, but directed in opposite directions, and enclosing a transverse oval space; those of each lateral pair are placed very slightly obliquely.

The *legs* are rather long, slender, 4, 1, 2, 3, furnished with hairs, and one or two erect bristles only, and of a pale orange-yellow colour.

The *palpi* are short; the digital and radial joints brown, the rest similar in colour to the legs. The cubital and radial joints are very short; the latter is the strongest and has its fore extremity on the upperside produced, but very slightly, into a somewhat pointed termination; and there is also a prominent point on the outer side: the digital joint is of moderate size; it has a small, blunt, somewhat tooth-like projection at its base; and on its outer side is a prominent, somewhat elevated subangular lobe. The palpal organs are complex and well developed, but present no very noticeable processes.

The *falces* are powerful, prominent near their base in front, divergent, and greatly cut away on the inner side of their fore half—so far as I could see, destitute of teeth, excepting a bluntish one at the extreme inner point near the insertion of the fang. The outer sides in front are furnished with minute piliferous tubercles. The colour of the falces is similar to that of the cephalothorax.

The *maxillæ* are like the falces in colour; they are strong, moderately long, rounded on their outer sides and at the extremities, and inclined towards the *labium*, which is short, somewhat roundly truncated at the apex, and of a dark black-brown hue.

The *sternum* is similar to the labium in colour.

The *abdomen* is narrow oviform, glossy and black, and thinly clothed with hairs.

A single example of this spider, which is allied to *Nerïëne subtilis*, *N. conigera*, and *N. innotabilis*, Cambr., was received from Count Keyserling, by whom it was found in Lüvland.

Gen. WALCKENAËRA, Bl.

Walckenaëra nasuta, sp. n. (Pl. XVII. fig. 4.)

Adult male, length $\frac{1}{14}$ of an inch.

The cephalothorax, legs, palpi, and falces are of a light rather orange-yellow colour, the tibiæ, tarsi, and metatarsi of the legs being a little the palest, and the caput slightly suffused towards the fore part on the upperside with a dusky brownish hue. The caput is elevated, and the fore extremity of the upperside projects forwards in a somewhat curved and tapering form, terminating in a round knob connected with the main portion by a narrow neck-like constriction, and giving it a very nose-like appearance; the fore part of the caput, as well as the knob, is furnished pretty thickly with hairs; there are also a few shorter ones along the upperside of the caput, directed slightly backwards. The thorax is a little gibbous about the middle of the upperside.

The *eyes* are small, seated on black spots, and in the usual four pairs; the lateral pairs are one on each side, towards the fore extremity of the caput, at about the thoracic level; the fore-central pair is in front, between and on a level with the laterals; the eyes of these three pairs are respectively contiguous to each other, while those of the hind-central pair are wide apart, one on each side of the produced part of caput, a little behind the neck or constriction.

The *legs* are slender, not very long, furnished with ordinary hairs, and a few erect ones on the upperside of the tibiæ and metatarsi.

The *palpi* are moderately long; the cubital joint is rather long and slightly clavate; the radial joint is short, but has its fore extremity produced into a long, tapering, twisted, sharp-pointed, rather prominent apophysis. The length of this joint and its apophysis is about equal to that of the cubital joint. The digital joint is of moderate size; and the palpal organs are prominent and rather complex, but have no very remarkable processes.

The *abdomen* is oviform; it projects but slightly over the base of the cephalothorax, and is jet-black, thinly clothed with hairs.

A single example, in excellent condition, of this very remarkable little spider was kindly sent to me, from Lisbon, with numerous other spiders, by Mr. H. O. Forbes.

Walckenaëra congenera, sp. n. (Pl. XVII. fig. 5.)

Adult male, length 1 line.

The *cephalothorax* is of a deep rich black-brown colour, the *legs* orange, and the *abdomen* jet-black. The caput is elevated into a moderate-sized, well-rounded eminence; the height of the clypeus is a little over half that of the facial space; it slopes forwards following the same line as that of the fore profile of the eminence on the caput. The upper (or hind-central) pair of eyes are seated on the fore part of the upper-side of the eminence, and are separated by an eye's diameter.

The *legs* are slender, of moderate length, 1, 4, 2, 3, and furnished with hairs only; if any other armature was ever present it had been rubbed off before the example came to hand.

The *palpi* are moderately long, slender, and of a yellow colour, excepting the digital joint, which is dark yellow-brown. The cubital joint is slightly clavate and bent downwards; the radial joint is stronger than the cubital, and has its fore extremity, on the upperside, produced into a long, somewhat tapering, and curved apophysis, whose broadly obtuse point is directed outwards across the middle of the digital joint, and a little turned upwards on the lower edge; within the curvature of this apophysis is a strong, not very long, obtuse, prominent process also directed outwards; and in front of it (though it was difficult to see its exact origin) is a small, sharp-pointed, spine-like projection; numerous bristly hairs issue from the outer side of the radial joint, chiefly towards its hinder part; the digital joint is oval and of tolerable size; the palpal organs are well developed and complex; they are closely encircled near the middle with a black spine; and a more slender one coiled in a circular form is situated at their extremity.

The *maxillæ* are of an olive-brown hue, the *labium* blackish brown; the *sternum* is glossy and black-brown; and the *abdomen*, which is also glossy, is jet-black, rather large, considerably convex above, and very sparingly clothed with hairs.

This spider is closely allied to *Walckenaëra prægracilis*, Cambr., but is larger; the legs are also shorter; the eminence on the caput is of a more rounded form, and less sloping in profile both before and behind; the two eyes seated on its summit are also nearer together. The *palpi* are somewhat similar to those of that species; but the radial apophysis is shorter, stouter, and more obtuse at its extremity, the process also within its curvature is straighter, shorter, and stouter.

It is also allied to *Walckenaëra erythropus*, Westr., though the palpi, as well as the eminence on the caput of this last species, differ in structure, the digital joint being larger, the radial apophysis less strong at its extremity, the process within its curvature longer, more prominently turned upwards, and furnished with a cusp-like point at its end.

A single example received for examination from Count Keyserling, by whom it was found near Munich.

EXPLANATION OF PLATE XVII.

Fig. 1. *Nériëne rasa,* sp. n., ♂, p. 343. Dux. *a,* profile, without legs or palpi; *b,* front view of eyes and falces; *c,* left palpus, sideways, above and a little underneath in front; *d,* curved process at base on outer side of palpal organs, from in front; *e,* natural length of spider.

Fig. 2. *Neriëne Keyserlingii,* sp. n., ♀, p. 344. Germany. *a,* profile, without legs; *b,* front view of eyes and falces; *c,* hinder extremity of abdomen, from underneath; *d,* same as *c,* in profile; *x,* fold in front of spinners, supposed to conceal spiracular orifices; *y,* the same as *x,* in profile; *e,* genital aperture; *f,* natural length of spider.

Fig. 3. *Neriëne iracunda,* sp. n., ♂, p. 346. Liivland. *a,* profile, without legs or palpi; *b,* front view of eyes and falces; *c,* left palpus, from outer side, rather in front; *d,* ditto, in front, rather on inner side; *e,* natural length of spider.

Fig. 4. *Walckenaëra nasuta,* sp. n., ♂, p. 347. Lisbon. *a,* right palpus on outer side; *b,* humeral, cubital, and radial joints of left palpus, from in front; *c,* profile, without legs or palpi; *d,* natural length of spider.

Fig. 5. *Walckenaëra congenera,* sp. n., ♂ (profile, without legs or palpi), p. 348. Munich. *a,* caput, from above and behind; *b,* left palpus, from above and rather in front; *c,* radial joint of ditto; *d,* natural length of spider.

XLI.—*Descriptions of new Species of Lepidoptera from Japan.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

THE moths described in the present paper were mostly presented to the British Museum by Mr. Henry Pryer of Yokohama, who collected them in that locality. Amongst them are many species of great interest, exhibiting marvellous resemblance to well-known European types, whilst one or two show greater similarity to forms occurring in the New World.

One insect in Mr. Pryer's collection I was much surprised to find, upon examination, to be absolutely identical with a West-Indian form; I allude to *Gonitis fractifera*. As the Indian species of *Gonitis* seem to be constant to locality, the various forms being nearly allied and limited in their range, it is very strange to find a form common to St. Domingo and Jamaica in Japan.

Sphingidæ.

1. *Acosmeryx metanaga*, n. sp. (no. 217).

♂. Rather larger than *A. sericeus* ♂; coloration intermediate between it and *A. anceus*; markings of primaries and entire coloration and marking of the under surface almost as in *A. naga*—lilacine grey, clouded and banded with fuliginous brown; wings tinted upon the disk with ferruginous; primaries with a lunated belt dividing off the basicostal area and an oblique darker belt from the costa just beyond the middle to the external border, both fuliginous brown; the usual transverse undulated dark brown lines; outer border smoky brown, undulated internally, intersected by a grey stripe from the subcostal furca to the second median branch; a triangular subapical marginal dark-brown spot; secondaries greyish, becoming reddish on the disk, which is crossed from near anal angle by a dusky bordered lilacine streak, followed by a rather broad fuliginous outer border, which tapers to the anal angle; thorax, excepting the tegulæ, red-brown; margins of abdominal segments red-brown; antennæ sordid white. Expanse of wings 4 inches.

2. *Pergesa mongoliana*, var., Butl. (no. 219).

Differs from the ordinary Japanese examples in its much deeper coloration above, the absence of the pale patches at apex and on the disk of the primaries, and in the bright reddish coloration of the under surface. In this last character, however, it agrees with the type from Mongolia.

3. *Triptogon sperchius*, Ménétr. (no. 205).

We have received a pair of what appears to be this species, agreeing fairly with the published figures, and therefore establishing the entire distinctness of my *T. piceipennis*. Although I could not hesitate to describe an insect so entirely distinct in coloration and marking as *T. piceipennis* from the figure published by Ménétriés, it is satisfactory to be able to confirm the validity of the species by comparison with actual specimens.

Zygænidæ.

4. *Illiberis sinensis*, Walker (no. 243 B).

This insect has now come from Yokohama.

5. *Procris funeralis*, sp. n. (no. 244).

Deep purplish brown, the fringes paler; the disk of secondaries whitish and semihyaline; abdomen black, claspers and proboscis horn-yellow; a whitish extruded anal tuft. Expanse of wings 9 lines.

Arctiidæ.

6. *Spilosoma leucothorax*, Felder (no. 288).

This species is new to Japan.

7. *Spilarctia imparilis*, var., Butl. (no. 286).

The male now sent agrees with the typical female in spotting, but the female sent with it agrees more nearly with the typical male; it is therefore clear that, as in the European species, the Japanese *Spilarctiæ* vary considerably in the number of spots upon the wings.

8. *Spilarctia inæqualis*, n. sp. (no. 294).

♂. Wings above pale buff, becoming pink towards the inner margins; a black spot at the superior angle of each discoidal cell: primaries with a spot in the cell, two or three close to inner margin, near to which commences an oblique series from the centre of the margin to the lower discoidal interspace, where it meets a series of abbreviated black dashes running to the apex; a second less distinct series of similar dashes between the oblique series and the outer margin: secondaries with a spot on the discoidal interspace and four near the anal angle blackish grey: thorax white, the head and shoulders tinted with buff; abdomen carmine, with lateral black dots and fringe of ochreous hairs; antennæ black. Wings below nearly as above: body below whitish, the collar and fringe of the palpi carmine; upper surface of palpi and of front legs and the tarsi and knees of the other legs black. Expanse of wings 1 inch 4 lines.

♀. Wings above semitransparent white, tinted with pale buff at the borders; a blackish spot at the superior angle of each discoidal cell: primaries with a double series of abbreviated black dashes as in the male, but without the oblique series of spots or other spots noted as existing in that sex:

secondaries with a spot near the apex and a second near the anal angle: thorax and base of abdomen white; remainder of abdomen pink, but with the anal segments pale buff, a series of black spots on each side; head slightly yellowish; antennæ black. Wings below as above: body below white, venter black-spotted, anus buff; collar and fringe of palpi pink; upper surface of palpi and of front legs black; upper surface of the remaining legs brown. Expanse of wings 1 inch 10 lines.

The female at first sight looks almost like *S. rhodophila*, whereas the male agrees better with *S. obliqua*.

9. *Spilarctia rosacea*, n. sp. (no. 289, ♂).

Primaries above fawn-colour, with the borders and veins pale creamy buff; the basal third of costal margin black; a small spot at the superior angle of the cell, a second on the costa beyond it, a third just above the bend of the submedian vein, an oblique series of black spots from inner margin to apex, interrupted at the fourth median or lower radial branch; an abbreviated series of black points near the outer margin: secondaries rose-coloured, with the margins buff; a large black spot at the end of the cell: thorax cream-coloured; head grey; antennæ and eyes black; abdomen rose-coloured, with dorsal and lateral series of black spots. Primaries below bright rose-red, with the outer and inner margins and a patch at basal third of costa ochraceous, base whitish, a black spot at the end of the cell, a broad interno-median longitudinal streak and an oblique series of spots from the latter to the apex black: secondaries rose-coloured, with yellowish borders; a black spot at the end of the cell: body whitish, palpi and coxæ and femora of anterior and middle legs carmine, tibiæ and tarsi of hind legs blackish, venter laterally spotted with black. Expanse of wings 1 inch 9 lines.

The insect sent as the female of this species is *S. seriato-punctata* of Motschulsky, the male of which we previously possessed; the sexes of that species do not differ either in size, form, or colour, whereas the insect now described differs in all of these points, its chief resemblance, indeed, consisting in the presence of the black basicostal streak on the primaries.

Lithosiidæ.

10. *Cyana decipiens*, n. sp. (no. 1126).

Primaries sordid white, with broad chocolate costal border not quite reaching the base, a dusky-bordered, irregular, subbasal, pale sandy yellowish stripe, and a second across the disk, close to the external border; the veins upon the broad central area enclosed by these two stripes dotted with olivaceous; external area limited internally by a series of black >-shaped markings, almost forming a zigzag line; external angle clouded with olivaceous; fringe obliquely streaked with ferruginous; an oblique curved discocellular black dash; costal margin yellowish, spotted with olivaceous: secondaries shining white, with slightly brownish external area, broadest at apex: body white. Under surface sordid white, primaries broadly suffused with grey; a discal series of blackish semicircles near the outer margin; fringe as above. Expanse of wings 1 inch 7 lines.

This species wonderfully resembles the New-Zealand genus *Declana*.

11. *Miltochrista torrens*, n. sp. (no. 266).

Primaries bright orange, with costal and outer margins red; two black dots at the base; two blackish irregular lines upon the basal half from inner margin to subcostal vein: secondaries yellowish rose-coloured, with bright rosy border; fringe of all the wings ochreous: thorax reddish orange; abdomen buff, with dorsal and lateral series of black dots. Under surface pale rosy, with the borders of the wings brighter in colour; body yellowish. Expanse of wings 1 inch.

12. *Systropha nivosa*, n. sp. (no. 270).

Snow-white, wings sericeous; primaries below pale brown with white fringe; anterior and middle pairs of legs brownish above. Expanse of wings 1 inch.

Notodontidæ.

13. *Stauropus persimilis*, n. sp. (no. 321).

Closely allied to *S. fagi*, but smaller, the ground-colour of the wings more uniformly reddish brown, the basal pale area of primaries much less defined; the whitish border below obsolete. Expanse of wings 2 inches 2 lines.

This is, of course, nothing but a small representative race of *S. fagi*; the caterpillar, probably of this species, from Hiogo, is black with castaneous head.

14. *Peridea cinerea*, n. sp. (no. 331).

Nearly allied to *P. sikkima*, with the same markings, but much smaller, altogether greyer, and with the yellow spots on the disk of primaries replaced by snow-white ones; the primaries and thorax, seen as a whole, are distinctly ash-coloured instead of greenish brown. Expanse of wings 2 inches.

This species is of the same general tint as *Phalera sigmata*; but the body is browner; it and "*Heterocampa*" *sikkima* are decidedly best placed in *Peridea*, with which they appear to agree in all essential points of structure.

PALECA, n. gen.

Allied to *Cleapa*, but with the palpi nearly twice as large (giving the genus quite a *Deltoid* character), and with the antennæ less widely pectinated, with the apical fourth simple; body slightly more slender and decidedly longer. Type *P. rufescens*.

15. *Paleca rufescens*, n. sp. (no. 1067).

Primaries above clay-coloured, shining; the basal and external thirds dusky and edged with a pale line, so that the central third forms a broad belt, expanding upon the costa, and enclosing a blackish discocellular spot: secondaries pale shining brown, the external half being distinctly more dusky with defined inner edge: thorax clay-coloured, abdomen pale brown. Under surface pale cupreous brown, shining; wings with indications of a blackish discal line and with black discocellular spots. Expanse of wings 1 inch 3 lines.

INGURIDIA, n. gen.

Allied to *Ingura* (*I. recurrens*), but the wings broader, the secondaries altogether larger; antennæ simple, palpi slightly more slender; hind legs quite as strongly quadrispinose, but apparently rather less densely hairy; pectus covered with long coarse hairs. Type *I. abrostolina*.

16. *Inguridia abrostolina*, n. sp. (no. 782).

Dark brown, primaries above clouded with greyish; the discoidal spots and a large rounded spot below the cell indicated by black outlines, and enclosed by two transverse black lines, which indicate the central belt; a pale grey submarginal line and a black marginal line formed of confluent lunated spots; head and thorax pale and silvery, abdomen dark greyish brown. Under surface dark brown, shining; wings with a darker discal line and pale fringe; the fringe of secondaries almost wholly white. Expanse of wings 1 inch 1 line.

This species, though similar in general tint to the allied genus *Ingura*, is even more like *Abrostola* in pattern and coloration.

17. *Lophopteryx Pryeri*, n. sp.

Near to the "*Notodonta*" *Sieversii* of Ménétriés, but shorter in the wings, with more prominent scale-tooth from the inner margin of the primaries, and with the central belt and discal spots on these wings more sharply defined. Expanse of wings 1 inch 5 lines.

L. Sieversii is carefully figured; and therefore, although we do not possess the species, I have no difficulty in characterizing the Japanese insect as distinct.

Drepanulidæ.

18. *Oreta auripes*, n. sp. (no. 348).

♀. Allied to *O. calida* (Ill. Lep. Het. pl. xxii. fig. 6), size of the male of that species, and of the same general colour above—laky brown, mottled with grey; wings crossed by two grey lines, wider apart than in *O. calida*, the outer one on primaries incurved and bounded by an ill-defined yellow line which runs to apex; fringe and margin of secondaries bright ferruginous: body pale whity brown, the metathorax and abdomen slightly rosy; head and antennæ ochreous; collar rosy brown. Wings below bright ochraceous, clouded with rosy reddish, reticulated and dotted with lilacine grey; a curved discal line of the same colour across the primaries: body below creamy yellowish; anterior legs bright reddish orange; other legs golden orange. Expanse of wings 1 inch 9 lines.

This species should be placed between *O. calida* and *O. pulchripes*. *Drepanulides palleolus*, Motschulsky (no. 345), is a *Callidrepana*.

Saturniidæ.

19. *Tropæa aliena*, n. sp. (no. 323).

♂. Wings above pale yellowish green *, white at the base and along the abdominal border of secondaries; the usual small oval ocelli closing the discoidal cells; a slightly sinuous yellowish olivaceous discal stripe from costa of primaries to abdominal margin of secondaries; fringe pale sandy yellow: primaries with a second, irregular, oblique, subbasal, yellowish

* Probably emerald-green when fresh from the chrysalis, as there are traces of this colour on the underside of the wings.

olivaceous stripe; costal border sordid plum-colour, densely irrorated in front with white scales, and bounded behind by a black stripe: body white; the head, collar, margins of the thorax and abdomen slightly yellowish; a broad belt of dark plum-colour across the prothorax and tegulæ; antennæ bright testaceous; hind margin of eyes red. Wings below with an undulated discal line in place of the sinuous stripe of the upper surface; body below sordid white, palpi and legs rosy. Expanse of wings 5 inches 10 lines.

This beautiful species most nearly agrees with the Mexican *T. dictynna*, but differs in the absence of the conical chocolate patch uniting the ocellus of primaries to the costal border, in the more wavy discal stripe, and the presence of a second stripe towards the base of the primaries.

Linnæus evidently confounded *T. dictynna* with *T. luna*; for although, in the 10th edition of his 'Systema,' he quoted Catesby's figure of the North-American insect and Petiver's representation of the same species as illustrations to his brief diagnosis, yet for the fuller description given in the 'Museum of Ulrica' he quoted Clerck's 'Icones' first of all; and the figure in the latter certainly represents the Mexican species, inasmuch as the wings are crossed by a well-defined discal stripe. It is probable that both descriptions are taken from the northern type.

Limacodidæ.

20. *Narosa culta*, n. sp. (no. 771).

Primaries above pale pinky brown; an irregular transverse subbasal olivaceous line followed by a broad unequal central olivaceous belt, a line of the same colour parallel to and immediately beyond the central belt; a black oblique patch just beyond the end of the cell, and above it one or two little brown lines; a rather broad olivaceous discal belt, indistinct towards the inner margin; a subconfluent marginal series of black dots: secondaries pale silky brown, with a dusky marginal line: body pale brown. Primaries and pectus below shining greyish brown; secondaries shining whitish, with indistinct irregular dusky discal line, a discocellular lunule and an interrupted marginal line blackish: venter whitish. Expanse of wings 1 inch 1 line.

Lasiocampidæ.

Mr. Pryer has sent home a pair of a curious variety of *Œona segregata*, in which the bands are ferruginous instead of blackish.

Hepialidæ.

21. *Gorgopis niphonica*, n. sp. (no. 236).

Primaries above olive-brown, shot with rose-colour towards the outer margin; the subbasal area darkest, marked with two unequal white dots placed obliquely; a spot closing the cell, an irregular discal series doubled above the median vein, and a marginal series deep olivaceous: secondaries greyish brown, shot with rose-colour; fringe brown, spotted in the middle with cream-colour: thorax olivaceous; abdomen greyish brown. Under surface bronzy olivaceous, tinted with rose-colour. Expanse of wings 1 inch 4 lines.

Cymatophoridæ.

22. *Cymatophora plumbea*, n. sp. (no. 625).

Silvery grey, primaries more metallic and less brown in tint than the secondaries; basal area crossed by six parallel blackish irregular lines, the three outer of which are thicker and more distinct than the others; a widely sinuated blackish line beyond the cell, followed immediately by two or three undulated parallel white-margined grey lines; veins on the disk alternately black and white; outer border broadly dusky, crossed by a white line limiting the dots on the veins; a wavy marginal blackish line; fringe sordid white, traversed by a dusky line: secondaries pale brownish, with broad diffused brownish external area, a whitish discal stripe, and a well-marked blackish dorsal tuft: thorax white, speckled with black, giving it the appearance of the colour of the primaries. Under surface pale whity brown, shining; a white-bordered dusky discal stripe; pectus white. Expanse of wings 2 inches.

Bombycoidæ.

Belosticta, n. gen.

Allied to *Acronycta*, but differing in the much more elongated form of the primaries, giving it quite the aspect of a Notodont: palpi much broader than in *Acronycta*, legs hairy; pectus clothed with long hair. Type *B. extensa*.

23. *Belosticta extensa*, n. sp. (no. 739).

Pale greyish brown; primaries indistinctly banded with bronzy brown; the discoidal spots black-edged; two widely divergent irregular white-edged black lines across the wings;

an oblique black litura between these lines and below the orbicular spot; veins on the disk alternately black and white, a series of more or less sagittate interneural black streaks along the external border, most prominent near external angle, limited internally by an ill-defined whitish line; an undulated marginal black line, fringe sordid white; thorax whitish: under surface whitish, primaries and pectus tinted with pale purplish brown; wings shining. Expanse of wings 2 inches 2 lines.

24. *Acronycta consanguis*, n. sp. (no. 637).

Close to *A. menyanthidis*, but decidedly greyer, the sagittate marking near external angle of primaries more distinctly and neatly formed, as in *A. tridens*, the ≈-like marking at the base replaced by a black-edged 8-shaped brownish marking. Expanse of wings 1 inch 7 lines.

The secondaries of this species are decidedly browner than in *A. menyanthidis*, and there is a well-defined pale brown discal stripe.

Leucaniidæ.

25. *Mythimna deparca*, n. sp. (no. 703).

Allied to *M. placida*; primaries pale greenish buff-coloured, external third ferruginous, crossed longitudinally by grey veins spotted with black, and transversely by a somewhat angulated dark-edged yellow line limiting the external border; inner edge of the external third regularly undulated, a slightly darker ferruginous undulated line just inside it across the disk; two geminated dark grey lines, converging towards costa, upon the basal area, a black dot between these within the cell, and a second below the cell; discoidal spots outlined in ferruginous, the reniform placed upon a ferruginous nebula from which a streak of the same colour runs to the inner margin; fringe rosy ferruginous, traversed by a grey line and spotted with ochreous: secondaries bronzy brown, darkest at outer border; fringe rosy, with yellow basal line: body above greenish buff-coloured, the centre of the thorax and fringe of the abdomen ferruginous; antennæ with brown pectinations. Wings below shining whity brown, with ferruginous borders, blackish discocellular spots, a dusky submarginal line; primaries clouded with greyish brown: body below ferruginous; palpi and upper surface of front legs purplish brown, tarsi yellowish; other legs above blackish, banded with white, below ochreous. Expanse of wings 1 inch 7 lines.

26. *Leucania Loreyi*, Duponchel (no. 648).

I at first thought this species distinct from the European form; but a close comparison under the lens has satisfied me that it is only a slightly rubbed example; all the markings are the same.

27. *Leucania extranea*, var., Guén. (no. 647).

This is a singularly sandy-coloured variety which at first sight I was inclined to believe a distinct species; I have, however, found a specimen similarly coloured in the collection from India.

28. *Nonagria turpis*, n. sp. (no. 655).

Whity brown; primaries with a curved series of black dots beyond the middle; thorax darker brown: wings below paler, shining, with blackish marginal dots, discocellulars and an indistinct discal line grey; body below brownish. Expanse of wings 1 inch 4 lines.

Xylophasiidæ.

29. *Xylophasia scitula*, n. sp. (no. 751).

Primaries above clay-brown, sericeous, traversed by three very irregular paler lines—the innermost line limiting the basal third, subangulated, spotted with black, the central line oblique discal, dentate-sinuate, with the denticles represented by pale-edged black dots upon the veins, outermost line irregularly undulated, limiting the external border, bounded internally on costal border by an ill-defined greyish diffused spot or nebula; one or two black dots on the costal margin, and a series between the veins on the outer margin; secondaries shining fuliginous brown, with pale argillaceous, traversed by a dusky line; thorax red-brown, with the front of the collar pale; abdomen fuliginous, with reddish fringe. Under surface fuliginous; wings paler than the thorax and shining, outer border whity brown; discocellular spots and a discal stripe dark brown; a marginal series of black dots, costa of primaries tawny; coxæ and fringes of legs purplish brown; venter whitish, with lateral black spots and yellowish fringe. Expanse of wings 1 inch 6 lines.

30. *Dipterygia caliginosa*, Walker (no. 659).

Closely allied to *D. pinastri*, but larger and much darker, less red in tint, the oblique undulated outline of the dark area less oblique, and consequently with shallower sinuations; body altogether of a more smoky tint; under surface shining grey, the postmedian line much less strongly defined and placed at nearly twice the distance from the outer margin. Expanse of wings 1 inch 8 lines.

Referred by Walker to the genus *Hadena*.

Apameidæ.

31. *Apamea limbata*, n. sp. (no. 749).

Primaries sandy whitish, mottled with grey, the central belt represented by two divergent undulated geminate black lines enclosing the discoidal spots, which are also outlined in black; reniform spot dark grey; an abbreviated black geminate litura close to the base, the costal area between the latter and the central belt suffused with dark grey; area between the central belt and the irregular outer border blackish, excepting at inner margin; outer border whitish, with widely bisinuate internal edge, a few scattered black scales and a marginal series of black dots; fringe testaceous, spotted with black: secondaries silky white, the external area, especially at apex, suffused with smoky brown; a spot closing the cell and a dentate-sinuate discal line of the same colour: body greyish brown; tegulæ grey at base, metathorax crossed by two subconfluent grey spots. Wings below shining sordid white; primaries slightly suffused with grey and with a distinct externally excised discal grey belt followed by a slender line of the same colour, marginal dots and fringe as above; secondaries with a spot at the end of the cell, a number of scattered scales on the costal area, a discal series of abbreviated dashes, and a marginal series of dots black: body below sandy brownish. Expanse of wings 1 inch 7 lines.

Possibly this may be the "*Caradrina variolosa*" of Motschulsky; but if so, the description is too imperfect for satisfactory identification.

Noctuidæ.

32. *Agrotis depravata*, n. sp. (no. 660).

Primaries whity brown, spotted here and there with greyish brown; an abbreviated black-edged zigzag pale line limiting the basal area; upon the latter several dark brown spots; two irregular parallel discal series of black lunules and a marginal series of partially confluent black dots; discoidal spots indistinctly indicated by black scales: secondaries sordid white, with diffused brown external area and blackish marginal line: body sordid whitish. Under surface sordid sericeous greyish white; wings with a slender black-dotted marginal line. Expanse of wings 1 inch 4 lines.

33. *Epilecta decorata*, n. sp. (no. 697).

Primaries above sap-green, the internal border from the inner edge of the central belt, and the external area suffused with red-brown, central belt indicated by two widely separated black-edged, pale green, lunulated stripes; a third somewhat similar stripe near the base; a blackish diffused spot at basal third of interno-median interspace; costal margin interrupted by oblique blackish spots and dashes, several of which are continuous with the transverse stripes; orbicular and reniform spots formed of dark grey annular markings enclosed within black lines, the reniform interrupting a subangulated red-brown stripe which crosses the wing; a submarginal series of spots, black internally and green externally; a wavy black marginal line, the sinuations of which enclose a series of pale dots at the base of the fringe: secondaries bright ochreous, clothed at base and on abdominal area with pale golden-brown hair; a large black discocellular spot; costal border fuliginous brown, shining; outer border, and several spots on the fringe confluent with it, broadly black: thorax green, varied with brown; abdomen brown. Primaries below stramineous, costa and outer border whity brown, a subcostal streak, a broad almost triangular discal patch (crossed by darker stripes), and a series of marginal dots blackish; secondaries bright ochreous, costal border whity brown, discocellular spot and outer border nearly as above; pectus greyish white; tarsi banded with black and white; venter brown. Expanse of wings 2 inches.

34. *Triphænopsis efflorescens*, n. sp. (no. 696).

Primaries above with the basal two thirds greyish brown, irrorated with bright green, mottled and striped with black, external third red-brown, crossed by an irregular blackish stripe limiting the outer border; a large white spot just beyond the reniform spot (which is black) edged with green: thorax brown, speckled with green and black, with dorsal orange tufts; the sides of the head, margin of collar, and shoulders white: secondaries bright ochreous, a broad streak in the cell, a broad interno-median streak from base to outer margin, the abdominal border, a large spot at the end of the cell, and a broad external border dark brown; costal border pale brown: abdomen brown. Primaries below sericeous brown, with the interno-basal area, a patch beyond the cell, the apical area, and outer margin pale stramineous; secondaries nearly as above, but the longitudinal streaks more slender: body pale greyish brown. Expanse of wings 2 inches.

35. *Graphiphora lepida*, n. sp. (no. 707).

Rosy brown, sericeous: primaries with the orbicular and reniform spots confluent and uniting with a longitudinal abbreviated basal dash below the median vein, these markings all very dark olive-brown; two very slender and irregular zigzag blackish central lines; a bisinuated submarginal series of pale-edged brown spots: secondaries dusky towards outer margin, fringe pale: thorax pale brown, with a greyish tint, rosy in front, with a blackish bisinuated line across the collar; head red-brown; abdomen brownish testaceous, with clay-coloured fringe. Wings and body below pale rosy brown; primaries greyish in the middle, discocellular spots and two continuous parallel discal lines grey. Expanse of wings 1 inch 8 lines.

36. *Graphiphora lubentia*, n. sp. (no. 699).

Primaries shining rosy brown, a chocolate-coloured nebula relieving the discoidal spots (which are well-defined and large), and limited internally by two parallel angulated brown lines, which cross the wing at basal two fifths; two or three brown markings near the base; two arched discal lines placed close together, the inner one undulated; a slightly wavy brown line, interrupted towards costa and terminating upon the costa in an oblique blackish dash, limiting the external area: secondaries silky greyish brown, darkest upon the outer border; fringe stramineous: thorax rosy brown, varied with chocolate-colour: abdomen greyish brown. Primaries below shining greyish brown, with reddish costal and external borders: secondaries shining creamy white, with broad, reddish, costal border, a greyish-brown streak parallel to the outer border, and an abbreviated discal line of the same colour across the costal area: body rosy brownish. Expanse of wings 1 inch 9 lines.

This species seems to be allied to "*Noctua*" *fuscostigma* of Bremer.

Orthosiidæ.

Mr. Pryer has sent an example of the European genus and species *Panolis piniperda*.

37. *Tæniocampa evanida*, n. sp. (no. 712).

Sordid whity brown: primaries crossed near the middle by two parallel straight dusky lines, terminating in the cell on each side of the orbicular spot; the latter is large and oblique, and touches the reniform spot, which is also large; the area enclosed between these spots is greyish brown, and the spots themselves are indicated by a dark brown outline; an indistinct zigzag discal line, beyond which the ground-colour is paler; a dark brown line edged with whitish, straight almost to the costa, and then slightly irregular, limiting the external area; a marginal series of black dots: secondaries with the discocellular spot and an oblique anal streak dusky; an incomplete series of blackish marginal dots: abdomen tinted with gravel-yellow. Wings below whitish, sericeous, irrorated with grey; primaries suffused with grey; secondaries with a black discocellular spot: body below testaceous. Expanse of wings 1 inch 10 lines.

38. *Eupsilia strigifera*, n. sp. (no. 726).

Pale rusty brown: primaries crossed by three slightly curved parallel and nearly equidistant white lines, the two inner ones being rather nearer together than the second to the third, a fourth yellowish line with the usual subcostal elbow limiting the external border, a blackish dot at each corner of the discoidal cell, but the ordinary discoidal spots obsolete; secondaries shining whity brown, with diffused grey border and reddish fringe: body with the thorax rather deeper in colour than the abdomen. Under surface altogether pale whity brown, with a rosy tinge; wings sericeous, with traces of two parallel pale-edged dusky lines; costal borders slightly irrorated with blackish scales; fringe of primaries red-brown; anterior coxæ and palpi also red-brown, but not much darker than the rest of the body. Expanse of the wings 1 inch 6 lines.

39. *Dasycampa evelina*, n. sp. (no. 725).

Primaries pale gravel-brown, with a rosy tint over them; all markings very indistinct, and almost all with slightly paler margins; the first line at basal third, the second from reniform spot to inner margin, the third irregularly undulated and crossing the disk, the fourth submarginal and interrupted throughout by a series of black dots; a marginal series of brown lunules; fringe greyish; discoidal spots indicated by yellowish outlines: secondaries grey, with dark diffused outer border and pale rosy fringe, traversed by a grey line: body rosy, the abdomen greyish. Under surface shining rosy whitish: the primaries, with the exception of the costal margin, apical and external areas, suffused with grey; two dusky dots on the discocellulars, two parallel sinuous discal lines and the external edge of the fringe dark grey: secondaries with a black discocellular lunule; a trisinuated, slender, black, discal line speckled with rosy scales. Expanse of wings 1 inch 5 lines.

40. *Dasycampa ardescens*, n. sp. (no. 724).

Primaries rich laky brown, sericeous; markings similar to those of the preceding species, but redder, reniform spot partly grey: secondaries pale brown, with reddish fringe: thorax coloured like the primaries; abdomen wanting (probably pale brown, with reddish fringe). Wings below pale shining rust-red, with indistinctly brown, undulated, marginal line and minute, black, marginal dots: primaries suffused with pale greyish brown, excepting on the costal and external areas; secondaries with a black discocellular spot, and a wavy grey discal line: pectus dull red. Expanse of wings 1 inch 7 lines.

41. *Mesogona dilatata*, n. sp. (no. 706).

Primaries above greyish brown, shot with lilac, inner margin slenderly sordid white; two brown lines across the basal area and two across the disk, the latter very regular, slightly arched; a dusky brown streak across the wing just beyond the middle, obscuring the reniform spot, which is barely visible; orbicular spot grey, upon a pale brown background; a marginal series of blackish dots: secondaries shining brown, with stramineous fringe: head and thorax purplish brown; tips of palpi, front of head, and antennæ whitish; abdomen pale sandy brown. Under surface reddish; primaries with the basal three fourths, excepting the costal border, greyish. Expanse of wings 2 inches 1 line.

42. *Mesogona divergens*, n. sp. (no. 722).

Shining cupreous brown; primaries clearer and more coppery in tint than the secondaries or body, which are slightly greyish; markings of primaries, chiefly red-brown, as follows—two widely divergent oblique lines crossing the wing at basal and apical thirds, outlines of the two usual discoidal spots, an ill-defined streak from the reniform spot to the inner margin, and scarcely visible indications of a submarginal irregular greyish line; fringe of secondaries clear; thorax darker than the primaries, greyish behind; abdomen grey, with a somewhat reddish fringe. Under surface generally clearer and redder than the upper surface: wings with two parallel dusky discal lines and dusky discocellular spots; primaries broadly suffused with grey; secondaries whitish, with reddish borders: body dull fleshy reddish. Expanse of wings 1 inch 8 lines.

Cosmiidæ.

43. *Cosmia achatina*, n. sp. (no. 734).

Primaries clay-brown, basal and external areas irrorated with blackish scales; a broadly dentate-bisinuate submarginal stripe, an angulated discal crenulated line, the margin of the orbicular spot, and two irregularly undulated oblique lines across the basal area sordid white; a blackish angulated line partially obscuring the reniform spot, which is indistinctly outlined in whitish; each of the lines united with a black spot on the costal margin: secondaries laky brown, with broad, diffused, blackish outer border, blackish discocellular lunule, and golden-yellow fringe: body pale bronzy brown. Wings below altogether paler; primaries pale brown, with a blackish discal belt, confined within two darker lines which extend beyond it from the costal almost to the inner margin; a pale costal patch just beyond the cell, and a white subapical spot; a marginal series of black dots: secondaries pale testaceous, with a diffused blackish subcostal spot and two discal lines, diffused between the median vein and the anal angle; a black discocellular lunule; a marginal series of black lunular markings. Body below whitish. Expanse of wings 1 inch 4 lines.

Xylinidæ.

44. *Xylina mirabilis*, n. sp. (no. 622).

Primaries with the costal half pearly white, the internal half pale bronzy brown; a black spot at base of internomedian interspace; an oblique dark brown fasciole from costal margin to median vein at basal fifth; costa beyond this fasciole dark brown; a slightly oblique longitudinal brown stripe from the apex to just beyond the cell, where it joins a slender, postmedian, irregular, transverse line; a similar line from the inferior extremity of the subbasal fasciole; a maculated, white-edged, dark brown submarginal line; a very indistinct transverse line between the latter and the discal line; a series of dark brown marginal lituræ almost confluent, so as to give the appearance of a crenulated line; a black spot at end of cell; fringe grey: secondaries white, with pale brownish outer border; thorax dark brown; abdomen white. Under surface sordid white; primaries brownish, with white and dark brown apical costal dashes: secondaries almost pure white, with pale golden-brown borders: body, with the knees of the legs, black; tarsi brown. Expanse of wings 1 inch 10 lines.

Acontiidæ.

45. *Acontia noloides*, n. sp. (no. 767).

Allied to *A. signifera*. Primaries above chalky white, a semicircular costal brown spot at basal fourth, two or three black dots at base; a grey spot towards the middle of the interno-median interspace; a rather irregular, central, brown band enclosing the reniform spot, which is represented by two black dots enclosed in a white 8-shaped figure; an indistinct blackish zigzag line just beyond the band, followed by an interrupted grey discal belt; an interrupted red-brown marginal border enclosing externally white-edged black dots; fringe pale pinky brown, spotted and edged with blackish: secondaries pale greyish brown, with creamy whitish fringe: thorax white, with brown-edged collar; abdomen brown. Primaries below brown, with pale-bordered, black, marginal dots; fringe whitish, spotted and edged with blackish: secondaries sordid white, costal area grey-speckled; two grey discal stripes, the inner one indistinct; discocellular spot and a marginal series of dots blackish: body brown, legs pale. Expanse of wings 8 lines.

The primaries above are marked somewhat as in *Nola candida*.

46. *Acontia arefacta*, n. sp. (no. 769).

Primaries above with the basal third sordid white, limited externally by a slightly angulated black line; external two-thirds pale golden brown, crossed in a line with the end of the cell by a very irregular, internally black-edged, white line, just beyond which the ground-colour is also whitish; orbicular and reniform spots represented by white-edged black dots; a very irregular, sinuated, submarginal, white line; fringe creamy white, traversed by a grey line: secondaries pale brown, with basal and costal areas whitish; fringe as in primaries: body sordid white. Wings below altogether paler than above; a grey discal line. Expanse of wings 9 lines.

Anthophilidæ.

47. *Anthophila hebescens*, n. sp. (no. 770).

Primaries above buff; a broad, indistinct, oblique, yellowish-edged, rosy belt across the disk; outer border and fringe tinted with rose-colour: secondaries greyish brown, with whitish fringe: body whity brown. Under surface chalky white; primaries with a greyish median suffusion. Expanse of wings 9 lines.

This is a dull little species.

Eurhipidæ.

48. *Thyris usitata*, n. sp. (no. 252).

Dark purplish brown, with cupreous reflections: wings spotted with golden yellow, most of the spots forming a submarginal series; primaries with two unequal and nearly central hyaline white spots, the larger one in front of the smaller; secondaries with a broad, irregular, hyaline, white belt upon the basal half, but not reaching the costal margin: head, collar, and palpi golden yellow at the sides; tegulæ edged internally with yellow; a snow-white spot on the shoulder; abdomen crossed by two slender white bands. Wings below nearly as above, the yellow spots larger and more numerous: venter crossed by two broad white belts. Expanse of wings 8½ lines.

The above description is taken from specimens obtained by Mr. Jonas. I delayed describing the species as I not only felt doubtful as to its correct location, but was uncertain as to the constancy of the characters distinguishing it from *T. fenestrella* of Europe. I now feel satisfied that it is distinct, having seen additional examples; and I have little doubt that its natural position is amongst the Noctuites, in the neighbourhood of *Penicillaria*.

49. *Penicillaria costalis*, n. sp. (no. 750).

Primaries purplish brown, the costal border, basal half of cell, median vein, and a V-shaped marking at the end of the cell (enclosing two dark brown lines) pale buff, two slender irregular black lines with dull castaneous borders indicating the central band; a reddish and black dash at base; a diffused castaneous nebula near the external angle, crossed by a submarginal series of >-shaped black markings; a whitish undulated marginal line: secondaries smoky brown, the discocellulars and marginal line dusky; a whitish line at the base of the fringe: body dark brown; the head, collar, and sides pinky buff. Under surface yellowish; a brownish diffused apical patch: secondaries with a blackish discocellular spot; two indistinct brown discal lines. Expanse of wings 1 inch 6 lines.

Plusiidæ.

50. *Plusia pyropia*, n. sp. (no. 795).

Primaries above fuliginous brown, with the central and externo-apical areas fiery cupreous; two widely separated, almost parallel, oblique, dark brown lines (the inner one slenderly edged internally with silver) representing the central belt, and enclosing two silver spots placed obliquely end to end in the centre of the wing; a zigzag dark brown line halfway between the central belt and the outer margin; fringe at apex cinereous: secondaries and body pale smoky brown, the former with the external half darker; head and collar salmon-coloured. Primaries below grey, with the veins and borders sandy yellowish; secondaries pale buff, with a discocellular dot and a diffused angulated discal belt, limited internally by a darker line, grey; palpi and front of anterior coxæ reddish brown. Expanse of wings 1 inch 2 lines.

About the size and coloration of *P. rutila*, but more nearly allied to *P. ornatissima*.

51. *Plusia serena*, n. sp. (no. 789).

Allied to *P. gamma*, but smaller and shorter in wing, the "gamma" marking clearly cut, slender, and golden; the pale cloudings less prominent, more as in *P. u-aureum*; the secondaries with the dusky border less strongly defined. Under surface nearly as in *P. u-aureum*. Expanse of wings 1 inch 4 lines.

Mr. Pryer has sent the female of *Deva splendida*, an example of the West-Indian species *Gonitis fractifera* differing in no respect from specimens taken in Jamaica, a female of *Toxocampa enormis*, a male of *Catocala nivea*, a large variation of *C. mirifica*, a specimen of *Nyctipao crepuscularis*, and what seems to be an interesting variety of *Hypopyra dulcina*. Another species of Hypopyridæ is the so-called *Remigia ussuriensis* of Bremer, which is referable to the genus *Entomogramma*.

Focillidæ.

52. *Lacera procellosa*, n. sp. (no. 816).

Closely allied to *L. capella*, with the same general pattern; larger, considerably darker, the projections of the outer margin in the primaries much more prominent, the outer margin of the secondaries noticeably more angulated; most of the pale spots and lines on the wings more distinct and sharply cut, but the transverse pale buff subapical dots absent or indistinct; the submarginal zigzag lines of the primaries exceedingly irregular, the inner one distinctly whitish in the centre; secondaries considerably larger, the borders of the marginal black spots cinereous; under surface of the secondaries much more varied with pale greenish, the subapical black spots reduced to one, which is less sharply defined; the black edging of the central band equal on both sides. Body dark smoky brown, almost black; the anterior femora with enormous development of woolly hair, their posterior and interior surfaces sordid buff-coloured. Expanse of wings 2 inches 6 lines.

Thermesiidæ.

53. *Bithiasa notigera*, n. sp. (no. 923).

Smoky brown: primaries with a minute white discocellular crescent, two scarcely visible wavy parallel lines, of a slightly darker hue than the ground-colour, just beyond the middle; external border limited by a similarly indistinct line; both it and the inner of the discal lines edged with white upon costal area; subapical portion of the external border snow-white, crossed by two zigzag brown lines, the outer of which is marginal and only distinctly visible because of the white fringe: secondaries with three indistinct lines, the innermost limited by the discocellular lunule, which is white; the second just beyond the cell, dentate-sinuate and partly edged with whitish; the third limiting the external border, dentate-sinuate and margined by white dots: anus with whitish tuft. Under surface as above. Expanse of wings 1 inch 4 lines.

54. *Capnodes curvipalpis*, n. sp. (no. 926).

Dark smoky brown, with a faint purplish reflection: wings from the centre crossed by three partly white-edged irregularly zigzag black lines; a marginal series of subconfluent triangular black spots, followed by a whitish line at the base of the fringe; the latter grey, traversed by a brown stripe; primaries with a partly white-edged zigzag black line near the base, discoidal spots small and buff-coloured. Wings below speckled with white scales, markings as above; tarsal joints white-edged. Expanse of wings 1 inch 2 lines.

Ennomidæ.

55. *Epione grata*, n. sp. (no. 363).

Pale golden brown; a line from apex of primaries to middle of abdominal margin of secondaries, the fringe, an angulated line limiting the basal area of primaries, and an oblique subapical costal dash ferruginous; costal area of primaries and the outer edge of the central line pearly greyish; secondaries with an arched grey discal line. Under surface bright yellow, mottled with laky red; external area clouded with pink and lilac and limited internally by an arched, slightly sinuated blackish line; a ferruginous line across each wing, that of primaries at basal third angulated, that of secondaries just beyond the cell and nearly straight; primaries with blackish discocellular dot. Expanse of wings 1 inch 3 lines.

E. arenosa, a variety of *E. strenioides*, and the male of *E. leda* have been sent from Yokohama by Mr. Pryer.

56. *Hyperythra stulta*, n. sp. (no. 364).

Sordid stramineous; external and internal areas of the wings shining, pearly; a dull testaceous nebula near the external angle of primaries; secondaries with a discocellular spot and numerous short striæ grey: body duller and more sordid than the wings, the tegulæ and main stem of antennæ whitish. Under surface sulphur-yellow, the wings sparsely sprinkled with little grey striations; discocellulars of primaries covered by a grey-bordered white litura, a diffused transverse abbreviated grey streak crossing the median branches almost to the inner margin; secondaries with a small 8-shaped grey discocellular marking: body sordid. Expanse of wings 1 inch 3 lines.

57. *Angerona nigrisparsa*, n. sp. (no. 373).

Clear ochre-yellow, the wings sprinkled with circular black dots; a marginal series of black dots terminating the veins; antennæ with brown pectinations; abdomen greyish: under surface paler, but otherwise as above. Expanse of wings 2 inches.

58. *Nematocampa straminea*, n. sp. (no. 484).

Nearly allied to *N. resistaria* of North America, much larger, paler, and with more numerous lines across the wings. Above cream-coloured, the body and bases of wings yellowish: primaries crossed by three nearly parallel angulated dark greyish-brown lines, a broad patch of the same colour at external angle; the discocellulars, the nervules, outer margin, and a number of fine short striæ upon the basal, costal, internal, and discal areas dark greyish brown: secondaries with the external two fifths, two central lines (the outer one angulated), the veins, and a number of speckles upon the abdominal area dark greyish brown: antennæ greyish. Under surface chalky white; the wings with two slender central lines, the discocellulars, a few scattered striations, the margin, and tips of fringe greyish brown; primaries with an abbreviated line across the middle of the cell, and a little patch near external angle, also greyish brown. Expanse of wings 1 inch 2 lines.

59. *Endropia gracilis*, n. sp. (no. 502).

Wings subangulated, above pale sandy brown, speckled with grey and black dots; a larger black dot on the discocellulars; an irregularly edged straight discal greyish fuscous stripe: primaries with a second interrupted angulated stripe limiting the basal area; costal margin up to the angulated stripe blackish; a blackish pyriform spot upon the outer margin just below the apex: thorax white, with blackish shoulders and brown anterior margin; head and collar orange; abdomen pale sandy brownish speckled with black dots. Under surface bright stramineous, the wings speckled and striated with dark brown; the indistinct stripes of the upper surface replaced by dark brown ones, the discal stripe being placed upon a diffused ferruginous band: body whitish, with the tibiæ and tarsi stramineous, bases of the tibial spines black. Expanse of wings 1 inch 4 lines.

60. *Endropia abjecta*, n. sp. (no. 366).

Pale testaceous, tinted with pink, mottled and speckled with grey: primaries with the apical two fifths bronzy brownish; two transverse externally white-edged ferruginous lines—the inner one at basal third straight, the outer one, which crosses the disk obliquely, abruptly angulated towards apex; a triangular costal lilacine patch between the outer line and the apex; a ferruginous discocellular lunule: secondaries crossed by a central line similar to those of primaries; a slightly irregular grey discal line: body greyish. Under surface saffron-yellow, mottled with rose-colour, with bright rust-coloured lines, as above in shape; legs orange. Expanse of wings 1 inch 8 lines.

I find, from an examination of specimens in Mr. Moore's collection, that my genus *Thiopsyche* will have to sink as a synonym of Walker's *Corymica*, the type of which is a Bornean species formerly in Mr. Saunders's collection and now in the Hope Museum at Oxford. Mr. Pryer has sent the female of *C. Pryeri*.

Amphidasidæ.

61. *Biston robustum*, n. sp. (no. 333).

Wings above smoky brown, with pink reflection, irrorated with black, crossed by three angulated and sinuated black lines, two of which are parallel and discal, the third crossing the discoidal cell and very indistinct upon the secondaries; primaries with an abbreviated central interrupted black stripe; secondaries paler than primaries: thorax blackish; the head, collar, and tegulæ pale greyish brown; abdomen smoky brown, with paler margins to the segments; antennæ testaceous. Primaries below smoky brown, with whitish mottlings and white borders; three costal black spots and a series of smaller spots along the outer margin: secondaries white, clouded with brown, speckled with black, and crossed by two angulated discal black lines: body below bronzy brown. Expanse of wings 2 inches 11 lines.

Boarmiidæ.

62. *Boarmia arguta*, n. sp. (no. 392).

Wings above white, densely and transversely striated with grey and blackish, and crossed by blackish belts arranged as in *B. lunifera*, but much broader and more prominent; a submarginal series of black-edged, white lunules, as in *B. lunifera* *, but much less prominent, those of primaries being barely distinguishable: body testaceous, thorax crossed by two transverse dusky strip . Under surface creamy white; wings with discocellular spots and an abbreviated discal series of dots dark grey; primaries with an angular subapical belt, enclosing a white apical patch, dark grey. Expanse of wings 2 inches 4 lines.

63. *Boarmia rimosa*, n. sp. (no. 394).

Sandy brown: primaries crossed by two interrupted sinuated oblique black lines, indistinctly edged with whitish; a brown-bordered zigzag whitish submarginal line: secondaries without the inner black line, but the others nearly as in primaries; an abbreviated, whitish, abdominal streak between the central black and the submarginal whitish lines. Wings below paler and greyer, crossed beyond the middle by a blackish-dotted paler stripe; a blackish dot on the discocellulars. Expanse of wings 1 inch 10 lines.

64. *Tephrosia petrosa*, n. sp. (no. 401).

Sandy yellow, densely mottled with dark brown; wings crossed at basal third by a mottled blackish band; a similar band, limited internally by a continuous dentate-sinuate black line; an interrupted submarginal series of externally pale-edged blackish spots; an undulated interrupted black marginal line. Under surface whity brown, mottled and striated indistinctly with grey: primaries greyish towards the base; external two fifths smoky brown; discocellulars dusky: secondaries crossed

* Ill. Lep. Het. iii. pl. xlviii. fig. 10.

by three blackish spots, the central one being placed upon the discocellulars; a diffused indistinct discal brown stripe. Expanse of wings 1 inch 7 lines.

LYCAUGES, n. gen.

Allied to *Hemerophila*; but the wings with the margins rounded and entire (not dentate-sinuate), the secondaries rather narrower, the palpi slightly shorter, the legs comparatively longer and more slender. Type *L. lactea*.

The species of this genus are small, and might by a casual observer be mistaken for *Acidaliæ*.

65. *Lycauges lactea*, n. sp. (no. 453).

♀. Creamy white; wings with marginal and discocellular black dots; an ill-defined brown stripe, followed immediately by a dentate-sinuate brown line from apex of primaries to middle of abdominal margin of secondaries; an indistinct sinuated submarginal brown line: abdomen speckled with dark brown and with two or three dorsal black dots on the posterior segments. Under surface creamy white, purer than above; the wings sparsely speckled with brown and with greyish discocellular spots. Expanse of wings 11 lines.

66. *Argidava maculata*, n. sp. (no. 513).

Sordid, shining, chalky white; primaries with a black basal dot, two spots near the base followed by an arched series of four crossing the basal third, a large spot at the end of the cell, two slightly undulated discal series (some of the spots in the outer series being large), and a marginal series of dots, all black; secondaries with a grey dot at the end of the cell, indications of a submarginal line and marginal dots of the same colour: front of head black, thorax greyish. Primaries below silvery grey, with barely a trace of any spots; secondaries shining white, with markings as above: body white. Expanse of wings 1 inch 1 line.

67. *Ophthalmodes cretacea*, n. sp. (no. 406).

Chalky white: wings crossed by two black lines, the outer one dentate-sinuate and postmedian; a black-edged grey spot at the end of each cell; two brownish discal stripes beyond the outer black line, the inner one close to it, the outer one submarginal; the outer border sprinkled with brownish scales; a marginal series of elongate black spots or fragments of lines: primaries with the inner black line placed far from the outer one near the base, and bounded internally by a brownish band; a second, indistinct band from the discocellular spot to the inner margin: secondaries with the inner black line close to the discocellular spot and placed upon a brownish diffused streak or band: abdomen with indications of brown spots in pairs upon each segment. Wings below white, the markings of the upper surface for the most part obsolete; discocellular spots black and prominent; a marginal series of black dots and a dentate-sinuate brown postmedian line; primaries with a brown subapical patch or belt enclosing a quadrate apical white spot. Expanse of wings 2 inches 3 lines.

[To be continued.]

XLII.—*On the Nutritive and Reproductive Processes of Sponges.* By H. J. Carter, F.R.S. &c.*

Conflicting statements have been made respecting the nourishment of sponges, which need but a little explanation to become reconcilable.

The subject has only just now presented itself separately, because it has hitherto been implied rather than stated that the nourishment of sponges was derived from foreign bodies observed in their interior.

* *Publications to which reference is made in the following Communication.*

1. 1826. Grant, R. "Observations on the Structure and Functions of the Sponge." (Concluded.) *Edinburgh New Philosophical Journal,* vol. ii. p. 121, pl. ii.
2. 1848. Carter, H. J. "Notes on the Species, Structure, and Animality of the Freshwater Sponges in the Tanks of Bombay." *Ann. & Mag. Nat. Hist.* ser. 2, vol. i. p. 303.
3. 1849. ——. "A Descriptive Account of the Freshwater Sponges in the Island of Bombay, with Observations on their Structure and Development." *Ib.* vol. iv. p. 81, pls. iii.–v.
4. 1854. ——. "Zoosperms in *Spongilla.*" *Ib.* vol. xiv. p. 334, pl. xi.
5. 1856. Lieberkühn, N. "Beiträge zur Entwicklungsgeschichte der Spongillen." *Archiv für Anat. Physiol. und wissenschaftliche Medicin*, pp. 1, 399 & 496, Taf. xv. und xviii.
6. 1857. Carter, H. J. "On the Ultimate Structure of *Spongilla*, and Additional Notes on the Infusoria." *Journal Bombay Asiatic Society*, vol. v. p. 574, April 9th, reprinted in *Ann. & Mag. Nat. Hist.* ser. 2, vol. xx. p. 21, pl. i.
7. 1857. Lieberkühn, N. "Beiträge zur Anatomie der Spongien." *Archiv für Anat. Physiol. und wissenschaftliche Medicin*, p. 376, Taf. xv. Juni (*der Gesellschaft naturforschender Freunde mitgetheilt in den Sitz.* v. 6. Sept. u. 2. Dec. 1856).
8. 1859. Carter, H. J. "On Fecundation in the Two *Volvoces* and their Specific Differences; on *Eudorina*, *Spongilla*, *Astasia*, *Euglena*, and *Cryptoglena*." *Ann. & Mag. Nat. Hist.* ser. 3, vol. iii. p. 1, pl. i.

Still, while attempting this reconciliation, it is necessary to bear in mind that the sponge-cell is unceasingly polymorphic except under the resting-form, which is spherical, and that this polymorphism enables it to assume a monadic monociliated form at one time and immediately afterwards almost any unciliated amœboid one that can be conceived—apparently amalgamating with its neighbours into a homogeneous mass, yet at any moment ready to separate and resume any of its wonted forms under favourable circumstances.

In 1849 I noticed that the "sponge-cell *itself* frequently contained pieces of *Confervæ* within duplicatures of its cell-wall, and other matters" similar to what might be seen in the "proteus" = *Amœba* (no. 3, p. 94); also that the "living sponge" presents "*ejecta*" on its surface, which "consist

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9. 1867. James-Clark, H. "Spongiæ ciliatæ as Infusoria flagellata." *Boston Soc. Nat. Hist. Mem.* vol. i. pt. 3, pls. ix. and x.

10. 1869. Carter, H. J. "On *Greyella cyathophora*, a new Genus of Sponges." *Ann. & Mag. Nat. Hist.* ser. 4, vol. iv. p. 189, pl. vii.

11. 1872. Häckel, E. 'Die Kalkschwämme.' 3 vols. (Two text, one Atlas.)

12. 1874. Carter, H. J. "On the Nature of the Seed-like Body of *Spongilla*; on the Origin of the Mother-cell of the Spicule; and on the Presence of Spermatozoa in the Spongida." *Ann. & Mag. Nat. Hist.* ser. 4, vol. xiv. p. 97, pl. x.

13. 1874. ——. "Development of the Marine Sponges from the earliest recognizable Appearance of the Ovum to the Perfected Individual." *Ib.* vol. xiv. p. 321, pls. xx.–xxii.

14. 1875. Schulze, F. E. "Ueber den Bau und die Entwicklung von *Sycandra raphanus*, Häckel." *Zeitschrift für wissenschaftliche Zoologie*, Bd. xxv. Suppl. Taf. xviii.–xxi.

15. 1876. Barrois, Ch. "Embryologie de quelques Éponges de la Manche." [Inaugural Thesis.] *Annales des Sci. Nat. Zoologie*, sér. 6, t. iii.

16. 1876. Keller, C. 'Untersuchungen über die Anatomie und Entwicklungsgeschichte einiger Spongien des Mittelmeeres. Ein Beitrag zur Lösung der Spongienfrage.' 4to. Basel, 1876. Taf. i. u. ii.

17. 1877. Schulze, F. E. "Untersuchungen über den Bau und die Entwicklung der Spongien.—Die Gattung *Halisarca*." *Zeitschrift für wissenschaftliche Zoologie*, Bd. xxviii. Taf. i.–v.

18. 1878. ——. Untersuchungen über den Bau und die Entwicklung der Spongien.—Die Metamorphose von *Sycandra raphanus*." *Ib.* Bd. xxxi. p. 262, Taf. xviii. und xix.

19. 1879. Balfour, F. M. "The Morphology and Systematic Position of the Spongida." *Quarterly Journal Microscopical Science*, no. 73, p. 103.

20. 1879. Metschnikoff, E. "Spongiologische Studien." *Zeitschrift für wissenschaftliche Zoologie*, Bd. xxxii. p. 349, Taf. xx.–xxiii.

21. 1879. Carter, H. J. "Contributions to our Knowledge of the Spongida." *Ann. & Mag. Nat. Hist.* ser. 5, vol. iii. p. 284, pls. xxv.–xxix.

of the cast-off parts of organisms from which the nutrient parts have been abstracted (*ib.* p. 98).

In 1857 (while still at Bombay, and totally ignorant of what Lieberkühn subsequently published at Berlin in the month of June of that year, from his communications to the "Gesellschaft naturforschender Freunde," on the 6th Sept. and 2nd Dec. 1856) I stated, among numerous other observations on the development of *Spongilla* from the seed-like body, that, on watching the feeding of it with carmine under the microscope (with immersed object-glass, of course), the particles may be seen to pass into the ampullaceous sacs ("Wimperkörbe"), where they are "instantly enclosed by the sponge-cell (spongozoon) on which they inpinge" (no. 6, p. 28); that the colouring-matter then is "wholly confined" to the ampullaceous sacs, and that when the latter are torn to pieces it is found to be contained in their cells (spongozoa), some of which are mono- and others unciliated; further, that after a little time the circulatory system of the young *Spongilla* becomes suspended synchronously with the closure of its *now* single osculum and the retraction of the tubular process which supports it; this lasts for about a "quarter of an hour," when the circulation is resumed the proboscidian process reproduced, the osculum at its extremity reopened, and that portion of the particles of carmine which may be assumed to have been deprived of their nutritive parts may be seen to leave the ampullaceous sacs, one after another, and, passing along the canals of the excretory system, finally to rush out at the osculum (no. 6) *. Here, then, it was naturally implied, rather than stated, that this was at least one of the ways in which nourishment got into the sponge.

It is also desirable to note that, among the carmine-bearing cells torn out from the ampullaceous sacs, there were unciliated as well as monociliated cells, and to connect this with the fact that shortly after a monociliated sponge-cell is eliminated from the sponge it loses its active, living, monadic form, and, retracting its cilium (which is but a hair-like extension of its own polymorphic body), assumes the more passive, amœboid one, which is really the only visible characteristic distinction between the monociliated cell of the ampullaceous sac and the cell of the parenchyma. Hence, whether the foreign material be in one or the other, the nutritive process may be assumed to be the same in both.

In 1857, also, Lieberkühn stated that on feeding *Spon-*

* This paper, in importance and amount of fact, is, to me, the best I have ever published on sponges.

gilla with carmine the particles entering by the pores were conveyed to and stuck in ("stecken") the ampullaceous sacs ("Wimperorgane") (no. 7, p. 384); also that Infusoria passing through the "canal-system" were taken into the parenchyma ("Körperparenchym"), and there falling to pieces, after some time disappeared without leaving a trace behind, after the manner of an infusorium which had been devoured by an *Actinophrys* (*ib.* p. 388).

Although nothing is said here, again, about "nourishment," no one can doubt what was passing in Lieberkühn's sagacious mind at the time, viz. that the Infusoria thus afforded nutrient matter to the *Spongilla*.

We now come to Häckel's views in 1872, viz. that the flagellate cells of the endoderm ("Geisselzellen des Endoderms") are exclusively the organs of reception for the digestion of the food (no. 11, vol. i. p. 372); and these we may pass by with Metschnikoff's observation, viz. that they are theoretical and not founded on matter of fact (no. 20, p. 372). This brings us to the following statements of Metschnikoff himself in 1879, made under the heading "Ueber die Nahrungsaufnahme bei Spongien" (no. 20, p. 371).

Beginning with Lieberkühn's observations, Metschnikoff observes that they were made more than twenty years ago, and that their result has of late been "lost sight of." If it had not been for Lieberkühn's observations, my own, which were made seven years previously, would have shared the same fate (no. 5, p. 400).

With Metschnikoff undue prominence seems to be given to the cells of the parenchyma (mesoderm) in the nourishment of the sponge. It is true that he says the ampullaceous sacs ("Wimperkörbe") were "usually" empty, and that in some sponges nourishment is carried on by the mesodermal element. But why, with the facts above stated, should he give illustrations (no. 20, Taf. xxii. figs. 16, 17) wherein the mesodermal cells are represented as charged with particles of carmine and the ampullaceous sacs ("Wimperkörbe") empty, without in the text alluding to the opposite results of other experimenters, and conclude his observations with the statement that it was clear that the mesodermal cells could take in the material and were more or less able to digest it (no. 20, p. 374)?—which implies that they alone are the nutrient organs, as the ampullaceous sac ("Wimperkorb") is not mentioned.

It is possible, and I should think probable, that Metschnikoff has never seen my paper "On the Ultimate Structure of *Spongilla*" (no. 6), and therefore is not aware of the reflection which his observations cast on the statement that, in *my* experiments, the carmine or "colouring-matter was wholly confined to the ampullaceous sacs." But then he ought to have been acquainted with that of Lieberkühn to which I have alluded, and which is in the page preceding that to which he has called attention (no. 20, p. 371, footnote), and again in 1857, viz. "in Wasser befindliche Karminkörnchen sieht man hier aus dem grossen Hohlraum unmittelbar in jene Wimperapparate gelangen" (no. 7, p. 385). That I should have made the statement in 1857 that the carmine was "wholly confined to the ampullaceous sacs" is no excuse for an observer in 1879 *exclusively* mentioning the cells of the parenchyma as engaged in this process.

Besides, in feeding the calcareous sponges with carmine and indigo respectively, the colouring-matter has always appeared to me to be so confined to the sponge-cells (spongozoa) of the ampullaceous sacs, that I have not sought for it anywhere else; while I have sometimes seen the green germ of an *Alga*, *together with the colour-particles*, in the body of a spongozoon.

Nevertheless our thanks are due to Metschnikoff for having *especially* pointed out that the mesodermal cells are capable of taking in nutritive material and digesting it, because, together with what had gone before, it is now shown that whether ciliated and in the ampullaceous sac, or unciliated and in the parenchyma, the sponge-cell generally is at least an alimentary organ; and thus the "conflicting statements" to which I have alluded become reconcilable.

Should the reader be inclined to recur to my paper in the 'Annals' of 1849, he will there find the following paragraphs:—

"If a seed-like body which has arrived at maturity be placed in water, a white substance will, after a few days, be observed to have issued from its interior, through the infundibular depression on its surface, and to have glued it to the glass; and if this be examined with the microscope, its circumference will be found to consist of a semitransparent substance, the extreme edge of which is irregularly notched or extended into digital or tentacular prolongations, precisely similar to those of the protean [*Amœba*], which, in progression or in polymorphism, throws out parts of its cell in this way (pl. iv. fig. 2, *c*). In the semitransparent substance may be observed hyaline vesicles of different sizes, contracting and dilating themselves as in the protean (fig. 2, *d*), and a little within it the green granules so grouped together (fig. 2, *e*) as almost to enable the practised eye to distinguish *in situ* the passing forms of the cells to which they belong; we may also see in the latter their hyaline vesicles with their contained molecules in great commotion, and between the cells themselves the intercellular mucilage (fig. 2, *f*).

"If this newly formed sponge be torn up, its isolated cells assume their globular or passive form, or become polymorphous, changing their position and their locality, by emitting expansions similar to the proteans or polymorphic cells developed after a forcible expulsion of the contents of the seed-like body, and differing only from them in being more indolent in their movements" (no. 3, p. 91, pl. iv. fig. 2).

With this statement, at that comparatively early period, how was it possible to come to any other conclusion than that every part of the sponge-parenchyma is capable of enclosing nutritious material and digesting it like the *Amœba* ("protean"), even if we had not had the observations of Lieberkühn, confirmed by Metschnikoff (no. 20, p. 374), to establish the fact?

In the first paragraph above quoted I have mentioned the extreme edge of the young *Spongilla* as composed of semitransparent substance charged with hyaline vesicles, as if this were a distinct portion; but from what I have stated at the commencement of this paper respecting the homogeneity of amœboid cells after amalgamation, defying all attempt to detect their individuality, although capable at a moment's notice of separating themselves from each other (as in the conjugation of two *Difflugiæ*), it is quite possible that this "semitransparent substance" may be composed of sponge-cells thus combined, and the "hyaline" their "contracting" vesicles respectively, since, as I have heretofore shown, the apparently homogeneous investing membrane or cuticle of the young *Spongilla* is so composed (no. 6, pp. 24, 25, pl. i. fig. 7).

Connected with this is the *curious fact* that the whole of the spongozoa of an ampullaceous sac ("Wimperkorb") may, under isolation, become thus amalgamated, and assume the form and habits of an *Amœba*, while the cilia of the spongozoa may be seen still playing in its interior, and the exterior enclosing particles of carmine which come into contact with it (no. 6, p. 26)—finally losing all appearance of cilia internally, and presenting an actinophorous form (*ib.* p. 33, pl. i. fig. 9).

Since, then, we find Balfour (no. 19, p. 108) stating, "It has not, so far as I know, been definitely made out where the digestion is carried on. Lieberkühn would appear to hold the view that the amœboid lining-cells of the passages are mainly concerned with digestion, while Carter holds that digestion is carried on by the collared cells of the ciliated chambers," the above must be my reply.

Although at one time the foreign material may be chiefly taken in by the sponge-cells (spongozoa) of the ampullaceous sac, and at another by the sponge-cells of the parenchyma, it cannot be inferred that there are two systems of alimentation, but rather that they are both the same, only that they are respectively more or less used according to circumstances.

Again, while it may be generally thought that there is no direct communication between the inhalant orifices (pores) of the surface and the exhalant or excretory canal-system of the interior except through the ampullaceous sacs ("Wimper-körbe"), facts now prove that branches of the excretory canal-system may commence directly under the pores (no. 10, pl. vii. fig. 5, and no. 21, pl. xxv. fig. 4, *e*, &c.); so that whatever nutritious material may be in the water which thus passes *directly* into the excretory canal, must be deflected from it to arrive where the sponge-cells of the ampullaceous sac and parenchyma respectively are *naked*—that is, uncovered by any membrane which would prevent the particles of food from coming into direct contact with them—indeed, where the canals are formed by the sponge-cells *alone*, as stated by Lieberkühn (no. 7, p. 388).

Bearing upon Nutrition is Starvation, under which, as I have long since stated (no. 2, p. 309, and no. 6, pp. 32, 33), the sponge-cells leave their "habitation" (that is, the skeleton) and creep about the watchglass wherein the young *Spongilla* might have been allowed to grow out from the seed-like body. Lieberkühn has recorded that the cells of *Spongilla* in the river Spree at Berlin are amœboid in the winter, but put forth a cilium in spring (no. 5, p. 2); and this is confirmed by Metschnikoff in *Spongilla* from the Dnieper in the months of October and November, together with the well-known fact that under "unfavourable" circumstances the retraction of the cilium may take place at any time (no. 20, p. 375).

But that the putting forth of the cilium in spring and its retraction in winter, when, as Metschnikoff states, the *Spongilla* had become charged with gemmules (seed-like bodies), seems to show that the active life of this sponge takes place during the warmer part of the year, like that of most organisms, when nourishment is chiefly required for the fulfilment of the reproductive process; and that the passive or amœboid state of the cells not only took place in the winter, when this activity was not required, but that the cilium at all times would be retracted under "unfavourable circumstances," according to Metschnikoff (no. 20, p. 375), may be inferred from the simple fact that these unfavourable circumstances take place before one's eyes when the *Spongilla* or any other sponge is torn to pieces; while Metschnikoff states that, on the other hand, when the favourable circumstances were renewed ("erneuertem Wasserwechsel"), not only the cilium but the ampullaceous sac ("Wimperkorb") was *remade* in the parenchyma of a young *Spongilla*.

I cannot say, however, that the sponge-cells of *Spongilla* lose the cilium in the winter in the tanks of the island of Bombay, perhaps because the temperature then and there is about that of our midsummer, since the last mention of it in my 'Note-book,' together with an illustration in which the "ear-like processes" (collar) are represented, is dated "9th January, 1859," just after my paper on the subject had been published in England (no. 8, p. 14, pl. i. figs. 12–14).

Reproductive Process.

While on the subject of alimentation, it might be as well to briefly enumerate the facts known in connexion with reproduction, since the latter is chiefly dependent on the former process.

As early as 1826, my late kind and talented teacher Prof. Robert Grant described and illustrated (among his imperishable records of the Spongida) the embryo (swarm-spore) of his *Spongia panicea = Halichondria incrustans*, Johnston, beginning with the ovum "lying in the recesses of the parenchymatous matter," following its development into the ciliated embryo, its exit afterwards through the excretory cell-system and subsequent fixation, finally ending in the full development of the young sponge (no. 1, pp. 127–133, and p. 140, pl. ii. figs. 26–29).

In 1854 I described and figured minute monociliated bodies which were observed in *Spongilla* at Bombay in the month of July, and conjectured to be zoosperms (no. 4). Afterwards Lieberkühn described and figured undoubted spermatozoa in *Spongilla* in July, at Berlin (no. 5, pp. 17, 18, pl. xv. fig. 34, and pl. xviii. figs. 10 17), previously observed by Müller (no. 5, p. 19).

That Lieberkühn should have identified my description and illustrations with *Trachelius trichophorus*, Ehr., I could never understand, because he must have known that the former carried the cilium *behind*, and *Trachelius* carries its cilium in front. Moreover, although I have hitherto been inclined to doubt if they really were spermatozoids or the common monociliated sponge-cell, I now observe, by the measurements of both (which have fortunately been published with their descriptions respectively), together with my better acquaintance with the subject, that the *smallness* of the monociliated bodies which I figured as zoosperms, when compared with the "eared" (collared) monociliated sponge-cell, is so much in favour of what I had conjectured, that little doubt can be entertained by those familiar with such bodies that they really *were* the zoosperms of *Spongilla*. The time of their appearance in the *Spongilla*, their mode of progression, and their inferior size, if we do not admit the absence of the ear-like processes (collar) also, must satisfy the most fastidious mind that they could have been nothing more or less than "zoosperms."

About the same time also, viz. 1856, Lieberkühn discovered and described, with illustrations, the swarm-spore (embryo) of *Spongilla* and its development, which Grant, as above stated, did of *Halichondria incrustans* in 1826 (no. 5, pp. 9–14 and pp. 405–413, pl. xv. fig. 35).

Finally, F. E. Schulze, in 1877, pointed out the existence of spermatozoa in *Halisarca lobularis* in a much more satisfactory way than had hitherto been done, as testified by his descriptions and illustrations (no. 17, p. 24, Taf. iii.), together with some of his beautiful preparations, which, through his great kindness, are now in my possession.

They occur in the form of globular groups ("Spermaballen"), so like in size and appearance to the ampullaceous sacs ("Wimperkörbe") that, but for the smallness of the monociliated colourless head of the former, they would be almost undistinguishable from the larger monociliated and collared form of the latter, both being polymorphic and bearing the proportion of about 1 to 5 (compare Schulze's fig. 12, Taf. ii., with fig. 17, Taf. iii., both of which are magnified 800 times). In size the two look respectively very much like the so-called microspores and macrospores of Algæ; and at first one would be inclined to think that reproduction was similarly accomplished by their union. But another factor steps in here, viz. the unciliated sponge-cells of the parenchyma or mesoderm, which Metschnikoff has shown to take in nourishment equally with the monociliated cells of the ampullaceous sacs, or, at all events, to do so when the latter do not. And here (in the mesoderm) it is, that the ova appear (see Schulze's satisfactory figure of the eggs in *Sycandra raphanus*, H., no. 14, Taf. xviii. fig. 2)—a fact that all who have studied any of the calcareous sponges in spring (that is, during the reproductive period) must be well aware of, although Grant, who first mentioned this, observed it (*Halichondria incrustans*) during the autumn ("October and November") (no. 1,

p. 128). Then the time varies with the species, as Grant has observed (no. 1, p. 133).

The spermatozoa which I saw in 1854 bore the proportion of about 1 to 5 when compared with the average size of the common sponge-cell in *Spongilla*, as the latter is much the largest. Those which Lieberkühn figured in 1856 bear a similar ratio; and so do those figured by Schulze in *Halisarca lobularis.*

The smallest size at which I could recognize the egg in *Halisarca lobularis* was 1-3000th inch (no. 13, p. 31, pl. xx. fig. 3, *a*); while the monociliated sponge-cell of the ampullaceous sac was a little smaller, viz. about 1-3600th inch in diameter (*ib.* fig. 2, *a*); and Schulze's figures of the body of a monociliated collar-cell (" Kragenzell "), compared with that of the spermatozoid (no. 17, *l. c.*), give about 1-18000th of an inch for the latter. It might be thought that it would have been better to have been able to omit the indefinite word " about " (*circa*); but those who have studied the minute anatomy of sponges well know that all their soft parts afford, from polymorphism and actual difference in size, only approximate measurement.

Häckel is the only one who believes (" glaube ") that he has seen the spermatozoids enter the ovum (no. 11, vol. i. p. 396, Atlas, Taf. 48. fig. 6) in *Sycortis lingua* = *Grantia ciliata*, Bowerbank.

Keller of Zurich also gives a figure of it in *Leucandra aspera,* H., with reasons for coming to the conclusion (no. 16, p. 21, Taf. 1. fig. 4, *c*).

But of all those who have so deeply studied the living calcareous sponges, it has been reserved for Häckel alone to see the *act*; and this, according to his statement (no. 11, vol. i. p. 396), he has done repeatedly (" wiederholten Malen "). Yet if his statements and figure are like those which he has given of my *Squamulina scopula* ('Jenaische Zeitschrift f. Naturwissen.' Bd. ix. 1877), I regret to be obliged to say that they are not trustworthy, as may be seen by Saville Kent's ample confirmation of my observations of 1870 in 1878 (Ann. vol. ii. p. 68, pls. iv. & v.); while it was not difficult to conjecture, with apparent certainty, that which the sagacious Lieberkühn had indicated sixteen years before by his descriptions and figures of the swarm-spore and spermatozoa respectively in *Spongilla* (*l. c.*).

Another difficulty here presents itself, viz. that, from the polymorphic condition of all the soft parts in the living sponge, even to the capsule of the ovum, it becomes doubtful, unless the spermatozoon is *seen* to enter the ovum, whether the remaining projection of the still waving tail, such as those in Keller's instance, is confirmative of impregnation, simply because, when these polymorphic bodies become amalgamated, their water-like sarcode so flows together that their individuality becomes lost—although, where the body is not a spermatozoon, they can immediately individualize themselves again. Nothing is more like the "*melting away*" of a spermatozoon when it passes into the ovum than the union of two polymorphic amœboid Infusoria; so, unless the act itself is seen (that is, the spermatozoid and ovum are both observed before union), the case may only remain "probable," as Keller has observed.

Gemmule or Seed-like Body of Spongilla.

Turning our attention shortly to the seed-like body of *Spongilla* for our present purpose, as I have already given this in detail (no. 12), we find that it is more or less globular in form according to the species, variable in size, although generally nearly as large as a small pin-head, so that they can be easily seen by the unassisted eye, congregated towards the base or first-formed parts of the *Spongilla*, consisting of a cellular crust more or less charged with peculiar spicules, lined by a coriaceous membrane, and filled with a yellowish substance, something like the yelk of a hard-boiled egg, which is composed of transparent spherical sacs varying under 1-1000th inch in diameter, more or less filled with grain-like transparent compressed firm cells of different sizes varying under 1-3000th inch in diameter, bearing in one part of the crust a hilous aperture, through which the contents issue a few days after the seed-like body has been placed in water, in the form of the young *Spongilla* (no. 3, p. 87, pl. iii. fig. 6, *a–i*).

If this growth be made to take place in a watchglass under cover of a bell-glass, or something of the kind, replenishing the water as required, it can easily be transferred to the field of a microscope from time to time, where it can be viewed under $\frac{1}{4}$-inch object-glass, of course immersed; when the "transparent spherical sacs" with their "grain-like cells" appear to issue entire with the rest of the substance from the seed-like body, and so become developed in their entirety, respectively, in this substance, now assuming the form of a parenchyma (no. 6, pp. 21, 22).

On the other hand, the development of the swarm-spore or embryo leads to the same result, when some of its cell-contents also become developed into ampullaceous sacs (no. 13, p. 337, pl. xxi. fig. 21, *c*, &c., and pl. xxii. fig. 34, *d*).

In the future development of *Spongilla* the "transparent spherical sac" and its contents, which have become developed into an ampullaceous sac ("Wimperkorb"), appear to me to grow into a gemmule or seed-like body (no. 6, p. 34), and thus this increase or reproductive process to be successively effected.

That the "grain-like cells" of the transparent sacs do pass into monociliated sponge-cells may be proved by taking out some of the "yellow substance" on the point of a needle and placing it in a watchglass with distilled water, when, after a few days, the "grain-like cells" for the most part disappear and are followed by a development of active monociliated sponge-cells (no. 3, p. 91, and no. 12, pp. 97, 98).

Now comes the question whether the monociliated "sponge-cells" of the ampullaceous sacs ("Wimperkörbe") are impregnated by the spermatozoa for the formation of the seed-like body, and the cells of the parenchyma or mesoderm for the formation of the ovum respectively.

When we reflect on the almost identity that exists between the spongozoon or monociliated sponge-cell and the solitary flagellated infusorium called "*Salpingœca*" by the late H. James-Clark, who first pointed out the resemblance (no. 9), we can hardly help thinking that what the "solitary" form possesses in the way of organs is equally possessed by the social one or monociliated sponge-cell, and we can hardly doubt that the solitary *Salpingœca* and its like possess either an hermaphroditic, monœcious, or diœcious system of reproduction respectively; while, assuming that of the sponges to be monœcious, the female organ or ovary must be looked for either in the monociliated sponge-cells of the ampullaceous sac ("Wimperkorb"), or in the unciliated sponge-cells of the parenchyma or mesoderm; and if this be the case, then we must consider the ampullaceous sacs in the marine sponges (wherein there are no seed-like bodies) abortive in this respect, and the ovum to be developed from the nutritive sponge-cells of the parenchyma. And as there are swarm-spores as well as seed-like bodies in *Spongilla*, both may become impregnated and developed in their respective cells, as already intimated, for the purpose of reproduction, in which case impregnation would take place in the *body* of the sponge-cell. How happens it, then, that Häckel has seen impregnation of the ovum to take place in the parenchyma or mesoderm? Perhaps the *ova* may be thrown off from the ovary of the parenchyma-sponge-cell in a very minute form, discharged, and then transported into the intercellular substance for increased growth previous to impregnation.

What Dr. Grant said of the sponge fifty-three years ago (no. 1, p. 138), equally applies to it at the present day, viz.:—"This animal still affords many curious and interesting subjects of inquiry to those who have leisure and opportunities of examining the more perfect species of tropical seas [? in temperate ones too !]; and, though probably the simplest of animal organizations, the investigation of its living habits, its structure and vital phenomena, and the distinguishing character of its innumerable polymorphous species, is peculiarly calculated to illuminate the most obscure part of zoology, to exercise and invigorate our intellectual and physical powers, and to gratify the mind with the discovery of new scenes of infinite wisdom in the economy of Nature."

XLIII.—*Preliminary Notice of a new Genus* (Parectatosoma) *of* Phasmidæ *from Madagascar, with brief Descriptions of its two Species.* By J. Wood-Mason*.

The interesting and remarkable animals briefly noticed below formed part of a large collection of insects, chiefly Coleoptera, recently received in London from Madagascar; and I was fortunate, while at home on furlough, to secure specimens of them from Mr. E. W. Janson, the well-known Natural-History agent.

They are unquestionably nearly related to *Ectatosoma*, an Australian genus, the three known members of which are three of the most curious and striking forms comprised in the whole class Insecta. This relationship I have indicated in the name of the new genus which the differences presented by these insects compel me to propose for their reception.

Parectatosoma †, gen. nov.

Closely allied to the Australian genus *Ectatosoma*, but differing therefrom in the following characters:—The prothorax is relatively longer and more spiny; the male is devoid of ocelli, and, like the female, brachypterous; the abbreviated tegmina in both sexes are shorter than the abbreviated wings; and the upper crest of each of the femora is produced into a sharp genual spine.

Of the species of the Australian genus, *Ectatosoma bufo-*

* From the 'Journal of the Asiatic Society of Bengal,' vol. xlviii. part ii. 1879, pp. 117, 118. Communicated by the Author.

† From παρὰ, by the side of, and *Ectatosoma*, generic name.

nium, Westw., is the one which the Madagascar forms most nearly approach.

1. *Parectatosoma hystrix*, n. sp.

♂ ♀. Head armed with 12 spines (besides scattered spinules) arranged in four longitudinal rows and in pairs, of which one is large, compressed, and thorny, and constitutes the conspicuous cephalic horns; the pair of spines immediately in front of these is also compound, each being provided with a sharp spine-like cusp in front. The post-antennary pair of spines is as well developed as in *Ectatosoma*.

Sides and upper surface of prothorax strongly armed with thorns, some of which are double. The apices of the small tegmina barely reaching the bases of the wings; the true metanotum is consequently exposed, and it is armed at the middle of its hinder margin with a pair of stout thorns. The tergum of the first somite and the terga of more or fewer (according to sex) of the remaining abdominal somites provided at their hinder extremities with two cross rows of spines. Posterior margin of tergum of last abdominal somite in the female symmetrically divided into six spinous processes.

Colour deep black-brown, almost black, blotched with yellow, sparingly so on the under surface and legs, but more profusely on the pronotum and on the terga of the abdominal somites, on which parts the colour assumes an orange tinge and extends to the points of the spines; the antennæ are ringed at the joints with the same colour; organs of flight greenish yellow, with their bases and principal nervures black.

♂. Length of body 61 millims., of head 7, pronotum 5, mesonotum 14, metanotum 7, abdomen 25 + 7 = 32, tegmina 2·5, wings 8, fore femur 17, tibia 17·25, intermediate femur 13·5, tibia 15·5, posterior femur 17, tibia 21, antennæ 53.

♀. Length of body 86 millims., of head 10, pronotum 7, mesonotum 18, metanotum 10, abdomen 31·5 + 12·5 = 44, tegmina 4·5, wings 10·5, fore femur 19, tibia 20, intermediate femur 16, tibia 18, posterior femur 21, tibia 25, antennæ imperfect.

Hab. Three males and three females from Fianarántsoa and one female from Antanánarívo, Madagascar, differing from the rest only in being much more variegated.

2. *Parectatosoma echinus*, n. sp.

♂ ♀. Slenderer, and less numerously and less strongly spined than the preceding. Head armed: female with ten spines, besides spinules, the cephalic horns more foliaceous and more sharply spined, with only one pair of spines in front of them instead of two, and that simple; male with eight only, one of the lateral pairs not being developed. Post-antennary spines reduced to minute tubercles. Vestiges of wings and tegmina larger, those of the latter overlapping one another and those of the former so as to conceal from view all but about one square millimetre of the unarmed metanotum. The tergum of the first abdominal somite with but one row of spines at its hinder end; that of the terminal somite of the female divided at its posterior margin into four spinous processes.

Colour. Body brown like rotten leaves, with the legs, antennæ, organs of flight (which have their principal nervures darker), and spines lighter.

♂. Length of body 64 millims., head 4·5, pronotum 4·5, mesonotum 14, metanotum 6, abdomen 27·25+8·5=35·75, tegmina 3·75, wings 7·3, fore femur 17, tibia 17, intermediate femur 12·5, tibia 13·5, posterior femur 17·5, tibia 19·5, antennæ 47.

♀. Length of body 80 millims., head 7, pronotum 6·5, mesonotum 16·5, metanotum 8, abdomen 31+12=43, tegmina 6, wings 11, fore femur 16·6, tibia 17, intermediate femur 12·5, tibia 13·6, posterior femur 18, tibia 21, antennæ 43·5.

The fore legs and all the tibiæ in the male of this species are nearly quite simple.

Hab. One male and two females from Fianarántsoa.

XLIV.—Monobia confluens, *a new Moneron.* By Aimé Schneider*.

[Plate XVIII.]

I now present the description of a new Moneron, which appears to me to possess some interest. The name I give it is in allusion to the community of life which is set up between the different individuals of the same group, the different members of a colony, as will be seen by-and-by.

Monobia confluens lives in fresh water, and perhaps also in moist earth. I met with it for the first time in June 1878. I have had living representatives of it for about a week in a

* Translated by W. S. Dallas, F.L.S., from the 'Archives de Zoologie expérimentale,' tom. vii. (1878) p. 585.

moist cell under my microscope; and they have furnished me with the following observations.

In its simplest form in a state of repose *Monobia confluens* is a small nearly spherical mass of finely granular sarcode, appearing bluish by transmitted light, without a nucleus and without a vacuole (Pl. XVIII. fig. 1) From this homogeneous body radiate in all directions excessively delicate pseudopodia, so long that they are four times the length of the body, so slender and transparent that one can hardly trace them except by the aid of the small inflations, like knots, which are arranged at intervals along their course, and which refract the light more strongly. These pseudopodia are rectilinear, slow of movement, and coalescent; and by the combination of these peculiarities they vividly recall those of the Foraminifera.

When the little creature thus formed becomes active, it abandons the spherical form and extends itself, more or less, in one direction by a general contraction of its body. The physiognomy which it then takes on varies much less than in other Protozoa; it is usually that of a Savoy biscuit, inflated at the extremities and slightly narrowed in the middle, the inflated extremities being the seat of the emission of the pseudopodia (fig. 4).

Sometimes the body becomes triangular, with pseudopodia radiating from each of the heads; more rarely it is quite irregular, with pseudopodia springing from all the little salient angles which are marked in its outlines (figs. 3 & 5).

It is evident that, under these aspects, *Monobia confluens* feeds and nourishes itself. I have not witnessed the prehension of food, and I cannot say what part the pseudopodia take in it. But it is certain that foreign bodies, often in considerable number, are to be seen in the mass of the body, sometimes each contained in a vacuole produced by their liquefaction, and representing the product of their digestion, not yet mixed with the general mass. The pseudopodia do not appear to me to be adapted to digest on the spot; at least this seems to follow from the fact that I have never seen them involve foreign bodies.

I have stated above that *Monobia* is destitute of vacuoles: by this I mean contractile vacuoles; for we have just seen that such cavities are formed in connexion with digestion, as in the *Amœbæ*.

As soon as the *Monobia* has thriven so as to double its size or thereabout, it propagates, in accordance with the immutable law that reproduction is the overflow of nutrition. We then see it elongate strongly, contracting and drawing itself out in the middle, until it presents the appearance of two spheres united by a band of sarcode. This band may become attenuated until it is no thicker than an ordinary pseudopodium; this filament may give way in its turn; and then we have two individuals instead of one. But most commonly this is not the course of events, and the two fractions of the division, although each acts independently, continue to hold one another, as it were, by the hand, like two sisters (fig. 2). They not only do not rupture the more or less attenuated thread which is interposed between them, but, as I have often witnessed, it also happens that two of their pseudopodia meet and become fused together, so as to set up a second point of communication parallel to the former.

Whenever two pseudopodia issuing thus from two different centres meet together, there is an amalgamation of the pseudopodia. This amalgamation effected, the bond of union becomes widened by afflux of plasma, and the communication between the two sarcodic territories is widely open, so that the granules can pass from one to the other. This mechanism explains the very varied aspects, changing from day to day, which the same colony presents.

Starting from a single individual, we have just seen how we get to two, which sometimes separate and sometimes remain connected. Each of the two new individuals, behaving like the first after the lapse of a certain time, we get to four, all united to one another like the links of a chain. I have counted as many as eight thus associated; and their line extended over a considerable distance, describing a slight curve (fig. 7).

The following day this was no longer the state of affairs. Each member of the colony had pulled upon the common cord; and a new resultant had been produced from these opposite caprices. My Monera were now grouped as shown in fig. 8—in a square surmounted by a triangle, the latter surmounted by an arrow. A few pseudopodia stretched from one individual to another, and, soldered together, had sufficed to substitute this aspect for the former one. A little later the same cause had produced a different spectacle; and, a more lively image of society than any other, this mobile colony was never the same at the close of the day as it had been at the beginning. I shall not stop here to describe the series of these fluctuations. It will be easily understood that the number of members increased by the division of some of the colony; but certain members also separate to live apart, at least for a time. Evidently we cannot but admit that separated individuals may resume their relations with a colony, or that two colonies may attach themselves to each other to form a larger confederation, after what has been said as to the facility with which the members of the same chapel married and divorced each other.

Here the observations close.

Is the mode of reproduction (fissiparity) which I have just described the only one possessed by this species? This is a question which I cannot venture to decide; we must not hypothecate the future; and if it is true that we do not know any other mode of propagation than the above in certain genera (*Protamœba*, *Myxodictyum*), it is not less true that our ignorance in this respect may merely be the consequence of adverse circumstances. We may, however, note that in the Monera which encyst themselves for the purpose of propagation (*Vampyrella*, *Protomyxa*, &c.) we rarely find that the species is also endowed with active fissiparity during the period of its free existence; and this consideration may lead us to assume that we have to do here with a simple organism having only the simplest and most rudimentary of all the modes of multiplication, division without any preliminaries in the free state.

After what has just been stated it can hardly be doubted that our *Monobia confluens* is a Moneron. Is it possible that we have to do with an evolutive phase of a higher organism? I see no reason to suppose any thing of the kind; and analogy is opposed to such a suspicion.

Like *Myxodictyum sociale*, this Moneron might be regarded, after the example of Claus, as a naked Foraminifer, if we did not know that the latest investigations on the Foraminifera tend to demonstrate the general existence of a nucleus in the representatives of that group. It therefore seems to me necessary to retain the order Monera as Häckel established it, until our knowledge of the mutual relations of the Protozoa shall become more complete.

BIBLIOGRAPHICAL NOTICES.

On the Structure and Affinities of the "Tabulate Corals" of the Palæozoic Period, with Critical Descriptions of Illustrative Species. By H. Alleyne Nicholson, M.D., D.Sc., F.L.S., &c. W. Blackwood & Sons: Edinburgh & London, 1879.

This work is a further contribution towards the history of the Tabulate Corals, and contains a record of researches carried on during some years past on the Palæozoic species. The study of the forms belonging to this group has become of considerable interest and importance, both as regards their general structure and zoological position. As to their affinities, considerable difference of opinion prevails on some important points. Formerly regarded as true Zoantharia, it now appears doubtful, from recent investigations, whether most of the forms so assigned belong to that group. In fact, says Mr. H. N. Moseley (1876), "it would be as well if the term Tabulata were dropped altogether, since it has reference to a structure common to certain Alcyonaria, Zoantharia, and Hydroida, and, being not characteristic of any natural group, only tends to confusion."

Twenty years ago (1859) Agassiz suggested the hydroid nature of *Millepora*, which view, adopted by Claus and others in Germany, and by Dana in America, was only partially accepted. M.-Edwards, in the following year (1860), did not consider the facts on which this opinion was formed sufficiently ascertained; and Prof. Allman has recently expressed some uncertainty on the subject. With the exception of Prof. Verrill (Ann. & Mag. Nat. Hist. 1872, vol. ix. p. 355), no one had examined the soft parts of any of the Tabulata, until the critical investigations of Mr. Moseley were communicated to the Royal Society in 1876, in which he states, "though no evidence as to the structure of the generative system of *Millepora* was obtained, the results yield convincing proofs that this interesting form is a true Hydroid;" and the subsequent still more elaborate paper on the Stylasteridæ (the Croonian Lecture, 1878) has further elucidated the subject, by showing that this family, with the Milleporidæ, should form a suborder, the Hydrocorallina.

Besides the Milleporidæ, Agassiz believed that the Favositidæ, and all the other species of which the septa are not continued vertically, ought not to be classed with the Corals—an opinion combated by Verrill and doubted by M.-Edwards; while M. Dollfus classed some genera of the Tabulata with the Hydroida, and the Chætetidæ and Favositidæ, he considered, were allied to certain forms of Polyzoa.

Prof. M. Duncan, in 1871 (Rep. Brit. Assoc.), treated of the structure and affinities of the Tabulata, still retaining them among the Zoantharia, classing them into two principal and five minor groups, but considering some genera, as *Chætetes* and similar forms, to be allied to the Alcyonaria.

The object of Dr. Nicholson in the work under notice is an attempt to elucidate the minute anatomy of the principal Palæozoic genera, which he has personally investigated; and this has been chiefly effected by means of microscopic sections; so that the present work is more extensively occupied with detailed descriptions of minute structure than treatises on fossil corals usually are; and well-known types have generally been selected for study.

The first chapter is devoted to the affinities and classification of the Tabulate corals, and also contains a concise historical sketch, showing the principal tendencies of the more recent researches of naturalists and palæontologists with regard to this group of corals. The investigations of the author lead him to corroborate the views of Verrill, Lindström, and Moseley (above noticed) as to the necessity of abolishing the "Tabulata" as a distinct and separate division of the Zoantharia; and, further, that under the old name of Tabulata there are included twelve distinct groups of Corals: some of these are Hydrozoa and Zoantharia; a large number may be referred to the Alcyonaria; but none are, probably, referable to the Polyzoa.

The twelve groups into which Dr. Nicholson proposes to divide the Tabulata are the following—Milleporidæ, Pocilloporidæ, Favositidæ, Columnariadæ, Syringoporidæ, Auloporidæ, Halysitidæ, Tetradiidæ, Thecidæ, Helioporidæ, Chætetidæ, and Labechidæ.

The first two groups, not containing any Palæozoic representatives, are but briefly noticed; the far larger portion of the work (chaps. 2 to 14) comprises the results of the author's investigations of the remaining ten groups. In chapters 2 to 6 (pp. 30–186) the author enters fully into the characters, position, and affinities of the older genera considered by him to belong to the Favositidæ, and concludes, after an extended study of their minute structure, that Prof. Verrill and Dr. Lindström are right in referring all the corals usually included under this head to the Z. perforata; and while not prepared to regard the group as a *subfamily* according to the views of the above authorities, Dr. Nicholson gives his reasons at some length for inferring that "a large number of the types are more or less allied to the Poritidæ, and some of which may perhaps be capable of final removal to the latter family, but which really represent a series of separate though allied groups."

Under the Columnariadæ are provisionally placed a few Palæozoic corals; but their precise position is uncertain, as the typical forms exhibit certain Rugose features, while, on the other hand, they present some conspicuous points of resemblance to the Astræidæ.

With regard to the Palæozoic family Syringoporidæ, Dr. Nicholson does not agree with the opinion of Dana and others as to *Syringopora* being allied to *Tubipora*, nor with Lindström that it is a Rugose coral, but considers that this family is related to the Favositidæ, and should therefore find a place among the Z. perforata.

The family Auloporidæ is considered to be in a chaotic condition, so that it is impossible to come to any positive conclusion as to its affinities or the forms it may contain, the materials in the author's possession being insufficient for its clear elucidation; but it may probably be regarded as a peculiar group of the Alcyonaria.

The Halysitidæ, typified by the so-called "chain-coral," are separated from the Syringoporidæ, which were included with them by M.-Edwards and Haime, and are stated to be nearly allied to the Helioporidæ, which they resemble in the general possession of two sets of tubes, differing in size and in the position of their tabulæ.

The singular Silurian genus *Tetradium*, Dana, forms the family Tetradiidæ; in general appearance it resembles some forms of *Chætetes*, as *C. radians*, and in some characters is allied to *Haly-*

sites and *Heliolites*; but from the quadripartite character of the septa, Prof. Safford regarded the genus as referable to the Rugosa.

The group Thecidæ includes but one genus, *Thecia*, restricted to the Silurian rocks, the typical species of which, *T. Swinderniana*, Goldf., the author has submitted to a careful macroscopic and microscopic investigation, from which it seems to form, in some respects, a link between the Perforate Corals and the Alcyonarian family of the Helioporidæ. For the structure and relations of the Helioporidæ we are indebted to the researches of Mr. Moseley (Phil. Trans. vol. clxvi. pt. 1, p. 91), which prove that *Heliopora* and its ancient allies are truly Alcyonarians. Most of the genera are Palæozoic; one (*Polytremacis*) is Secondary; and *Heliopora* is both Cretaceous and Recent.

The next group, the Chætetidæ, Dr. Nicholson considers to be made up of very heterogeneous materials, which must ultimately be disintegrated. The chief member (*Chætetes radians*) and its allies are in some respects similar to the Favositidæ, "except that 'mural pores' in the walls are wanting, while there are (in reality) no traces of septa, and the walls of the corallites are completely amalgamated." Although these forms are far removed from the Favositidæ, he is satisfied that they are genuine Actinozoa, and seem to have more affinities with the Alcyonaria.

The group Monticuliporidæ, founded on the genus *Monticulipora*, D'Orb., and originally considered to be a Bryozoan, includes numerous forms whose position is uncertain, and which "constitute perhaps the most difficult and intricate assemblage of Palæozoic fossils with which the zoophytologist is called to deal" (p. 270).

Although giving the results of his investigations in considerable detail (pp. 270–330) as to the internal structure of the corals usually referred to *Monticulipora* and allied types, Dr. Nicholson proposes to publish hereafter an entirely separate memoir on the group. He considers, however, that although strong evidence has been brought forward to prove these forms to be Polyzoa, yet, from their general structural character and resemblance to Cœlenterate types, the majority will prove to belong to the Actinozoa.

The last family, Labechidæ, comprises the anomalous genus *Labechia*, originally placed by M.-Edwards and Haime among the Chætetidæ, and considered by Dr. Lindström truly a Hydrozoon allied to *Hydractinia*. The peculiarities in its structure, however, are so numerous, and the apparent total absence of superficial openings of any kind is so puzzling, that Dr. Nicholson does not at present see how it can be placed among either the Hydrozoa or the Actinozoa.

We have attempted but a brief and imperfect sketch of the chief views of Dr. Nicholson on the twelve subdivisions of the Tabulata, which the reader will find given in detail in the separate chapters treating of each special group.

That some of the conclusions arrived at will be generally accepted the author does not expect; but while acknowledging the assistance he has derived from the labours of previous observers, it is fair to state that most of the facts recorded in the volume have been verified by himself, and that nearly all the illustrations, whether in the text or in the plates, are from original drawings of sections prepared by him, with the view of showing the minute structure of the principal Palæozoic genera of the Tabulata, thus rendering the work a useful addition to this branch of Palæontology.

Geological Survey of Canada. Mesozoic Fossils. Vol. i. part ii. *On the Fossils of the Cretaceous Rocks of Vancouver and adjacent Islands in the Strait of Georgia.* By J. F. Whiteaves, F.G.S. Montreal, 1879.

This work forms the second decade of the first volume of Mesozoic fossils, published by the Geological Survey of Canada, and contains a description by Mr. Whiteaves of the fossils collected by Mr. Richardson from the Cretaceous rocks of Vancouver Island and adjacent districts, an account of which strata appeared in the 'Progress Report' of the above survey for the years 1871–76. The coal-bearing strata from which the fossils were obtained occupy a narrow strip on the shores of the Georgian Strait, and their continuity is broken by crystalline rocks so as to divide them into two areas, respectively termed the Comox and the Nanaimo coal-fields.

About one hundred species are noticed, chiefly from the productive coal-measures. These, with one exception, a *Smilotrochus*, belong to the Mollusca: more than half the species are Lamellibranchs; and the Gasteropoda are more abundantly represented than the Cephalopoda.

The geology of Vancouver Island was noticed many years since (1861) by Dr. Hector; and some of the fossils have been described during the last twenty years by Mr. Meek, Mr. Gabb, and Dr. Shumard; but seventeen are new to science. In order, however, to present as complete a report as possible on the fossil fauna of these deposits, Mr. Whiteaves has added in their proper places the names of species described or recorded from them by other naturalists.

Thirty species from the coal-bearing rocks of Vancouver are also found in the Chico group of California, which, with the Martinez group, probably represent the Lower and Upper Chalk of Europe, while on palæontological and stratigraphical grounds (says Mr. Whiteaves) it seems likely that the coal-formation of the Nanaimo, Cowitchin, and Comox districts is the equivalent in time of the whole of the Upper Cretaceous. Some of the fossils of the Vancouver Cretaceous appear to have an extensive geographical range, as about fourteen species are believed to be common to the coal-bearing rocks of the Nanaimo and Comox districts and to the Chalk formation of Europe, Asia, or Africa. Among other interesting facts alluded to in the Report is that of the former extent of the Cretaceous ocean in North America, which, according to some authors, was separated into two basins by a land barrier nearly coincident with the present main axis of the Rocky Mountains. This hypothesis is now considered untenable, both on physical and palæontological grounds; and the results of recent explorations confirm the opinion of Mr. Gabb, that there must have been a water communication between the great Cretaceous sea that covered so much of what is now the central portion of the continent on the one side and the Pacific on the other.

Ten plates accompany the descriptions of the species; and a table is given of their ranges in the different subdivisions of the Vancouver and Californian Cretaceous rocks.

MISCELLANEOUS.

On Hyale Lubbockiana (=Allorchestes imbricatus, *Sp. Bate, and* Nicea Lubbockiana, *Sp. Bate*). By the Rev. T. R. R. Stebbing.

At Banff this August I had the pleasure of being shown over the museum of the place by Mr. Edward, the well-known naturalist. In his collection of Crustacea I observed *Allorchestes imbricatus*, a species of which I had long been in search. Upon examining the rocks along the coast I found it living in great abundance. It was easy to distinguish it from *Allorchestes Nilssonii* by the imbrication. On closer view a large hooked and serrated spine on the hand in the pereiopoda proved to be an equally constant and distinguishing character. A spine, however, of this description is the special characteristic of *Nicea Lubbockiana*; and upon comparing the accounts given by Mr. Spence Bate of *Allorchestes imbricatus* and *Nicea Lubbockiana*, I think it is evident that the two names belong to one and the same species. As explained in the 'Annals' for May 1876, the generic name should be *Hyale*. Of the two specific names, *Lubbockiana* will have the precedence.

The difference in the length of the inferior antennæ in the two descriptions merely results from a difference in the age of the specimens described. The question of the telson has already been discussed in the paper above mentioned.

On Robert Kerr's Translation of the 'Systema Naturæ' of Linnæus. By Oldfield Thomas, Assistant in the Zoological Department, British Museum.

Having seen the above work quoted in certain of the papers on North-American Mammalia by Dr. Elliott Coues, the quotations being generally put in inverted commas, as though the work had not itself been referred to, I thought it worth while to examine the catalogue of the Banksian Library, where, as I expected, I found a copy of this rare and little-known book. It is dated 1792, and purports to be a revised edition of Gmelin's 'Systema Naturæ.' There are a considerable number of species named in it, with full descriptions and references. It was never continued beyond the first volume, which contains the Mammalia and part of the Birds.

Among the birds, nearly all the species additional to Gmelin appear to be quoted from Latham's 'Index Ornithologicus;' but among the Mammalia, the new species described in Pennant's 'History of Quadrupeds' (1781) and in Governor Phillips's 'Voyage to Botany Bay' (1789) have received Latin names, thus forestalling those in Shaw's 'General Zoology' (1800–4), which have hitherto been looked upon as the first Latin binomial names of these species.

On a cursory inspection I have noticed the following changes in nomenclature to be necessary:—

The species hitherto known as	*must stand as*
Dolichotis patachonica (*Shaw*)	D. magellanica (*Kerr*).
Sciurus Plantani, *Ljung*,	S. badging, *Kerr*.
Xerus namaquensis (*Licht.*) ("X. setosus, *Forst.*," auct.)	X. capensis (*Kerr*).
Petaurus taguanoides, *Desm.*,	P. volans (*Kerr*).
Phalangista vulpina (*Shaw*)	P. vulpecula (*Kerr*).

But fortunately, in a large number of cases, it will only be necessary to accredit the old specific name to Kerr, later authors having used the same name.

In this latter class the following may be instanced:—

M. Lutra canadensis, *Kerr*,	=	L. canadensis, *Turt.*
M. zibellina americana,	=	Martes americana (*Turt.*).
Ursus indicus,	=	Mellivora indica (*Shaw*).
Hystrix mexicana,	=	Sphingurus mexicanus (*Shaw*).
Mus messorius,	=	M. messorius, *Shaw*.
Didelphis virginianus,	=	D. virginianus, *Shaw*.

The British-Museum copy has evidently never been referred to, the leaves being uncut throughout.

The full title is "The Animal Kingdom, or Zoological System of the celebrated Sir Charles Linnæus. Class I. Mammalia, containing a complete systematic description, arrangement, and nomenclature of all the known species and varieties of the Mammalia, or animals which give suck to their young, being a translation of that part of the Systema Naturæ, as lately published, with great improvements, by Professor Gmelin of Goettingen. Together with numerous additions from more recent zoological writers, and illustrated with copperplates: by Robert Kerr, F.R. & A.SS.E., Member of the Royal College of Surgeons, and of the Royal Physical Society, and Surgeon to the Orphan Hospital of Edinburgh. London: 1792."

I have thought it well to draw the attention of zoologists to this work, as the sooner the oversight of a book of this kind is noticed the better it is for the correctness of zoological nomenclature*.

On the Structure of the Cephalic Ganglia of Insects. By M. N. Wagner.

It is well known that the two pairs of ganglia lodged in the head of an insect differ considerably with regard to their physiological functions. Formerly the part of an apparatus of coordination was ascribed to the subœsophageal ganglion; but several naturalists have

* During the printing of the above, a second copy of this book has been purchased for the library of the Zoological Department.

demonstrated that coordination of all the movements of the appendages takes place regularly in decapitated insects. The subœsophageal ganglion principally governs the appendages of the mouth, and differs but little in its histological structure from the other nodes of the ganglionic chain. As to the cerebroid or supraœsophageal ganglia, they are the seat of nearly all the functions of the hemispheres of the brain in vertebrates. There are situated the organs of the perceptions, of memory, of intelligence, &c. Hence they have a more complicated histological structure. These nervous centres are nevertheless constructed on the same general plan as the other ganglia. In the middle they present bundles of nervous fibres, while the nerve-cells principally occupy the periphery. Towards the centre of the ganglion there are three groups of small cells arranged in stages one above the other and communicating by numerous fibres. The group situated in front of the others may be regarded as having the most intimate relations with the convolutions (or organs in the form of a horseshoe), which are especially developed in the social Hymenoptera, the most intelligent of insects. The greater or less development of these parts of the nervous system coincides with the intellectual development. Thus we find the most remarkable development in the working ants, and then in the working bees; there is a less development in the female ants and in the queen bee. In the males these parts only exist in a rudimentary state. Sexual life, and especially the development of the ova and semen, are therefore opposed to the development of these organs. We can easily trace the bundles of nervous fibres which run from the base of the ganglion to the convolutions. From the sides of the ganglia issue the lobes which go to the compound eyes. In the humble-bees, in which each eye occupies nearly half the head, these lobes have an enormous development. They are of an oval form, and composed, in the median part, of short cylinders arranged in series.

These cylinders give origin to the fibres which penetrate into the base of the brain. In the exterior part of the optic lobes these fibres interlace and present the form of two flattened cones with their apices turned towards each other. In this way the fibres of the left side appear upon the right side, and the inferior fibres become superior. Each fibre by thus changing its direction enters into the constitution of the optic nerve which runs to each of the eyes forming together the compound eye. The intercrossing of the fibres does not occur here between the two opposite eyes as in the chiasma of the vertebrates, but between the eyes of the same side of the head. Such an organization very probably causes a perfect coincidence between all the optical impressions received separately by each eye.

To obtain the preparations which have given me these results, I extracted the brains of the insects, hardened them by means of Betz's fluid (a mixture in equal proportions of sulphuric ether and chloroform), and made thin slices of them.—*Comptes Rendus*, August 11, 1879, p. 378.

On the Part played by Insects during the Flowering of Arum crinitum, *Ait.* By M. B. Schnetzler.

The spathe of *Arum crinitum* diffuses so strong an odour of putrid flesh that the insects which deposit their eggs upon decomposing animal matters are attracted by it. The author found dozens of specimens of *Musca Cæsar* at the bottom of the spathe: they had deposited their eggs; and numerous small larva were creeping among the viscous hairs lining the interior of the spathe. Common house-flies and even mites were also caught among these hairs.

Sir John Lubbock has described the transportation by insects of the pollen of *Arum maculatum* to the protogynous stigmas of other individuals. Hairs, which are nothing but aborted stamens, are directed from above downwards, and thus facilitate the access of the insect to the lower part of the spathe, which, by means of these hairs, becomes a temporary prison for it.

In *Arum crinitum* all the hairs produced by the abortion of the sexual organs are directed from below upwards; and although they do not present any great obstacle to the access of insects they certainly do not facilitate their entrance. The viscous hairs which line the inner surface of the spathe, however, are directed downwards, and certainly present an obstacle to the escape of insects from the bottom of the spathe.

On examining under the microscope the ovaries of *Arum crinitum* at the time when numerous flies occurred at the bottom of the spathe, the stigma was found ready to receive the pollen, and a few grains of pollen were already there, besides many crystals of oxalate of lime. The stamens, although the anthers were not yet open, contained perfectly ripe pollen; and the least pressure sufficed to make it issue from the anthers.

All the flies found by the author at the bottom of the spathe were dead. The insects penetrating into this prison do not, therefore, carry out the pollen which has ripened during their captivity, as described by Lubbock in the case of *Arum maculatum*; nor is this the office of their larvæ (which soon die of starvation) or of the mites. Of the flies attracted by the fetid odour of the plant some lay their eggs at the bottom of the spathe, and then, being prevented from escaping from their prison by the viscous hairs which line its entrance, they die. Others, less pressed to oviposit, are attracted by the glandular hairs which cover the spadix and lead them, like the rungs of a ladder, to the stamens. Here, walking over the anthers, they cause the pollen to escape; and still ascending the spadix in the direction of the hairs, they fly away to lay their eggs in another spathe, at the bottom of which they deposit upon the stigmas the pollen derived from the stamens of the former plant, and finally die in their turn.

When the dead flies are examined after the lapse of a few days, their chitinous envelope is found dried up; but this is not the result of simple desiccation, as the insect lies upon a moist surface, upon which a portion of the liquid contents of the hairs has exuded. These hairs are filled with a purplish-red, violet, or even blue liquid. When the violet or blue liquid is treated with dilute sulphuric acid it becomes bright red. Ammonia restores the original colour. The purple-red liquid scarcely changes colour with acid; but it becomes violet or blué under the influence of ammonia. The purple-red hairs which cover a great part of the inner surface of the spathe of *Arum crinitum* may therefore probably contain an acid which, like that exuded from the hairs of *Drosera*, may contribute to the conversion of the nitrogenous materials of insects into matters capable of absorption by the spathe.

The spathe is, in fact, a simple leaf, the parenchyma of which contains grains of chlorophyll, like all leaves capable of assimilation. We need only immerse the purple spathe of *Arum crinitum* for a few days in a saturated solution of borax, to get rid of all the colouring-matters which masked the green colour of the chlorophyll. Thus, while admitting the possibility of the transportation of the pollen of *Arum crinitum* by flies to the stigmas either of another individual or of the same, the author is of opinion that insects also furnish nitrogenous nourishment to the plant through the mediation of the spathe. The name of *Arum muscivorum*, given to the plant by the younger Linné, would therefore be appropriate*.

The so-called hairs which occur above the fertile stamens up to the extremity of the spadix present a structure very different from that of ordinary hairs. They are formed by an epidermic tissue, a parenchyma, and an axial vascular cord composed of tracheids. They are stamens, transformed, like those immediately below the fertile stamens, into glandular organs, which perform the same function as the aborted stamens of *Parnassia palustris*. The numerous living *Bacteria* which occurred upon the bodies of the dead flies among the hairs of the spadix of *Arum crinitum* show that here we have to do with a simple putrefaction of the albuminous materials of the insect; none of the dead flies among the viscous hairs lining the interior of the spathe presented any trace of *Bacteria*. Between the stamens and the pistils there is a whorl of aborted ovaries in the form of glandular appendages.—*Comptes Rendus*, September 8, 1879, p. 508.

On a new Species of Wild Dog from Demerara.

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

Gentlemen,—I observe that inadvertently I have omitted to name the new species of dog described by me *suprà*, p. 316. I propose for it the name of *Canis rudis*.

Believe me,
Yours truly,
A. Günther.

British Museum,
October 1, 1879.

* M. E. Aschmann has also cited *Dracunculus crinitus* among insectivorous plants. See Just's 'Botanische Jahresbericht,' 1877, p. 730.

THE ANNALS

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[FIFTH SERIES.]

No. 24. DECEMBER 1879.

XLV.—*On the Structure of* Astrophiura, *a new and aberrant Genus of Echinodermata.* By W. Percy Sladen, F.L.S., F.G.S.

[Plate XX.]

A brief summary of some of the structural peculiarities of this abnormal Echinoderm was published last year (Proc. Roy. Soc. vol. xxvii. p. 456); and subsequently a short note, together with a specific diagnosis of the form, appeared in Carus's 'Zoologischer Anzeiger,' Jahrg. ii. (1879), p. 10.

It is the purpose of the present communication to furnish a description in detail of *Astrophiura permira*, and to offer such remarks upon its affinities and relationship as are naturally suggested by the investigation. Some delay has intervened in the publication of these observations, prompted chiefly by the desire to obtain a further supply of material, in order to give a more exhaustive description of the anatomy of the organism; but as such a wish may remain unrealized for an indefinite period, it does not now seem desirable to withhold longer the present notes upon this interesting specimen.

Astrophiura permira, nobis.

General Form.—The body is pentagonal and much depressed, arched above and slightly concave beneath, suggesting, at the first rough glance, a superficial resemblance to the *Asteriscus* type of starfish. The test is entirely covered with calcareous plates, which are very conspicuous on account of the form and the arrangement which they present: those situated within the central half of the abactinal surface are disposed after the manner of the tessellation of an Ophiuroid disk, whilst the outer portion of the pentagon is occupied by plates which belong exclusively to the radial series, and represent highly modified brachial plates of very abnormal development. The margin of the test is surrounded by a close-set fringe of small compressed spinelets; and the singular appearance of the organism is still further enhanced by the possession of very short rudimentary rays of Ophiuroid type, which extend from the angles of the disk in continuation of the radial series of plates. These diminutive arms, however, are quite insignificant both in size and character, in proportion to the general dimensions of the disk; and, as will be pointed out more fully hereafter, they would seem, when considered in relation to function, to be little more than aborted members.

On the actinal side, the mouth is central and surrounded by ten large mouth-plates, which bear papillæ only; jaws, jaw-plates, and teeth being wanting. In one of the interradii there is a large escutcheon-shaped plate, homologous in its position with the mouth-shield of an Ophiuran; it bears a puncture, and is probably the madreporite; no other shields are present in the remaining four interradii. The ambulacra are largely developed and conspicuous, the tentacle-pores being separated by thin plates and guarded by long lanceolate tentacle-scales. The median line of the radii is occupied by a series of large quadrate plates, which extend from the oral rimæ and represent under arm-plates, or what may perhaps be more correctly spoken of as subambulacral accessory pieces. The extensive triangular interradial areas are covered with a scaling of small hexagonal plates, which diminish in size as they recede from the actinostome; and the plating terminates at a short distance from the edge of the disk, leaving a portion of the radial plates exposed, in the form of a narrow marginal border.

Description of a Specimen. Abactinal Aspect.—The upper surface of the disk is regularly tessellated with clearly defined symmetrical plates arranged in the following manner. One irregular heptagonal plate, apparently the representative of what would normally be a pentagonal one, occupies the centre, and is encircled by seven slightly elongated plates, irregularly pentagonal and hexagonal, which are the representatives of a normal series of five, the splitting of two of these having given rise to the present irregularity, to which is also due the modification of the contour of the central plate. These represent the "primary plates" of Ophiuridæ. External to the last-named series of plates follows a ring of ten more or less symmetrical pieces: the five which stand in the median line of the radii are subtriangular or somewhat arrow-headed in outline; and the intermediate or interradial ones are irregularly pentagonal. Each of the five radial plates, as well as the single central plate, bears a small tubercle of slight elevation. The radial plates have their apex directed outwards and inserted between two large subtriangular plates, which represent the radial shields of a typical Ophiuroid disk. These touch, but only for a very short way on the middle of their inner sides, being again separated by the insertion on their outer margin of the triangular first upper arm-plate. The interradial space between the shields of two neighbouring rays is occupied by a single large quadrate plate, the outer margin of which is nearly in line with the outer margin of the radial shields. The whole series of plates above described form a circular area which occupies the central half of the pentagonal disk, the remaining outer portion being filled up by extraordinary radial plates, the abnormal development which these attain furnishing a highly remarkable feature in this Echinoderm, as the following description will indicate.

Succeeding to the triangular first upper arm-plate, and situated in the median line of the ray, follow a series of 5–7 rectangular plates, twice as broad as long, and which diminish in size as they approach the margin of the disk, where they become modified in form and pass off, by a gradation of stages, onto the rudimentary ray as the aborted representatives of upper arm-plates. On either side of each upper arm-plate is a long, narrow, band-like lateral plate, representing a side arm-plate, the breadth being equal throughout and corresponding with the length of the upper arm-plate, whence they extend to the margin of the pentagonal disk, each plate in the series being consequently shorter than its more internal predecessor. With the exception of the pair belonging to the first, each side plate is connected with its own proper upper arm-plate, and proceeds from it at right angles to the median line of the ray; this direction, however, is almost immediately changed, and the plate is bent sharply, though only slightly, outwards; whilst corresponding with this flexure in the pseudo-side arm-plates there is a slight downward depression, with a graceful curve, of the whole lateral series, which gives to the median portion of the ray a decidedly raised or gibbous character; and the series as a whole suggests some resemblance in appearance to the body of a trilobite. Although the pseudo-side arm-plates, which belong to the first upper arm-plate, are separated from it by reason of the development of the radial shields and the position which it occupies, they maintain nevertheless their own relative position in respect to the succeeding side arm-plates, and at the place where their inner margins meet on the edge of the disk they mark the middle of a side of the pentagonal body. In consequence of the angle of direction at which the lateral plates are prolonged from the median line, a large triangular interbrachial space is enclosed between the first side arm-plates of two adjacent radii and the central area of the disk; this is occupied by a single and uniform triangular plate, which is largest and most conspicuous upon the dorsal surface.

The extremity of each side arm-plate which enters into the marginal edge of the pentagonal disk is notched, and bears articulated thereon (normally) three short, stout, compressed spinelets of uniform breadth throughout, their length being equal to or rather greater than the breadth of the side arm-plates. These spines are truncate at the tip or slightly rounded, and so closely placed that they join tightly up to one another laterally, and form a continuous series, which borders the entire margin of the disk. The breadth of the fringe is rather greater at the middle of an interbrachial space than at the extremities, in consequence of the gradual diminution in the length of the spines as they approach the angles. Here and there, in the specimen under notice, the perfect continuity of the series is somewhat interrupted, owing, probably, to accidental breakage and abrasion; occasionally there is an additional spinelet to a side arm-plate, whilst in other cases two or three become merged together. Normally there are about 48–50 spinelets in each interbrachial space.

The manner in which the radial plates of the disk-series become modified in the course of their passage onto the rudimentary arms is very interesting; and the transition into the true side arm-plates of the little rudimentary ray takes place so continuously and intelligibly that no doubt can exist as to the homology of the strangely developed, band-like, lateral plates in the disk with the true Ophiuroid elements of normal form (Pl. XX. fig. 3). It will be observed that the two or three terminal upper arm-plates, which fall within the limits of the pentagonal disk, lose their rectangular shape, and that the first change undergone by the oblong rectangular plate normally consists of a lateral contraction by which the disproportion of breadth to length is reduced; this contraction in the next outward plate is still more developed, its action being greater on the proximal than on the distal margin of the plate. This gives to the side arm-plates the appearance of resting upon the preceding upper arm-plate, at the same time inducing therein a pentagonal figure.

In the last radial segment included within the pentagonal disk, the upper arm-plate has generally been so much reduced in size that the side arm-plates meet and hold it within the angle which they form, whilst the upper arm-plates, which follow upon the rudimentary ray, have become subtriangular or fan-shaped and quite insignificant in size.

A slight variation, consequent on the irregularity of some of the plates, is noticeable in one of the radii of the present specimen (Pl. XX. fig. 4). This consists of the radial series apparently passing off into the free rudimentary ray before the margin of the disk is reached—a deceptive effect arising from a modification of the last segment included in the disk, by which the side arm-plates and their marginal spinelets remain isolated and form a continuous collar-like rim beneath the ray connecting the lateral fringes of the two neighbouring sides, whilst in all the other rays the series of marginal spines is separated by the presence of the free armlet.

In one of the rays considerable irregularity occurs in consequence of the splitting-up of some of the upper arm-plates and the coalescence of two or more of the side arm-plates, the former circumstance being, to a certain degree, suggestive of the broken character of these plates in *Ophioplocus* and some *Ophiuræ*.

Actinal Aspect.—The mouth is situated in the centre of the under or actinal surface, and is surrounded by ten large plates arranged in pairs, representing side mouth-shields. They are subtriangular or somewhat coulter-shaped, with the small end directed inward; and the two plates of a pair touch one another along their interior half only, the outer portion arching outward towards the radii. These mouth-plates project prominently towards the centre of the actinostome, the mouth-slits being consequently deep and wide; and each mouth-plate (pseudo-side mouth-shield) bears on its outer side three or four short, oblong, flattened mouth-papillæ; and a single, large, semicircular papilla stands at the apex of the pair of mouth-plates (Pl. XX. fig. 5).

A mouth-shield is present in only one of the interbrachial spaces. It is roundly shield-shaped, and is, in all probability, the representative of the madreporiform body—an inference drawn from the fact that this plate bears a raised tubercle punctured with a large pore near one of its outer corners. No jaws (*scutella oralia*), no jaw-plates (*tori angulares*), and no teeth are present.

Extending from the mouth-slits along the median line of the radii are a series of large quadrangular plates, occupying the position of under arm-plates in an Ophiuran (Pl. XX. fig. 6). The first or innermost under arm-plate is much larger than any of the succeeding ones, elongate and somewhat escutcheon-shaped inwardly, but having two broad alæ or extensions produced with a graceful curve from the corners of the outer margin, the whole plate bearing a fanciful resemblance to the gorget of ancient armour. The succeeding under arm-plates are subquadrate, and, being bounded laterally by incurved lines, resemble vertebræ in outline; the number included within the disk is nine or ten, of which the two or three terminal ones diminish very rapidly in breadth, the passage of these into the true under arm-plates of the aborted ray being clearly traceable—a subject to which attention will be directed presently.

The space occupied by the ambulacral system is very considerable, forming in each radius a petaloid area, down the middle of which runs the series of under arm-plates above described (Pl. XX. fig. 6). The entire intermediate space between two neighbouring radii is covered with a tessellated scaly membrane, composed of small, uniform, hexagonal plates. The tesselłæ, which form a more or less straight line bordering on the pore-area, diminish in size as they approach the edge of the disk, and at the same time become somewhat rounded in contour; and the plating terminating altogether at a short distance from the margin of the disk, a border is left around the test exposing a portion of the lateral or side arm-plates, in breadth rather greater than the length of the longest spines of the marginal fringe.

Returning now to the ambulacra. A pair of tentacles accompanies each under arm-plate, one on either side; and the neighbouring tentacles or ambulacral feet are separated from those of the next joint by a thin straight partition or septum, which extends somewhat upward into the disk or body in a manner suggestive of the arrangement of the ambulacral plates in certain Asteroids. Owing to the prominence of these septa, which extend between the outer angles of the under arm-plates and the margin of the interradial plating, they have the appearance of cutting up the ambulacral area into square compartments; over these is stretched a thin membranous skin, which is punctured with a large round pore for the passage of the ambulacral tentacle, the orifice being frequently very little less in diameter than the length of the under arm-plate itself (fig. 6). Judging from the appearance of the specimen, the tentacles were, in all probability, entirely retractile. Each pore is protected by tentacle-scales: one, which is large and lanceolate, is situated on the interradial side of the aperture, and is very frequently found reflected or bent quite backward towards the actinostome; another scale, smaller and more rotund, occurs on the side of the pore adjacent to the under arm-plate, but is often wanting on the pores of the outer portion of the radii. Both of these are unmistakably "scales" in the proper sense of the term, and bear no resemblance whatever to the usual form of tentacle-"papillæ" found in many Ophiurids. In addition to those just described there is frequently a free ovoid-shaped scale present on the outer or aboral portion of the membrane of the tentacular aperture.

The last two or three arm-segments included within the disk are worthy of notice, since they show the gradual stages of modification which the radial series undergo in the course of their passage onto the rudimentary arm. In the last joint but two the breadth of the under arm-plate is very greatly reduced, the proportion to length being less than one half, and the aboral end forms, at the same time, two sloping facets, in consequence of the encroachment of the succeeding pair of side arm-plates, which extend, by the prolongation of their adoral margin, quite up to the median plate, the tentacle-pore being scooped out of the outer margin of the plate itself, as usual in Ophiuridæ. In the last under arm-plate but one the diminution in size becomes still greater, whilst in the segment which follows the side arm-plates meet for more than half their length in the median line, the under arm-plate being reduced to a small subtriangular plate enclosed in a notch on their outer margin; this is the basement joint of the rudimentary arm, and is situated half within and half without the pentagonal disk; the side arm-plates belonging to this segment bear three marginal spines, which are only very slightly modified from those of the marginal fringe. Passing outward to the second joint of the free ray, the under arm-plate is very insignificant, and the arm-spines are present as short, stout, rounded spinelets of true Ophiuroid type, whilst in the third joint the under arm-plate has become quite microscopic and the spines reduced to mere papillæ (Pl. XX. figs. 6, 6 *a*).

Concurrent with the changes noted above in the plates of the terminal segments of the disk, the pore-areas become very greatly reduced in breadth towards the extremities of the radii; for whilst midway between the centre of the actinostome and the angle of the disk the half pore-area on either side is broader than the median range of under arm-plates, the last pair or two of pores are scarcely larger than the usual Ophiuroid tentacular orifices. This circumstance, together with the fact that the pores in the neighbourhood of the actinostome are likewise somewhat more circumscribed in breadth than those in the middle of the radius, imparts the petaloid form to the outline of the poriferous area.

It is also of importance to note that there are no tentacle-pores or tentacle-scales present on the rudimentary arms. Owing to the state of preservation of the specimen under consideration, it is impossible to determine what was the length originally attained by these aborted prolongations of the radial system, as they have been unfortunately broken in every case; but from the rapidity with which each succeeding joint diminishes both in size and character from its predecessor, as well as from the rudimentary nature of the parts, the probability would seem very doubtful that these stunted, undeveloped arms were ever of any great extension. As indicating the really diminutive size of the small free rays, it may be mentioned that the first three segments *together* measure little more than one tenth of the diameter of the disk.

The innermost or basal portion of the pore-area is restricted on either side by a narrow elongated plate, which joins up to the alæ of the first under arm-plate and is directed downwards towards the side mouth-shield (mouth-plate); it is somewhat sigmoid in shape, thickened at the outer (aboral) end and terminating inwardly in a point, and forms the interradial margin of the first tentacle-pore. This plate I am disposed to regard as the homologue of the Ophiuroid genital scale, although in the present case it is comparatively small and insignificant, being even shorter than the first under arm-plate. There appear to be traces of a slit on the interradial side of this plate, between it and the interradial plating, such as would correspond with one of the *rimæ genitales*; but in the present condition of the specimen it is impossible to speak with certainty on this point.

The communication between the oral cavity and the interradial space is uninterrupted by any calcareous development, so far as I am able to determine without injuring the specimen. By throwing a strongly concentrated ray of light through the test, two small reddish stains, about 1·5 millim. in diameter, are discernible in each interradial area, situated on the sides adjoining the radii, and at about one third the distance between the mouth and the margin: whether, however, these indicate the limits and position of the generative organs cannot be stated decisively without further material; but from the position which they occupy, as well as from the connexion which is apparently traceable with the genital scales at the base of the radii, it seems not improbable that such may be the case. It would be hazardous, however, even to surmise, with our present information, whether these extended interradial spaces are utilized mainly as a prolongation of the peritoneal cavity, or whether, on the other hand, they serve more specially the purpose of a marsupium or nidamental cavity—a function not unfrequently called into action amongst Echinoderms.

Internal Arm-skeleton.—As might be expected from the abnormal character of the animal, the internal structure of the radii is both remarkable and peculiar. A form of arm-skeletion or central axis is present, but of a highly modified and aborted description; indeed, from the manner in which light is transmitted through the radial portion of the disk, it would be at once inferred that any internal structures were of the most simple and rudimentary kind, as compared with similar parts in the regular Ophiuroid test. A section was made through one of the radii, between the fourth and fifth under arm-plates; and although the separation of the elements was not effected as satisfactorily as might be, owing to the partial ankylosis of the various ossicles, which made a certain amount of fracture unavoidable and entailed the consequent destruction of some detail, the section is sufficient to show the general features of this portion of the anatomy of *Astrophiura* without risking further damage to the specimen. The body or axis of the arm-skeleton is small and slender, and situated very high in position in the dorsal portion of the ray (figs. 7, 8, *d*, *e*); in fact the inferior longitudinal notch is situated entirely below, instead of being (in part at least) excavated out of the lower portion of the axis; the alæ or wing-like disk-processes, which in the Ophiuroid arm occupy the whole space between the side arm-plates, are here quite small and rudimentary, being reduced to the diminutive ear-shaped structures marked *b*. The inferior longitudinal neuro-vascular notch is very large and triangular in section, being, in fact, most extraordinary in size, as well as remarkable for its great extension upward.

We now come to a very noteworthy feature in the internal anatomy of the present animal, which is presented by the septa dividing the tentacular compartments. These consist of large, broad, thin plates which join up to the aborted disk-processes of the axis (figs. 7, 8, *a*), and form partitions reaching up to the inner surface of the abactinal wall of the test, their actinal edge forming the prominent straight divisions which are seen, on the superficial aspect of the underside of the animal, to span across the ambulacral area at each segment. It would seem also that there is occasionally a thickening of the side arm-plate in order to form a junction with, or prolongation of, this plate; but whether such a development is the rule in every segment, I am unable to say, without destroying the specimen. It may be noted that this thickening of two neighbouring side arm-plates is productive of a deep trench or groove between the side arm-plates, following the direction of their line of suture and leading into the main interradial cavity. Close up to the abactinal wall is the trace of a thin, delicate, arched plate, which forms the boundary of the tentacular cavity (fig. 8, *f*) : the extraordinary space occupied by the tentacular pit, to the exclusion (almost absolutely, I believe) of the muscular area, is highly remarkable. This is rendered very striking when a comparison is made of diagrams of the respective parts in *Astrophiura* and a typical Ophiuran.

The internal skeleton of the aborted ray-extensions is quite rudimentary and abnormal, the arm-plates being increased to such a thickness as to form almost solid joints, and the communications between the succeeding segments being of the most limited character. This is apparent in the first free segment of radius iv (fig. 9); whilst a little further out upon the ray, in the fourth segment of radius v, the axis has the appearance of a miniature vertebra located in the centre of a disproportionately thick and solid arm-joint (fig. 10).

Skin-appendages.—The plates of the entire test are smooth and naked, there being no trace of pedicellariæ, granules, spinous stumps, or any corresponding developments whatever.

Locality, Preservation, and Colour.—The present example of this Echinoderm was taken at Madagascar, and sent over by a collecting agent along with a number of littoral or shallow-water Asteroids and Echinoids from the same locality. The specimen was simply dried; and its colour in that condition is yellowish white, the marginal fringe of spinelets approaching a light brownish shade, and the actinal or underside a deeper tint of the same.

Measurements of an Individual.

	millim.
Diameter of pentagonal body	14
Length of side of ,,	9·75
Length of a radius	8
Diameter of the centro-dorsal "ophiuroid" disk	8
Radial shields, length to breadth	2 : 1·5
Second upper arm-plate, length to breadth	0·5 : 1·3

Second side arm-plate, length to breadth	0·5 : 2·75
Mouth-shield (madreporite), length to breadth	0·9 : 0·8
Side mouth-shields, „ „ ..	1·25 : 0·75
First under arm-plate, „ „ ..	1·25 : 1·4
Second under arm-plate, „ „ ..	0·6 : 0·55
Outer margin of a mouth-piece to inner point of opposite first under arm-plate	millim. 2·25
Length of spines in the marginal fringe:—	
a. At the extremity of a side	0·3
β. At the middle of a side	0·75
Length of three segments of rudimentary arm ..	1·3
Breadth of rudimentary arm at base	0·85

General Conclusions.—The following peculiarities in the structure of *Astrophiura* suggest themselves as worthy of special attention, in consequence of their important bearing upon the question of the affinities and relationship of the form.

1. The pentagonal, flattened, goniodiscoid body, combining within its area representatives of the whole free radial system as well as of the disk of a typical Ophiuran, presents us with nothing less than the anomaly of an organism having Ophiuroid ray-plates expanded and then consolidated along with their disk into a pentagonal Asteroid form of test. Such a remarkable arrangement of the entire brachial series and abnormal development of the side arm-plates is, so far as I am aware, quite without parallel amongst the Ophiuroidea *, and constitutes a character which I regard as an approach to the structure of the Asteroidea. Although it may be asserted that the resemblance is largely superficial, and that the plates when taken individually are truly Ophiuroid after all, the objection is counterbalanced by the fact that this combination of radial and interradial systems within a common periphery involves morphologically a principle of much higher import than simply outward form, and to which testimony is borne, more or less fully, by each of the following particulars.

* Mr. Theodore Lyman, writing some months ago, has kindly drawn my attention to an interesting species of *Ophiomusium* which he described amongst the material obtained by the 'Challenger' expedition, *O. flabellum*, Lyman, in which a monstrosity occurs in the side arm-plates, the first pair meeting outside the mouth-shield in the median line of the interbrachial space. If I am not mistaken, the same peculiarity is found also in *Ophiozona* (?) *dubia*, Lyman ("Blake" Exped., Bull. Mus. Comp. Zool. vol. v. p. 224, pl. ii. figs. 19–21). It is difficult, however, to look upon these cases as in any way fairly homologous with the extraordinary development present in *Astrophiura*, in which we have the series of side arm-plates produced as flat plates extending from the upper arm-plates and occupying entirely a dorsal position upon the test, whilst in the instances cited above the prolongation of the plates occurs on the actinal surface and in a single segment of the ray only. Nevertheless it is a very interesting feature.

2. The limitation of the tentacular pore-system to the disk likewise supports the above view as to the affinities of *Astrophiura*. An approach in the same direction, although in a very different degree, is not wholly unknown in true Ophiurans, the tentacle-pores extending very little, if at all, beyond the disk in *Ophiomusium* and *Ophiolipus*.

3. The extremely rudimentary condition and aborted character of that portion of the radial series which is prolonged beyond the body-disk would seem to give indications of disuse and cessation of function in this area of Ophiuroid organization, followed by a localization of function according to the plan of Asteroid organization. Perhaps, to a certain extent, we find a step in the same direction in *Ophiomusium* and a few of the *Ophioglyphæ*.

4. The extraordinary development of the tentacular or ambulacral system compared with its usual standing in Ophiuran anatomy, together with a most extreme modification of the muscular system characteristic of that group, indicate unequivocally a tendency towards the growth of Asteroid characters; whilst the septa or supplementary plates which form the divisional partitions of the tentacular compartments in *Astrophiura* are not only unknown in Ophiuroidea, but, as far as I am aware, are confined to the Asteroidea. Regarding the aborted axial elements of the radii in the present echinoderm as the natural homologues of the ambulacral plates of Asteroidea, it remains only to determine the equivalents of the septa or accessory plates; and these I propose to identify with the internal connective pieces which occur in Astropectinidæ and Linckiadæ, and fill in the angle formed by the ambulacral and ventro-lateral plates, and to which M. Viguier (who has recently studied the calcareous test of starfishes) has applied the name of "soutiens ambulacraires." If the view just enunciated be correct, we are presented by this plate in *Astrophiura* with the indications of a stage in the genetic development of Asteroidea all traces of which have gradually passed away in the course of the evolution of the more advanced forms of the group.

It should be mentioned that an approach towards the large size of the cavity for the reception of the tentacle is perhaps to be found in *Ophiomyces frutectosus*, Lyman.

Respecting the under arm-plates, which seem to accord so fully with the homologous plates in Ophiuroidea, it may be remarked that their peculiarity in this instance may be accounted for by the abnormal development of the whole organism, and the consequent action of correlation, rather than as the direct outcome of inheritance or functional utility. The original estimate of the ordinal value of these plates, in consequence of their being elements of structure supposed to be entirely unrepresented in Asteroids, is placed in quite a different light by the statement made by A. Agassiz that homologous plates occur in an early stage of the Asteroid larva, but ultimately become resorbed during the growth of the ambulacra.

5. The prolongation of the peritoneal cavity into the radial portion of the animal is a divergence towards a structure usual in the Asteroid group*.

6. The simple and rudimentary character of the mouth-armature certainly follows much more closely in principle the plan of structure obtaining in Asteroidea than the highly modified and complex organization which is found in most Ophiuroids. In fact simple mouth-plates bearing papillæ only are in *Astrophiura* the sole representatives of the elaborate apparatus, consisting of side mouth-shields, jaws, jaw-plates, and teeth, which is met with in the latter group.

It may be suggested that the mouth-plates, which are spoken of in the foregoing description as representatives of the side mouth-shields, might with more propriety be styled "jaws," since these latter are the first formed and are the result of the development of the first adambulacral plate, whilst the side mouth-shields are the modification of the second adambulacral plate. A moment's consideration, however, will show that any dogmatic insisting upon such a nomenclature is a mere play on words; for it will be seen that the term which I elected to use, for descriptive purposes only, was that which expressed most clearly the position of the plates in relation to the mouth-shield, as well as their own individual form; whilst the fact of their wanting both jaw-plates and teeth would have rendered the application of the other term, if perhaps somewhat more precise, certainly much more misleading.

7. The aborted character of the axis or internal arm-skeleton is particularly noteworthy, and gives evidence of a divergence from a very characteristic Ophiuroid structure, from which due significance must not be withheld when formulating the affinities of the present animal.

In conclusion, it may be noted here that *Ophiophyllum petilum*, Lyman †, a strangely abnormal Ophiuroid taken during the 'Challenger' expedition, superficially resembles *Astrophiura* in having a fringe-like border of spines round the margin of the disk: but here the comparison ceases; for they are not homologous with the same appendages in our

* So far as the ovaries are concerned, Mr. Lyman informs me that he thinks he has found some such extension in *Ophiocreas*.

† "Ophiuridæ and Astrophytidæ of 'Challenger' Exped.," Bull. Mus. Comp. Zool. vol. v. p. 130, pl. vii. figs. 179–181.

specimen, which are modified arm-spines belonging to the side arm-plates, whilst those in *Ophiophyllum* are, so far as I am able to judge from the figure alone, simply disk-spinelets attached indiscriminately to radial and interradial plates alike.

Without reviewing in further detail the structural peculiarities of this abnormal Echinoderm, it will be clear that no group of genera or family hitherto known can include a form of such aberrant type within the present limits of definition. *Astrophiura* consequently stands apart, and, in a classificatory point of view, must be considered as the representative of a family of which it is, as yet, the only member known.

Regarding the serial position which the Astrophiuridæ would occupy amongst Echinodermata in relation to the accepted arbitrary divisions in present use, they will naturally be placed, by logical reasoning from the structure of the present form, intermediate between the Ophiuroidea and Asteroidea. Respecting the affinities of *Astrophiura*, the conclusion seems inevitable that they apparently point to Ophiuroid ancestry, whilst the modifications from the true Ophiuroid arrangement which are present unquestionably take the direction of the more centralized Asteroid plan of organization, and thus form a step which diminishes the distance of structural difference which has been considered to separate the two orders : upon such grounds *Astrophiura* has a due claim on the consideration of systematists as an intermediate and connecting form. It is undoubtedly premature, in the present state of our information, to endeavour to indicate absolutely how far *Astrophiura* bridges over the differences between Asteroids and Ophiuroids ; but it is certainly not too much to say that this genus passes very much further over the borderland than any other Echinoderm with which we are at present acquainted.

The following diagnosis will embrace the characters involved in the preceding description :—

Fam. **Astrophiuridæ**, mihi.

Brachia cum disco ophiurano in corpore pentagonali inclusa. Dentes absunt. Oris armatura simplex et imperfecta. Pori pedum ambulacralium septis angustis ad perpendiculum radii directis disjuncti. Cava interbrachialia perlata.

Astrophiura permira, gen. et sp. nov.

Corpus pentagonale, depressum, supra convexum, infra paulo concavum, obtectum squamis concinnis et planis, in dimidio interiore more disci ophiurani dispositis, in dimidio exteriore scutella lateralia brachiorum simulantibus maxime prolatis. Brachia incipientia ab angulis disci producta, series radiales continuantia.

In superficie actinali os medium, decem magnis ossiculis oralibus cinctum, prostantibus scutellis adoralibus. Unum scutum buccale adest; dentes, scutella oralia et tori angulares absunt. Papillæ orales ternæ aut quaternæ, cum unâ magnâ, ad angulos oris appositâ.

Series scutorum quadratorum a rimis oris per radios procedunt, scutellis ventralibus prostantibus, et per brachia inchoata producuntur.

Foramina pedum ambulacralium septis angustis disjuncta, permagna, protecta singulâ longâ papillâ ambulacrali ad margines interbrachiales, lanceolatâ et squamæformi, alterâ minore ad partem interiorem radii juxta scutella brachiorum ventralia positâ. Areæ interbrachiales squamis parvis hexagonalibus obtectæ; marginem appropinquantes decrescunt, relinquentes limbum angustum expositum; disci margine cincto densis spinis brevibus et compressis.

Hab. in mari ad oras insulæ Madagascar.

EXPLANATION OF PLATE XX.

Fig. 1. *Astrophiura permira*, nobis, abactinal aspect. × 6·5.
Fig. 2. Actinal aspect of the same specimen. × 6·5.
Fig. 3. Brachial series of radius ii, abactinal aspect. × 10.
Fig. 4. Brachial series of radius v, abactinal aspect. × 10.
Fig. 5. Actinostome: mouth-armature. × 10.
Fig. 6. Pore-area and actinal aspect of radius iii. × 10.
Fig. 6 *a*. Terminal portion of pore-area and actinal aspect of radius ii. × 10.
Fig. 7. Transverse section, showing the proximal extremity of the fifth segment in the brachial disk-series of radius iv. × 10.
Fig. 8. Transverse section, showing the distal extremity of the fourth segment in the brachial disk-series of radius iv. × 10.
Fig. 9. Distal extremity of the first free segment of the rudimentary free arm of radius iv. × 20.
Fig. 10. Distal extremity of the fourth segment of the rudimentary free arm of radius v. × 20.

XLVI.—*On two new Isopods* (Arcturus, *sp.*, *and* Tanais, *sp.*) *from New Zealand.* By George M. Thomson.

[Plate XIX. figs. 1–6.]

The two new species of Isopods described in this paper represent genera not hitherto found in New Zealand; and they are both somewhat remarkable for their resemblance to, and dissimilarities from, already known species. Both forms were obtained by the dredge in from 4–5 fathoms in Dunedin Harbour; and I have reason to believe that they are somewhat rare species.

The first belongs to the genus *Arcturus*, and approximates very closely to *A. corniger*, Stebbing*, a species found at Algoa Bay. After reading Mr. Stebbing's description of this species, and comparing it with that found here, I am inclined to think that he has only seen females. It is very similar to the female of the new species, but differs considerably from the male.

The species found here, which I propose to call *A. tuberculatus*, differs in the following general respects from *A. corniger*:—The superior antennæ are four-jointed, having a large broad basal joint, and they extend considerably beyond the extremity of the second joint of the inferior antennæ. At the extremity of the terminal joint there occur several minute jointed appendages, regarding the function of which I am quite ignorant. The fourth segment of the body, which in *A. corniger* is produced upwards into six cone-like swellings, bears in the male of the local species one stout conical tubercle near each extremity (the anterior one being trifid), while in the female it has ten pointed tubercles. The branchial opercula are very long, and extend to the extremity of the abdomen. The following is a specific description of this interesting form.

Arcturus tuberculatus, sp. nov.

Male. Body rather robust. Head very indistinctly separated from first segment of body, its antero-lateral margin produced forward, apex crowned with a two-lobed tubercle. Three anterior segments also produced upwards into acute tubercles. Fourth segment smooth, bearing a single stout spine at each end on the median line, the anterior one being trifid. Superior antennæ reaching beyond the extremity of second joint of inferior; basal joint stout; second and third short; fourth as long as the two preceding, and bearing several jointed appendages, each consisting of a minute basal joint and a slender narrow lamella. Inferior antennæ rather longer than first four body-segments; first and second joints short; third and fourth long, not ciliated, but with rows of minute tubercles on the under margin; flagellum three-jointed, sparingly ciliated, with a row of acute spines or serrations on its inner margin.

These sharp teeth are present on the antennæ of both sexes, and must materially assist the animal in grasping its prey;

* Ann. & Mag. Nat. Hist. 4th ser. vol. xii. p. 97 (1873).

but the tubercles are found only on the male. They are very characteristic, each being a well-marked denticle with four or five rounded and roughened crowns.

The *female* differs from the male in having the whole body, except the lower antennæ, more or less tuberculate. The head and three posterior segments of the body bear a row of tubercles on each side, and have their inferior margins laterally extended. The fourth segment is flattened on its postero-lateral margins; it bears on the median line at its anterior extremity a large three-pointed tubercle; behind this are three smaller tubercles placed transversely, the middle one being the smallest; and on each side of the anterior margin are two tubercles, the lower of which is the largest. The oviferous pouch does not extend the whole length of this segment. The fifth segment of the body is extended downwards as if to form a supplementary pouch; but I do not know at all what the function of this enlargement can be. Length 0·2 of an inch, exclusive of the antennæ.

Hab. Dredged in Dunedin Habour, in 4–5 fathoms.

The second species described in this paper is a *Tanais*, of which I have hitherto only obtained a single specimen, and of which consequently the description is somewhat meagre. It approximates rather closely to *T. vittatus*, Lilljeborg, of Europe, and is probably its representative in these seas, but at the same time is sufficiently distinct. The following are the chief points of difference. The antennæ are not so setose. The first gnathopoda are well developed; but the immovable finger is destitute of tubercles on its inner margin, while it is much thicker than the movable finger. The posterior pereiopoda are terminated by sickle-shaped fingers, but wanting the denticulations which are found in *T. vittatus*. The fascicles of hairs on the pleon are composed of rather dense furry hairs, not slender cilia. Lastly the terminal uropoda have five instead of three articulations. The following is the specific character:—

Tanais novæ-zealandiæ, sp. nov.

Body broader than deep, with transverse fascicles of rough hairs on the three anterior segments of the pleon. Eye very small, black, and circular, placed on a prominent lateral lobe of the anterior margin of the head. Superior antennæ three-jointed, setose at the extremity; first joint longer than the two succeeding. Inferior antennæ rather shorter than superior. First gnathopoda very stout, the immobile finger of the hand smooth on its inner margin, or only slightly denticulated. Second gnathopoda very slender. Posterior pleopoda bearing a smooth sickle-shaped finger, with a few long cilia at its base. Terminal uropoda almost as long as antennæ, five-jointed, and with numerous setæ. Length 0·18 inch.

Hab. Dredged along with the previous species in Dunedin Harbour, in 4–5 fathoms.

EXPLANATION OF PLATE XIX. Figs. 1–6.

Fig. 1. *Arcturus tuberculatus* (male). × 13.
Fig. 2. The same (female), head and part of body. × 13.
Fig. 3. The same, superior antennæ. × 56.
Fig. 4. The same, lamellar plate of abdomen. × 28.
Fig. 5. *Tanais novæ-zealandiæ.* × 13.
Fig. 6. The same, extremity of last pair of legs. × 28.

XLVII.—*On a new Species of* Nebalia *from New Zealand.* By George M. Thomson.

[Plate XIX. figs. 7–9.]

In dredging during the past summer in Dunedin Harbour I obtained a single specimen of a *Nebalia* differing from any species hitherto described, and which, from the great length of its inferior antennæ, I have named *N. longicornis.*

In a paper in the Linnean Society's Transactions for 1875 (ser. ii. vol. i.), "On some Atlantic Crustacea of the 'Challenger' Expedition," Dr. Willemoes-Suhm described a new species of *Nebalia* from Bermuda (*N. longipes*), in which the phyllopodal character of the legs has been entirely lost, and the schizopodal character approached more than in any other species of the genus. Taking this fact in conjunction with the characters of several new deep-sea genera of Schizopods examined by him, he reopened the whole question of the position which *Nebalia* occupies in reference to other groups of Crustacea, and proposed to unite it with these new forms, the Mysidæ, &c., in the enlarged group of the Schizopoda. Seeing, however, that it differs from all others of the family in the number of its segments, in the well-developed phyllopodal character of the thoracic appendages in the majority of the species, and also in its development, it seems a better plan to adopt the proposition made by Dr. A. S. Packard, Jun. (in the 'American Naturalist,' vol. xiii. p. 128), viz. to make it the type of a new order, the Phyllocarida. As he points out, *Nebalia* probably represents a persistent form of a very generalized type of great antiquity, and thus unites in itself characters of Phyllopoda, Copepoda, and Decapoda.

The specimen found by me, which was over $\frac{1}{3}$ inch in length, has the carapace extending back to about the third abdominal segment on the sides, but with a rather wide dorsal sinus. The beak is large and well developed. The eyes are similar to those of *N. bipes* of Europe, being situated on movable peduncles, and formed of numerous crystalline bodies under a common cornea. The antennæ are furnished with numerous hairs on their peduncles. The superior pair have a peduncle of two joints, the last of which bears two appendages, consisting of:—(1) a short triangular joint, with spines on its outer margin, and an oval ciliated plate; and (2) a slender flagellum of several articulations, the number of which were not made out. The inferior antennæ consist of a peduncle of three stout joints (the second of which bears a large tooth on its upper margin, while the terminal one is furnished with rows of spines and hairs on its outer margin and a bunch of hairs at its extremity), and a long slender flagellum, consisting of between 70 and 80 articulations, and almost equal in length to the whole body. The branchial feet, which were apparently very slender, were completely concealed beneath the carapace. The third to the seventh (inclusive) abdominal segments have their posterior margins finely dentated. The four pairs of natatory feet have the peduncles largely developed; and their branches bear a row of spines on each outer margin. The caudal appendages also have a row of spines on each side, and are terminated by several long filaments, which are minutely plumose.

Pale yellow in colour and semitransparent. Length 0·35 inch.

EXPLANATION OF PLATE XIX. Figs. 7–9.

Fig. 7. *Nebalia longicornis.* × 10.
Fig. 8. The same, base of superior antennæ. × 20.
Fig. 9. The same, base of inferior antennæ. × 20.

XLVIII.—*More Moot Points in Ornithological Nomenclature.* By Alfred Newton, M.A., F.R.S., &c.

Nomenclature is so trifling an adjunct to zoology that no true student of the science can fail to grudge the time which he is, on certain occasions, compelled to bestow upon it, or ought to be ungrateful to those who have expended their toil in preparing some rules for his guidance through the intricate maze of synonyms that, from one cause or another, enfolds almost every object with which he has to deal. Of such rules, the code adopted by the British Association, after the consultation of almost every eminent naturalist at home and abroad, and after more than twenty years' deliberation, is naturally that to which the student turns, and is that by which, if he has any respect for the opinion of others, he will be governed. In one very small department of zoology I have tried to carry out these rules; and I am glad to say that my efforts so far have been favourably regarded by many of my fellow-workers. It is, however, impossible to please everybody; and two of my friends lately deemed it their duty to demur to some of the decisions at which, in obedience to that code, I had arrived. Their objections I essayed to answer without delay (*suprà*, pp. 158–163); and from the communications of several correspondents I judge that my reply has been pretty generally considered to be conclusive. I then said that I had no desire to convert my critics; and I certainly had no expectation that I should do so. On the other hand, I did not anticipate that one of them would so immediately begin to prefer a fresh series of charges against me, such as I find in 'The Ibis' for October, which reached me yesterday, and this, I may remark, without deigning to take any direct notice of my former reply. I am now accused of disturbing nomenclature by changes which are both "frivolous" and "revolutionary," of having (in conjunction with others) "gradually undermined" the principles of the aforesaid code, of being guilty of "flagrant offences" in violation of the same, of pursuing a "reckless course," of "corrupting the ornithological morality" (whatever that may mean) of the age, and generally of high crimes and misdemeanors. I therefore ask the dispassionate attention of the readers of this journal while I try to clear myself from the charges upon which I am thus peremptorily arraigned—premising that, with all the humility which ought to be displayed by a defendant, I shall not throw back hard words on my assailant.

Mr. Seebohm's opinions I do not wish to influence; but it is incumbent on me to correct his assertions when they are contrary to fact. He may think that the code of the British Association requires amendment—even to the extent of five "riders" to be added to one rule—or total abolition; and I have no desire to check the utterance of his expression; but when he states (Ibis, 1879, p. 429) that, "to make confusion more confounded," Mr. Sharpe followed my "unfortunate lead" through two volumes of his 'Catalogue of Birds,' I am bound to say that out of *thirty-four* species of *Accipitres* treated in common by that gentleman and myself, his nomenclature differs from my own in *thirteen* instances, including the important cases of *Syrnium* and *Strix**. The fact that Mr. Sharpe did not follow me further is not only a proof of his wholly independent action, but a disproof of the imputation of his ever following me "blindly." Whatever epithet may be applied to my "lead," it is surely Mr. Seebohm's statement that is "unfortunate."

Leaving, however, my supposed copartners in crime to answer for themselves, and for their eyesight, which none can doubt they are competent to do, I will proceed to the charges now brought against me personally by Mr. Seebohm. Formidable as they seem, examination reduces them to two †, of which one is the old story—the proper scientific name to be given to the Greater Whitethroat. I really hoped I had disposed of this before ‡; but although he has never adduced an atom of evidence in support of his assertion (which fact does not much surprise me, seeing that none is forthcoming), Mr. Seebohm still maintains that "Pl. Enl. 581. fig. 1" is "unintelligible" (which fact has the contrary effect). He is absolutely obdurate on this point, and will hear not Moses or the prophets. In vain for him have Temminck and Kuhl, Bonaparte and Gray, Gerbe and many others written. What was intelligible to them is not so to Mr. Seebohm; but as it is no part of my business to find any of my friends in intelligence, I will here dismiss the matter, merely suggesting, as a subject of curious inquiry on the part of those who have leisure, whether, if the beloved and "familiar" name "*Phylloscopus rufus*" be not set aside, owing to the prior use of its

* On the subject of the nomenclature of the *Strigidæ* I may perhaps be allowed to remark that, in the same number of 'The Ibis,' an editorial notice (p. 480) assumes that Forster's first application of the name *Bubo ignavus* to the Eagle-Owl was made in his "second catalogue" (p. 46), ignoring the fact of its use in his "first catalogue" (p. 3), which duly bears date 1817. This fact must be deemed conclusive. Those, however, who are curious as to the date of the "second catalogue" (to my mind so needlessly called in question) may like to know that the copy of the work in the library of the Linnean Society, containing (like my own) *both catalogues in the original binding*, is included in the list of "Additions" to the library of that Society, printed at the end of the 12th volume of its 'Transactions' (p. 590), which volume bears date 1817, and is therefore undeniable evidence of the "second catalogue" having been published in that year—unless, indeed, ground be shown for doubting the identity.

† The question whether we should write "*Acrocephalus aquaticus* (Gmel.)" or "*Acrocephalus aquaticus* (Temm.)" seems scarcely to require notice.

‡ I wish here to correct a misprint in my former paper (*suprà*, p. 161, line 13): "remiges" should be "rectrices."

trivial term, might not Rule 11 of the code apply to it? To call a species "*rufus*" which has not a shade of that colour about it certainly has the appearance of implying "a false proposition."

The next and last specific charge is that concerning *Acrocephalus arundinaceus*; and herein I at once claim an acquittal, since Mr. Seebohm has himself pronounced my decision to be "legal" and confesses that its legality has been "indorsed" by at least half a dozen other writers.

It would be an easy matter to extend my remarks to the rest of Mr. Seebohm's diatribe, and to criticise his proposed "riders," five in number, to the unhappy Rule 12, which at present falls so short of his desires. I would only observe thereon that there may be a something worse than "judges' law," namely law which is not judges'. Would-be legislators on nomenclature must take a wider view of the subject than ornithology only affords; but I cannot stop to establish that position. My inclination is not towards controversy; I have little time to spare; and, lastly, I am deeply affected by one of Mr. Seebohm's statements. He declares (pp. 430, 431), doubtless from experience of his own case, that the blunders of ornithologists are "pretty much in the direct ratio of the amount of work they do." This declaration should make all of us cautious; for it may be true in other cases.

Mr. Seebohm is greatly averse from any change of established custom. So am I; but I want to know what establishes custom; and, if he favours the readers of 'The Ibis' with another dissertation on nomenclature, I hope he will define what he means by "general use." It is not enough that all ornithologists have hitherto agreed to regard a certain figure as a representation of a certain species: Mr. Seebohm says the figure is "unintelligible;" and so all their opinions ("general use" notwithstanding) are to go for nothing. He objects to my carrying out rules "without regard to consequences"—or, in other words, impartially—that it is "reckless." In his eyes obedience to a code is a "flagrant offence" in violation of it. He finds me pursuing a strictly "legal" course; hence he terms that course "revolutionary" and wishes (pp. 429, 430) to alter the rules to suit his views of what the rules ought to be. If there is not here as nice a "derangement of epitaphs" as any Mrs. Malaprop would desire, I hardly know where else it can be found.

Magdalene College, Cambridge,
November 3, 1879.

XLIX.—*On the Geological Distribution of the Rhabdophora.*

By Charles Lapworth, F.G.S. &c.

Part II. Data.

[Continued from p. 341.]

Bala Formation.

In the present state of our knowledge it is impossible to fix upon the physical or palæontological line of demarcation between the Llandeilo and Bala (or Caradoc) formations. The Upper Llandeilo and Lower Bala rocks both consist, in great part, of dark and more or less carbonaceous shales, tolerably prolific in Graptolites. In the south of Scotland, strata of this nature (*the Glenkiln Shales*), unequivocally superior in systematic position to the generality of the Welsh Llandeilo rocks, afford a Graptolite fauna of a most distinctive character, but which, upon the whole, has a facies intermediate between that of the typical Llandeilo of Siluria and that discoverable in strata of undoubted Bala age. I have hitherto looked upon this Glenkiln fauna as of Upper Llandeilo age. Not only, however, have I failed this summer in detecting many of its most characteristic species in the highest Llandeilo rocks of South Wales, but the recent researches of American geologists appear almost to demonstrate that in New York and Canada a similar fauna is characteristic of the shaly strata immediately overlying the Trenton Limestone—in other words, of shales admittedly homotaxeous with the lower beds of the British Bala formation. This also appears to be the systematic place of the same fauna in Ireland and in Scandinavia. Till the lowest boundary of the Bala has been satisfactorily settled by careful research in the typical districts of North Wales, it is perhaps a matter of no great moment whether the fauna in question be considered as of Upper Llandeilo or of Lower Bala age. At present, however, the balance of evidence leans decidedly in the latter direction. It will therefore be more convenient to regard this peculiar fauna, provisionally, as of Lower Bala age.

Llandeilo-Bala or Lower Bala.

Scotland.—The Glenkiln or Lower Moffat shales of the south of Scotland, above referred to, yield, both in the typical localities near Moffat and in the district of the Leadhills, the following species:—

Didymograptus superstes, *Lapw.*
Cœnograptus gracilis, *Hall.*
Cœnograptus surcularis, *Hall.*
—— explanatus, *Lapw.*

Cœnograptus pertenuis, *Lapw.*
Leptograptus flaccidus, *Hall.*
Dicellograptus divaricatus ?, *Hall.*
—— patulosus, *Lapw.*
—— sextans, *Hall.*
Dicranograptus formosus, *Hopk.*
—— ziczac, *Lapw.*
—— Nicholsoni, *Hopk.*
—— ramosus, *Hall.*
Clathrograptus cuneiformis, *Lapw.*
Glossograptus Hincksii, *Hopk.*
Lasiograptus Harknessi, *Nich.*
Lasiograptus? bimucronatus, *Nich.*
Diplograptus foliaceus, *Murch.*
—— dentatus, *Brongn.*
—— angustifolius, *Hall.*
—— tricornis, *Carr.*
—— Whitfieldi, *Hall.*
—— euglyphus, *Lapw.*
Climacograptus bicornis, *Hall.*
—— Scharenbergi, *Lapw.*
—— perexcavatus, *Lapw.*
—— ? cælatus ?, *Lapw.*

The lowest or *Stinchar Division* of the Lower Palæozoic rocks of Girvan includes the two conglomerates of the valley of the Stinchar, with an intermediate limestone (Craighead) and some overlying shales. The Crustacea and Brachiopoda are of a Lower Bala type with numerous Llandeilo (Trenton) affinities. The Graptolites I have collected from this division include, among others, the following Glenkiln forms :—

Dicranograptus formosus, *Hopk.*
—— ramosus, *Hall.*
Glossograptus Hincksii, *Hopk.*
Lasiograptus Harknessi, *Nich.*
Dicellograptus moffatensis ?, *Carr.*
Leptograptus flaccidus, *Hall.*
Climacograptus Scharenbergi, *Lapw.*
Climacograptus bicornis, *Hall.*
—— cælatus, *Lapw.*
Diplograptus tricornis, *Carr.*
—— dentatus, *Brongn.*
—— foliaceus, *Murch.*
—— angustifolius, *Hall.*
—— euglyphus, *Lapw.*

Ireland.—Every form of Graptolite enumerated in the Glenkiln list given above has been detected in similar association in corresponding rocks (Ballygrot beds) in the Lower Palæozoic strata of county Down by my friend Mr. William Swanston, F.G.S., at Ballygrot and other localities to the south of Belfast Lough*.

Portions of the same fauna have also been recognized at several localities in the south of Ireland. In Tramore Bay, county Waterford, the following forms were collected by officers of the Geological Survey, from dark shales interbedded with fossiliferous rocks full of Lower Bala fossils†.

Didymograptus, sp. (Hisingeri, *Baily*).
Dicellograptus sextans, *Hall.*
Cœnograptus gracilis, *Hall.*
Diplograptus foliaceus, *Murch.*
Climacograptus bicornis, *Hall.*
Dicranograptus ramosus, *Hall.*

In the neighbourhood occur *Leptograptus flaccidus*, Hall, and a species of *Didymograptus* (*Hisingeri*).

* Swanston, Trans. Belfast Naturalists' Field-Club, Appendix, 1876–1877.

† Memoirs Geol. Surv. Ireland, Explanation Sheet 167, &c., p. 23, *et seq.*; also Baily, Quart. Journ. Geol. Soc. 1869, vol. xxv. pp. 158–162.

At Balleymoney near Gorey, in the adjacent county of Wexford, a similar group of forms is met with, viz. :—

Didymograptus (Hisingeri).	Diplograptus mucronatus, *Hall.*
Dicellograptus sextans, *Hall.*	Climacograptus (bicornis ?), *Hall.*
Leptograptus flaccidus ?, *Hall.*	Dicranograptus ramosus, *Hall.*

The most prolific locality, however, appears to be that of Six-Mile Bridge, county Clare, on the western slope of the Slieve Bernagh mountains. From this locality Mr. Baily quotes

Cœnograptus gracilis, *Hall.*	Diplograptus Baylii, *Carr.*
Dicellograptus sextans, *Hall.*	—— foliaceus, *Murch.*
Climacograptus bicornis, *Hall.*	Didymograptus, sp. (Hisingeri).

and some others.

Wales.—The Graptolitic black mudstones of Llanfaelrhys, Anglesey, noticed by Mr. Salter, probably belong also to this doubtful horizon. They occur in the neighbourhood of limestones of Bala age, and yield *Dicranograptus formosus**, Hopk., *Climacograptus Scharenbergi*, Lapw., and species of *Didymograptus.*

America.—The typical Glenkiln fauna of South Scotland reappears almost unmodified in corresponding strata on the continent of North America. It is confined to the convoluted shales that form the banks of the Hudson River in the neighbourhood of Albany, and to their Canadian equivalents. These so-called Hudson-River shales were formerly regarded by the great majority of American palæontologists as the representatives of the Lorraine shales that form the highest member of the Ordovician of Western New York. I have myself advocated the theory that they are of much earlier date, and inferior in systematic position to the Trenton Limestone. In the face of recent discoveries, however, neither of these theories appears to be any longer tenable. Mr. Whitfield's opinion, that they correspond, generally speaking, to the Utica Slates of Western New York and Canada, is probably the nearest to the truth; but it is possible that some of the fossils quoted from them belong in time to the upper beds of the Trenton Limestone of the west.

At the locality of Norman's Kiln, near Albany, Professor Hall has collected

Clematograptus multifasciatus, *Hall.*	Cœnograptus gracilis, *Hall.*
Didymograptus serratulus, *Hall.*	—— surcularis, *Hall.*
—— superstes ?, *Lapw.*	Dicranograptus ramosus, *Hall.*
	—— furcatus, *Hall.*

* Salter, Mem. Geol. Survey, vol. iii. p. 256; Quart. Journ. Geol. Soc. vol. viii. p. 359.

Dicellograptus sextans, *Hall.*
—— divaricatus, *Hall.*
Clathrograptus Geinitzianus, *Hall.*
Diplograptus marcidus, *Hall.*
—— Whitfieldi, *Hall.*
Diplograptus foliaceus, *Murch.*
—— mucronatus, *Hall.*
—— angustifolius, *Hall.*
Glossograptus spinulosus, *Hall.*
Climacograptus bicornis, *Hall.*

Of these species the following occur in similar beds in the valley of the St. Lawrence, Canada*:—

Diplograptus foliaceus, *Murch.*
Climacograptus bicornis, *Hall.*
Dicranograptus ramosus, *Hall.*
Dicellograptus sextans, *Hall.*
—— divaricatus, *Hall.*
Cœnograptus gracilis ?, *Hall.*

From the enigmatical Taconic shales of the valley of the Hudson, Dr. Emmons collected a few of the same forms †, viz.:—

Cœnograptus gracilis, *Hall.*
Glossograptus ciliatus, *Emm.*
Didymograptus, sp.

and from shales in Augusta County, Virginia, possibly of the same geological age, *Dicranograptus ramosus*, Hall, and several other species of Graptolites of the Norman's-Kiln type. A few like forms are also quoted by him from the shales of Parrotsville, Tennessee, which are apparently upon a similar geological horizon.

The only Graptolite hitherto quoted from the true Trenton Limestone is *Diplograptus amplexicaule*, Hall ‡. The overlying Utica Slate affords at Oxtumgo Creek, Fort Plain, New York, the following species § :—

Didymograptus serratulus ?, *Hall.*
Diplograptus foliaceus, *Murch.*
Climacograptus bicornis, *Hall.*
Dicranograptus ramosus, *Hall.*

From strata overlying the Trenton Limestone of Nevada, Dr. Charles White enumerates ||

Dicranograptus ramosus, *Hall.*
Diplograptus hypniformis, *White.*
Diplograptus quadrimucronatus, *Hall.*
—— foliaceus, *Murch.*

Australia.—A few forms of this Llandeilo-Bala fauna are enumerated by Professor M'Coy from the so-called Llandeilo Flags of Australia. The forms that may possibly belong to this general horizon are ¶

* Hall, 20th Report State Cabinet, New York, p. 221.
† Emmons, 'American Geology,' vol. i. pp. 104, 110.
‡ Hall, Pal. New York, vol. i. p. 79.
§ Whitfield, Report 100th Meridian, vol. iv. p. 10.
|| Dr. C. White, Report West 100th Meridian, vol. ii. Palæontology, p. 9.
¶ M'Coy, 'Prodromus Palæontology of Victoria,' decade ii. pl. xx. &c.

Didymograptus extensus ?, *Hall.*
Dicranograptus ramosus, *Hall.*
—— furcatus, *Hall.*
Cœnograptus gracilis, *Hall.*
Goniograptus Thueauri, *M'Coy.*

Higher Bala or Caradoc Formation.

Wales.—We now ascend into the rocks of which the Bala or Caradoc age is unequivocal. The most prolific graptolitiferous rocks of this date known to myself in Wales are exposed in the railway-cutting a little west of the town of Conway. Here the black shales of the district are crowded with poorly preserved forms, principally*

Dicranograptus Clingani, *Carr.*
Idiograptus margaritatus, *Lapw.*
Diplograptus foliaceus, *Murch.*
Climacograptus bicornis, *Hall.*

In the railway-cutting near the tunnel above Cynghordy station, South Wales, the black shales of Bala age have afforded me

Diplograptus foliaceus, *Murch.*
Climacograptus bicornis, *Hall.*
Dicellograptus Forchhammeri, *Gein.*

and a few others.

In the Harnage shales of the Caradoc area of Shropshire, *Diplograptus foliaceus* is not uncommon. A species of *Climacograptus*, allied to *C. Wilsoni*, Lapw., was met with by myself at Soudley. An example of *D. foliaceus*, Murch., from the Caradoc of Robeston Wathen, is preserved in the Jermyn-Street Museum †.

Scotland.—The higher Caradoc beds of Wales are represented in South Scotland by the Middle Moffat beds, or *Hartfell Shales.* Up to the present date I have collected from these the following species :—

Pleurograptus linearis, *Carr.*
—— radiatus, *Lapw.*
Amphigraptus divergens, *Hall.*
Leptograptus flaccidus, *Hall.*
—— capillaris, *Carr.*
Dicellograptus moffatensis, *Carr.*
—— anceps, *Nich.*
—— Forchhammeri, *Gein.*
—— Morrisi, *Hopk.*
—— caduceus, *Lapw.*
—— elegans, *Carr.*
—— complanatus, *Lapw.*
Dicranograptus ramosus, *Hall.*
—— Nicholsoni, *Hopk.*
—— Clingani, *Carr.*
Glossograptus Hincksii, *Hopk.*
Lasiograptus Harknessi, *Nich.*
Idiograptus margaritatus, *Lapw.*
Retiolites fibratus, *Lapw.*
Climacograptus bicornis, *Hall.*
—— caudatus, *Lapw.*
—— tubuliferus, *Lapw.*
—— Wilsoni, *Lapw.*
—— Scharenbergi, *Lapw.*
Diplograptus foliaceus, *Murch.*
—— tricornis, *Carr.*
—— truncatus, *Lapw.*
—— quadrimucronatus, *Hall.*
—— socialis, *Lapw.*
—— euglyphus, *Lapw.*

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* Compare also Salter, Memoirs Geol. Surv. vol. iii. pl. xii. &c.
† Case iv. | $\frac{2}{26}$.

The second or Ardmillan Division of the Girvan rocks is composed of the four successive subgroups of the Pinmore, Tralodden, Shalloch, and Drummuck beds. The Pinmore beds have yielded me

Dicranograptus ramosus, *Hall.*
Dicellograptus moffatensis, *Carr.*
Leptograptus flaccidus, *Hall.*
Diplograptus foliaceus, *Murch.*
—— euglyphus, *Lapw.*
Diplograptus tricornis, *Carr.*
Climacograptus Scharenbergi, *Lapw.*
—— cælatus, *Lapw.*

The Tralodden beds afford

Dicellograptus elegans, *Carr.*
—— Forchhammeri, *Geinitz.*
—— Morrisi, *Hopk.*
—— complanatus, *Lapw.*
Diplograptus foliaceus, *Murch.*
—— socialis, *Lapw.*
Diplograptus truncatus, *Lapw.*
—— quadrimucronatus, *Hall.*
Climacograptus bicornis, *Hall.*
—— tubuliferus, *Lapw.*
Idiograptus aculeatus, *Lapw.*

The Shalloch or Nematolites-beds yield only a few specimens of

Dicellograptus Morrisi, *Hopk.*
Diplograptus foliaceus, *Murch.*
Diplograptus truncatus, *Lapw.*
Idiograptus margaritatus, *Lapw.*

The Drummuck beds are also very poor in Graptolites. The only forms hitherto collected from them by Mrs. Gray or myself include

Dicellograptus anceps ?, *Nich.*
Diplograptus truncatus, *Lapw.*

Ireland.—The central member of the Black Graptolitic shales of county Down has yielded to the industrious researches of my friend Mr. William Swanston the following Hartfell species :—

Leptograptus flaccidus, *Hall.*
Dicellograptus caduceus, *Lapw.*
—— moffatensis, *Carr.*
—— Forchhammeri, *Geinitz.*
—— Morrisi, *Hopk.*
Dicranograptus ramosus, *Hall.*
—— Clingani, *Carr.*
—— Nicholsoni, *Hopk.*
Climacograptus bicornis, *Hall.*
—— Scharenbergi, *Lapw.*
—— tubuliferus, *Lapw.*
Retiolites fibratus, *Lapw.*
Diplograptus truncatus, *Lapw.*
—— foliaceus, *Murch.*
—— quadrimucronatus, *Hall.*
—— tricornis, *Carr.*

Sweden.—The Swedish Graptolite-bearing rocks that correspond to the Llandeilo and Bala strata of Britain are the *Middle Graptolite-Schists* of Linnarsson (*Dicranograptus-Schists* of Dr. Tornquist) and the overlying *Trinucleus-Schist.* These beds repose at once upon the *Orthoceras-Limestone* (Arenig), and are surmounted by the *Brachiopod-Schists* (Llandovery) that form the basal formation of the Swedish Silurian proper. According to the most recent communications of Mr. Linnarsson, the *Middle Graptolite-Schists* of Scania are composed of the following subgroups of strata in ascending order*:—

(*a*) Zone with *Phyllograptus typus* (Hall ?),

containing, in addition to *Phyllograptus typus*, representatives of the under-named British species:—

Didymograptus patulus, *Hall.*	Climacograptus confertus, *Lapw.*
—— geminus, *His.*	—— perexcavatus, *Lapw.*
Diplograptus Hopkinsoni, *Nich.*	—— Scharenbergi, *Lapw.*

(*b*) Zone with *Didymograptus geminus* (*Didymograptus Murchisoni* of British Palæontologists).

This is characterized, like the corresponding British zone, by the abundance of the tuningfork-shaped *Didymograpti* generally known under the names given above. They occur together with many of the same forms common in the underlying zone (with the notable exception of *Phyllograptus*) and the addition of *Diplograptus foliaceus*, Murch.

(*c*) Zone with *Glossograptus Hincksi*, Hopk.

The chief fossil of this zone is a beautiful form of *Glossograptus* doubtfully referable to Hopkinson's species. The *Murchisoni*form *Didymograpti* are wanting; and only a single patulous species remains. *Dicellograptus* (*Dicellograptus moffatensis* ?, Carr.) makes its first appearance in this zone.

(*d*) Zone with *Diplograptus mucronatus* (Linnrs.).

The characteristic fossil of this zone is a peculiar Graptolite, probably an *Idiograptus*. The associated forms are identical with, or allied to, the British species:—

Diplograptus foliaceus, *Murch.*	Climacograptus caudatus, *Lapw.*
—— tricornis, *Carr.*	Dicellograptus sextans, *Hall.*
—— teretiusculus, *His.*	—— moffatensis, *Carr.*

(*e*) Zone with *Climacograptus Scharenbergi*, Lapw.

This is marked by the prevalence of the species to which the zone owes its name, and rarer examples of the representatives of

Diplograptus foliaceus, *Murch.*	Diplograptus teretiusculus, *His.*
—— Hopkinsoni ?, *Nich.*	Didymograptus superstes, *Lapw.*

* Linnarsson, Geol. Föreningens Förhandl. 1879, Bd. iv. no. 8.

(*f*) Zone with *Dicranograptus Clingani*, Carr.

This is locally prolific in the British forms

Diplograptus foliaceus, *Murch.*
—— quadrimucronatus, *Hall.*
Climacograptus bicornis, *Hall.*
—— caudatus, *Lapw.*
Lasiograptus, sp. n.
Dicranograptus Clingani, *Carr.*
DicellograptusForchhammeri, *Gein.*
—— Morrisi, *Hopk.*

(*g*) Zone of *Orthis argentea*, His.

The only species noted from this zone is an undetermined form of *Climacograptus*.

These results harmonize the data previously collected from the district by former observers*, and are in strict concordance with the little that is yet known respecting the fossils of the corresponding strata in Westrogothia, Dalarne, and the island of Bornholm†.

The zones (*a*) and (*b*) represent those British strata which, pending the advent of a more suitable title, we may term the Passage-beds between the Arenig and Llandeilo formations. The zone (*a*) is essentially Arenig in its general facies. The zone (*b*) is the exact representative of the Lower Llandeilo or *Murchisoni*-zone of Aberciddy Bay. The zones (*c*) and (*d*) are, as Linnarsson remarks, distinctly of Llandeilo age. Zone (*e*) is probably the equivalent of the transitional Glenkiln shales of South Scotland. Zones (*f*) and (*g*) are, as Linnarsson observes, the Swedish representatives of the main mass of the Hartfell shales, and are therefore of unequivocal Bala age.

The highest strata of the Swedish Ordovician are the so-called *Trinucleus-Schists*. The only Graptolites they have yielded hitherto are‡

Diplograptus pristis, *His.*
Dicellograptus elegans, *Carr.*

America.—The Hudson-River group or *Lorraine Shales* of New York and Canada, and their western representative the *Cincinnati group* of Ohio, occupy the systematic place of the British Caradoc rocks. Only a few Graptolites are yet known from these beds. From the Cincinnati group Hall enumerates§

Climacograptus bicornis, *Hall.*
—— typicalis, *Hall.*
Diplograptus putillus, *Hall.*

* Tornquist, Œfvers. af K. Vet. Akad. Förh. 1875, no. 10, 4; Linnarsson, Geol. Fören. no. 22, 1875, &c.

† Johnstrup, Forh. Skand. Naturf. 11 (Copenhagen, 1873), pp. 305–308.

‡ Conf. Linnarsson, Geological Magazine, June 1876.

§ Hall, Grapt. Quebec Group, p. 44, &c.

In the Utica or Hudson-River Shales of Lake St. John, Lower Canada*, occur

Leptograptus flaccidus, *Hall.*
Diplograptus mucronatus?, *Hall.*
Diplograptus quadrimucronatus, *Hall.*
Retiograptus? eucharis, *Hall.*

From the Lorraine Shales of New York Professor Hall figures

Amphigraptus divergens, *Hall.*
Diplograptus hudsonicus, *Nich.*

and some other species†.

In the corresponding beds near Montreal occur *Climacograptus bicornis*, Hall, *Diplograptus foliaceus*, Murch., and *Dicranograptus Nicholsoni*, Hopk.‡.

L.—*Note on the so-called "Farringdon (Coral-Rag) Sponges"* (Calcispongiæ, *Zittel*). By H. J. Carter, F.R.S. &c.

A few days ago, while turning out the contents of a box, I found a parcel of fossils labelled "Coral Rag," and, on opening it, not only saw that it contained several beautiful specimens of the so-called "Farringdon sponges," but recollected that these fossils had been given to me by a dear fellow student who lived at or near Farringdon in Berkshire, and whose untimely decease, somewhere about forty years ago, was about coeval with the present; thus the parcel seems to have been unopened for this lapse of time.

At once I observed that the Farringdon sponges belonged to the Order called by Professor Zittel, in his "Studies on Fossil Sponges"§, "Calcispongiæ," which were first brought to my notice by his kindness in not only sending me entire specimens of these sponges themselves from the "Upper Jura, &c.," but slides of *Peronella multidigitata* and *P. cylindrica* respectively—showing that these, at least, contained triradiate spicules which, in the former, to me as well as to himself, seemed to be identifiable *only* with those of a recent Calcisponge.

* Hall, Grapt. Quebec Group, pp. 143 &c.

† Hall, Grapt. Quebec Group, p. 13; Palæontology New York, vol. i. pl. 72.

‡ Logan, 'Geology of Canada,' p. 200.

§ Abhandlungen der k. bayer. Akad. der Wiss. ii. Cl. Band xiii., 1877, I. Hexactinellidæ; *Ib. ib.* Abth. i. pp. 67–154, II. Lithistidæ; *Ib. ib.* pp. 93–138, III. Monactinellidæ, Tetractinellidæ, und Calcispongiæ. 'Annals,' 1877, vol. xx. p. 357 *et seq.*; 1878, vol. ii. p. 113 *et seq.*; 1879, vol. iii. p. 304, respectively. Translated by W. S. Dallas, F.L.S.

Here the matter rested, so far as I myself was concerned, although Prof. Zittel had afterwards to embody the whole of his results in the article "Spongiæ" of his 'Handbuch der Paläontologie" (2te Lieferung, p. 128 *et seq.*, 1878), of which he kindly sent me a copy; and had I not unexpectedly come upon the "parcel" of Coral-Rag fossils above mentioned, I probably, on account of other engagements, should not have returned to the subject—although, on account of sundry objections made at the time, I could never heartily accept Prof. Zittel's views of the nature of these sponges; but finding those in the parcel awoke in me a desire to make myself more particularly acquainted with the Farringdon sponges than I had hitherto been, partly because I could not reconcile myself to the name "Calcispongiæ" for them, and especially because I had, through the kindness of Mr. Sollas, made myself almost as familiar with *Pharetrospongia Strahani* as himself previous to the publication of his excellent description and illustrations of it (Quart. Journ. Geol. Soc. May 1877, vol. xxxiii. p. 242, pl. xi.), in which he rightly insists, according to my views, on the *originally* siliceous nature of this, now calcareous, fossil and so-called "Farringdon sponge."

At first these fossil sponges appeared to me very much like what *Clathrina*, Gray, = *Ascetta clathrus*, Häckel (which abounds on the rocks here), would be if fossilized; but the fact of the Farringdon ones representing in a *solid* state the fibre of the sponge, and the apparent fibre of *Clathrina* consisting of a reticulated anastomosing *hollow* tube representing the excretory canal-system *minus* the parenchyma which fills up the interstices in other sponges, at once pointed out the delusion.

Hence it becomes desirable to premise that the fibre of the so-called "Farringdon (Coral-Rag) sponges" is *entirely* composed of calcareous material, solid, white, round, reticulated, massive, but still in this massive reticulation assuming a variety of definite forms in which the fibre itself is generally covered with a thin layer of granular crystalline calcite that, thickening in proportion to its distance from the surface, often leaves the interstices of the latter open, while it fills those of the interior, so that the fibre on the surface appears to be free; and in this white, weathered-out structure consists their great beauty. Sometimes the fibre is entirely composed of linear spicules overlying each other like a rope, as in *Pharetrospongia Strahani*, Sollas (*op. et loc. cit.*), and sometimes of compact crystalline calcite, in the midst of which the spicules exist like a core, as in the Farringdon specimen of *Peronella dumosa*. That which Prof. Zittel sent me is from the Duchy of Brunswick (see his illustration, 'Handbuch, &c.' p. 190, fig. 108).

On grinding down a slice of the Farringdon *Peronella dumosa* for microscopic examination, I was gratified to see that it presented triradiate spicules, something like those of the preparation of *P. multidigitata* sent me by Prof. Zittel, to which I have alluded; but, to my great perplexity, I also saw that they were accompanied by an unintelligible mixture of incongruous forms like those represented by Mr. Sollas in his genus "*Catagma*" (Annals, 1878, vol. ii. p. 356. fig. 1, and pl. xiv.), whose species also belong to the so-called "Farringdon sponges."

Thinking, however, that I might find the triradiate spicules (quadriradiate? for they only loom indistinctly by their transparency through the thin slice) strikingly shown in the other preparation to which I have alluded, viz. *Peronella cylindrica* from the Upper Jura (see illustration, 'Handbuch, &c.' p. 190. fig. 107), I ground down slices of the remaining specimens from Farringdon, viz.:—1, *Verticillites anastomans* (Zitt. *op. cit.* p. 190, fig. 106); 2, *Corynella*, sp.; 3, *Oculospongia*, sp.; 4, *Elasmostoma acutimargo* (Zitt. *op. cit.* p. 193, fig. 113); 5, a specimen like *Pharetrospongia* (*Manon*, Sharpe) *farringdonensis* (*op. cit.* p. 193, fig 114); and 6, a thick, massive, crenulated, circular, horizontal form about 1½ inch in diameter, with square margin, presenting a plurality of deep holes like that of *Corynella*.

The result of this examination was as follows:—No. 1, ?Lithistid (it should be remembered that, in addition to the looming indistinctness above mentioned, we must add, in the radiate or branched spiculation, the thinness of the slice, which, although it may not affect the linear form, such as that of *Pharetrospongia Strahani*, Soll., must, in the radiate or branched spiculation, leave fragments *only* of the spicules, so that, while the bifurcated ends of a tetractinellid spicule may simulate the radiate, the shaft alone might simulate the monactinellid spicules of a Calcisponge); no. 2, ? Lithistid, with large ? bihamates; no. 3, simply granular, with no appearance of spicules; no. 4, ? Lithistid, branched; no. 5, linear, flexuous; no. 6, ? Lithistid, branched.

Thus the case now seemed to me hopeless, so far as the finding out of the kind of sponges which these fossils represented either generally or specially; for I could neither see the triradiates so like those of a Calcisponge in Zittel's preparation of *Peronella multidigitata*; neither could I see, in any of the linear spicules, the slightest approach in form to the monactinellid one of the recent Calcispongiæ, which, to the best of my knowledge, is so far peculiar that it is never seen in a siliceous state, any more than the form of the simple acerate of a Renierid or *Chalina* is observed in a calcareous one among the recent sponges.

I then thought, if I could get an instance such as those mentioned by Prof. Zittel and Mr. Sollas respectively, of a siliceous sponge presenting itself under a calcareous fossilized form, I might then see how far its fibre would represent that of the Farringdon sponges; and it so happens that there exist among my Farringdon collection two cylindrical fossils each about one inch and a half long by half an inch broad, with an axial cavity and furrowed oral aperture, so like Lithistids that if they had not presented the same kind of white, round, open, reticulated, calcareous fibre on the surface as that of the Farringdon sponges with which they were associated, I should have set them down immediately as such. But on making polished longitudinal and transverse sections of the *bodies* of these fossils for further observation (by reflected light), I found that their spiculation *was* Lithistid, and that instead of this spiculation presenting itself under the form of continuous reticulated fibre of the same size, like that to which I have alluded (that is, wrapt up in calcareous material), *the spicules were naked*, and, in this condition, bore unmistakable evidence of that Lithistid nature which, if viewed while invested in the calcareous fibre of the surface so characteristic of the so-called Farringdon sponge when seen under the microscope by transmitted light in a slice ground down to extreme thinness, would lead to the difficulty above expressed, the uncertainty of whether we were looking at the remains of an originally siliceous or calcareous spiculation.

Thus my anticipation was realized, and some at least of the Farringdon sponges proved to have been originally siliceous.

In reducing the slice of *Elasmostoma* from my Farringdon sponges to a sufficient thinness for microscopical examination it proved so intractable, from the presence of mineral crystals much harder than my grinding-stones, that I was obliged to have recourse to the Neocomian specimen for this purpose, kindly sent to me by Prof. Zittel; but just previously to the breaking-up of the slice of the Farringdon one, although not until it had been almost sufficiently reduced, I saw that it was in structure similarly composed; nor could I help remarking at the same time the resemblance, in form at least, that existed between these two specimens and the Lithistid *Verruculina auriformis,* also represented by Zittel (Handbuch &c.

p. 153. fig. 68). *My* Farringdon specimen of *Elasmostoma* is very perfect, but in form cupellate with a chink on one side and still open below, evidencing what I have elsewhere stated respecting the funnel-shaped sponges, viz. that they begin in the form of a fan, and then curving round, the opposite borders unite to such an extent as finally to convert the fan into a vase-shaped sponge.

Now no one can confound the triradiate spicule of a Calcisponge with the tetracladiate one of a Lithistid when both are clearly exposed; but in these obscure indications which can only be dimly seen in the calcified fibre of the Farringdon sponges when it is ground down to a thinness which must take off one or more of their branches, we are as likely to find an apparent identification with one as with the other. Hence, perhaps, the value of my communication to Prof. Zittel that his slice of *Peronella multidigitata* presented triradiates which could only be identified with those of the recent Calcispongiæ; and hence the dubiousness which attended the "results" of my grinding-down of the slices of the Farringdon sponges above mentioned.

Professor Zittel's "Studies on Fossil Sponges," to which I have already alluded, are to me beyond all praise; they form quite an epoch in the palæontological history of the Spongida, especially as regards the Hexactinellidæ and Lithistidæ; but when we come to his Monactinellidæ and Tetractinellidæ his material, if not also the time that he could spare for this part of his 'Handbuch der Paläontologie,' appears to have been pretty well exhausted; for while, in the translations ('Annals,' *l. c.*), about 128 pages are occupied by the Hexactinellidæ and Lithistidæ, only 14 are given to the Monactinellidæ and Tetractinellidæ, with 43 for his fossil Calcispongiæ.

Thus, considering that the Monactinellidæ and Tetractinellidæ are incomparably more numerous at the present day than the Hexactinellidæ and Lithistidæ, it follows that either the former were far less plentiful in palæontological times than they are now, or that very few specimens have come to Prof. Zittel's hands in a fossilized condition; while the chances of the Calcispongiæ not being preserved, for the reasons I have heretofore stated, make it questionable whether Zittel has not termed "Calcispongiæ" many which ought to be among the siliceous sponges.

Again, I agree with Mr. Sollas (Ann. 1878, vol. ii. p. 361) that, if "well cleansed by caustic potash," or, indeed, by fresh water, so as to extract the salt (chloride of sodium), the spicules of a Calcisponge might be preserved in balsam for an indefinite period; but I do not think this cleansing is likely to occur in the sea, and therefore that the rapid destruction of these sponges, which appears to me to be owing to the presence of sea-salt in the spicules, must be opposed to their ever being found in a fossilized condition.

But I cannot agree with Zittel in considering *Pharetrospongia Strahani* a Calcisponge; for, in the first place, from what has been above stated, there is no reason to assume that calcareous material was its original composition; and, secondly, the acerate spicule is in form as peculiarly that of a Renierid as it is *not* that of a Calcisponge.

With reference to my having also heretofore shown that both Pachastrellid and Echinonematous sponges may possess triradiate spicules (Ann. 1876, vol. xviii. pl. xiv. and 1879, vol. iii. pl. xxvii.), I do not think that the latter can be confounded with the triradiates in the fossil *Peronella multifida*, nor are they like those of *P. cylindrica*, although those of *P. cylindrica* might be confounded with the spicules of a Pachastrellid, e. g. *Dercitus niger*, Gray (Ann. 1871, vol. viii. pl. iv. fig. 3), = *Battersbya Bucklandi*, Bowerbank (Mon. Brit. Spongiadæ, vol. iii. pl. xcii. fig. 8, 1874): the spicules in the latter illustration are particularly like those of *P. cylindrica*.

Lastly, I have of late been examining the cherty, flint-like detrital remains of the Upper Greensand (Cénomanien) which are now strewn over the surface of the New Red Sandstone of this neighbourhood in vast abundance, from their consisting of the once continuous and superincumbent strata of these parts, which, judging from their composition, were formed of the subtle material of a deep ocean-bed, in which all kinds of sponges, but especially the Hexactinellida and Lithistida, seem from their abundance to have attained their maximum of development; yet while these are imbedded, for the most part, in large fragments in this more subtle material, which has now passed into a translucent, flint-like, siliceous matrix, equally abounding in isolated spicules of every kind of siliceous sponge, I have never seen a form among the latter that I could identify with a triradiate, quadriradiate, linear, or any other kind of spicule of a Calcisponge, although often a Lithistid with weathered-out white fibre like that of the Farringdon sponges but *silicified*.

Furthermore, a few days ago a fragment of this detritus was brought to me, out of which I extricated the digital process of a fossilized sponge about two and a half inches long and three eighths of an inch thick, which by its fixed end had evidently been attached to a larger branch, and at its free end is obtusely round. Thus from its shape, together with the presence of some of the remaining acerate spicules left end to end on its surface in a reticulated form, there can be no doubt that it had belonged to a digitate *Chalina*; but, with the exception of a few points, the whole of the fibre of the interior had disappeared, leaving the parts which it had occupied in the form of a reticulated, anastomosing, *empty* tubulation, while the interstices were filled with translucent homogeneous flint-like silex.

Now here is a condition exactly opposite to that presented by the Farringdon (Coral-Rag) sponges, in which the *fibre is retained* and the *interstices* more or less *empty*, while the fibre is *calcareous*, and the interstices, where occupied, filled with calcareous material also.

Thus I cannot help thinking that this silicified digital process of a *Chalina* in the Upper Greensand flint might have been calcareous if it had been in the Coral Rag, and therefore that most, if not all, of Prof. Zittel's fossil Calcispongiæ may, after further examination, have to be transferred to his other orders; while I know no one would rejoice more to see this effected than Prof. Zittel himself, if the evidence in favour of it warranted the alteration.

Budleigh-Salterton,
Nov. 3, 1879.

LI.—*Descriptions of new Species of Lepidoptera from Japan.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

[Continued from p. 374.]

Geometridæ.

68. *Thalera veneta*, n. sp. (no. 425).

Emerald-green: wings crossed just beyond the middle by a white-edged darker line; a very slender bronze-brown marginal line; fringe snow-white, spotted with ferruginous at the terminations of the veins: primaries with a second white line across the basal third; the costa buff-coloured: head bright clay-red; antennæ with golden-yellowish pectinations: thorax, excepting the tegulæ, and abdomen sordid white. Wings below pale sericeous green; primaries with buff-coloured costa: body below sordid white, legs pale buff. Expanse of wings 1 inch 5 lines.

69. *Tanaorhinus prasinus*, n. sp. (no. 431).

Wings above pale pearly grey, with the external border rather broadly sap-green, a discal stripe close to the outer border of the same colour: primaries with the base, costa, and a regularly trifurcate central belt sap-green: secondaries crossed in the middle by a rather broad, straight, central sap-green belt; costal border rather broadly snow-white: thorax green; antennæ with ochraceous pectinations; abdomen cream-coloured. Under surface of wings stramineous, becoming ochraceous upon the costa, the outer border slightly greenish; an indistinct straight postmedian greyish transverse stripe: body white, the anterior coxæ green in front; proboscis ochreous. Expanse of wings 1 inch 10 lines.

Ephyridæ.

70. *Ephyra grata*, n. sp. (no. 470).

Stramineous, the outer borders of the wings golden yellow; a rather broad, internally sinuated, submarginal, purplish-brown belt, the outer edge of which is ragged and divided into short transverse striæ; a postmedian zigzag series of minute black dots; several internal spots and two basal bands grey: body grey, with yellowish head and shoulders. Under surface altogether paler, the black dots obsolete. Expanse of wings 11 lines.

Closely allied to "*Acidalia*" *ærata* of Moore. *A.? trigonata* of Walker is also an *Ephyra*.

Acidaliidæ.

71. *Asthena auricruda*, n. sp. (no. 438).

Bright buff-yellow: wings crossed by four equidistant, parallel, irregularly zigzag, leaden grey bands; base of primaries also leaden grey: thorax greyish; front of head and centre of antennæ black, vertex and the remainder of antennæ sordid white. Under surface altogether paler; wings whitish, with faint indications of the bands of the upper surface. Expanse of wings 9 lines.

72. *Acidalia impexa*, n. sp. (no. 439).

Pale testaceous: wings with ochraceous fringe; outer border laky purple, leaving the margin near apex of primaries, so that it encloses an oblong marginal spot of the ground-colour; costal margin of primaries tinted with purplish lake; collar of the same tint. Wings below creamy stramineous, marginal border grey; an indistinct, transverse, central, dusky line, followed by a barely distinguishable irregular discal line. Expanse of wings 9 lines.

Allied to *A. jakima* (Ill. Lep. Het. iii. p. 40, pl. 50. fig. 10).

73. *Acidalia macescens*, n. sp. (no. 448).

Very pale greyish brown: wings with black discocellular dots, immediately followed by a pale sinuous band; this is followed by a broader band, slightly darker than the ground-colour, followed again by a second, sinuous, pale submarginal band; inner edge of the brownish intermediate band traversed by a series of blackish dots; a marginal series of black dots. Under surface whitish, minutely irrorated with brown; discocellular and marginal dots as above; discal band indistinctly seen, its inner edge indicated by a sinuous brown line. Expanse of wings $10\frac{1}{2}$ lines.

74. *Acidalia fœdata*, n. sp. (no. 456).

Shining olivaceous brown; wings with greyish borders, blackish discocellular dots, and a dark grey, subangulated, externo-discal line: thorax greyish; vertex of head white; anus yellowish. Under surface pale shining greyish brown, with indications of the markings of the upper surface. Expanse of wings 10 lines.

75. *Acidalia invalida*, n. sp. (no. 463).

Whity brown, minutely irrorated with darker brown: wings crossed by two sinuous dark-edged bands, one central, the other discal; discocellular spots and marginal dots black. Wings below whitish: primaries with brownish costa; the markings of the upper surface indistinct, the inner edge of the discal band indicated by a series of brown dots: body cream-coloured. Expanse of wings 1 inch.

"*Acidalia*" *defamataria* and "*A.*" *emissaria* of Walker are referable to my genus *Lycauges*.

Caberidæ.

Orthocabera, n. gen.

Nearly allied to *Cabera*, but the costal margin of primaries straighter and longer, the outer margin nearly straight and decidedly longer, the inner margin about the same. Type *O. sericea*.

In marking the type differs from *C. pusaria* (the species which it most resembles) in having most of the lines duplicated and those of the primaries oblique and converging towards the apex.

76. *Orthocabera sericea*, n. sp. (no. 477).

♂. Sericeous snow-white: wings crossed by four bands, the first three of primaries and the third of secondaries formed of double sandy brown lines, tapering and converging towards the apex of the primaries, the first and second of secondaries reduced to single lines of the same colour, the first being quite basal and therefore only just visible; a submarginal line sinuated on the primaries and a marginal line also of the same colour: primaries with a minute dark brown discocellular dot; costal margin slenderly brownish: head and antennæ yellowish. Wings below snow-white, immaculate: primaries with the costa pale golden brown: palpi yellowish; legs varied with dead gold (perhaps due to abrasion). Expanse of wings 1 inch 5 lines.

Macariidæ.

77. *Macaria Pryeri*, n. sp. (no. 494).

Snow-white: wings streaked and mottled with greyish brown, crossed by two sandy brown lines, the first at basal fourth, the second duplicated as far as the second median branch of primaries, where it divides into a fork, the inner branch running through the discocellulars to costa, the outer branch carried on for a short distance and then abruptly elbowed so as to run parallel to the inner one, this outer stripe upon the primaries interrupted by black spots; a broad greyish-brown band almost uniting with the duplicated stripe and sharply angulated externally, divided from the outer border (which is striated with dark brown) by a macular stripe of the ground-colour; a marginal series of black spots: crest of head, antennæ, and collar sandy or golden brown; abdomen pearly white, the anterior segments with black dorsal dots in pairs. Wings below with the lines simple and badly defined, the mottling golden brown. Expanse of wings 1 inch 5 lines.

78. *Macaria irrorata*, n. sp. (no. 496).

Clear sandy yellow, speckled with black: wings with the fringe black-spotted; a small black spot on the discocellulars; a slender, arched, black line, bordered with pale buff, and interrupted by the yellow veins, just beyond the middle; traces of a discal series of black spots, most distinct upon the primaries; these wings also with a second black arched line near the base. Under surface nearly as above, slightly yellower. Expanse of wings 1 inch 3 lines.

Allied to *M. indictinaria* of Bremer.

Fidoniidæ.

79. *Lozogramma vapulata*, n. sp. (no. 497).

Whity brown, striated with little dashes of slightly darker brown, two indistinct angulated lines of the same tint across the basal half; a marginal series of black dots: primaries crossed obliquely from inner margin to apex by a darker-edged brown band, which widens abruptly at costal third, and is edged externally with white; an elongated small black spot on the second median interspace; an indistinct submarginal brownish streak: secondaries crossed just beyond the middle by a brown angulated stripe, which tapers to a line as it approaches the costa; an indistinct brownish line halfway between the postmedian stripe and the margin. Wings below white, with the markings of the upper surface sandy yellowish. Expanse of wings 1 inch 5 lines.

This species seems allied to "*Macaria*" *castigataria* of Bremer.

80. *Ozola terranea*, n. sp. (no. 614).

Pale brown, slightly greyish at the outer borders of the wings; a slender dark brown marginal line; a submarginal line formed of series of geminated almost confluent black dots; three parallel, sinuated, discal dusky lines (the two outer ones approximated), crossed by black-spotted median branches and submedian vein: primaries darker than secondaries, the discoidal area and a belt enclosed by the discal lines rust-red; three indistinct, sinuated, dusky lines across the basal area. Wings below pale brown, the secondaries darker and greyer than the primaries; all the discal veins black-spotted; the lines crossing the disk more distinct than above, but the lines crossing the basal area only represented by black spots on the costa of primaries; small blackish discocellular spots: body greyish. Expanse of wings 1 inch.

Larentiidæ.

81. *Emmelesia phasma*, n. sp. (no. 435).

Sericeous white: wings crossed by nine more or less distinct, grey, sinuated lines, the third and fourth and the sixth and seventh from the base approximated, very irregular, and dotted with black; the ninth or submarginal line indistinct; a series of black marginal lunules. Wings below immaculate; anterior coxæ, tibiæ, and tarsi pale golden brown. Expanse of wings 11 lines.

82. *Eupithecia signigera*, n. sp. (no. 574).

Sandy brown, crossed by numerous, parallel, undulated or zigzag, darker brown lines; an interrupted black marginal line: primaries with the costal border almost wholly occupied by five large, black-edged, brown spots, the third and fifth of which are connected with similar subcostal spots above the end of the cell and close to the apex; the first and third of the transverse brown lines expanded into bands; a white-edged black spot at the end of the cell; a submarginal series of externally white-edged black spots, united by longitudinal dashes to the interrupted marginal line: secondaries paler than primaries, the costal half whitish; a blackish discocellular dot; the submarginal zigzag line externally white-edged and terminating at anal angle in a blackish spot: thorax whitish, with dark brown head and collar. Under surface grey, discocellular spots and interrupted marginal line black and sharply defined; transverse lines indistinct, only indicated upon the disk. Expanse of wings 1 inch.

Allied to *E. rufescens* (Ill. Typ. Lep. Het. iii. p. 52, pl. liii. fig. 12).

83. *Eupithecia consueta*, n. sp. (no. 568).

Whitish, crossed by numerous undulated grey lines, some of which are deepened in colour, and their interspaces are filled in with grey so as to form a small basal band, a broad angulated belt occupying the central third of the wings, a submarginal externally zigzag stripe and an external border: primaries with a prominent black discocellular litura: body varied with grey transverse stripes and lines. Wings below grey; the outer edge of the central belt represented by a blackish stripe; prominent black discocellular spots; a diffused discal stripe with pale external edge; fringe with white basal line; costal margin of primaries white, crossed by large blackish costal spots. Body below white; legs greyish above. Expanse of wings $10\frac{1}{2}$ lines.

In the pattern of the primaries this species almost agrees with *E. excisa* (Ill. Typ. Lep. Het. iii. p. 52, pl. liii. fig. 11).

84. *Eupithecia lucinda*, n. sp. (no. 578).

Primaries pale sap-green, with blackish markings nearly as in the preceding species: secondaries sordid white, a few scales indicating traces of transverse lines: body pale sap-green, abdomen black-spotted. Under surface shining white; primaries with a few indications of the commencement of lines upon the costa: secondaries crossed by two slender grey lines, indicating the central belt. Expanse of wings 8 lines.

Seems allied to *E. sophia* (Ill. Typ. Lep. Het. iii. p. 51, pl. liii. fig. 9).

85. *Lobophora misera*, n. sp. (no. 563).

Wings smoky brown, tinted with pink: primaries with greenish costal and internal areas; darker than the secondaries and crossed by numerous black and brown lines, the inter-spaces between some of which are filled with brown darker than the ground-colour, so as to form a well-defined central band; a subbasal angulated stripe, and one or two abbreviated bands and spots at apex; indications of a zigzag white sub-marginal line; a marginal series of black dots in pairs; fringe dark brown; a black discocellular litura: secondaries with dusky marginal line: body blackish, irrorated with grey. Under surface of wings pale reddish brown, with traces of the bands of the upper surface. Primaries with whitish internal area: body white, with blackish sides; legs banded with black. Expanse of wings 1 inch.

86. *Melanippe abraxina*, n. sp. (no. 533).

Wings snow-white, with a broad and slightly irregular dark greyish-brown outer border, traversed through the centre by a dentate-sinuate white stripe, and interrupted on second median interspaces by a marginal white spot; a black marginal line; fringe spotted with dark greyish brown. Primaries with a yellow-edged blackish spot close to the base, followed immediately by two angulated dark brown stripes; a very irregular constricted central band enclosing a black discocellular spot: secondaries greyish at base: body ochreous, covered with black spots; antennæ dark brown. Wings below with paler and more confused markings: body whitish, not spotted; abdomen transversely banded with black; legs externally black, banded with yellow, internally white and yellow. Expanse of wings 1 inch 6 lines.

87. *Larentia comis*, n. sp. (no. 528).

Greyish whity brown: primaries with the basal fourth dark brown, limited externally by a zigzag oblique white line; a broad angulated central dark brown belt, limited on both sides by zigzag white lines, and enclosing a black discocellular spot; a white dentate-sinuate discal line; an interrupted blackish marginal line: secondaries rather paler than primaries, with faint indications of two arched grey discal lines: head white, antennæ brown; thorax brown, with white fringes to the tegulæ; abdomen white, with blackish dorsal dots or transverse lines. Under surface whitish; the wings slightly grey to beyond the middle, where this colour is limited by an angulated dusky stripe; blackish discocellular spots. Expanse of wings 1 inch 4 lines.

88. *Larentia inamœna*, n. sp. (no. 541).

Primaries white, crossed by numerous irregular dark brown lines; some of these are united by having their interspaces filled in with slightly paler brown, so as to produce three basal stripes and a broad irregular central belt; the two lines nearest to the outer margin become black, and the outer one expands into large white-edged spots above the third median branch; outer border grey; a marginal series of black dots in pairs; basal half and tips of fringe brown: secondaries greyish brown, pale, crossed from just before the middle to near the outer margin by parallel indistinct whitish undulated lines; marginal dots and fringe as in primaries: body brown. Under surface grey, with paler external area crossed by grey lines; black discocellular dots. Expanse of wings 1 inch 2 lines.

89. *Anticlea umbrifera*, n. sp. (no. 538).

Primaries above rust-red, traversed by numerous zigzag blackish lines, and crossed by an irregular central white belt enclosing a black discocellular dot; a series of black marginal dots in pairs; fringe tipped with grey: secondaries white, crossed by two parallel approximated blackish zigzag postmedian lines; outer border reddish; marginal dots and fringe as in primaries: body above grey, varied with rust-red and whitish. Under surface sordid white: wings crossed by two grey lines; discocellular dots black. Expanse of wings 1 inch 4 lines.

90. *Scotosia sericata*, n. sp. (no. 588).

Shining bronzy grey: wings crossed by numerous zigzag and sinuated darker grey lines, three of which on the disk are filled in with reddish cupreous to form a discal band, three near the base of primaries and two close to the base to form a subbasal band and basal stripe; the central belt indicated upon the primaries by the partial filling-in of three lines on each side with brown and by black dots upon the veins: in the secondaries the outer edge is alone indicated by black dots on the veins; a black marginal line; fringe brown: head brown, first three abdominal segments with a central black dot. Wings below shining grey, the markings obsolete; fringe brown: body grey. Expanse of wings 2 inches 1 line.

INUROIS, n. gen.

Allied to *Cheimatobia* (*C. brumata*), but the neuration utterly different. In the primaries of *Cheimatobia* the costal vein is normal, joining the costal margin at about the third fourth; in *Inurois* it unites with the subcostal vein just beyond its origin. The subcostal vein of *Cheimatobia* has four branches, all emitted at some distance from the end of the cell; that of *Inurois* has six branches, the first four of which are very short, and cross the costal area much less obliquely than is usual. In *Cheimatobia* the upper radial is trifurcate, the uppermost branch uniting with the subcostal so as to form a post-discoidal cell; in *Inurois* it is simple. In *Cheimatobia* the lower radial is emitted from an angle of the lower discocellular; in *Inurois* it is emitted normally from between the two discocellulars. In *Cheimatobia* these veinlets are irregular, and the upper one sloping backwards; in *Inurois* they are regular and transverse. In the secondaries the differences are nearly as striking: thus the subcostal vein of *Cheimatobia* emits its branches from a long footstalk, whilst in *Inurois* there is none; *Cheimatobia* has the discocellulars oblique and sigmoidal, the upper being about four times the length of the lower, but *Inurois* has a perfectly simple angle, with the radial emitted from the centre; in *Cheimatobia* the third median and radial are about equal distances apart, whilst in *Inurois* the second and third median branches are emitted near together and at some distance from the radial. In other respects the two genera are much alike, both in form, texture, and coloration.

Type *I. tenuis*.

91. *Inurois tenuis*, n. sp. (nos. 553 & 556).

Primaries semitransparent whity brown, with a faint indication of a slightly darker greyish broad central belt, its outer edge dotted with black upon the veins; a well-defined black discocellular spot and a marginal series of black dots: secondaries slightly paler, with black discocellular and marginal dots: body brown. Wings below with a brown discal line across both primaries and secondaries. Expanse of wings ♂ 1 inch 2 lines, ♀ 1 inch 3 lines.

92. *Cidaria mendica*, n. sp. (no. 604).

Smoky brown; wings sericeous, crossed by a very irregular white discal stripe, an indistinct series of whitish spots bounding the external area internally: primaries indistinctly striated with whity brown; a convex line of the same colour across the basal fourth; a white spot at base; a black discocellular spot: secondaries paler than primaries, indistinctly striated with grey: abdominal fringe whitish; external fringe of all the wings pale, tipped with white and interrupted by large dark brown spots; thorax paler than the head, collar, and abdomen. Wings below sericeous greyish brown, indistinctly mottled (particularly on the primaries) with whitish; crossed by a very irregular whitish discal line; dusky discocellular spots; the fringe and the costal border of primaries yellowish, spotted with dark brown: body pale greyish brown, the pectus and a number of mottled markings on the legs whity brown. Expanse of wings 1 inch 7 lines.

A very distinct but dull-looking species.

Hypenidæ.

93. *Hormisa morosa*, n. sp. (no. 1063).

Greyish brown: primaries with the interno-median area gravel-coloured and crossed by an oblique externally brown-bordered snow-white stripe, which runs from inner margin to apex; external border grey, fringe intersected and edged by dark brown lines: secondaries with a sandy tint, base of fringe gravel-coloured: abdomen with whitish posterior edges to the segments. Primaries below greyish, with a slight sandy tint, particularly on the outer border: secondaries whitish, with sandy yellowish borders and fringe: body below whitish, the venter yellowish. Expanse of wings 1 inch.

94. *Hormisa calamina*, n. sp. (no. 1064).

Primaries above pale buff, with two minute blackish dots at the angles of the cell; a submarginal series of very minute black dots; fringe brownish, becoming white at external angle: secondaries cream-coloured, with a slender marginal line and submarginal series of minute dots grey: body pale buff, the abdomen rather paler than the thorax. Under surface slightly greyer and paler than the upper, otherwise similar. Expanse of wings 1 inch.

Herminiidæ.

95. *Herminia dolosa*, n. sp. (no. 892).

Primaries above sandy brown; a slender dark brown angulated line across the basal fourth, a second parallel to it just beyond the cell, and a third (nearly straight) limiting the external area; a <-shaped dusky marking at the end of the cell interrupting a dusky diffused streak which crosses the centre of the wing; a slender black marginal line: secondaries greyer than primaries, two indistinct oblique dusky lines crossing the disk, the outer one running to anal angle, where it is edged outwardly with white; a slender black marginal line. Wings below paler and more uniform in colour; primaries crossed by one blackish discal line, secondaries by two, the outer one with a pale border; a blackish marginal line. Expanse of wings 1 inch 2 lines.

96. *Herminia helva*, n. sp. (no. 915).

Pale stramineous, speckled with brown; primaries crossed by two very slender and irregular brown lines, representing the central belt and enclosing a dark brown discocellular dot; an oblique dark brown line, bounded on each side by a diffused brownish indistinct stripe from external angle to apex; a black marginal line: secondaries with whitish costal half, the two usual whitish-bordered oblique discal lines; a marginal black line. Under surface more uniform in tint, the markings very indistinct, the innermost line of primaries obsolete. Expanse of wings 1 inch 4 lines.

97. *Bleptina onerata*, n. sp. (no. 930).

Primaries above shining chocolate-brown; the base, a broad belt just before the middle, a costal spot immediately beyond it, and the outer margin densely irrorated with white scales; a discocellular spot and a marginal series black; fringe greyish brown, spotted at the base with darker brown: secondaries shining greyish brown, darker towards outer margin, fringe with a dark basal line: thorax bronze-brown, mottled with white; abdomen white, transversely banded with blackish. Wings below shining grey; fringe spotted with whitish; a white costal spot beyond the cell of primaries: body below white; legs above blackish, banded with white. Expanse of wings 1 inch.

98. *Locastra amica*, n. sp. (no. 933).

Primaries with the basal third sordid buff, speckled with black; central third white, slightly speckled and broadly bordered with black, the outer border being biangulated or zigzag; two small black spots (the outer one lunate), indicating the discoidal spots; external third copper-brown, clouded near apex and external angle with blackish; a marginal series of black spots; fringe pale, spotted with blackish: secondaries pearly hyaline white; a dot at the superior angle of the cell, and a broad external border blackish: thorax coppery brown, varied with black, whitish behind; abdomen white, speckled with black, and with the basal and anal segments dark brown. Wings below white, external area broadly tinted with brown; crossed by a series of diffused dark brown subconfluent spots, and limited within by an angulated series of subconfluent blackish spots: a blackish discocellular dot on each wing: primaries with the costa brownish, the base appearing grey from transparency; the internal border silvery: pectus and legs pale shining brown, anterior coxæ and palpi black; venter white, with blackish anus. Expanse of wings 1 inch 5 lines.

99. *Locastra inimica*, n. sp. (no. 932).

Primaries fuliginous brown, mottled with whity brown, the external area tinted with pink; a blackish oblique streak across the basal fourth; a blackish rhomboidal costal spot which crosses the cell just beyond the middle; a blackish discal zigzag series of spots across the disk just beyond the cell; a nebulous subapical patch and a marginal series of black spots; fringe grey, dark at base: secondaries sordid white, the apical area, outer margin, and a submarginal streak dark brown; a longitudinal blackish streak on first median, and a second on the submedian vein: body fuliginous brown. Wings below pearly white, becoming sordid towards outer margin and on costal border; discocellulars dusky; a subangulated blackish discal line, and a large blackish subapical patch on each wing; a marginal series of blackish spots: body white. Expanse of wings 1 inch 1 line.

100. *Bocana incongruens*, n. sp. (no. 904).

Fuliginous brown, tinted with lilacine; wings crossed by two broad dark brown parallel oblique stripes, the first central, the second discal; fringe grey; primaries with a small yellow discocellular crescent. Under surface greyish brown: wings with small discocellular white dots; secondaries with indication of a discal line slightly darker than the ground-colour. Expanse of wings 1 inch 3 lines.

TROTOSEMA, n. gen.

Allied to *Echana*; palpi shorter, recurved, and pressed close over the front of the head; wings rather short and broad, primaries with a pouch-like tuft of overlapping curly hair on the costal margin beyond the cell. Type *T. sordidum*.

101. *Trotosema sordidum*, n. sp. (no. 905).

Smoky brown: wings crossed by two dusky diffused stripes, the first central, the second (with defined sinuated outer edge) limiting the external border; a series of black marginal dots: primaries with black discoidal spots, both very small. Wings below irrorated with whity brown; two irregular sinuous dusky-bordered whitish discal lines; black discocellular spots and blackish marginal dots. Expanse of wings 1 inch 3 lines.

CIDARIPLURA, n. gen.

Allied to *Edessena*, but differing in its enormous compressed sabre-like palpi; first palpal joint 4 millims. in length, curved upwards at the base, gradually expanding but straight from near the base to the crown; second joint $4\frac{1}{2}$ millims. in length, placed at right angles to the first, narrow at base, slightly widening towards the crown, thickly fringed with hair internally; third joint $4\frac{1}{2}$ millims. in length, narrow at base, gradually tapering to a point at apex, slightly incurved and fringed internally with hair. Primaries acuminate, with arched outer margin. Type *C. gladiata*.

102. *Cidariplura gladiata*, n. sp. (no. 902).

Smoky brown: wings crossed by a white-edged dark brown discal line; a black marginal line: primaries with a white reniform spot and a very minute white orbicular dot. Under surface paler; wings with an ill-defined dusky discal line and blackish discocellular spots. Expanse of wings 1 inch 4 lines.

103. *Amblygoes albinotata*, n. sp. (no. 921).

Primaries bronzy brown, with grey external border; two nearly central parallel stripes, slightly darker than the ground-colour, and terminating upon the costa in reversed snow-white spots; a subapical costal white dot or slender transverse dash; a lunular orange discocellular spot: secondaries dull copper-brown, with grey outer border, separated from the ground-colour by a scarcely perceptibly darker diffused band: thorax bronze-brown; abdomen grey. Under surface greyish brown: primaries with the costa bronze-brown, interrupted by a marginal short white line near the base, an oblique dash beyond the cell, and a slender subapical line parallel to the outer margin; outer border irrorated with white scales; a slender blackish marginal line: secondaries irrorated with white scales; a whitish submarginal line; a slender black marginal line: legs brown, tarsi banded with white. Expanse of wings 1 inch 2 lines

104. *Egnasia argillacea*, n. sp. (no. 954).

Reddish clay-colour, speckled with grey; a marginal series of minute black dots followed by little transverse white lines; fringe rosy, traversed by basal and central lake-red lines; a pale-edged brown discal line just beyond the discoidal cells, followed by a diffused indistinct greyish belt: primaries crossed near the basal third by a pale-edged brown line parallel to the discal one; costal border sericeous, crossed by two or three white dashes and with black marginal dots: thorax and abdomen dusky. Wings below pale greyish brown; markings indistinct: body white, legs yellowish. Expanse of wings 10 lines.

105. *Egnasia fallax*, n. sp. (no. 917).

Primaries above whitish olivaceous, indications of an arched central band, dusky upon inner margin, and bounded externally by a series of minute blackish dots; three parallel indistinct greyish arched lines across the basal third, the innermost line dotted with blackish; a very irregular grey discal line; a marginal series of black dots; fringe grey; costal margin pale buff, spotted with blackish: secondaries grey: thorax whitish olivaceous; abdomen slightly greyer, with pale margins to the segments. Primaries below sericeous greyish, with pale borders and dark fringe; costal border buff, crossed beyond the cell by an abbreviated oblique dusky line: secondaries sandy yellowish, speckled with grey; two indistinct parallel arched discal lines; a black discocellular dot. Body below golden whitish, shining; legs paler. Expanse of wings 10 lines.

106. *Egnasia erebina*, n. sp. (no. 927).

Smoky brown, with the external area broadly darker and limited internally by a sinuated black stripe or band; a pale-edged blackish line limiting the external border; a marginal series of small blackish spots enclosing white semicircular lines; fringe spotted with blackish; centre of the wings occupied by little variously formed hyaline white characters: primaries crossed at basal fourth by an irregular series of about four black spots; a black costal spot close to the base: thorax smoky brown, abdomen greyish. Under surface greyish; the basal area speckled with white; the discal lines with pale edges; the sinuated stripe of the upper surface forming the inner discal line more regular than above and dentate-sinuate throughout; the hyaline white markings more distinct and black-edged; marginal spots represented by subconfluent depressed triangular blackish dots followed by a slender whitish line. Primaries without basal markings: body whitish, with the legs greyish. Expanse of wings 11 lines.

107. *Egnasia opalina*, n. sp. (no. 895).

Primaries strongly angulated; pearly grey, with brownish costal margin and fringe; two diverging transverse central orange-margined ferruginous lines: secondaries pale brown; a dusky marginal line, followed by a whitish line at the base of the fringe: body pale brown. Under surface sericeous whity brown: primaries with faint traces of a darker transverse discal line. Expanse of wings 1 inch.

Pyralidæ.

Deana (*Adena*, Wlk., nec *Hadena*, Guén.).

108. *Deana sericea*, n. sp. (no. 1042).

Sericeous greyish brown; a slightly darker discal angulated line, partly bordered outwardly with whitish; fringe cream-coloured, traversed near the base by a black line, white at the anal angles, and with a black patch at the angulation of the outer margins: primaries with the costal border cream-coloured beyond the middle; a pale-bordered dusky line across the basal fourth; a large white spot immediately beyond the discocellulars, which are blackish and <-shaped: secondaries with a pale spot beyond the discocellulars: frons silvery white, palpi blackish, antennæ testaceous. Wings below paler and more sericeous, the discal line well defined, with better-marked whitish border; the spots beyond the cells white on all the wings; the primaries without basal transverse line; body below silvery white. Expanse of wings 1 inch.

Walker refers his genus to the *Crambites*, remarking at the same time that it hardly belongs to that group. His type (*A. xanthialis*) is identical with a species doubtfully referred by him to the genus *Scopula* under the name of *S.*? *hybreasalis*.

109. *Pyralis valida*, n. sp. (no. 938).

Greyish brown, with a slight cupreous reflection; wings crossed by two stramineous lines, those of primaries much wider apart and more angular than those of secondaries, fringe bright stramineous black at base: primaries with the apical two thirds of the fringe tipped with black; centre of costal margin spotted with yellow, apical portion blackish; a blackish dot at the end of the cell. Wings below shining, the inner stramineous line obsolete; basal two thirds of costal margin of primaries stramineous, spotted with black; anal angle of secondaries occupied by a diffused subquadrate stramineous patch: legs pale yellowish. Expanse of wings 1 inch 1 line.

Allied to *P. rubidalis* of Europe.

110. *Pyralis yokohamæ*, n. sp. (no. 939).

Primaries above greyish brown, with a feeble rosy reflection, crossed by two widely separated parallel slender stramineous lines; fringe pale brown, with a dusky subbasal line: secondaries pale brown, crossed by two slender whitish lines, the inner one angulated, the outer one arched; fringe as in primaries: thorax coloured like the primaries; abdomen pale brown, with a pink reflection. Wings below stramineous, with a paler discal line across the wings: secondaries whitish towards the abdominal border. Expanse of wings 1 inch 1 line.

111. *Pyralis regina*, n. sp. (no. 942).

Primaries above shining purple, with faint indications of two widely separated paler lines, the outer one commencing in a well-marked golden-yellow costal dash; centre of costal margin minutely flecked with gold; fringe golden-yellow, with a basal lake-red line: secondaries lake-red, with purple outer border; two irregular yellow-edged central blackish lines; fringe as in primaries: body brown, with purplish reflections. Under surface shining grey; wings with stramineous fringe, slightly rosy at base; a yellow costal dash as above; basal two thirds of costal margin flecked with yellow: secondaries whitish towards the base; a diffused rose-red discal belt enclosing an arched yellow-edged blackish line: legs and venter silvery. Expanse of wings 8 lines.

Near to *P. lucillalis* of Walker.

112. *Doththa consocia*, n. sp. (no. 950).

Wings above reddish cupreous, with the basal third laky brown, edged externally by a silvery-white line; basal half of fringe shining pink, bounded on each side by a black line, external half silvery white: primaries with an internally pale-edged slender black submarginal line; outer border rosy; internal area immediately beyond the subbasal line whitish: secondaries with a nearly central blackish-bordered white line: body pale brown. Wings below shining rose-red, with fringe as above: primaries with a large subapical patch and the costa clay-coloured; a number of black-edged white costal spots; a discocellular black lunule; a blackish patch below the end of the cell, and another below the clay-coloured patch, and enclosed by a forked black-edged white line, the outer or main stem of which replaces the submarginal line of the upper surface: secondaries crossed at basal third by a diffused constricted whitish belt enclosing an irregular black line, and followed by a deep-reddish discocellular dot; a black-bordered angulated white discal line; body below whity brown, anterior coxæ rose-red. Expanse of wings 11 lines.

Allied to *D. icelusalis* (*Pyralis icelusalis* of Walker).

Asopiidæ.

113. *Samea commixta*, n. sp. (no. 965).

Wings above with the basal two thirds stramineous, varied with white: primaries with two black dots at base, two large dark brown spots close to base, followed by an irregular belt of the same colour almost crossing the wing; a blackish-bordered stramineous quadrate spot at the end of the cell; an irregularly angulated pale-bordered black discal line limiting the external third, which is dark brown, a marginal series of black dots; fringe stramineous, with central and terminal blackish lines: secondaries crossed by two irregular black lines; external area and fringe as in primaries: body whity brown, abdomen banded with blackish. Under surface whity brown, markings very indistinct. Expanse of wings 9 lines.

Allied to *Samea inscitalis* (*Ædiodes inscitalis* of Walker).

114. *Samea exigua*, n. sp. (no. 1032).

Wings cream-coloured, with very pale cupreous-brown outer border, bounded internally by a dusky line; fringe grey, with white and blackish basal lines; two central dusky lines, the outer one almost sigmoidal (but angular) upon the primaries, straight and uniting with the submarginal line on secondaries; costal area of primaries brownish: body cream-coloured, brown in front; anus yellow. Under surface white, markings as above, but all grey. Expanse of wings 7 lines.

Margarodidæ.

115. *Glyphodes Pryeri*, n. sp. (no. 989).

Very like *G. pyloalis* of North China (*G. sylpharis* of Japan), but larger, the white areas sordid, the bands broader, duller, and connected upon the inner margin of primaries: secondaries crossed by a central bisinuated dark brown stripe;

lower discocellular covered by a cuneiform black spot. Expanse of wings 1 inch.

The type of Walker's *G. pyloalis* is in such poor condition, being much rubbed and destitute of fringe to the wings, that it is no wonder that I did not at first recognize its specific identity with the fresh and nearly perfect example obtained by Mr. Jonas.

116. *Margaronia inusitata*, n. sp. (no. 983).

Snow-white, sericeous: wings crossed by a sinuous discal greyish-brown line; three black-edged pale copper-brown discoidal spots confluent with the costal border, which is also pale copper-brown; a fourth spot below the cell: secondaries with a black-edged small spot in the cell, and a larger one closing the cell: frons yellow; palpi black; shoulders red-brown. Under surface with the markings much less distinct, partly obsolete. Expanse of wings 11 lines.

Nearest in appearance to *Cirrhochrista brizoalis*, but very distinct in form.

Botididæ.

117. *Mecyna prunipennis*, n. sp. (no. 1024).

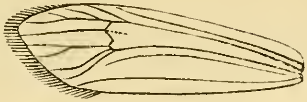
Primaries above reddish brown, tinted with plum-colour; a greyish spot at the end of the cell: secondaries sordid ochreous, with a grey external border: thorax plum-coloured; abdomen testaceous. Under surface ochreous; wings with rose-coloured tips; primaries with an oblique brown dash at the end of the cell, fringe brown; legs whitish, the femora clouded with rose-colour. Expanse of wings 1 inch 4 lines.

Phycidæ.

PARALIPSA, n. gen.

Aspect of *Achroëa*; allied to *Alipsa*, from which it scarcely differs in the neuration of the secondaries; but the structure of the primaries is altogether distinct, that of *Alipsa* being very simple, the costal vein simple, terminating at about second third of costa, the subcostal four-branched, the cell very long, the discocellulars forming a transverse zigzag line, from the uppermost angle of which the upper radial is emitted, and from the lowest the third median and lower radial are emitted upon a long footstalk, the first and second median being emitted near together from the inferior extremity of the cell, and being distinctly curved, the median vein is slightly inarched, as well as the vein-like fold immediately below it, and the submedian is long. In *Paralipsa* the base of the costal border is swollen out into a bladder-like excrescence, the costal vein (so far as can be seen without actually destroy-

1



2

Neuration of (1) *Alipsa* and (2) *Paralipsa.*

ing the specimen) appears to spring from near the base of the subcostal, and both of these veins almost immediately pass under a long depressed mass of hair-scales, from which they emerge just about the centre of the wing, the costal vein passing obliquely upwards to the margin, and the subcostal throwing off the first of its five branches parallel to it; parallel to and below the subcostal is an arched vein, from which both the radials are emitted; the discocellulars are absent; and the median vein, which is normal in structure, curves slightly upwards towards the radials; the false vein below the median curves slightly downwards at its extremity; the submedian is decidedly shorter than in *Alipsa*: the principal difference in the secondaries is that the second and third median branches are unusually short, little more than half the length of those in *Alipsa*: the palpi are unfortunately absent; but in other respects the body is similar. Type *P. modesta.*

118. *Paralipsa modesta*, n. sp. (no. 1170).

Coloration of *Alipsa angustella*: primaries above lilac-grey, speckled with black, and with a central forked pale ferruginous streak, a minute black subbasal dash, and a rounded black subcostal spot at apical third: secondaries sericeous white, with diffused dusky outer border, most distinct at apex: thorax lilacine grey; abdomen testaceous, with a pearly lustre. Under surface sordid white, the primaries with dusky external fourth. Expanse of wings 10 lines.

Crambidæ.

119. *Crambus sabulinus*, n. sp. (no. 1110).

Primaries red-brown, with a lilac reflection; costal border white; a band of clay-colour across the basal third, its inner half formed of large embossed scales, its inner margin limited by a diffused transverse greyish stripe: secondaries sordid hyaline white, with brown veins and margins; fringe traversed by a brown line: thorax shining clay-colour; abdomen testaceous. Under surface shining, the primaries and body stramineous, the secondaries whitish, with testaceous veins and margins. Expanse of wings 11 lines.

120. *Crambus yokohamæ*, n. sp. (no. 1087).

Primaries above bright golden yellow; discoidal area bright silver; a black line starting from the base of costa running to near the end of the upper radial, and there uniting with a second line starting from the base of the median vein, thus enclosing the basal half of the costal border and the discoidal area; three black-dotted longitudinal silver streaks upon the median branches, the third being almost obliterated by a large, oblique, pearly white spot; a fourth silver streak on interno-median interspace, and a fourth abbreviated one just below the subcostal vein beyond the end of the cell; a cuneiform, pearly white costal patch, bounded internally by an oblique abbreviated black line; a partly blackish-edged angular discal line; a silver triangular character filling the angle of the apex and edged internally with black, below it five black marginal dots; fringe white: secondaries sordid white, with greyish diffused outer border and silvery-white fringe: thorax golden yellow, with metallic cupreous tegulæ; abdomen pale yellowish. Wings below greyish brown, with whitish outer borders: secondaries paler than primaries, whitish towards abdominal margin. Body below whitish. Expanse of wings 1 inch 1 line.

121. *Crambus vigens*, n. sp. (no. 1088).

Primaries above satiny white, with incurved, metallic, silver fringe; several variously shaped black-bordered pearly white dots and lituræ on the internal and interno-median areas, the best-marked indicating part of a central band, the upper portion of which is indicated by two parallel, irregular, macular greyish lines; discoidal cell and the disk beyond it speckled with scattered black scales; two curved, parallel, approximated, golden-brown discal lines, a spot of the same colour, speckled with black, close to apex; a greyish submarginal line; three nearly marginal black dots, followed by a very slender black marginal line: secondaries creamy white, fringe silky white: thorax white; abdomen cream-coloured. Wings below cream-coloured: primaries suffused with brownish grey; fringe satiny white; three submarginal black dots: body below white. Expanse of wings 11 lines.

122. *Apurima lineata*, n. sp. (no. 960).

Primaries creamy white, streaked here and there longitudinally with pale golden brownish, and crossed from inner margin to apex by a golden-brown stripe; a black spot at the origin of the second and third median branches: secondaries, body, and under surface of the entire insect satiny white. Expanse of wings 1 inch 1 line.

Tortricidæ.

In a collection obtained in 1867 and collected by Mr. Whitely in Hakodaté, was an example of *Penthina arcuella*, Clerck, not differing in any respect from European specimens. This species was accompanied by one of the *Tineina*, which evidently mimics it in Japan, being so like it as, at first sight, to have deceived several experienced Lepidopterists.

Gelechiidæ.

123. *Gelechia imogena*, n. sp.

Basal third of primaries opaline; two divergent, golden orange, basal dashes; a straight transverse orange band limiting the opaline area externally, its outer edge bisinuated, the lower sinuation receiving the inner extremity of an elongated black patch, which fills up the remainder of the internal area; this patch is interrupted by irregular lines of shining amethystine and orange scales, and is bounded above by a diffused pale yellow border; above the black patch the ground-tint of the wings is whity brown, irrorated with dark brown, and bounded externally by a broad, shining, golden belt enclosing an amethyst-coloured stripe; a blackish-edged submarginal stripe tapering towards the external angle, its upper portion pearly white, its lower portion amethystine; outer border and internal fringe golden orange; external fringe dark brown, with plumbaginous lustre: secondaries bronzy brown; fringe very long and interrupted by longitudinal paler streaks: body dark brown; tegulæ orange, with plumbaginous internal fringe. Primaries below shining brown; secondaries shining grey: body brownish, with whitish legs, the tarsi above with blackish bars. Expanse of wings 9 lines.

Hakodaté (*Whitely*).

This species, although far more gorgeous in colouring when seen through a lens, bears a remarkable general resemblance to *Penthina arcuella*.

LII.—*On a new Copepod of the Genus* Doridicola. By Henry N. Ridley, B.A.

Cephalothorax broad oval, showing division into four segments. Antennæ—first pair seven-jointed, terminating in a flagellum; the third joint the longest, but not so long as the flagellum; the whole antenna as long as the cephalothorax: second pair three-jointed, ending in two claws, the terminal segment also bearing two smaller hooks. Mandibles flat and broad, with a single-jointed appendage with three setæ. First pair of maxillipeds two-jointed, with two terminal setæ; second pair similar, but with two terminal claws. Swimming-feet broad; both rami in all the feet similar, three-jointed, the terminal joint bearing three spines and two setose bristles; the middle joint shorter, with one lateral spine, and two setose bristles on the lower margin; basal joint with one lateral spine and one bristle; the outer margin of the segment setose. Fifth pair of feet a single joint supported on a lateral prominence of the segment, and terminated by two bristles. Abdomen of four segments, the first not swollen; terminal appendages short, bearing each three setose bristles.

Ovisacs oval. Colour white; pigment of eye rosy purple. Length 2 millims.

Habitat. The tentacles of *Anthea cereus*, var.

Locality. A pool at low water, near Ilfracombe, North Devon. August 1878.

Obs. This animal closely resembles *Doridicola agilis* of Leydig; but is distinguished by its habitat, colour, and shape of the last pair of thoracic feet, also the absence of any swelling in the first abdominal segment, and a few other minor differences.

Like *D. agilis* it was extremely active and difficult to secure, concealing itself among the tentacles of the *Anthea* or clinging tightly to them.

There were no males present. If the animal has not been already noticed, I propose the name of *Doridicola antheæ* for it.

Note.—It may be worth recording that the variety of *Anthea cereus* on which I found the *Doridicola* was entirely of a dark purplish slate-colour, and does not seem to have been hitherto noticed.

LIII.—*On certain new Species of Coleoptera from Japan.* By GEORGE LEWIS.

WHILE recently compiling a catalogue of Japanese Coleoptera, I found in my cabinets a few new species, some of which are of more than ordinary interest; and I have therefore drawn out the following diagnoses with the object of clearing off old material before starting again to the East. As many authors have shown, the fauna of Nipon consists chiefly of species derived from the same source as those of Northern Asia and Europe; but it is in part made up also of genera from the tropics, together with a few from the New World. There is more connexion between the fauna of the south of Japan and the Philippine Islands and Borneo than with South China, so far as the researches of entomologists at present lead us; and this is illustrated in the well-marked genera *Nodynus*, *Xuthia*, *Ichthyurus*, *Ischalia*, and *Prionocerus*, noted here. And this is not surprising; for from South Japan, through to Formosa and thus on to Luzon, there is a series of small connecting islands not far distant from each other.

The *Necydalis* described below is of American type; and it is well to observe that the line of communication afforded by the Aleutian and Kurile Isles brings into Japan just such links from America as we might expect from a broken line of islands.

Formerly, perhaps, this line was less interrupted or even complete; but if so, it would appear from the paucity of analogous genera to have been connected only prior to the lifetime of existing races. There is one instance, worth recording, of an insect crossing the Pacific by this route; it is the ever-varying *Corymbites lateralis*, Leconte, the home of which is, I believe, Vancouver's Island. Then in the genus *Penthe*, the Japanese is allied to the American, not to the Javan species; and in the new genus of Necrophaga lately established by Dr. Kraatz, *Ptomascopus*, there are two species described from Japan and one from China; yet the second Japanese species is allied to an Amazon insect rather than to either of its fellows in Asia. These instances, which are, however, the exception and not the rule, could be extended considerably did space allow; but the general result would be left unchanged. It will be an interesting day for those who study the Eastern-Asiatic fauna when a good collection comes from Korea or Saghalien.

Tachycellus subditus, n. sp.

T. elongatus, subovatus, niger, nitidus; thorace distincte marginato, basi sparsim punctato; elytrorum sutura marginibusque testaceo-rufis; tibiis tarsisque piceis, coxis rufis. L. 2–2½ lin.

Easily known from *T. anchomenoides*, Bates, by its less convex form, smaller size, and the red sutures of the elytra, the striæ of which are more lightly impressed.

Hab. Hiogo, very common in marsh lands.

Ptomascopus plagiatipennis, n. sp.

P. niger, subnitidus, undique punctatus; elytris singulatim plaga sanguinea notatis; abdomine, corpore subtus, pedibusque griseo-pubescentibus. L. 7 lin.

More robust than *P. morio*, Kraatz, with the punctuation larger and much more distinct, that of the elytra being of a somewhat larger grade than that of the thorax. The red blotch is broad, beginning near the apex of the scutellum, extending outwards to the edge of the elytra (leaving the suture black), and, then turning upwards, occupies half the base at the humeral angle: towards the apex there is a narrow streak of red filling the space between the carina and exterior margin.

Hab. Kagoshima; also Pekin.

Note.—I have a species of this genus from the Amazon river:—

Ptomascopus carbunculus, n. sp.

Niger, nitidus; capite subtiliter punctato; thorace elytrisque sparse subtilissime punctatis; subtus griseo-pubescens. L. 5–5½ lin.

Nodynus leuco-fasciatus, n. sp.

N. oblongus, depressus, niger, nitidissimus, fronte punctulata; pronoto antice et ad latera grosse punctato, stria integra, margine laterali angustissimo, elevato; elytris striis distinctis punctiformibus, fasciis transversis medio albis; abdomine subtilissime punctato. L. 4 lin.

Broader than *N. nitidus*, C. Waterh., with acute angles to the thorax, which gradually widens to the base, where it is as wide as the elytra. The fascia is irregular, and, during life, white. Suture and antennæ black, and the apex of the elytra truncate.

Hab. Yamato.

Scaphidium Reitteri, n. sp.

S. ovatum, piceum, nitidissimum; fronte, ore, thorace ad marginem et in medio late, elytrorum fasciis duabus, pygidio propygidioque rufescentibus; antennis basi piceis, articulo ultimo rufo.

Half the stature of *S. japonicum*, Reitter, with elytra more truncate, and the colour wholly different. I have much pleasure in dedicating this insect to Herr E. Reitter, the well-known microcoleopterist of Paskau.

Hab. Hiogo, near Maiyasan temple.

Hister margine-punctatus, n. sp.

H. ovalis, subconvexus, niger, nitidus, stria frontali subsinuata; pronoto lateribus punctato, stria integra, margine subelevato, ante scutellum foveolato; elytris striis 1.–4. dorsalibus integris, 5. et 6. medio abbreviatis; propygidio pygidioque grosse sed parce punctatis; mesosterni lateribus parce punctatis. L. $2\frac{3}{4}$ lin.

Allied to the European *H. marginatus*, from which the larger size and system of striation easily separate it.

Hab. Hakodaté.

Hister simplicisternus, n. sp.

H. ovatus, niger, nitidus; fronte impressa, stria integra; pronoti stria laterali interna integra, externa abbreviata; elytris striis 1.–3. dorsalibus integris, 4. et 5. et suturali brevibus; propygidio punctato, subfoveolato; pygidio apice subtiliter punctato; mesosterno marginato, basi non sinuato. L. $2\frac{3}{4}$–3 lin.

Much smaller than *sibiricus*, Mars., to which section it belongs; it may be recognized by the finer punctation of the pygidium (in some specimens almost smooth at the apex), and by the mesosternum having no notch to admit the prosternum.

Hab. Hiogo, where it is common.

Bacanius niponicus, n. sp.

B. ovalis, convexus, rufo-castaneus, undique sat dense punctatus; pronoti stria integra, linea basali arcuata e punctis paucis composita; elytris haud striatis; antennis pedibusque rufo-brunneis.

Near *B. rhombophorus*, Aubé, but half as large again; the punctures are coarser and more equally distributed; and the punctured line before the scutellum is a simple bow of twelve or thirteen points.

Hab. Nagasaki; under dead leaves at Suwosama temple in April.

Acritus komai, n. sp.

A. ovalis, convexus, piceus, nitidus, supra dense punctatus; pronoto linea basali punctorum transversa impresso; antennis pedibusque infuscatis.

Very near *A. minutus*, Herbst, and of the same stature, but more closely punctured, especially on the dorsal region. The line of points before the scutellum is less defined, and extends transversely without any perceptible angle.

Hab. Nagasaki; from an old tree in May.

Xuthia niponia, n. sp.

X. elongata, cylindrica, opaca, rufo-testacea; capite haud grosse punctato; thorace grosse punctato, sulcis tribus longitudinalibus, inæqualibus, vix conspicuis notato; elytris striis angustissimis elevatis, interstitiis seriatim grosse punctatis. L. $1\frac{1}{4}$ lin.

The thorax is roughly punctate, with an uneven depression in the median region, and one on each side, rather more defined, running laterally. The sutural stria of the elytra is for about the basal fifth of the wing-case separated from the second stria by an interstice of the same width as the remainder; but nearer the apex it closes towards the suture, with which it then again runs parallel. It is smaller than any of Mr. Pascoe's species, as might be expected, from its northern locality.

Hab. Nagasaki.

Teredus politus, n. sp.

T. elongatus, cylindricus, niger, nitidus; capite thoraceque distincte punctatis; elytris striato-punctatis; antennis pedibusque rufis. L. $1\frac{3}{4}$ lin.

Shorter and broader than *T. nitidus*, F. Although the colour and punctation of these two species do not materially differ, the Japanese one may hereafter form a new genus, the club of its antenna consisting of one large terminal ovate joint preceded by two small ones.

Hab. South Japan.

Macrodorcus Vanvolxemi, n. sp.

M. elongatus, parallelus, niger, subopacus; mandibulis capite vix longioribus, in medio unidentatis; clypeo transverso, medio prominulo; capite thoraceque subtilissime punctatis; abdomine subtus distincte punctato. L. 9 lin., mandib. ♂ $1\frac{3}{4}$.

Amongst Japanese species, allied to *M. opacus*, C. Waterh.; it is, however, more parallel, and the punctation of the abdomen is general and distinct. The elytra are finely and clearly punctured on the disk and near the suture, the points at intervals assuming the form of irregular striæ; but at the outer sides the punctation is deeper and more dense. The clypeus is raised to a point in the centre only, the outer angles being obtuse.

Hab. Yezo. Captured by M. Jean Van Volxem of Brussels.

Cetonia brevitarsis, n. sp.

C. breviter ovata, subnitida, cuprea, albo-variegata: *C. submarmoreæ* affinis. L. 9–10 lin.

The chief differences between this species and *C. submarmorea* are:—the clypeus is raised in front, but not notched; the whole outline is more quadrate; the punctation below the humeral angle more strigose, and the tarsi are both shorter and thicker. These points are very perceptible in a large series I have from South Japan, where it is very common. In colour it varies from blackish brass to a reddish coppery tint.

Hab. Nagasaki.

Cetonia insperata, n. sp.

C. ♀ oblonga, nitida, purpureo-ærea; elytrorum lineis transversis albis angustissimis, disco obsolete punctato; abdomine convexo, lævi. L. $9\frac{1}{2}$ lin.

Not closely allied to any species I know. The polished surface separates it from any Japanese species; the punctation of the elytra is comparatively obsolete; and the white markings are very narrow. The head is fairly punctured, and the edge of the clypeus slightly raised both in front and at the sides. The propygidium and pygidium have the strigose punctation of the preceding, but rather less deeply impressed. The outline of the insect viewed sideways between the lobe of the mesosternum and the apex of the elytra is concave.

Hab. Yezo.

Ichthyurus niponicus, n. sp.

I. fuscus; fronte depressa, flavo-testacea, capitis basi late nigra; thorace disco nigro, margine antice late, basi anguste flavo; elytris nigro-fuscis, marginibus externis flavis; antennis testaceis, apicem versus fuscescentibus; abdominis margine late flavo. L. $2\frac{3}{4}$ lin.

This species is the smallest yet observed in the genus, and possesses the usual colours. The large middle thigh is dusky at the joint; and the posterior leg has the tibia and half the thigh darkish; but the anterior leg is wholly pale.

Hab. Hiogo, foot of Maiyasan.

Ischalia patagiata, n. sp.

I. oblonga, depressa, nigra, parce albo-hirta; antennis pedibusque obscuro-nigris; elytris externe late luteo-marginatis. L. $2\frac{1}{2}$–3 lin.

The yellow margin does not extend over the carina at the apex of the elytra, which are ribbed strictly to the pattern of *I. indigacea*, Pascoe. This species is rare; but I have found it in elevated sylvan districts both at Hiogo and Nagasaki in August.

Hab. South Japan.

Epicauta taishoensis, n. sp.

E. elongata, subparallela, nigra, subnitida, griseo-pubescens; capite thoraceque dense punctatis; elytris subopacis, dense rugoso-punctulatis. L. 7 lin.

The head is black, with a broad margin of red behind the eyes, which is narrowly interrupted in the centre before the neck. There is also a red spot on the forehead between the eyes; and the basal joint of the antennæ has a red patch in the middle, on the underside.

Near *E. flabellicornis*, Germ.; but in that European species the thorax is much more closely punctured. From *E. Gorhami*, Marseul (Japanese), it is separated by its wholly black thorax and elytra and the black surface behind the eyes.

Hab. Tsusima.

Prionocerus fuscipennis, n. sp.

P. obscuro-fuscus vel subæneo-metallicus; capite scutelloque obscuro-viridibus; thorace rufo; elytris thorace latioribus, postice subdilatatis, carinulis vix distinctis, nigro-pubescentibus. L. 5 lin.

About the size of *P. cyanipennis*, Perty, from which it differs wholly in colour. The elytral nerves are furnished at intervals with long stiffish black hairs; and this seems a special character of this species.

Hab. Yokohama.

Leptura succedanea, n. sp.

L. ♀ nigra, elongata, vix nitida, brunneo-pubescens; thorace supra, elytris totis, tibiis in medio rubris.

This is the representative in Japan of the European *L. rubra*, L.; the chief differences are its bright colour, more slender figure, comparatively longer antennæ, blacker legs, and much finer punctation on the segments of the abdomen. I do not know the male.

Hab. North Nipon (*Van Volxem*).

Necydalis pennata, n. sp.

N. elongata, nigra, nitida, cinereo-tomentosa; capite punctato; oculis prominulis; thorace disco lævi, ad basin punctato, scutello nigro; elytris rufescentibus vix grosse punctulatis; pedibus rufis. L. 6 lin.

The large head and prominent eyes of this species bring it near *N. mellita*, Say, to which, however, it has no very close resemblance. The tarsi are pitchy brown, as are also the lower portions of the hind tibiæ.

Litocerus Roelofsi, n. sp.

L. niger, griseo-pilosus; rostro ad basin capiteque sub oculis albo-pilosis; thorace in medio macula testacea traguliformi, subtus obscure testaceo; elytris testaceis, nigro-bifasciatis, fasciis marginalibus angustioribus albis; pedibus testaceo variegatis. L. 3½ lin.

Black; rostrum behind the antennæ and a patch under the eyes pubescent white; thorax with a mesial arrow-shaped spot testaceous. The elytra are testaceous, with two beautiful fasciæ, irregular, and narrowly margined with white. There is also a black spot on each of the tubercles at the base, which is confluent with the narrow line of black occupying the base, and behind the humeral spot a small black isolated spot, the latter white-margined. Abdomen has the last five sections testaceous and immaculate. The first joint of each tarsus has a broad testaceous annulus, as has also each tibia.

Hab. Nagasaki, Iponmatzu, on the wax-tree (*Rhus succedanea*, L.).

Cassida erudita, Baly (1873), = *C. rugoso-punctata*, Motsch. (1866).

Cassida consociata, Baly (1873), = *C. fusco-rufa*, Motsch. (1866).

Episcapha hamata, n. sp.

E. elongata, subparallela, nigra, nitida; thorace subquadrato, antice leviter angustato, lateribus modice rotundatis, crebre subtiliter punctato; elytris obsoletius punctatis, annulo humerali integro, extus denticulato, ramum brevem emittente, fasciaque lata subapicali pallide fulvis. L. 6 lin.

Allied to *E. indica*, Crotch, but not so obsoletely punctured; it is also rather smaller and less convex. It is the only species from Japan at present with the isolated humeral spot.

Hab. Hakodaté.

Episcapha Gorhami, n. sp.

E. elongata, sublævis, nigra, crebre fortius punctata; thorace subopaco, antice angustato, lateribus fere rectis, medio obsolete biimpresso; elytris sat convexis, annulo humerali fere integro, extus bidentato, ramum unidentatum emittente, fasciaque denticulata subapicali rubris. L. 6 lin.

This species comes into the *E. vestita* group; but it is not pubescent, and is more clearly punctured than any of its allies. The denticulations of both the humeral annulus and the apical lunular fascia are of the pattern of *E. Fortunei*, Crotch; but the form and punctation are very different. I have much pleasure in dedicating this species to my friend the Rev. H. S. Gorham.

Hab. Yezo.

Coccinella Crotchi, n. sp.

C. niger, subnitidus, punctatus; capite maculis duabus flavis notato; prothoracis margine anteriore angusto, flavo; elytris basi (sutura excepta) late flava, ante apicem singulatim flavo maculatis; pedibus anterioribus flavis. L. 2 lines.

The type of this species has two pale spots on the head; but in a series these spots are often confluent, or the head wholly flavous. I do not observe greater variations. The anterior margin of the thorax is pale; and the angles being wholly so, give an appearance of greater breadth in that region. There is a broad margin of yellow colour at the base of the wing-case (suture black), and a patch just before the apex, the last not touching the edge of either elytron.

Novius concolor, n. sp.

N. niger, subnitidus, undique subtilissime punctatus; griseo-pubescens; thorace elytrisque totis rufis.

Half as large again as *N. limbatus*, Motsch., from which it may be known by its red thorax, scutellum, and elytra.

Hab. Hiogo, Maiyasan temple, from which I possess a series.

Note.—I am indebted to Mr. H. W. Bates for the following descriptions of two new Japanese Longicorns in his collection:—

Saperda tetrastigma.

S. punctatæ affinis; nigra, griseo-pubescens, supra griseo-fulva, nigro-setosa; capite maculis duabus, thorace quatuor, elytris utrinque quatuor lineatim digestis nigris; antennis articulis 3. et 4. et 6.–11. basi griseis. Long. $6\frac{1}{2}$ lin. ♂.

Of similar form to *S. punctata*, but rather less narrowed posteriorly. The head is broader and the forehead strongly transverse and plane. The elytra are rounded at the apex, and the sides are not abruptly vertical. The whole upper surface is clothed with short, erect, dusky bristles. The colour above is greyish tawny, with the following rounded black spots—one in the middle of the forehead and one on the occiput, four in quadrangle on the disk of the thorax (besides one on each flank), and four on each elytron, placed in a line from the shoulder to near the apex, the apical one being much the smallest. The under surface, legs, and antennæ are black, clothed with fine grey pile, the base of the third to the eleventh joints (with the exception of the fifth) being grey.

Japan. From the collection of the late Mr. W. W. Saunders.

Glenea chrysochloris.

S. Swinhoei affinis, at differt corpore metallico-squamoso. Subgracilis, nigra, squamulis argenteo-viridibus dense vestita, et passim nigro-setosa; thorace maculis duabus elongatis medianis alteraque minore laterali nigris; elytris utrinque maculis duabus angulatis alteraque postica C-formi nigris. Long. $7\frac{1}{2}$ lin. ♂ ♀.

Differs from the allied *G. Swinhoei* by the metallic-coloured clothing of the body. In this respect it agrees with the East-Siberian *G. metallescens* (*Saperda id.*, Motsch.), from which its large black markings conspicuously distinguish it. The elytral spots are, on each side two large and angular, placed in succession on the disk before the middle, and one describing nearly an oval between the middle and the apex; the shoulders and lateral carinæ of the elytra are also black. The elytra are briefly truncated at the apex, with a short tooth at the external angle of the truncature. The apex of the tibiæ is black, the tarsi above pale blue. The antennæ are black, with the basal joints more or less marked with blue.

Yezo; on elm trees. Taken by M. Jean Van Volxem (*coll. H. W. Bates and G. Lewis*).

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

November 5, 1879.—Henry Clifton Sorby, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "On the Fish-remains found in the Cannel Coal in the Middle Coal-measures of the West Riding of Yorkshire, with the description of some new Species." By James W. Davis, Esq., F.G.S., &c.

The remains described by the author were from a bed of Cannel

Coal about 400 feet above the base of the Middle Coal-measures, and were chiefly obtained from this bed at the Tingley Colliery. The author described the general geological structure of the district. At Tingley the fish-remains were stated to occur in greatest abundance between the Cannel Coal and the "hubb;" but they are also found in both those portions of the deposit. Of known species the author has identified *Cœlacanthus lepturus*, *Ctenodus elegans*, *Megalichthys Hibberti*, *Rhizodopsis*, sp., *Palæoniscus*, sp., *Gyracanthus formosus*, *Ctenacanthus horridus*, *Diplodus gibbosus*, *Ctenoptychius pectinatus*, *Helodus simplex*, teeth of *Cladodus* and *Petalodus*, scales of *Rhizodus*, ribs and bones of *Ctenodus*, *Pleuracanthus lævissimus*, and six other species, and the following, which are described as new forms—(1) *Compsacanthus triangularis*, (2) *C. major*, and (3) *Ostracacanthus dilatatus*, the type of a new genus resembling *Byssacanthus*, Agass. The teeth of *Cœlacanthus* were said to be small and sharply pointed: they have not been found attached to the jaw; but in certain specimens of the latter the alveolar spaces are well shown, extending in a single row along the rami. The air-bladder of this genus is also said to be preserved, and to present some resemblance to the bony air-bladders of Siluroid fish inhabiting the fresh waters of Northern India; and, in general, the author dwelt at considerable length upon the possible relationships existing between the fishes whose remains he described and the Teleostean Siluroids and *Ostracion*.

2. "On the Skull of *Argillornis longipennis*, Owen." By Prof. R. Owen, C.B., F.R.S., F.G.S., &c.

In this paper the author described a fragmentary cranium from the London Clay of Sheppey, from which it was procured by W. H. Shrubsole, Esq., who also furnished him with the humerus described in a former paper under the name of *Argillornis longipennis* *. In the present specimen the lower jaw and the fore part of the upper jaw are deficient. The author described the characters presented by the specimen in detail, and stated that, like those of the humerus previously described, they seemed to approximate the fossil most nearly to the Albatross among existing birds, although, like *Odontopteryx*, it differed from *Diomedea* and also from the Cormorant and the Totipalmates generally, in the absence of the basirostral external nares and of the supraorbital gland-pits. The present fossil differs from *Odontopteryx* in having the fore part of the frontal broader and the upper tract of the bill less defined, as also in some other characters; but no comparison of the palatal structure can be made upon the existing specimens. In point of size, taking the Albatross as a term of comparison, this skull may well have belonged to a bird with wings of the extent indicated by the humerus already described; and the resemblance of the skull to that of the Albatross would also seem to be confirmatory of the specific collocation of the two specimens. The presence of four small pits

* Quart. Journ. Geol. Soc. vol. xxxiv. p. 124.

or perforations on the only part of the alveolar border which appears to be uninjured, leads the author to conjecture that the bird may have been dentigerous.

MISCELLANEOUS.

John Miers, F.R.S.

By the death of the late J. Miers, F.R.S., science has lost one of the most industrious systematic botanists of the present day, and one who was formerly a frequent contributor to the pages of this journal. Born in London, on the 25th of August, 1789, of a Yorkshire family, Mr. Miers, in early years, showed a marked inclination for scientific pursuits; and, although mainly occupied with his father in his business as a jeweller, he found time for the study of the physical sciences, especially of chemistry and mineralogy. Chemistry was at that period of his life his favourite study; and he undertook a series of important researches which led to the publication, in 1814, of two papers on the nature of azote, in Thomson's 'Annals of Philosophy.' At this time he made the acquaintance of Michael Faraday, and of many others who subsequently distinguished themselves in various branches of science. In 1818 he married. Henceforward the whole tenour of his life was changed. He accepted an invitation from his friend Lord Cochrane (afterwards Earl Dundonald) to proceed to Chile, to assist in the erection of very extensive machinery for the reduction and manufacture of copper—an undertaking in which they were jointly interested. He landed at Buenos Ayres, crossed the Pampas and Cordilleras, and remained in Chile for upwards of six years, during which period, as he was unable to continue his chemical researches, he turned his attention to the study of the natural history of the country, at that time almost a *terra incognita* to botanists. He was as yet wholly unacquainted with the elements of botany, and had no books to assist him in his studies; but he spent his leisure time in making drawings and dissections of the plants that he collected during his journey across the continent and in his travels in Chile. His energy and enthusiasm in collecting may be estimated by the fact, mentioned in his subsequently published work, that he made upwards of two hundred analytical drawings of plants, illustrated by descriptions, and collected materials for nearly as many more. These were of the greatest assistance to him in his subsequent career. On his return to England in 1825 he made the personal acquaintance of both Robert Brown and Dr. Lindley, and during his few months' stay arranged for the publication of his 'Travels in Chile and La Plata." This work, which appeared in 1826, in two volumes, illustrated with maps and engravings prepared from his own drawings, was long regarded as the chief authority on the geography of the country, and on the manners and customs of the people with which it dealt. On returning to Buenos Ayres he crossed the country once more to Mendoza, to meet his wife and family; and it was during his return journey that he made his principal collections of the plants of the Pampas. Having successfully erected a mint at Buenos Ayres, he contracted with the Brazilian Government to supply the mint-machinery at Rio de Janeiro; and during a seven years' residence at that capital (a period of close application to his duties as an engineer, and of many and prolonged professional anxieties), he succeeded in making most extensive botanical and entomological collections, besides many observations upon the structure and affinities of the plants of Rio in the living state. He left South America finally in 1838.

From this period may be dated his career as a botanist. He was elected a Fellow of the Linnean Society in 1839, and from that date almost till his death was a regular and frequent contributor to the various scientific journals and the 'Proceedings' of the Linnean Society. Among his principal papers may be mentioned a valuable series of "Contributions to the Botany of South America," which appeared in the 'Journal of Botany' between the years 1845 and 1851; "Observations" on the affinities of the *Solanaceæ*, *Olacaceæ*, *Canellaceæ*, *Rhamnaceæ*, and *Menispermaceæ*, published in this journal in 1849, 1851–52, 1858, 1860, and 1864–67, his "Memoir on the *Triuriaceæ*," in Trans. Linn. Soc. for 1850, and his "Observations on the Structure of the Seed and Development of the Raphe," in the 'Transactions' of the same Society for 1855–56.

Mr. Miers was also the author of several monographs, which, although consisting in great part of reprints of his smaller papers, are enriched with many additional observations and numerous elaborate lithographic plates, all executed from original drawings, and many drawn by himself upon the stone. His 'Illustrations of South-American Botany,' in two volumes, appeared in 1850 and 1857; and his 'Contributions,' in three volumes, followed in 1867, 1869, and 1871; the third and concluding volume is occupied exclusively with his "Monograph of Menispermaceous Plants," and is an enduring monument of the industry and learning of its author. His latest volume, a 'Memoir on the *Apocynaceæ*,' was published in 1878, when its author was in his eighty-ninth year. He may be said to have died, as he had lived, in harness; for his last two papers appeared in the 'Journal of the Linnean Society' not two months before his decease.

Mr. Miers was elected F.R.S. in 1843, and served two years upon the Council. He was subsequently a Vice-President of the Linnean Society, and was also a member of several foreign learned bodies. He served as juror in the Brazilian section of the Exhibition of 1862, and was rewarded for his services by the Cross and Grand Cross of the Brazilian Order of the Rose, conferred upon him by the emperor.

As a botanist, Mr. Miers was distinguished by the accuracy of his observations and descriptions, and the beauty and fidelity of his drawings and analyses. He was a most indefatigable worker; and his botanical researches, pursued in earlier days amid circumstances of great difficulty, became in later years the ruling interest of his life, and to them he devoted the whole of his time and thoughts. If, in the opinion of some botanists, he unduly multiplied generic and specific definitions, and if his generalizations have not in all cases met with universal acceptance, none can deny the importance of the facts he adduced, or the minuteness and laborious accuracy of his original investigations. He was, to the last, an opponent of the theory of evolution.

In June 1879 he was compelled by failing health to desist from active work. From this period he became more infirm, and after a gradual decay, borne with never failing patience, expired on the 17th October, 1879, in the ninety-first year of his age. In private life he was esteemed by all who knew him.

The whole of his extensive herbarium has been bequeathed by him to the British Museum.

Nicholson's 'Manual of Palæontology.'

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

Gentlemen,—I am very sorry to find that my esteemed friend Prof. H. Alleyne Nicholson has, in the new edition of his 'Manual of Palæontology' (vol. ii. p. 138, footnote), committed the mistake of quoting my authority for elevating the Platysomid fishes to the "rank of a distinct division of Ganoids." No such proposition occurs in my unpublished paper to which he refers, which was written to follow up the views which I expressed in my account of the structure of the Palæoniscidæ (Palæontogr. Soc. 1877) as to the abolition of the suborder "Lepidopleuridæ," necessitated by the demonstration of the fact that the Platysomidæ are not really allied to the Pycnodontidæ, but are, on the other hand, so closely linked to the Palæoniscidæ by ties of structure, that wherever we place the one family, thither the other must follow.

My paper on the "Structure and Affinities of the Platysomidæ" was read before the Royal Society of Edinburgh on May 5 of this year, and will, in a few weeks, appear in the forthcoming fasciculus of that Society's 'Transactions.' Prof. Nicholson's mistake as to my views is obviously due to his having had only a very hurried glance over my proof-sheets, and that only on a single occasion.

I am, &c.,

Edinburgh, Nov. 12, 1879. R. H. Traquair.

On the Organization and Classification of the Orthonectida. By M. A. Giard.

In a former communication * I indicated the existence of a new class of animals which present permanently the usually transitory form called *planula* by embryogenists. New investigations enable me now to complete the history of these animals and to settle the place which they should occupy in the subkingdom

* 'Comptes Rendus,' October 29, 1877, p. 812; translated in Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 181.

Vermes. My researches have been made upon *Intoshia linei*, parasitic upon a Nemertean, and upon two species parasitic upon Ophiurans, *Rhopalura ophiocomæ* and *Intoshia gigas*.

The movements, independent of vibratile cilia, which I observed in these parasites are due to the presence of musculoid bands belonging to the endodermic cells, and forming a splanchno-pleural pseudo-mesoderm, analogous to the somato-pleural pseudo-mesoderm formed in the Cœlenterata by the epithelio-muscular cells of Kleinenberg and Korotneff.

To the *ensemble* of these elements I give the name of *pseudo-mesoderm*, because I think it right to reserve the name of *mesoderm*, properly so called, for other formations, which do not exist in the Orthonectida, and the homology of which in the various groups of Metazoa is rather difficult to establish. I distinguish :—

1. A *solid mesoderm*, formed very early at the expense of the endodermic cells of the embryo (rudiment of the chorda of the Tunicata and Vertebrata; skeletogenic cells of the embryo of Echinoderms ; mesodermic cells issuing from the four first spheres of the endoderm of the *Planariæ* and of *Bonellia*, according to the researches of P. Hallez, Sprengel, &c.).

2. A *cavitary mesoderm*, formed by diverticula of the endoderm (enterocœles) and appearing generally at a later period (aquiferous system of the Echinoderms, enterocœle of the Tunicata, Brachiopoda, *Sagitta*, *Amphioxus*, &c.).

The solid mesoderm gives origin especially to the muscular system ; the cavitary mesoderm principally forms the vascular organs.

The physiological function of a histological element, however, is only of secondary importance in the determination of phylogenetic homologies. A muscular element, for example, will always originate where the want of it is felt, whether in a rudiment of endodermic origin, or at the expense of ectodermic elements (Nemerteans). It may even be formed from only a portion of a cell (plastidule), as occurs in the Infusoria, the Cœlenterata, and the Orthonectida.

The reproduction of the Orthonectida is effected in two different manners :—

1. Sexually. In different cases, there is formation of a *blastula* which becomes laminated (*Intoshia gigas*), or production of an epibolic *gastrula* which finally closes (*Rhopalura ophiocomæ*). In either case the result is a permanent ciliated *planula* with a metamerized ectoderm. The ectodermal metameres contain each a single series of cells in *Rhopalura* and several series in *Intoshia*.

2. By gemmiparity in the interior of enormous sporocysts, formed by the endoderm of the progenitive animal. It is in consequence of this gemmiparous reproduction that the Orthonectida are met with in such great abundance in an infested animal.

This double mode of reproduction approximates the Orthonectida to the Dicyemida and other parasitic worms (Trematoda and Cestoda). Their more simple organization during the embryonic period leads us to place them below the Dicyemida. The subkingdom Vermes will therefore include the following classes :—

1. Orthonectida.
2. Dicyemida.
3. Trematoda.
4. Cestoda.
5. Turbellaria (Planarians and Nemerteans).

Of the animals formerly classed with the preceding, some (Bryozoa, Annelida, and associated groups) are intimately allied to the true Mollusca, with which I unite them to form the subkingdom *Gymnotoca* ; the others constitute a whole which may be called *Nematelmia*, including the Nematoida, Echinorhyncha, Desmoscolecida, Gastrotricha, &c. The Tunicata must be placed at the foot of the subkingdom Vertebrata.

The Orthonectida are Gastræada brought by parasitism to the state of *planula*. Their importance from the point of view of the *Gastræa*-theory is much greater than that of the *Physemaria*. These latter, in fact, only lead to the Cœlenterate branch, which terminates in a *cul-de-sac* ; while the Orthonectida represent a stem of the Vermes, and consequently belong to the main trunk of the genealogical tree of the Metazoa.—*Comptes Rendus*, September 22, 1879, p. 545.

Remarks on Orgyia.

Prof. Leidy remarked that *Orgyia leucostigma*, which now seriously infests the shade trees of Philadelphia, especially the horse-chestnuts and silver maples, had recently passed into the moth stage. The trunks of the trees and the surrounding railing of the square opposite to the Academy exhibit a profusion of cocoons. In seeking for specimens of the male moth, he had collected only three, in a walk along one side of the square, from the railing, where hundreds of the wingless females were to be obtained as they rested with their foamy white masses of eggs on their cocoons. From the fewness of the males he was led to suspect that the females might perhaps, in many instances, deposit the eggs in an unfecundated condition. To ascertain if this were so, he collected several dozen cocoons with pupæ of females, distinguished by their comparatively robust character, and placed them in a covered box in his study in the third story of a back building, separated from the nearest place where there were other cocoons by the front building and the width of the street in front of his house. As the females came out of the cocoons, distended with eggs, these, with the exception of a few which appeared to be accidentally dropped, in several individuals were retained. After some days, as none of the females laid their eggs, the box was uncovered ; and on the second morning subsequently several individuals had deposited masses of eggs, though no males were present in the box. However, on examining the vicinity, four male moths were detected on the outside of the curtain of the window in which the box had been placed, from which it was supposed that the females had been visited by males attracted during the night from the neighbourhood.

The case related reminded him that some years ago a collector of butterflies in the suburbs informed him that he frequently obtained male specimens of the Cecropia and Luna moths by pinning females to the side of the window, when, in the morning after, he would almost certainly find males in conjunction with them. The means by which the males thus find their mates at night and in out-of-the-way places were not obvious, as the insects appear to be incapable of producing sounds or scents that are appreciable to our senses.—*Proc. Acad. Nat. Sci. Philad.*, July 1879.

On Myrmecocystus mexicanus, *Wesm.*

Rev. H. C. M'Cook exhibited several glass formicaries containing a large number of living specimens of the honey-ant, *Myrmecocystus mexicanus*, Wesmael. These embraced three worker castes (major, minor, and dwarf), the honey-bearer, and the fertile queen. The artificial nests had been brought from the Garden of the Gods, Colorado, where the honey-ant had been discovered by Mr. M'Cook. They had previously been supposed to be confined to a more southern latitude. The nests are found on the tops or southern slopes of ridges. In exterior architecture they are small gravel-covered moundlets, truncated cones, pierced in the centre by a gate or perpendicular opening from three to six inches deep. The interior architecture was illustrated by numerous specimens brought from excavated nests. It consists of a series of underground galleries and chambers, cut through the gravel and sandstone to the distance of nearly eight feet in length, two to four feet beneath the surface, and about ten to twelve inches in width at the widest part.

The honey-bearers were found hanging in groups to the roofs of the honey-chambers by their feet, their large globular abdomens looking like bunches of small Delaware grapes. About eight to ten chambers, containing each an average of about thirty honey-bearers, were found. The workers cared for the honey-bearers when the chambers were opened, and dragged them into the unopened parts.

The ants proved to be nocturnal in their habits, remaining within doors until after sunset, about 7.30 P.M., each evening, when the workers issued forth in column and dispersed among the clumps of scrub oak (*Quercus undulata*). Here they sought the galls made by a species of *Cynips*, which grow abundantly on the bushes, and licked therefrom a sweet exudation which issued in small transparent beads from the surface. From 11.30 P.M. to about 3.30 A.M., when the first streakings of dawn began to appear, the workers returned home laden with the honey. This appears to be fed to the sedentary honey-bearers by disgorging it in the usual way, and remains within the globular abdomens as a store for future use. The economy of this habit appears to resemble that of the bee, the exception being that the bee's honey is stored within the inorganic substance of a waxen cell, while the ant's is lodged within the organic tissue of the living insect.—*Proc. Acad. Nat. Sci. Philad.*, Sept. 1879.

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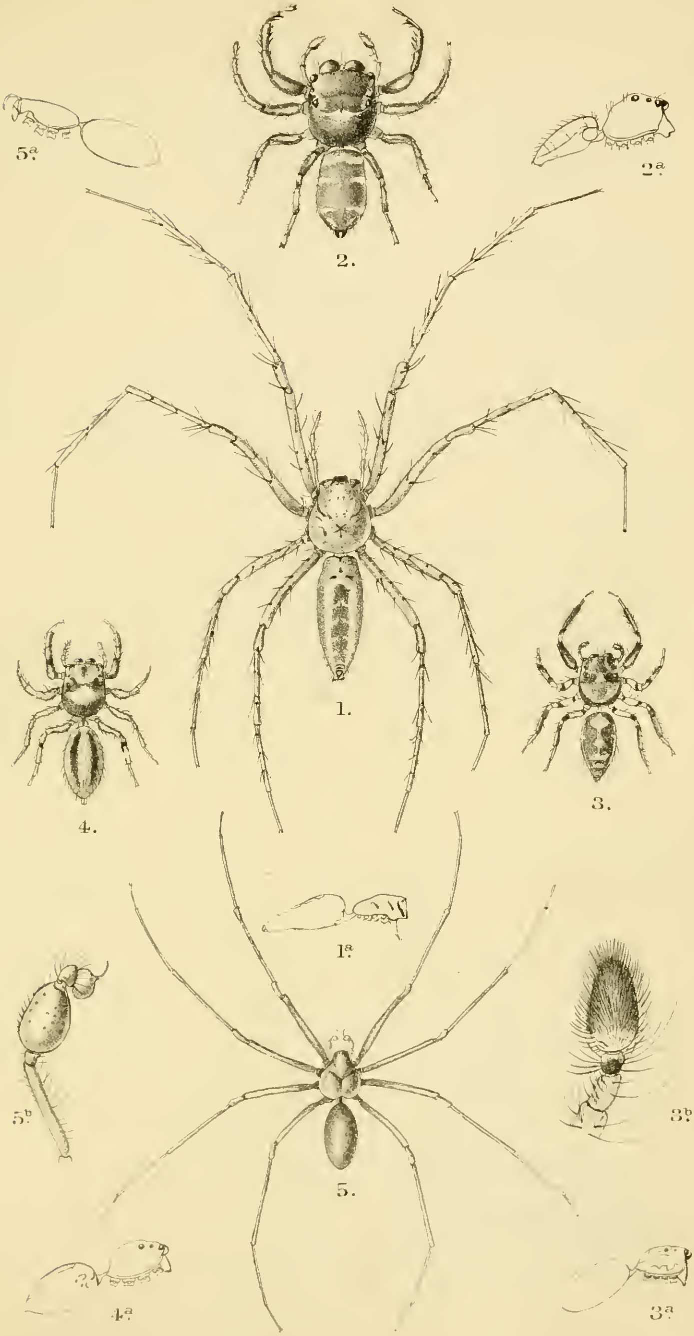

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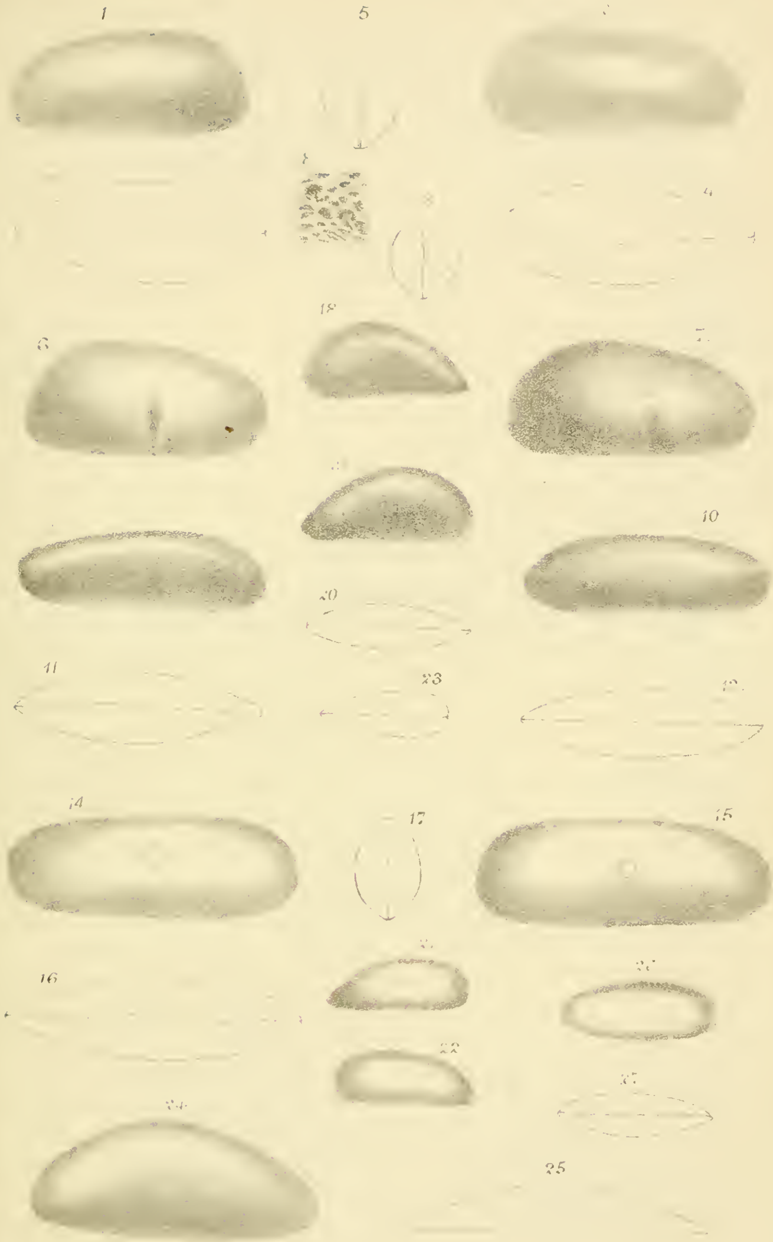

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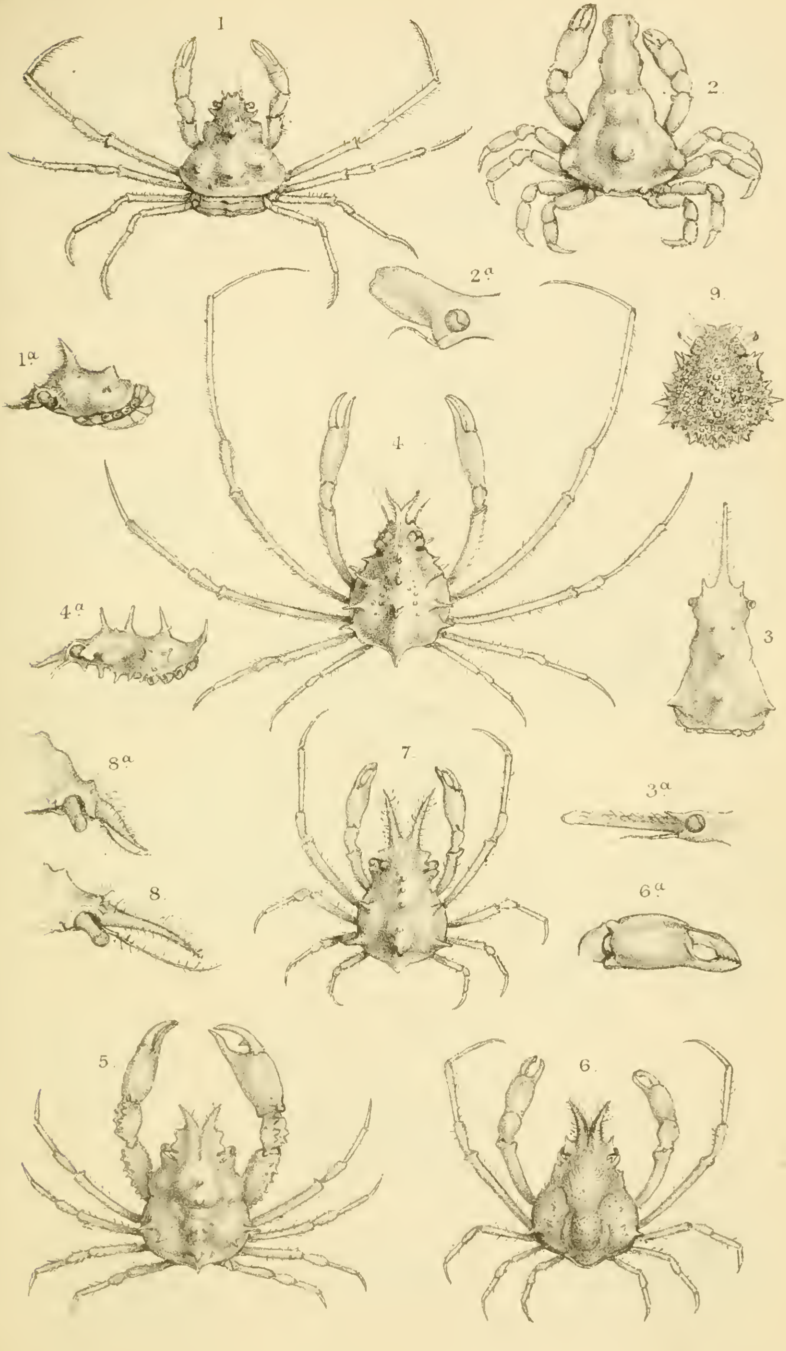

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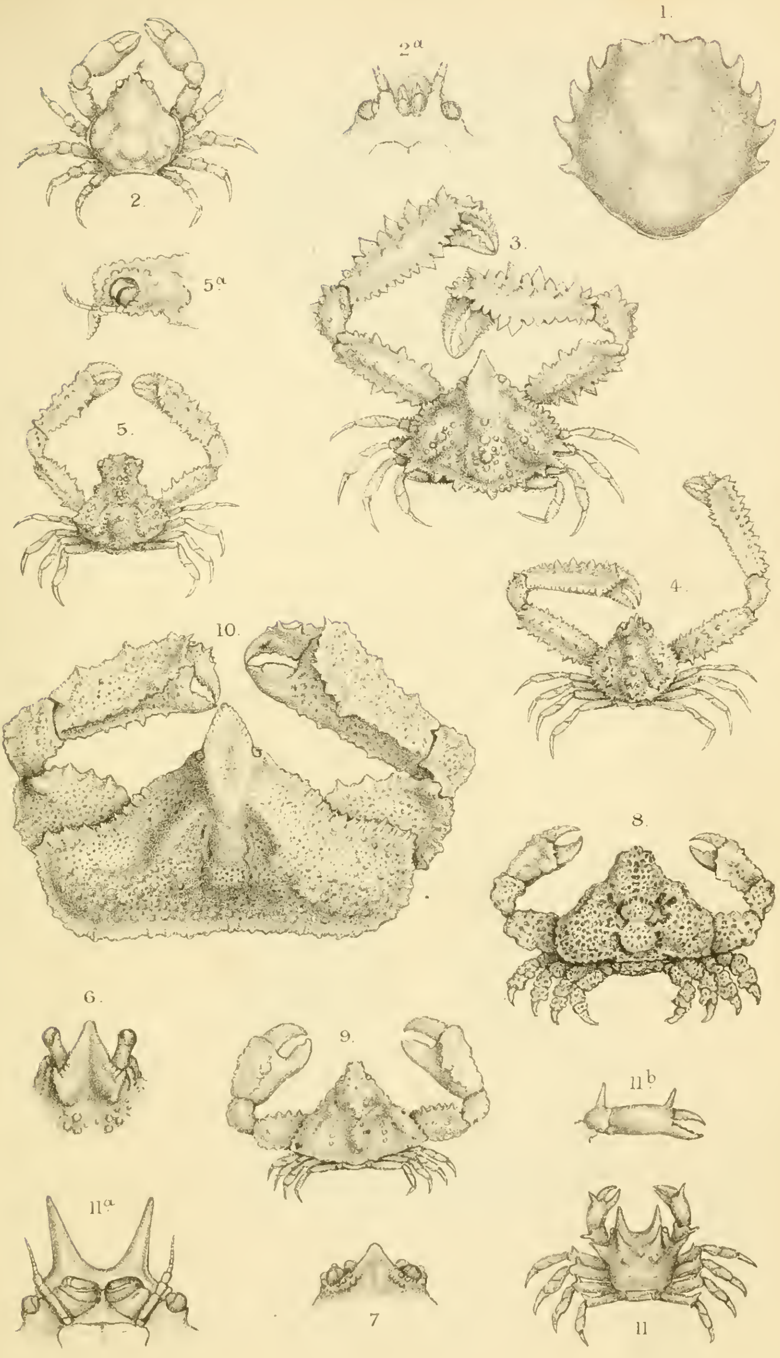

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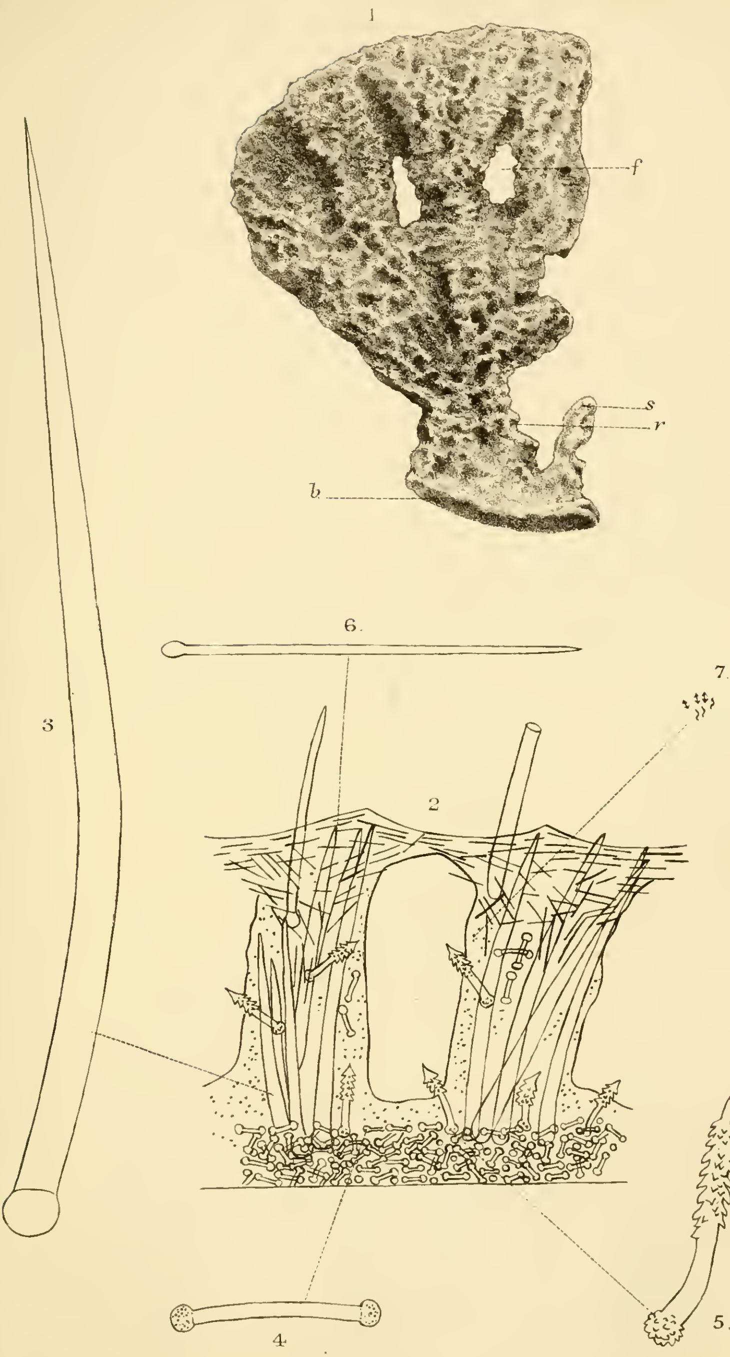

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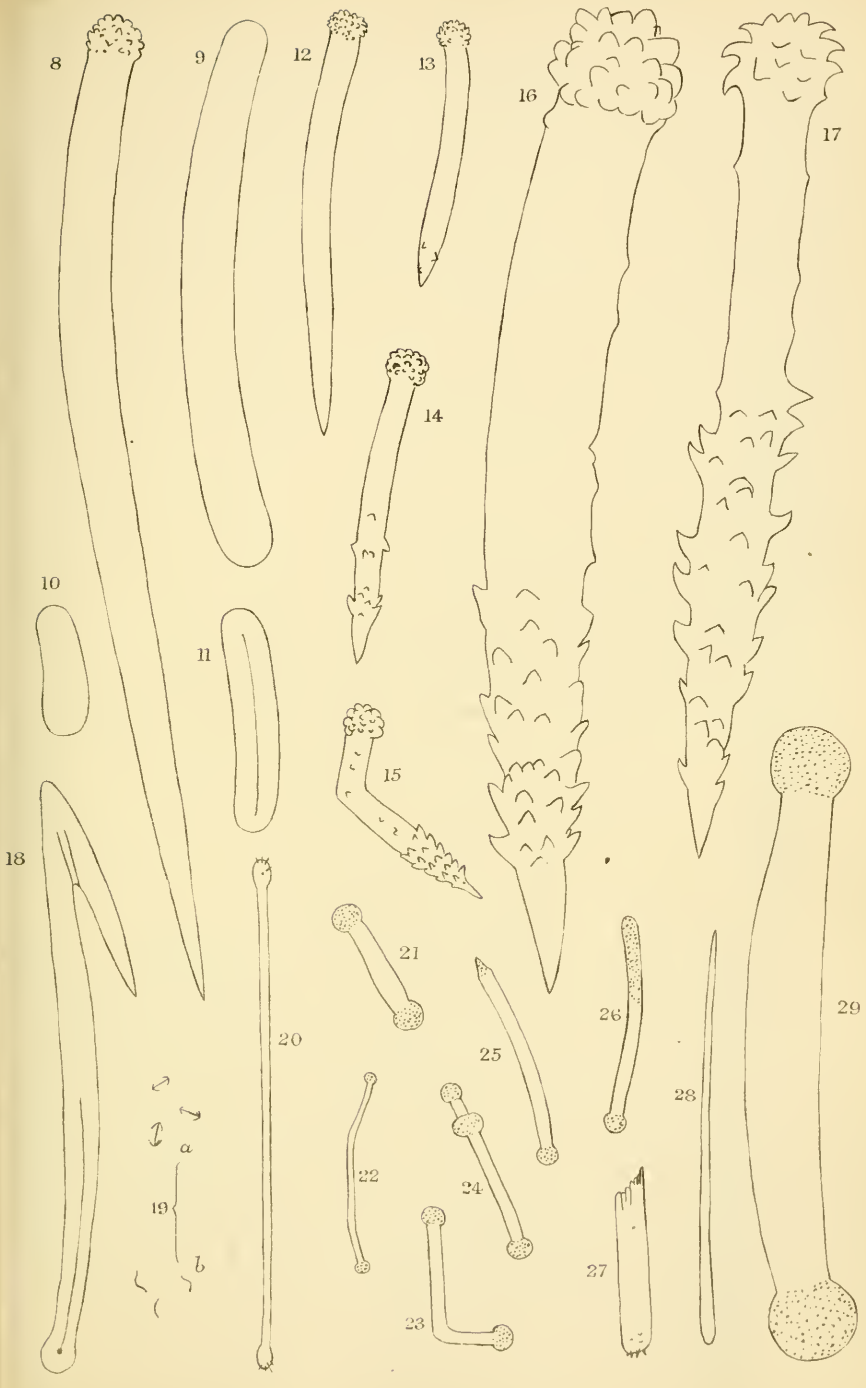

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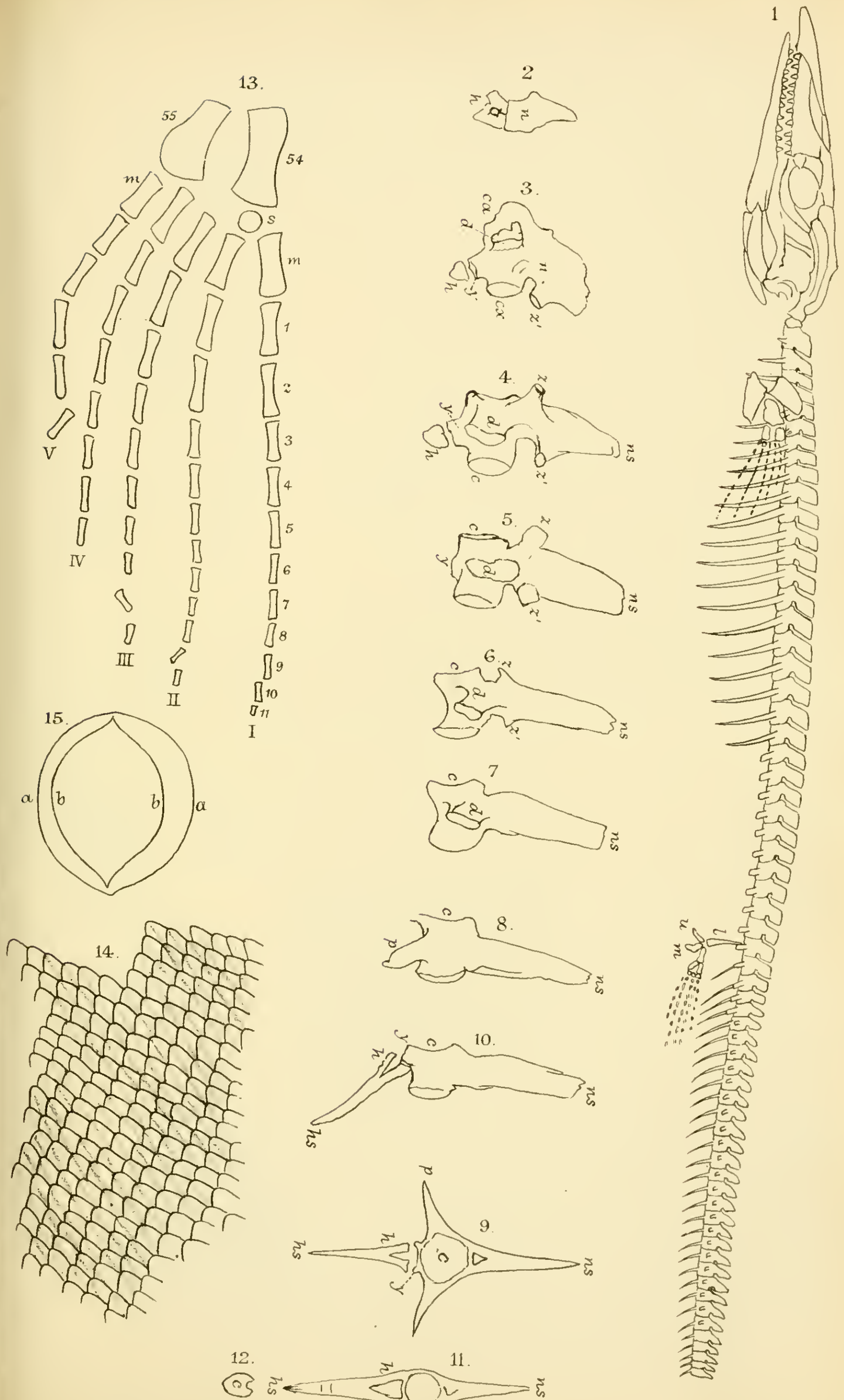

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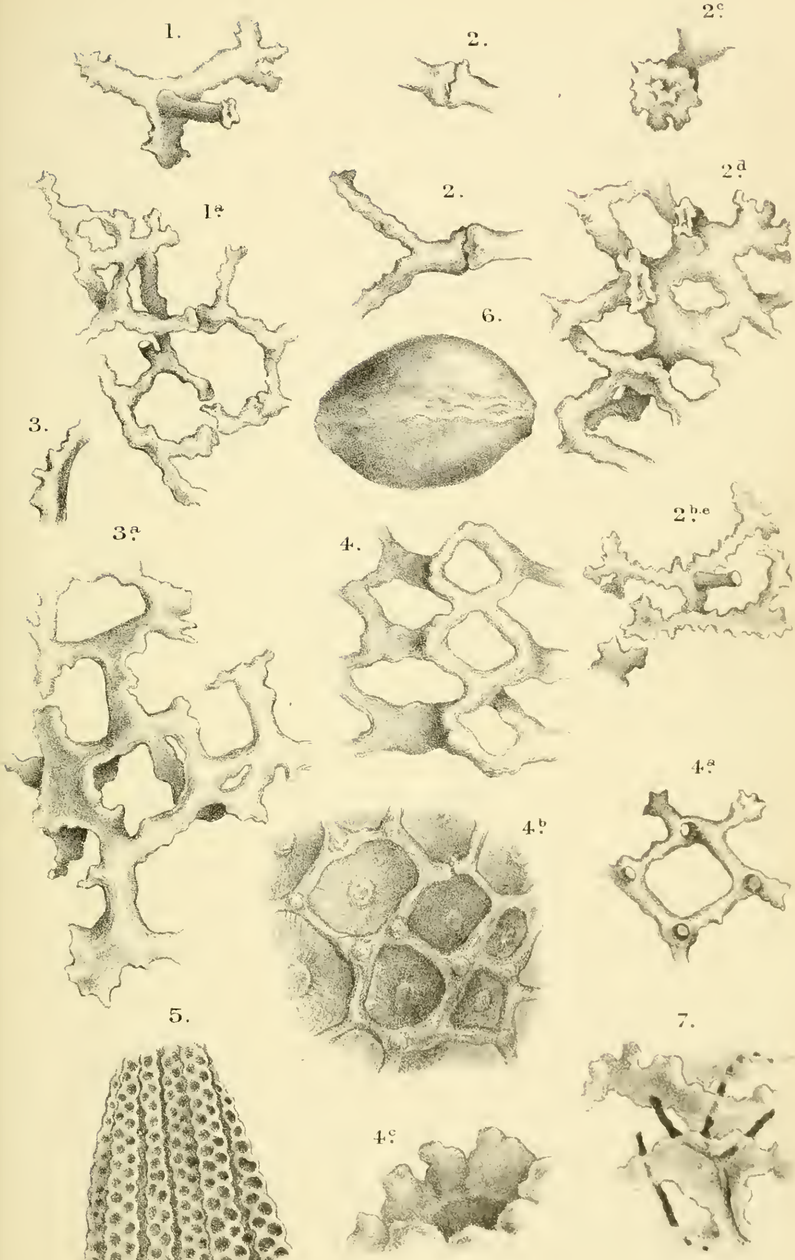

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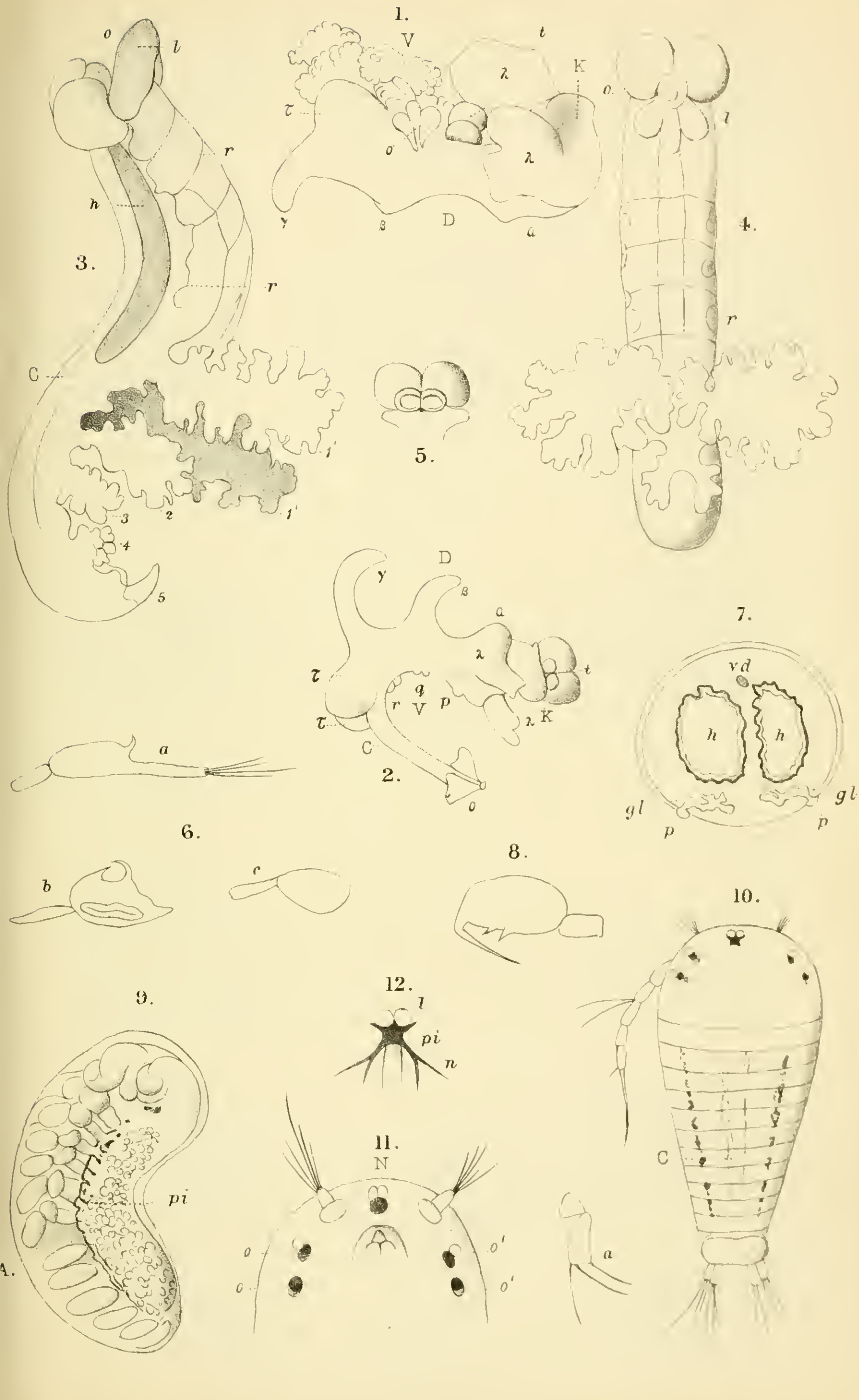
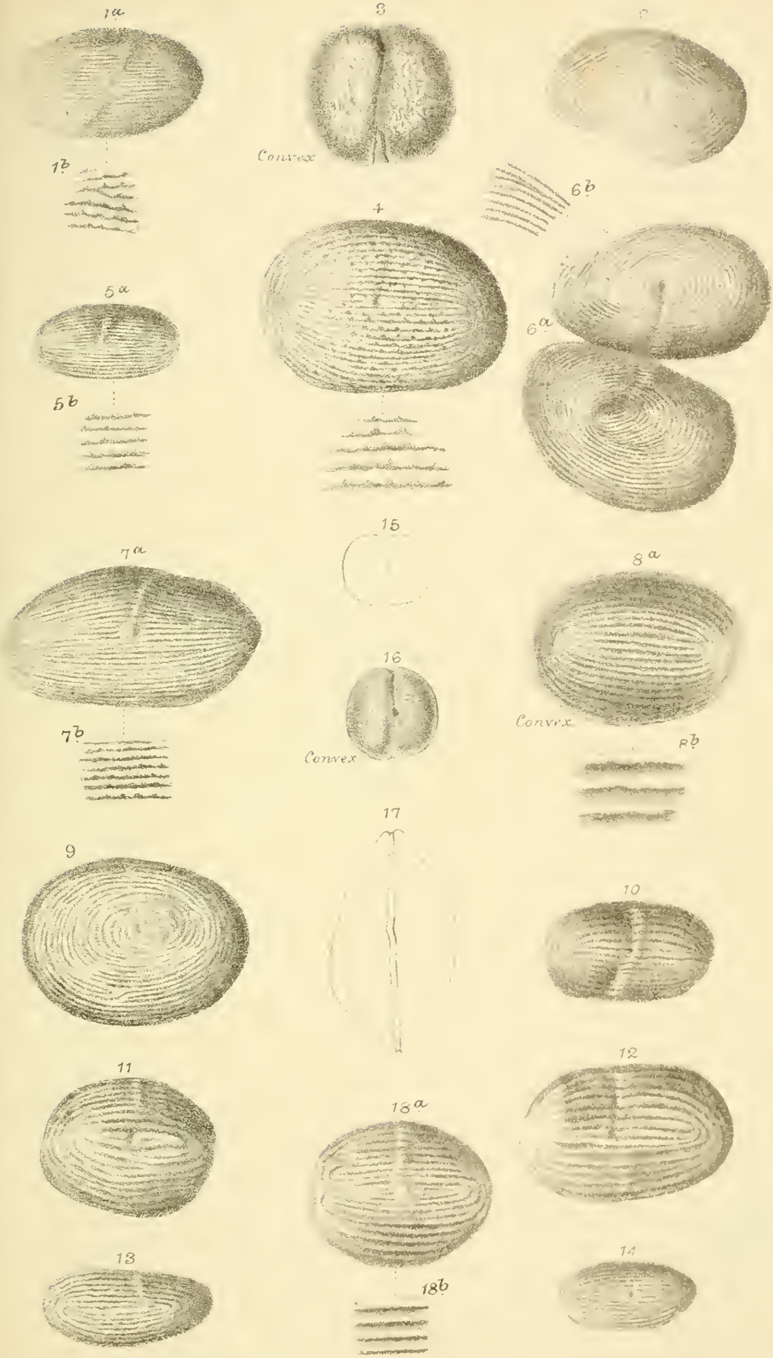


ENTONISCUS CAVOLINII & E. MONIEZII (A. Giard)

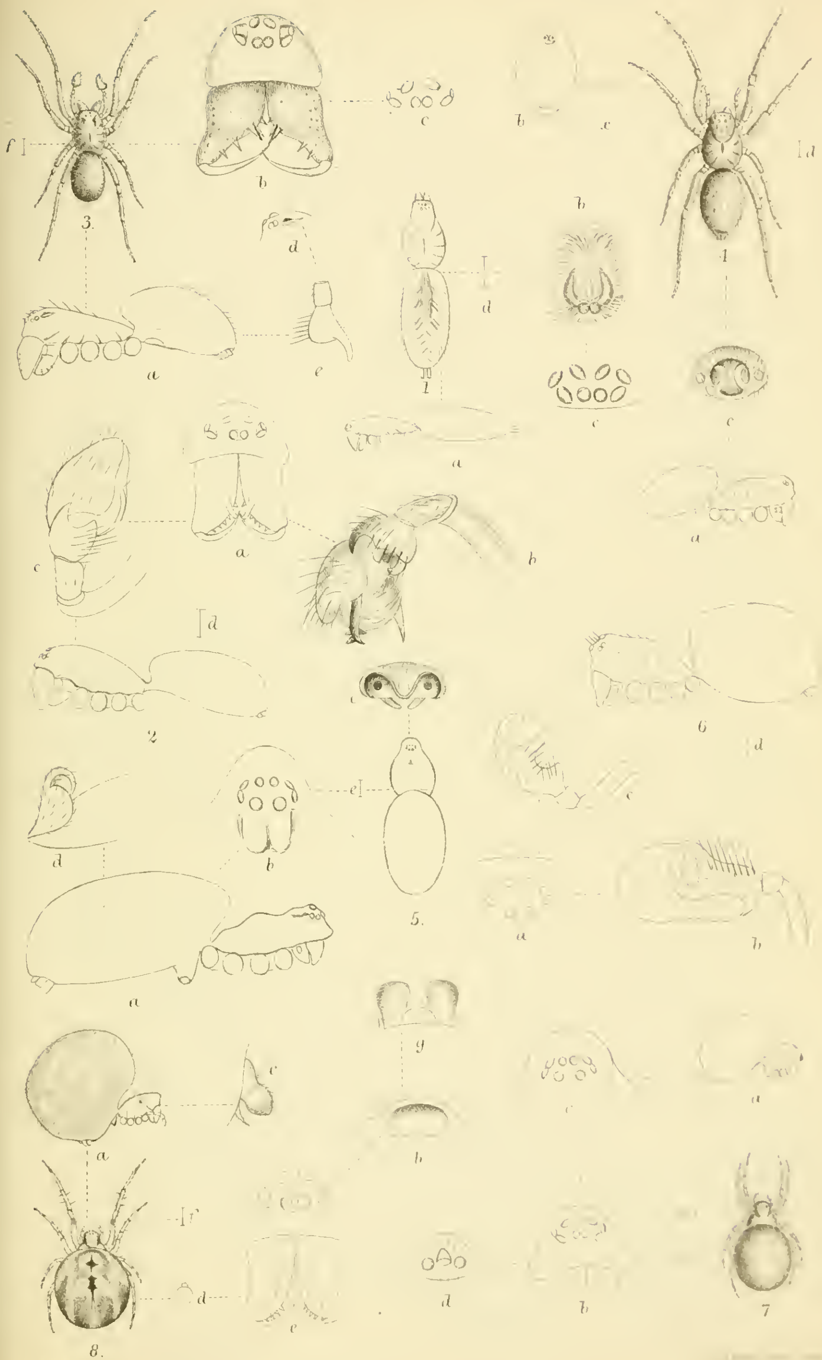
Mintern Bros lith.



G.W. & A.S. Foord del. et lith.

West Newman & Co. imp.

Devonian Entomides.

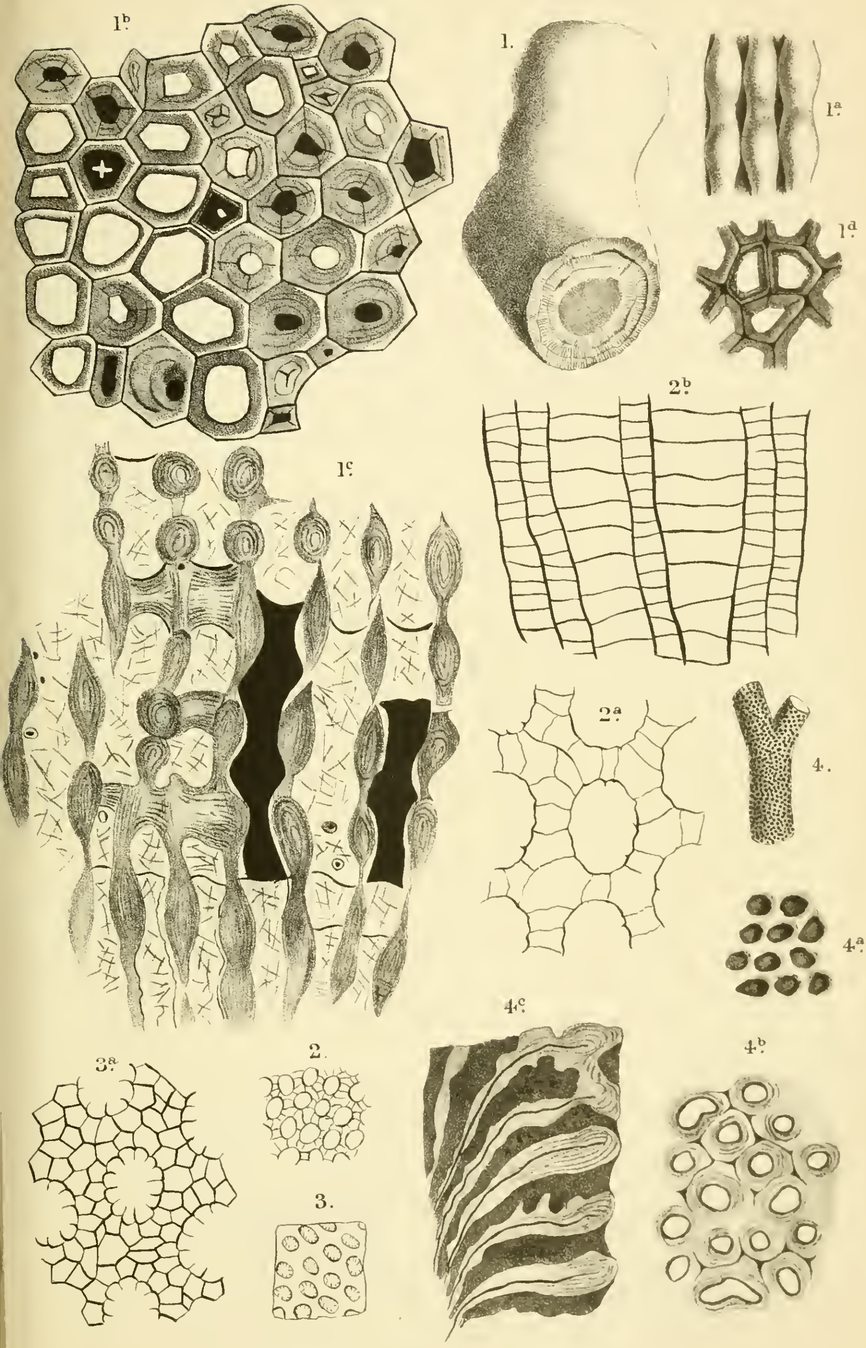


O. P. Cambridge del. E. Carter lith.

Mintern lith.

Mintern Bros imp

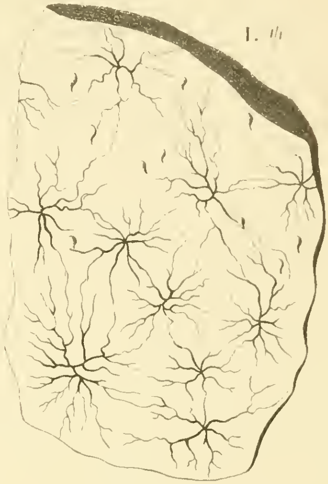
CHAMÆLEON MINOR.



R. Mintern lith.

Mintern Bros imp.

1. 1/1



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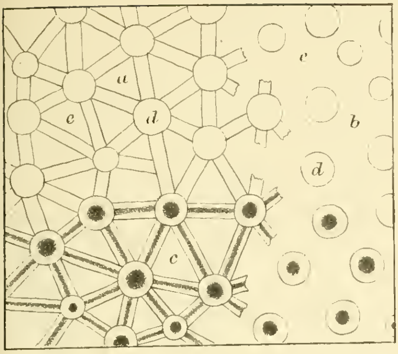

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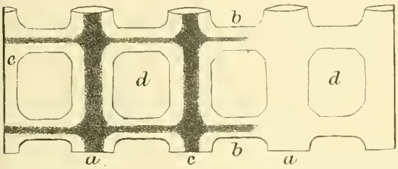

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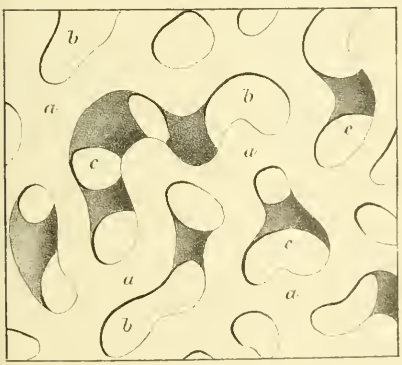

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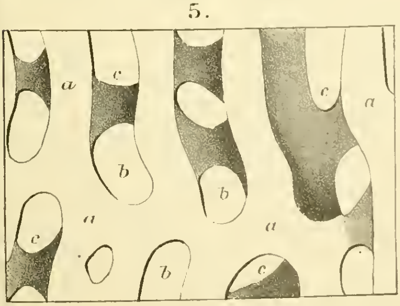
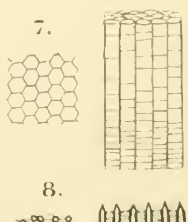


6. 5/1

7.

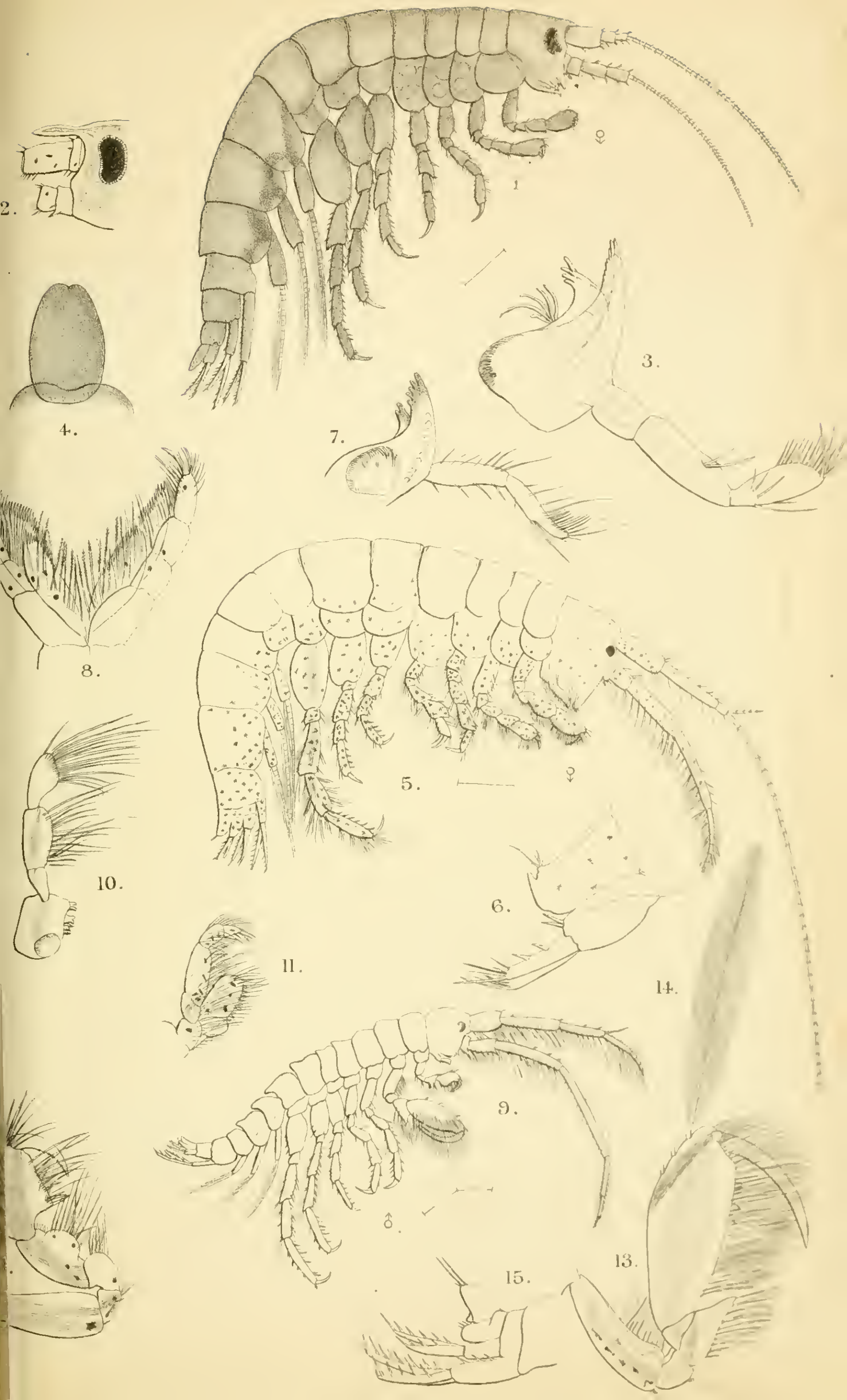
a  b

8.

a  b

H.I.C del.

Mintern Bros imp.


1
2.
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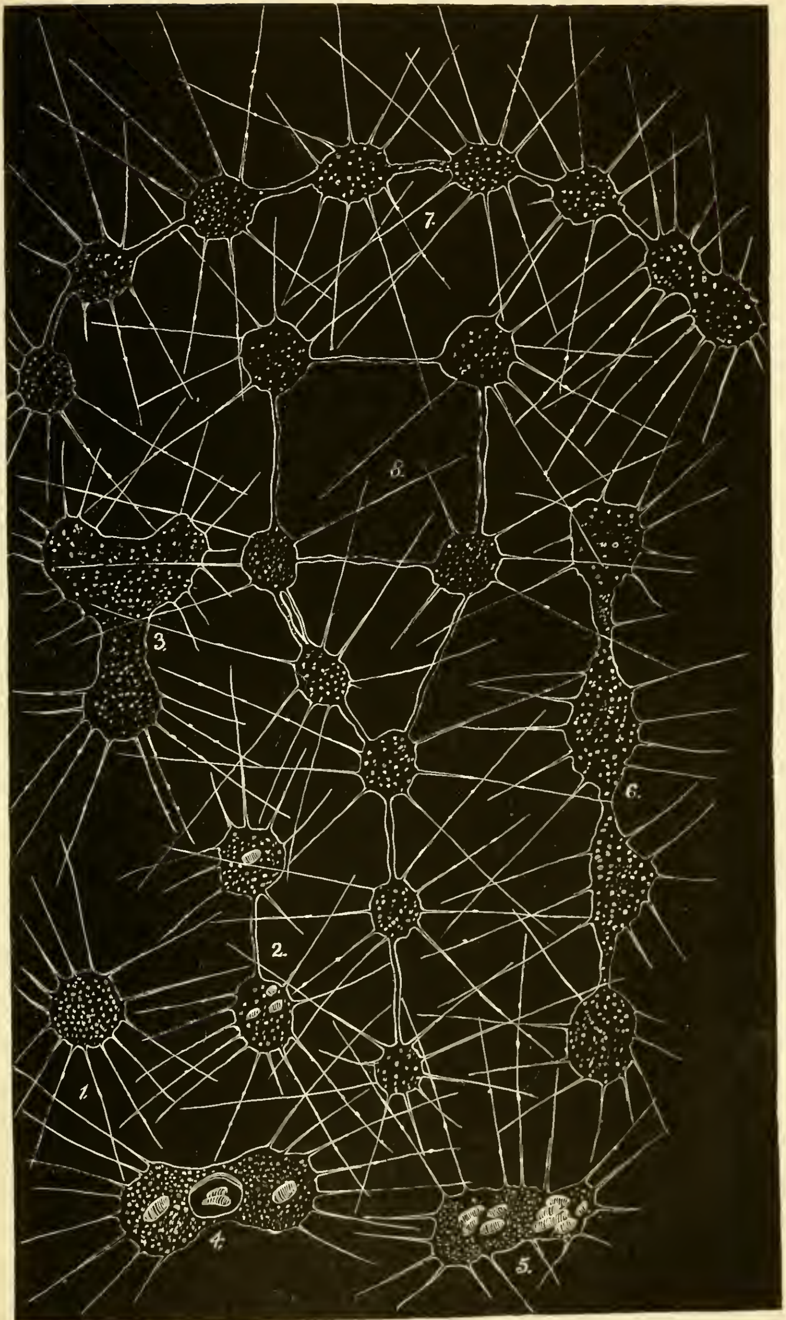


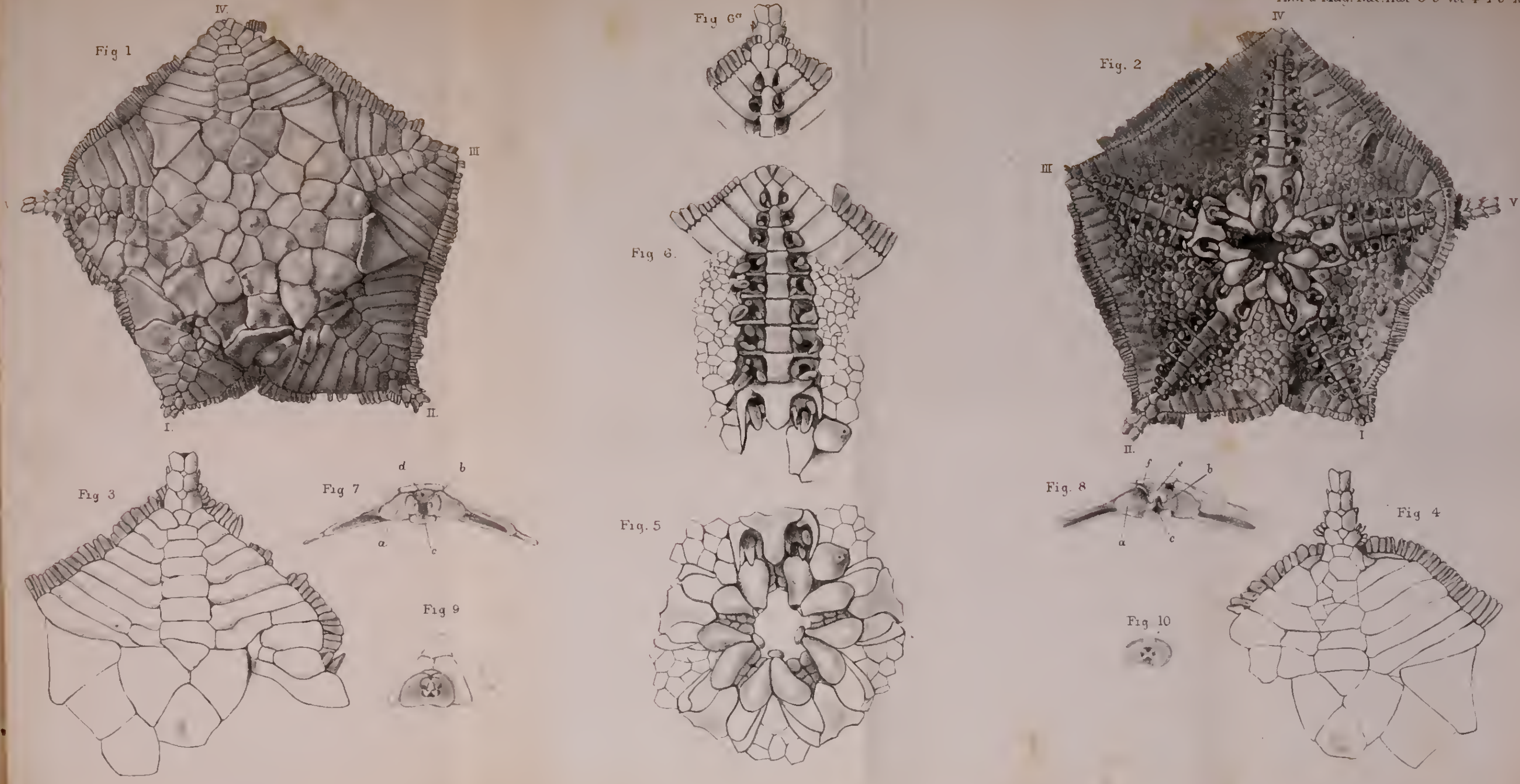
Mintern Bros imp

Mintern Bros. lith.

V.

.Percy Sladen

laden.



Sladen del. A.S. Foord lith.

ASTROPHIURA PERMIRA Sladen

Mintern Bros imp