THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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

CONDUCTED BY

ALBERT C. L. G. GÜNTHER, M.A., M.D., Ph.D., F.R.S.,
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WILLIAM CARRUTHERS, F.R.S., F.L.S., F.G.S.,
AND
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1881.

"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
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No. XLIII.

JULY 1881.

CONDUCTED BY

ALBERT C. L. G. GÜNTHER, M.A., M.D., PH.D., F.R.S.,
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BEING A CONTINUATION OF THE "ANNALS" COMBINED WITH MESSRS. LOUDON AND CHARLESWORTH'S "MAGAZINE OF NATURAL HISTORY."

WITH THREE PLATES.

Illustrative of the Rev. T. Hincks's Contributions towards a General History of the Marine Polyzoa.

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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. 43. JULY 1881.

I.—*Contributions towards a General History of the Marine Polyzoa.* By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Continued from vol. vii. p. 161.]

[Plates I.–IV.]

VI. POLYZOA FROM BASS'S STRAITS.

THE present paper will be devoted chiefly to a report on the new forms which occur in the dredgings obtained by Capt. W. H. Cawne Warren in Bass's Straits, and presented by him to the Liverpool Free Museum*.

The whole collection, which we owe to Capt. Warren's intelligent use of opportunities which are commonly wasted, is a very interesting one; and he has the merit of having made an important addition to our knowledge of the fauna of the Australian seas.

The material submitted to me for examination is compa-

* A list of the species detected in this very interesting collection, including a diagnosis of such as appear to be new, has been presented to the Liverpool Philosophical and Literary Society, and will be published in its 'Transactions.' The type specimens are deposited in the Liverpool Free Museum.

ratively small in amount; but it has yielded no less than ninety species, of which twenty-three appear to be undescribed. I say *appear* to be undescribed; for I confess that in several cases I have had the greatest difficulty in making out the forms intended by previous writers; and in the interest of all students I venture to protest against meagre diagnoses without figures as a serious injury to science.

The greatest depth from which dredgings were obtained seems to have been 40 fathoms: a large proportion of the species were taken in the neighbourhood of Curtis Island.

Of the ninety species included in the collection, twenty-two (or about a quarter) are European forms and occur on our own coasts. They are as follows:—

Eucratea chelata, *Linn.*
Cellaria fistulosa, *Linn.*, var.
Membranipora lineata, *Linn.*
Micropora coriacea, *Esper*, var.
Cribrilina radiata, *Moll.*
Microporella ciliata, *Pall.*, vars.
—— Malusii, *Aud.*
Schizoporella Cecilii, *Aud.*
—— biaperta, *Michelin.*
Hippothoa divaricata, *Lamx.*
—— distans, *MacGill.* (=H. flagellum).
Rhynchopora bispinosa, *Johnst.*
Porella concinna, *Busk.*
Smittia Landsborovii, *Johnst.*, var.
—— reticulata, *J. MacGill.*, and var.
—— trispinosa, *Johnst.*
Stomatopora Johnstoni (?), *Heller.*
—— dilatans (?), *Johnst.*
Idmonea atlantica, *E. Forbes.*
Diastopora suborbicularis, *Hincks.*
—— patina, *Lamk.*
Lichenopora hispida, *Fleming.*

The most interesting special points determined by means of Capt. Warren's collection are undoubtedly the structural peculiarities of *Membranipora radicifera*, n. sp., and *Cribrilina ferox*, MacGill., which are noticed in the account of those species.

Suborder Cheilostomata.

Family **Cellulariidæ.**

Caberea, Lamouroux.

Caberea grandis, n. sp.
(Pl. III. figs. 4, 4 *a*, 4 *b*.)

Zoarium dichotomously branched. *Zoœcia* in from three to six rows, subquadrate; aperture subelliptical, sunk, the inner surface of the cell-wall minutely roughened; two spines on the outer margin above, and one on the inner; operculum with a very broad peduncle, entire, pretty regularly oval, with a loop-like marking across the centre; on the outer edge of the marginal cells, a little below the vibraculum, a small sessile *avicularium*, elongate, tapering off to a point below, the upper extremity occupied by a triangular mandible; below each of the inner cells two small raised *avicularia*, with pointed mandible directed downwards*; occasionally gigantic avicularia resembling those on the marginal cells (except in size) distributed over the zoarium. *Vibracular grooves* extending to the very base of the organ; seta of great length and serrate. *Oœcium* immersed, smooth; front flattened, surrounded by a raised border.

Loc. Off Curtis Island.

In some cases the large avicularia, of the same type as those on the marginal cells, scattered amongst the zoœcia are a striking character; but they are very commonly wanting. The vibracular seta in this species is of remarkable length.

Caberea rudis, Busk, which was originally described from Bass's-Straits specimens, also occurs in Capt. Warren's collection.

Family **Membraniporidæ.**

Membranipora, De Blainville.

Membranipora pyrula, n. sp.
(Pl. I. fig. 2.)

Membranipora lineata, MacGillivray, Prodr. Zoology of Victoria, Polyzoa, decade 3, p. 34, pl. xxvi. fig. 3.

Zoœcia pyriform, quincuncial, hyaline, silvery; area elongate-oval, occupying three fourths of the length, wholly covered in by membrane, surrounded by a thickened border, from which spring on each side four broad flattened spines with an expanded base, which bend over the area and meet in the centre; a single spine at the bottom, or (sometimes) two or three; on each side of the semicircular orifice an erect spine; the portion of the cell below the area smooth and glassy, the base subtruncate or (sometimes) pointed. Large, elongate, subspatulate *avicularia*, with dark-coloured mandible, distributed amongst the zoœcia, occupying a distinct area and replacing a cell. *Oœcia* somewhat elongate, smooth, with a central keel running from the margin to the summit, and on each side of it, close to the margin, a fossa.

Loc. Bass's Straits, very common.

This handsome species is undoubtedly identical with the *M. lineata* of MacGillivray's work on the Victorian Polyzoa; but it has no claim whatever to the Linnean name.

* Except when the oœcium is present, in which case it points upwards.

Membranipora inarmata, n. sp.
(Pl. IV. fig. 4.)

Zoœcia ovate, placed closely together in lines, alternate (quincuncially disposed); aperture occupying the whole of the front, with membranous covering; margins raised, thin, smooth, bearing on each side from four to six tall, straight, silvery, pointed spines, which are inclined inwards towards the centre; at the top a single erect spine on each side. *Avicularia* none. *Oœcium* rounded, very shallow, just covering the extremity of the cell, smooth, silvery, often projecting into a point in front, with a broad calcareous band stretching over it.

Loc. Bass's Straits, on shell.

In this species the acutely-pointed spines do not bend abruptly over the cell, but incline inwards slightly towards the centre, the tips almost meeting. The cells are very regularly disposed in lines and are placed close together; those in neighbouring rows alternate, so that the arrangement is quincuncial. The band across the oœcium is formed by the margin of the cell above it. Avicularia seem to be totally wanting. There is nothing very distinctive in this form; but I cannot identify it with any described species.

Membranipora vitrea, n. sp.
(Pl. I. fig. 1.)

Zoœcia regularly oval, very shallow; area occupying the whole front, and closed in entirely by membrane; margin thin, smooth; two rather stout spines on each side at the top. *Oœcium* smooth, glassy, broader than high, rather flattened, with a raised triangular figure in front, from the apex of which a rib passes off to the back. *Zoarium* forming a delicate network of very fine glassy material.

Loc. Off Curtis Island.

The cells are remarkable for their extreme regularity of form.

Membranipora punctigera, n. sp.
(Pl. III. fig. 3.)

Zoœcia elongate-ovate, commonly running to a point below; aperture ovate or elliptical, with a membranous covering, occupying more than three fourths of the front, the remainder being filled in by a thin minutely-punctate lamina, which is continued up the sides as a narrow edging; margin raised, thin, smooth; at the bottom of most of the cells an *avicularium*, slightly raised, with an acute mandible directed upwards.

Oœcium rounded, smooth and silvery, somewhat compressed, on the front an area inclosed by a raised line, which is minutely pitted over.

Loc. Off Curtis Island, on *Retepora* &c.

Membranipora radicifera, n. sp.
(Pl. II. figs. 6, 6 *a*, 6 *b*.)

Zoœcia very large, quincuncial, ovate, attached by means of numerous slender radical tubes given off from the dorsal surface; aperture occupying the whole front, with a membranous covering; margin rather thin and smooth; two short and stout spines at the top of the cell, and a little below on one side a single forked spine; opposite to it a very large sessile avicularium, placed on the margin and occupying a great proportion of the side, somewhat turned over towards the area, with a rather slender pointed mandible, directed upwards, the beak hooked at the extremity; occasionally an avicularium on each side of the zoœcium. *Oœcium* (?).

Loc. Bass's Straits, spreading over soft mud.

This is the most interesting form which occurs in the Warren collection. It is, I believe, the only known *Membranipora* in which attachment is effected by means of tubular fibres emitted from the dorsal surface of the zoœcia. In other cases the members of this genus adhere directly by the base of the zoarium, which is closely soldered to the substance on which the polyzoon grows. But in *M. radicifera* each cell gives off a cluster of very long slender tubes, so that the inferior surface of the zoarium is completely villous (Pl. II. fig. 6 *b*). This structural modification points of course to some peculiarity of habitat; and accordingly we find that the Bass's-Straits specimens had evidently been spreading over a soft mud filled with small particles of shell, stone, &c., into which the long rootlets had penetrated, thus holding the polyzoon firmly to its place. Whether the structure is constant in the species as it now exists, or whether it is an exceptional adaptation to peculiar circumstances, I am not in a position to say. It exists in all the specimens I have examined; but they were all subject to the same conditions.

We have instances of remarkable plasticity in the radical appendages of the Cellulariidæ; but in this case the very existence of a radical appendage is an anomaly, attachment being effected in this tribe, as I have said, by simple adhesion.

Another structural peculiarity occurs in this species which deserves notice. The cells are not united in the usual way; they are partially disjunct (Pl. II. fig. 6 *a*). Each one is connected with its neighbours by six stout but very short processes, which originate one at each extremity of the cell and two on each side. These six connecting-bands are separated by as many rather deep depressions or hollows, which do not, however, pass through the zoarium. The disconnection of the cells therefore is only partial; but we have in this structure a most interesting transition-form between the solid and compact zoarium and the disjunct and retiform condition, which distinguishes the genus *Diachoris*. The dorsal surface of the zoœcium in *M. radicifera* is decidedly convex, and always bears a number of small raised tubular processes, from which the radical tubes originate. The latter are very slender and often of great length.

The avicularium of this species is of a very interesting type. Though perfectly sessile and fixed, it is to a large extent of the bird's-head form, and represents a developmental stage which is not far distant from the highest or articulated grade.

In *M. Carteri* (see 'Annals' for July 1880, pl. xi. fig. 8), which has a movable avicularium, we have a link between *Membranipora* and *Bugula*; through the present species the former genus is connected with *Diachoris*, which has the closest affinity with *Bugula*. We seem here to catch a glimpse of the lines along which the evolution of the Bicellarian forms may have proceeded.

Membranipora inornata, n. sp.
(Pl. IV. fig. 5.)

Zoœcia quincuncial, shallow, obscurely six-sided, often rounded at the top and bottom; margins thin, smooth; aperture occupying the whole of the front, with a membranous covering, which lies on a level with the rim of the cell; orifice placed at the very top of the aperture in a kind of recess in the margin, much broader than high (almost transversely elliptical), the margin rising a little above it, and very slightly hollowed out to receive it. *Oœcium* (?). *Zoarium* flat, depressed, of a brownish colour.

Loc. Bass's Straits, on shell.

This species bears a very close resemblance in many points to *M. hexagona*, Busk; but a comparison of it with a British specimen of the latter (for which I am indebted to Mr. Busk's kindness) shows them to be distinct. The cells of *M. inornata* are much larger than those of *M. hexagona*, and much less regularly hexagonal; the orifice is much larger and of a different shape, that of the British species being small, almost semicircular, and placed at some little distance from the top.

In the present form the membranous wall appears to be of stouter material, and the margins of the cells are more distinct; the zoarium is always of a brownish colour. A figure of *M. hexagona* is given for comparison with the present form (Pl. IV. fig. 6).

Family **Microporidæ.**

MICROPORA, Gray.

Micropora coriacea, Esper, var.

The variety without the marginal knobs, which I have figured in a previous paper ('Annals,' November 1880, pl. xvi. fig. 6), occurs amongst Capt. Warren's dredgings. The avicularia, which are sparingly developed on British specimens of this species, are very abundant on those from Australia.

STEGANOPORELLA, Smitt.

Steganoporella magnilabris, Busk.

This species, which is commonly found incrusting, forms in Bass's Straits erect, bilaminate, foliaceous expansions of considerable size; it was obtained by Pourtales in a similar condition off the coast of Florida. It seems to be very variable in its mode of growth, and might pass in turn for a *Lepralia*, *Eschara*, and *Siphonella*, under the older systems.

Family **Cribrilinidæ.**

CRIBRILINA, Gray.

Cribrilina ferox, MacGillivray.

I have some doubt whether this curious species should be referred to the genus *Cribrilina*. The structure of the cell-wall seems to be peculiar, and may possibly afford a basis for a new generic group; but my specimens do not yield the material for a satisfactory study of the development of the zoœcium.

It is a point of much interest (not noted in MacGillivray's description) that this species exhibits the remarkable peculiarities which I have described as occurring in *Membranipora radicifera*.

The cells are connected as in the latter form; and the zoarium is attached by means of radical tubes originating from the dorsal surface. The specimens which occur are growing upon sponge, the soft substance of which is penetrated to some depth by a multitude of the slender rootlets. Whether the species is ever found on hard bodies, attached in the usual way, I do not know. All the specimens which I have examined are furnished with the radical appendages; and taking into account the convexity of the dorsal surface, I should have been inclined to suppose that this is the normal condition, and that in *M. radicifera* and *Cribrilina ferox* we have forms specially modified for life on soft or porous substances. But as MacGillivray states that the species is found incrusting Algæ, the question whether the radical appendages are provisional or permanent structures can only be settled after further investigation*.

Cribrilina tubulifera, n. sp.
(Pl. I. fig. 7.)

Zoœcia oval, white, the front occupied by a flattened area of about the width of the orifice, which is surrounded (except above) by a row of erect tubular processes (about fourteen) open at the top; the inclosed space crossed by shallow depressions or furrows, in each of which are situated four rather large pores; numerous minute slightly raised foramina irregularly distributed; outside the line of tubules the cell-wall, which descends abruptly, is broken up into a number of lobate processes separated by narrow elongate spaces; orifice arched above, lower margin straight, peristome not raised, three spines above, two of which are usually very slightly divided at the top. *Oœcium* (?).

Two small colonies occur on shell.

Cribrilina speciosa, n. sp.
(Pl. I. fig. 8.)

Zoarium of a brownish colour. *Zoœcia* large, usually elongate-ovate (sometimes shorter), quincuncial, distinct, not very convex, carinate, a large proportion of the front occupied by an oval area traversed down the centre by a prominent keel, from which ridges (7–12) pass to the border, the furrows between them not punctured; area surrounded by a narrow margin of smooth cell-wall; orifice suborbicular, rather contracted below; no spines or avicularia. *Oœcium* large and rounded, smooth, dense, whitish, slightly flattened in front, and above the flat space rising into a knob, from which a shallow sigmoid fissure descends on each side.

* I have a specimen spreading over a tough fibrous substance (? stem of weed) into which the radical fibres (which are present in great abundance) have penetrated, binding the polyzoon closely and firmly to the surface.

Loc. Off Curtis Island, on shell, forming a large spreading patch.

This handsome species belongs to the same group as *C. figularis.*

Cribrilina monoceros ?, MacGillivray.
(Pl. III. fig. 6.)

Zoœcia subcylindrical or ovate, flattish, separated by a smooth raised line, highly calcified and confluent in older states; the whole of the front surface pierced by numerous holes of various shapes and sizes, some of them large; orifice well arched above, lower margin straight, with a strong central mucro, on the front of which is a small pointed *avicularium*, the mandible directed upwards; immediately above the orifice two or three small pointed avicularia; four oral spines, two on the upper margin, tall, slender, forked at the extremity, and two (placed one on each side) just within the peristome, immediately above the lower margin, articulated, tall and very stout, forked; frequently great numbers of *avicularia* of various forms distributed over the zoarium. *Oœcium* rounded, subimmersed, smooth, often with a thickened rib round the opening, and bearing usually several small avicularia, closed by a large, dark-coloured operculum.

Loc. Bass's Straits, very common on shells, *Reteporæ*, &c.

I refer this form doubtfully to the *Lepralia monoceros* of MacGillivray. If the two are indeed identical, his brief description must have been founded on imperfect specimens; for it omits some important characters, such as the avicularium on the mucro and the forked spines.

The species varies much with age, and in its older states presents a flat uniform surface (the boundaries of the cells being obliterated) completely covered with large perforations. When young the surface is bright and somewhat shining. There is sometimes only one of the large articulated spines *. In certain states there is a remarkable profusion of avicularia of various forms: some, very large, elongate, raised and placed on a distinct area, occur chiefly on the margin of the colony (Pl. III. fig. 6 *a*); others of a smaller size and sessile are scattered abundantly over the cells, whilst occasionally a very different kind is present in great numbers, which is erect, and rises considerably above the surface, rounded on one side and having on the other a triangular mandible, directed straight upwards. I have also met with a spatulate form.

* MacGillivray's description, "a large thick vibraculum or spine *below the mouth* on one side" does not apply to this appendage, which is placed within the peristome.

Remarkable as the profusion and variety of these appendages are in many cases, specimens frequently occur in which only the oral avicularia are present.

Family **Microporellidæ**.

Microporella, Hincks.

Microporella (*Eschara*) *mucronata*, MacGillivray.

This species is very common amongst the dredgings, sometimes forming large erect and branching zoaria, sometimes creeping on shells, in which state it bears a general resemblance to *M. violacea*. In all cases it originates in a crust of larger or smaller extent, from the middle of which the erect stems rise.

I have little doubt that this form is identical with the *Eschara lichenoides* of Busk, though not with Milne-Edwards's species of that name *. Busk describes two avicularia, situated one on each side immediately below the mouth, whilst MacGillivray only notes one placed centrally; but the fact is that both conditions occur on one and the same specimen: the younger cells have very frequently the pair of avicularia; in the older portions of the colony there is more commonly one. The cluster of stellate pores is the distinctive character. If I am right in supposing that M.-Edwards's *E. lichenoides* is a different form, MacGillivray's name will hold its place, unless, indeed, the older *E. coscinophora* of Reuss should prove to be the same thing.

In older states, as calcification advances, the front of the cell is occupied in great part by a large oblong depression, within which the orifice and the pores, and not unfrequently the avicularia, are included.

I have referred to the resemblance between the cell of this species and that of *M. violacea*: their leading features, which are sufficiently marked, are identical; and it is impossible not to recognize a close relationship between them; yet in the older systems these kindred forms are relegated to distinct *families*, simply because, though they both commence life as incrusting species, one of them grows upward when adult.

Haploporella, n. gen.

Gen. char.—*Zoœcia* destitute of a membranous area or aperture, and of raised margins; orifice arched above, with the lower lip entire; no special pores.

* Kirchenpauer has pointed out that Busk's species is quite distinct from that of Milne-Edwards.

This group is formed for species with a Microporellidan orifice, but destitute of the median pore, which is so striking a character of the genus *Microporella*. It is difficult to believe that this structure has no special significance; it is at least a much better clue to affinity than mode of growth. If this be so, the Microporellidan forms from which it is absent may well be set apart as a distinct group*.

Haploporella nodulifera, n. sp.
(Pl. I. fig. 4.)

Zoœcia massive and thick-walled, ovate, irregularly disposed, of a brownish colour; a depressed area extending downwards from a little below the orifice, and occupying a large proportion of the front, the cell-wall elevated around it, surface minutely roughened and punctured; orifice arched above, inferior margin straight; peristome slightly raised, three spines on the upper edge, with a black base; at each side of the orifice, on a level with the lower margin, a prominent nodule, often of a rich brown colour and polished. *Oœcium* (?).

A single colony only has occurred on shell.

Haploporella lepida, n. sp.
(Pl. II. fig. 2.)

Zoœcia hexagonal, very regular in shape, quincuncial, separated by somewhat shallow sutures and raised lines, slightly convex; surface minutely granular, shining, of a delicate greyish colour; orifice arched above, much broader than high, lower margin straight, rather raised and everted; peristome thin; a rather large circular perforation on each side a little below the orifice, and commonly a few others, usually smaller, round the edge of the cell. Occasionally an *avicularium*, placed on a distinct area, at the bottom of a cell, with an elongate mandible directed upwards. *Oœcium* globose, prominent, granular.

Loc. Off Curtis Island, on shells.

A very pretty species, singularly regular and neat in appearance.

* Smitt's genus *Escharipora* (as far as I understand it) is founded for Microporellidan forms with more than a single pore. But the physiological significance is the same, whether there be one or many, and the distinction seems to be unimportant; so also are differences in the shape of the pore.

Family **Porinidæ**.

Porina, D'Orbigny.

Porina (*Eschara*) *gracilis*, Lamouroux.
(Pl. III. fig. 5.)

Zoarium erect, irregularly branched, somewhat compressed. *Zoœcia* elongate, confluent, quincuncially disposed, the wall rising towards the orifice; surface reticulato-punctate; orifice, in young cells, arched above, the lower margin slightly curved inward; in adult cells suborbicular, moderately raised, the peristome thickened and bearing several (sometimes as many as six) round *avicularia*; at a very short distance below the orifice an elongate pore (which frequently becomes round as calcification proceeds). Small circular *avicularia* often distributed irregularly over the cells. *Oœcium* immersed.

Loc. Curtis Island, not uncommon.

Busk does not notice the oral avicularia; the two mamillary projections mentioned by him are avicularian. MacGillivray describes the pore as round; it is *primarily* elongate.

Family **Myriozoidæ** (part.), Smitt.

Schizoporella, Hincks.

Schizoporella biaperta, Michelin (?=*Lepralia megasoma*, MacGillivray).

This species occurs in two conditions, incrusting and with an erect branching zoarium, often of very considerable size, the branches *cylindrical*. I can find no characters in the cell of the latter to distinguish it from that of the more usual crustaceous form. Mr. Waters records an Escharine variety from the Sicilian Pliocene, which is erect and *foliaceous*; so that this widely distributed form exhibits the most striking differences in its habit of growth.

Schizoporella triangula, n. sp.
(Pl. II. figs. 4, 4 *a*.)

Zoœcia subquadrangular, depressed, arranged in linear series, bordered by a raised line; surface reticulato-punctate, or thickly covered with nodules; orifice subtriangular, margin not raised, a sinus below marked off by two lateral dentate processes; immediately below the orifice an elongate *avicularium*, with pointed mandible directed straight downwards, either immersed or with the beak standing out prominently.

Oœcium very large, covering almost the whole of the cell above it, rounded, often traversed by raised white lines, with one or more projecting pointed processes on each side in front, overhanging the opening, and opposite to them on the lower margin two (sometimes more) strong conical teeth; surface covered with large nodules and punctured; orifice of the ovicelligerous cell very large, elongated transversely, with a slightly sinuated lower margin.

Loc. Bass's Straits, 40 fms., common.

The zoœcia are often very irregularly disposed, turned in all ways, and variable in shape. They are sometimes much more convex than is usual, and ovate, losing much of the normal appearance. These irregularities occur amongst the secondary cells, which are developed upon the primitive layer.

The typical character is very constant in the primaries. *S. triangula* belongs to the *S. linearis* group.

Schizoporella tumida, n. sp.
(Pl. I. fig. 3.)

Zoœcia ovate, disposed in linear series, which radiate in all directions from a centre, perfectly smooth, moderately convex; orifice arched above, lower margin with a rounded sinus in the centre; peristome not raised; immediately below the orifice a pouch-like swelling, bearing on the upper surface a small rounded *avicularium*; frequently an ovate rising on one side of the cell, extending from the orifice down a considerable portion of its length, bearing on its upper extremity an immersed avicularium, with pointed mandible directed downwards. *Oœcium* globose and prominent, with a smooth surface.

Loc. Bass's Straits, on shell.

This species bears some resemblance to the *S. marsupium* described by Mr. Stuart Ridley in his valuable paper on the 'Alert' collections from the Straits of Magellan and Patagonia, but is, I think, distinct. Mr. Ridley (Proc. Zool. Soc. Lond. for Jan. 4, 1881, p. 48, pl. vi. fig. 6) identifies his species with the *Lepralia marsupium* of MacGillivray; but the latter is, I believe, a *Porella* very nearly allied to *P. minuta* of our own coasts, and extremely abundant in Bass's Straits. MacGillivray's diagnosis is unfortunately brief, giving no account of the shape of the mouth; so that it is by no means easy to determine the species which he had in view. On the whole, however, it agrees better with the *Porella* so common in South-Australian waters than with any other form I know.

Schizoporella acuminata, n. sp.
(Pl. II. fig. 1.)

Zoœcia short, lozenge-shaped (somewhat irregular), flattish, quincuncially disposed, bordered by a smooth raised line; an acuminate suberect extension of the cell-wall behind the orifice, the apex or peak of which is slightly bent forward, and occupied by a smooth somewhat nodular prominence; surface thickly covered with minute punctures; orifice semicircular, with a rounded sinus on the lower margin, contracted at the opening and expanded below, rim slightly thickened; on one side, a little below the orifice, an *avicularium*, with pointed mandible directed upwards. *Oœcium* occupying the place of the acuminate extremity of the cell, large, rounded, deeply immersed, the opening the same as that of the cell, but larger than the ordinary orifice, closed by the opercular valve; surface punctate.

Loc. Off Curtis Island, a single colony incrusting another polyzoon.

A remarkable form, distinguished by the elevated peak-like upper extremity of the zoœcium.

HIPPOTHOA, Lamouroux.

Hippothoa distans, MacGillivray.

Hippothoa flagellum, Manzoni.

A species occurs very abundantly amongst the Bass's-Straits dredgings, creeping over shells &c., which is undoubtedly the *H. flagellum* of Manzoni. I believe that it is the form described by MacGillivray as *H. distans*; and if so, the latter name, as the older, must take precedence.

[To be continued.]

II.—*Description of a new Species* of Alactaga *from Mesopotamia*. By OLDFIELD THOMAS, F.Z.S., British Museum.

THE type specimens of the species here described (a male and a female) were obtained during the Euphrates expedition of 1835–37, and are now in the British Museum. They probably represent the "*Dipus jaculus*" of the list of Mammals of Arabia and Mesopotamia, given in the Appendix to Col. Chesney's account of that expedition*, being, to a superficial observer, somewhat similar to the *D. jaculus* (Pall. et auct. *nec*

* Vol. i. p. 728 (1850).

Linn.), a species for which the correct name is *Alactaga decumana*, Licht.*

Alactaga euphratica, sp. n.

Ears slightly shorter than the head, and rather narrow. Tail longer than the head and body, with a bicolor distichous tuft as in the other species. Hind feet short and slender, as compared with those of the larger *A. decumana*, and more like those of *A. acontium*, Pall.†, to which this species, though decidedly larger, seems on the whole to be most nearly allied.

Fur very long and soft; above slate-coloured for half its length, then pale fawn, the tips black. Belly white throughout. Ears thinly clothed with short fawn-coloured hairs. Fore limbs wholly white; external surface of hind limbs fawn, internal white. Tail dark yellow above and below until within about an inch of the tip, then black for half an inch, and the tip white; the longest tuft-hairs at the end of the tail about half an inch long; a white stripe, as usual, from the front of the hip to the root of the tail.

The skull, as compared with that of an unusually large specimen of *A. acontium*, is somewhat longer, though of about the same breadth. The brain-case is much more elongated, as shown by the fact that the width at the orbital constriction is barely half the length from this point to the occiput, while in *A. acontium* it is just two thirds. The anterior palatine foramina are longer and more open, the muzzle (at their centre) is decidedly broader, and the upper molar series is distinctly longer in *A. euphratica* than in *A. acontium*. The comparative measurements of the two skulls are given below.

Dimensions (in inches and tenths).

	♂.	♀.
Head and body	5·6	5·0
Tail-vertebræ	6·75	..
Hind foot, without claws	2·05	2·04
Heel to tip of fifth toe	1·25	1·28
Head	..	1·25
Ear	1·15	1·14

Measurements of the Skulls of A. euphratica *and* A. acontium.

	A. euphratica ♂.	*A. acontium* ♂.
Total length	1·15	1·10
Zygomatic breadth	..	0·85
Breadth of brain-case	0·63	0·63

* Abh. Akad. Berl. 1825, p. 154, tab. vi.
† Zoogr. Ross.-As. p. 182 (1811).

Interorbital constriction	0·32	0·37
Nasal bones	0·45	0·40
Anterior palatine foramina ..	0·23	0·20
Upper molar series	0·25	0·22
Lower jaw, from condyles to tip of incisors	0·80	0·78

This species may be readily distinguished from *A. decumana*, *annulata*, and *spiculum* by the comparative shortness of its hind feet, from *A. acontium* and its allies by the cranial characters already mentioned, and from *A. saltatrix* *, a species which I only know from the original description, wherein no measurements are given, by the fact that in that species the usual white tip to the tail is absent, the tail ending in a wholly black tuft.

III.—*Supposed new Species of Horse from Central Asia.* By M. Poliakof.

[We are indebted to Mr. E. Delmar Morgan, already well known for his having rendered the travels in Mongolia of the celebrated Russian explorer, Colonel Prejevalsky, accessible to English readers, for the following translation of the description and account by the Russian naturalist Poliakof, in the 'Izvestia,' or 'Proceedings of the Imperial Russian Geographical Society' for January last (1881, pp. 1–20, pls. i. & ii.), of a new species of horse presented by Prejevalsky to the Museum of the Imperial Academy of Sciences of St. Petersburg.]

Prejevalsky's Horse (Equus Przewalskii, *n. sp.*).

For a very long time zoologists included among the representatives of the solid-hoofed family of the Ungulate order of Mammals only one genus, the *Equus* of the present day. In 1824, the English zoologist Gray formed a subdivision of the whole group, under the new generic designation *Asinus*. He characterized the genus *Equus* as follows:—"Tail wholly covered with hair, no dorsal stripe, warts on fore and hind legs;" or "Cauda undique setosa, linea dorsali nulla, verrucis brachiorum pedumque distinctis." The genus *Asinus* he distinguished in the following way:—"Tail furnished with hair only at extremity; dorsal stripe present; warts on fore, but not on hind legs;" or "Cauda apice setosa, linea dorsali distincta ornatus, verrucis brachiorum distinctis, pedum nullis."

* *Dipus saltator*, Eversm. Bull. Soc. Nat. Mosc. xxi. p. 188, pl. i. (1848).

The only living representative of the former of these two genera was, in Gray's opinion, our domestic horse, *Equus caballus*. To the latter he referred the djiggetai (*Asinus hemionus*, Pall.), the common ass (*Asinus vulgaris*), the quagga (*Asinus quagga*, Gmel.), Burchell's ass (*Asinus Burchellii*, Gray), and, lastly, the zebra (*Asinus zebra*, Linn.). (See Gray's Revision of the Family Equidæ, in Zool. Journ. vol. i. 1825, p. 241).

In this article, I propose describing a new and existing representative of the family of undivided-hoofed mammals. It appears to be in some respects intermediate between our domestic horse and the wild ass; but a very important external distinction places it properly in the genus *Equus*, and not among the asses. This peculiarity in the new species I am about to describe consists in its having four warts or callosities, one on each front and hind leg; whilst every member of the asinine group has only two, on the inside of each fore leg, the hind legs being invariably free from them. The warts on the hind legs of the domestic horse, as well as of the species I am describing, are on the inside of the hock, a little below the joint.

From the following description, it will be evident that the new species closely resembles the domestic horse, both in shape of skull and in many other particulars, as, for instance, in the form of the hoof, absence of dorsal stripe, &c. A new wild representative indigenous to the plains and deserts of Central Asia has therefore been added to the family of Equidæ, hitherto said to consist only of one genus, a representative, moreover, hitherto untamed by man; and in order to admit this new species, the classification of solid-hoofed mammals must undergo a change. Assuming the warts to be the most important generic distinction, the genera *Equus* and *Asinus* must henceforward be distinguished as follows.

Genus i. Equus.

Verrucis brachiorum pedumque distinctis, artubus crassis; ungulis latis rotundatis; cauda undique vel in dimidio posteriore setosa.

1. *Equus caballus*, Linn.

Cauda undique setosa, juba pendula vel suberecta, capronis (*i. e.* jubæ partibus in frontem devexis [*Anglice* "forelock"]) longis; loro dorsali plerumque distincto.

2. *Equus Przewalskii*, n. sp.

Caudæ dimidio posteriore setoso; juba brevi, erecta; capronis et loro dorsali nullis.

Genus ii. Asinus.

Verrucis brachiorum distinctis, pedum nullis ; artubus gracilioribus ; ungulis contractis, subcylindraceis ; cauda apice setosa.

Without recapitulating here the various species of ass comprised in the genus, let me say that all other distinguishing marks mentioned by Gray are only of relative importance. Thus, he lays stress on the dorsal stripe, saying of the horse "linea dorsali nulla," and of the ass "linea dorsali distincta ;" whereas Isidore Geoffroy de St.-Hilaire remarked that this was of no real importance, because many horses have a streak along the back, and, on the other hand, not a few asses are without it (vide "Sur le genre Cheval et spécialement sur l'Hémione," extrait des Nouvelles Annales du Musée d'Hist. Natur. vol. iv. p. 1). He, too, observed, that the distinction "cauda apice setosa" properly only applies to the djiggetai,—the ass, and particularly the zebra, besides other striped species of the solid-hoofed animals, having tails furnished with hair so as to form a regular gradation from the tail of the horse to that of the djiggetai. The tail of my horse must be regarded as intermediate between the horse and the ass ; it is, however, so well furnished with hair at the extremity and is so bushy, thick, and bristly at the root, as to differ from most asses ; and I am inclined to attach weight to the characteristic "cauda apice setosa" as distinguishing the asinine genus from the equine. Upon the whole, therefore, I dissent from Isidore Geoffroy de St.-Hilaire, in so far as he rejects Gray's division of the solid-hoofed mammals into two genera. My horse has the mane of an ass, and resembles it further in having no forelock. Besides the above-mentioned distinguishing marks, asses differ from horses in having more slender legs and narrower hoofs. And as regards warts, these occur on the fore legs of all asses, and have the appearance of smooth hairless patches ; whilst with horses they take the shape of horny excrescences, particularly on the hocks. Taking also into consideration the skull as another distinguishing feature between the ass and the horse, although it may be only in the size of its several parts, Gray's division of the solid-hoofed animals must, I think, be upheld.

The materials I have availed myself of in comparing this new species of horse with others are :—the stuffed specimens, in the Zoological Museum of the Academy of Sciences, of Burchell's horse and zebra ; a domestic ass ; two kiangs (*Asinus kiang*) brought by Prejevalsky from Northern Tibet ; four stuffed kulans (*Asinus onager*, Pall.), two from General Poltoratzky's collection in Eastern Dzungaria, and two from the

Aralo-Caspian steppes obtained by General Perofsky; and one stuffed and two unstuffed skins of the djiggetai (*Asinus hemionus*, Pall.) from Southern Dauria or the northern confines of the Gobi steppe, from M. Radde's collection. The last-mentioned specimens are typical, having served Pallas for his description. The kulan (*Asinus onager*) was described by Pallas in his 'Zoographia Rosso-Asiatica,' p. 263, and called by him *Equus asinus β. onager*. He considered it most closely allied to the domestic ass, an opinion accepted by many other naturalists, including Gray, but one which I regard as wholly erroneous—the kulan, or *A. β. onager* of Pallas, having no external resemblance to the domestic ass, and being more readily confounded with the djiggetai, its closest congener and nearest geographical neighbour. But without ample materials I could not enter upon a complete analysis of the wild asses of Asia; suffice it therefore to say, that in the following remarks I shall refer to the djiggetai under the name of *Asinus hemionus*, and the kulan under that of *A. onager*.

In describing my new species I shall chiefly dwell on external marks, only examining the head in a general way for the sake of comparison with the domestic horse and the asses. The dentition, specially valuable in examining fossil remains of horses, has been purposely omitted, the materials for a comparative study of this branch of the subject being limited to Owen's description of the Cave of Bruniquel and its organic remains, in Phil. Trans. of Royal Soc. vol. clix. (1869), and the article on American fossil horses in the same volume. An examination of the tooth-system would be interesting also on the basis of Rütimeyer's researches ("Beiträge zur Kenntniss der fossilen Pferde," in the 'Verhandlungen der naturforschenden Gesellschaft in Basel,' vol. iii. 1863, and the continuation of this work published in the 'Abhandlungen der schweizerischen paläontologischen Gesellschaft,' vol. iii. 1875); but this important subject deserves to be considered in a separate article.

The hunting expedition sent by M. Tihonof from the post Zaisan to the sand deserts of Central Asia, in quest of wild camels, obtained another interesting animal hitherto unknown to science. This was a new species of the equine race, identical with the "Surtakeh" of the Kirghiz, if we may judge from Dr. Brehm's information, collected from the Kirghiz inhabiting the tracts where the wild camel is known to exist ('Zoologische Garten,' 1876, p. 340). One single specimen was shot by these native hunters; and its skin was preserved and sent as a gift to Prejevalsky, who happened to be then at Zaisan. He presented it to the Zoological Museum of the

Academy of Sciences, under the designation "tarpan." After the donor I have named this species of horse *Equus Przewalskii*; but, though more nearly akin to the domesticated horse than to any variety of wild ass existing in Asia, it is distinct from the "tarpan" or wild horse of travellers and explorers of the last century. Indeed the information regarding the tarpan collected by Rytchkof, Gmelin, Georgi, and Pallas is of so contradictory and confusing a nature that many zoologists have decided that the so-called wild horses, or "tarpans," were not, strictly speaking, wild, but tamed horses which had resumed their wild state on recovering their liberty (Wagner in Schreber, 'Die Säugethiere,' pt. vi. pp. 20–29, 1835). A similar opinion was expressed by M. Bogdanof at a meeting of the Society of Naturalists of St. Petersburg; and Pallas was disposed to take the same view (Reise durch versch. Prov. des Russ. Reichs, iii. p. 346) when he assumed the feral horses, or "tarpans" in Tartar-Kirghiz dialect, roaming over the steppes of the Yaik and the Don as well as on that of Baraba, to have originated from domesticated horses owned by Kirghiz, Kalmuks, or other wandering tribes, and to have become wild. In his 'Zoographia Rosso-Asiatica,' vol. i. p. 260, however, Pallas does not speak of the tarpans (*Equus equiferus*) in the same way, but merely states that there had been an intermixture, wild stallions having covered domesticated mares separated from the herd. Ecker, in a recently published work ('Das europäische Wildpferd und dessen Beziehungen zum domesticirten Pferd,' Globus xxxiv. Braunschweig, 1878), accepts the tarpan as the true typical representative of the wild horse, resembling in every particular the animal which, in his opinion, was indigenous at a period of remote antiquity in various parts of Europe, and became subject to man in prehistoric times, probably in the stone period. Ecker finds a striking resemblance between the tarpan and the wild horse of the Caves of Solutré [near Mâcon], particularly in regard to size of body, head, &c. (See also "Le Cheval sauvage de l'Europe et ses rapports avec le Cheval domestique, d'après M. Ecker," by M. Viguier, 'Revue Scientifique de la France et de l'Etranger,' no. xl. 5 Avril 1879, pp. 940–943.) Unfortunately we have no reliable information on this legendary tarpan since the end of last century, not a single traveller either in Siberia or Russia having communicated any information concerning it during the present century; and the testimony of the above-mentioned explorers is merely conjectural. In any case, the animal I have named *Equus Przewalskii* cannot be the tarpan as described by Rytchkof, Gmelin, Pallas, and others. Rytchkof describes the tarpan as equal in size to an average horse, but rounder in shape, colour dun or bluish, other shades exceptional, with larger head than the Kirghiz horse (Topography of Orenburg, pt. i. p. 290, St. Petersburg, 1762).

Gmelin remarks that the largest of the wild horses is scarcely to be compared for size with the smallest of domesticated breeds; the head is very large in proportion to the rest of the body; the ears are pointed, and either of the same size as those of the domesticated animal, or long and pendulous like those of the ass; the eyes are fiery, the mane very short and curly, the tail in some instances thick, in others scanty, and always shorter than in the domestic animal; the colour is invariably that of the mouse, with an ashy shade underneath the belly, whilst the legs, from the knee downwards, are black; the coat is long and thick, more like fur to the touch than horsehair ('Reise durch Russland in den Jahren 1768 und 1769,' vol. i. p. 44).

According to Pallas, the following was the appearance of the tarpan:—"Plerique sunt *colore* griseo-fusco vel pallido, juba, loro dorsi, caudaque fuscis, rostro albido, circa os nigricante. Sed immiscentur variorum colorum equæ a domesticis gregibus per feros admissarios abactæ vel allicitæ. *Statura* sunt minore domesticis, capite majore, pedibus procerioribus, *auriculis* paulo majoribus, apice summo falcatim subreflexis. *Frons* iis supra oculos convexior, cum vortice inter oculos; *ungulæ* contractæ, subcylindraceæ. Juba ab intervallo oculorum ad scapulas, minus prolixa, suberecta. *Vellus* hyeme hirtum, laxius in dorso subundulatum. Cauda parum prolixa." (Zoographia R.-As. i. p. 260.)

From these descriptions of the tarpan or wild horse by Gmelin and Pallas, it is evident they were unacquainted with *Equus Przewalskii*; and Rytchkof had perhaps only accidentally heard of it when he mentioned a horse of dun colour (*lutescens*). As to tarpans of blue (*cærulescens*) and other colours mentioned by Rytchkof, they were such as had probably resumed a feral state in the same way as those described by Gmelin and Pallas. If it could be proved that *Equus Przewalskii* had ever been indigenous further west, and if when crossed with the domestic breed, unlike all the asinine tribe, it produced a fruitful progeny, some secrets in the history of our domestic horse might be brought to light—a conjecture partly confirmed by Rytchkof himself when he refers to the dun-coloured tarpans in the neighbourhood of Yaik in company with blue and other coloured tarpans.

It also gathers consistency from the testimony of Pallas as to the habit of tarpan stallions, although in this instance not of pure breed, to entice mares away from domestic herds; and if from this intermixture of blood were born descendants, these may have shown marks characteristic also of *Equus Przewalskii*. To these may be referred the characteristic of the mixed breed noticed by Gmelin, viz. "legs from knee to hoof black." The converse might also occur: stallions from half-wild troops owned by the nomads of Asia might entice mares from the wild herds; and a peculiar mixture of colour and breed would result from this union. It may be considered very probable that *Equus Przewalskii* would give parentage to a fruitful progeny when intermingled with the domestic animal; and perhaps the wild herd of parti-coloured tarpans was the result of this cross-breeding. On the other hand, it is also probable that the domestic horse, varying in colour, size, and shape, is the descendant of a variety of wild, now extinct breeds. That *Equus Przewalskii* may have been indigenous further to the west, not only on the Yaik or Ural of the present day, but even beyond, in North-eastern Europe, is highly probable, judging from the history of its companions in the steppes of Central Asia.

The saigak in the Diluvial epoch was met with at the Carpathians, where its bones have been discovered, together with stone implements, in caves (Albin Kohn and Dr. C. Mehlis, 'Materialien zur Vorgeschichte des Menschen im östlichen Europa,' Jena, 1879, p. 41). Remnants of the skull of a saigak have also been found in the Volga valley near Sarepta. Not longer ago than the end of last century the saigak was very numerous in West Siberia; and Pallas mentions having seen herds of this antelope on the Irtish below Semipalatinsk, where it is now never met with and has been completely forgotten. It is even rare at the present day in the environs of Lake Balkash, where not long since it was as numerous as the kulan, large herds of this last-named animal having in Rytchkof's time roamed near the Yaik. In my last excursion to Balkash, during several days passed in its solitudes I did not observe a kulan, and only saw the tracks of one imprinted on the saline soil. These animals exist still in large numbers in the little-inhabited steppes of Eastern Dzungaria and Western Mongolia. A similar fate has probably befallen *Equus Przewalskii*, whose habitat has now been discovered to be the same as that of the saigak, the kulan, and wild camel. If this horse was indigenous at any time further to the west and became closely allied to the troops of domesticated horses owned by the nomads, it would of course be the object of the keenest pursuit, and would the sooner disappear from its earlier habitat. But there exist herds in more remote parts of Asia called *wild* by Col. Prejevalsky. "Wild horses, called by the Mongols *dzerlik-adu*, are rare in Western Tsaidam, but more numerous near Lob-nor. They are generally in large herds, very shy, and when frightened continue their flight for days, not returning to the same place for a year or two. Their colour is uniformly bay, with black tails and long manes hanging down to the ground. They are never hunted, owing to the difficulties of the chase" (Prejevalsky's 'Mongolia,' English ed. vol. ii. p. 170).

Our specimen of *Equus Przewalskii* is about three years of age; in size it is no bigger than the kulan and djiggetai; its head is nearly of the same length as that of those animals, but lower, and better shaped near the end of the muzzle and nasal bones, with shorter ears than those of the wild ass. Its size is decidedly small in proportion to its head. In shape it takes after the horse; its legs are relatively thick for the size of its body, its hoofs rounder and broader, and its tail better furnished with hair, than in the case of the wild ass. Its colour is dun, with a yellowish tinge on the back, becoming lighter towards the flanks, and almost white under the belly. Its hair is long and wavy, brick-red on the head and nasal bones, of the same colour but longer on the cheeks and about the lower jaw. The extremity of the nose is covered with almost white hairs, a remarkable contrast to the brick-red on the upper part of the head. A short upright [hogged] mane extends from between the ears to the withers, of a dark brown colour, with long yellowish hairs on the margins. It has no stripe of the same colour as the mane along the back, as all Asiatic asses and dun horses have, and a hardly perceptible one along the pelvis. The upper half of the tail is of the same colour as the back; it is longer, thicker at the root, and more bushy than that of any kind of ass; halfway down the tail yellowish hairs are mixed with the brown; and the extremity is dark brown or nearly black. The fore legs are brown near the hoofs and on the knees; and oblique indistinct bars of brown hair extend down the legs. The prevailing colour of the lower parts of the fore legs is brown, a peculiarity never known to occur with wild asses, these having only a narrow barely distinguishable brown margin round the upper rim of the hoof. Dark hairs also occur on the hind legs about the hoofs and much higher.

Thus in external appearance as well as in colour *Equus Przewalskii* is distinct from all wild asses indigenous in the same and neighbouring tracts. Moorcroft's *Asinus kiang* from Tibet differs from it in colour. Of two specimens brought by Prejevalsky from Northern Tibet, the colour of one on the upper parts of the body and flanks was a reddish brown; the other was partly of an ash-grey, with white hair on the belly, the end of the muzzle, and chest, contrasting with the reddish brown of the upper parts. The fore legs, too, had a reddish tinge about them, whilst the hind legs were light grey, and the tips of the ears inside and outside black. *Equus Przewalskii*, on the other hand, has a barely visible brown patch on the outer side of each ear.

The skull of *Equus Przewalskii* is also distinct from that of all the asinine group, while it closely resembles that of the horse. It is about the same length, but wider at the cheek-bones than kulan, djiggetai, zebra, Burchell's or the common ass; besides this, the brain-cavity is greater, the bones of the face are longer, and the skull is less prominent about the nasal bones than these and all other kinds of wild asses. The section of the cranium measured from the orifice at the back to the frontal hollow on the margin of the ethmoid bone is the greatest. Here, again, *Equus Przewalskii* surpasses all Asiatic as well as African asses, two specimens of a djiggetai and kulan (old ones) excepted.

[The remarks immediately following and the table to which they refer have been omitted, as being too detailed and elaborate to interest any body but specialists.]

The hoofs have also more of the equine than the asinine character about them, as will be seen by comparing the measurements in the annexed Table, given in millimetres.

		Asinus kiang, Moorcroft.			*Asinus onager*, Pall.					*Asinus hemionus*, Pall.		
	Equus Przewalskii.	Northern Tibet (Prejevalsky).		Altyn-tagh (Prejevalsky).	Dzungaria (Tihonof).	Dzungaria (Poltoratzky).		Kirghiz Steppe (Count Perofsky).		Dauria (Radde).		
Width of hoofs on fore legs	92	75	73	79	84	95	77	72	83	97	73	82
Length of hoofs on fore legs	110	125	123	125	115	117	·110	104	108	108	116	110
Width of hoofs on hind legs	77	75	65	70	73	74	69	..	75	90	77	79
Length of hoofs on hind legs	108	130	117	114	104	102	110	..	104	102	104	109

Of all wild asses, only in two specimens, one an old kulan and the second an evidently old djiggetai, are the hoofs of the fore feet as wide as or wider than in *Equus Przewalskii*; and these may be accounted for by the fact that, in the case of one (the djiggetai) at all events, the hoofs were broken. In all other specimens (kiangs, kulan, and djiggetai) the hoofs are narrower, and in the case of the kiang longer, than in our specimen (a young one).

Thus in Central Asia, besides the kiang (distinguished by the colour of its hair and long narrow hoofs, forming a separate species), besides the kulan and djiggetai (if not distinct species, at all events geographical varieties), there exists another representative of the solid-hoofed family—a whole mass of evidence distinguishing it from the wild asses we have mentioned, and at the same time characterizing the domestic horse. Supposing the upper part of the tail of our new species were more hairy, we should see a small domestic horse of dun colour and low stature; for its comparatively large head would not be striking or extraordinary compared with varieties of domesticated breeds often seen. And if it were possible to prove that culture influenced the growth of the tail, that this became more hairy and the mane longer under altered conditions of life, I would affirm that *Equus Przewalskii* was indeed the animal whose ancestors were reclaimed by man in the stone period, the so-called domestic horse of our day. For the present, however, this cannot be asserted, because other species having affinity with it, belonging either to geographical varieties or distinct kinds, indigenous in other countries under different physico-geographical and climatic conditions, might even more closely resemble the domestic horse in colour and size, although differing from it in hair, and might in this state have become subject to man.

That animals like *Equus Przewalskii* may present different forms and geographical varieties is to be assumed, judging from the instance afforded by the wild ass. Contrary to Dr. Georgi's views ("Etudes zoologiques sur les Hémiones et quelques autres espèces chevalines," in Ann. Sci. nat., Zoologie, 5e série, xii. 1869, pp. 5–48), including in one species all kinds of the wild ass throughout the vast continent of Asia, from Southern Dauria, across the Gobi, to the Aralo-Caspian plains on the one side, and the highlands of Tibet and the Himalayas to Persia and Syria on the other, I am convinced that many distinct species exist, and a large number of more or less constant geographical varieties. The kiang, for instance, I consider an independent species; the djiggetai and kulan from the Aralo-Caspian plains differ partly in colour and partly in their hoofs from one another; and most probably the Syrian wild ass (*Equus hemippus*) will be found to vary considerably from the djiggetai. Of all the wild asses of Central Asia, the kiang is most like the domestic ass, owing to the length of its ears and the ash-colour of the upper parts of its body, whilst it differs from it in being bigger and having no transverse dark stripes on the shoulder-blades. The congeners of *Equus Przewalskii*, occupying an enormous extent of territory in Europe and Asia, as we are led to infer from their fossil remains, may have been still more varied and multiform; and the first to be tamed were probably those on the outskirts of the great barren steppes, inhabiting well-watered and hilly tracts near one or other of those land-locked water-basins, the earliest abodes of primæval man. In such regions in Siberia, in the spurs and valleys of the Altai and Sayan ranges, in Dauria, even in more northern and central parts of Siberia, fossil remains of the stone period have been discovered by me and other explorers, whilst the outlying mountains of the Tian-Shan and Pamirs will doubtless afford many more. The primæval horse indigenous in these localities may have been more easily brought under subjection than its fellows in the steppes, and may have presented some such relationship to our *Equus Przewalskii* as exists between the kiang and the djiggetai and kulan. Afterwards descending with man from the more favoured hilly region, they may have together entered the plains, where human activity appears to have been of a more recent date, probably the bronze and iron period. But, however this may have been, *Equus Przewalskii* is the sole wild species having close affinity with the horse (our domesticated *Equus caballus*).

Having pointed out the peculiarities which distinguish our horse from all wild asses, and amongst others the generic distinction, I must nevertheless distinguish it from the domesticated animal for reasons already mentioned, viz. its erect mane, absence of forelock, and tail only partly furnished with hair. Whilst possessing all the internal characteristics of the horse, externally *Equus Przewalskii*, were it not for the warts on the hocks, occupies an intermediate place between the wild ass of Asia and *Equus caballus*. Indeed, admitting that domestic horses are to be found with similar peculiarities, and even recognizing in the dun horse a descendant of the same stock as *Equus Przewalskii*, I hold nevertheless that the domestic horse of the present day is not merely the result of culture, but is an intermixture of various breeds inhabiting several parts of the Old World.

IV.—*Notes on a small Collection of Rhynchota from Tokei, Japan.* By W. L. Distant.

The Rhynchota of the Japanese fauna having lately been studied by Scott and Horváth, who have published lists of species and described many novelties, I have considered it useful to give the result of an examination of a small collection (principally Pentatomidæ) from the above locality, which has recently passed through my hands. The most interesting contribution which it contained is a somewhat remarkable new genus in the subfamily Asopinæ.

Neoglypsus, n. gen.

Femora unarmed; abdomen armed with a short basal spine, which about reaches posterior coxæ. Head large, elongate, lateral lobes much longer than central, meeting in front, but cleft at apex. Rostrum reaching the intermediate coxæ, thick, second joint longest, third broad and flattened, about equal in length to fourth. Antennæ long; second joint longer than the third, subequal to the fourth; third and fifth subequal. Pronotum with the lateral angles strongly produced and spinous, the anterior lateral margins crenulated. Scutellum broad at base, with the apical portion elongated and the apex rounded, extending a little beyond base of membrane. Mesosternum with a distinct, central, moderately raised keel. Tibiæ strongly sulcated; anterior tibiæ armed with a distinct spine near middle.

This genus is allied to *Glypsus*, from which it is at once separated by the unarmed femora.

Neoglypsus viridicatus, n. sp.

Above bronzy green, very coarsely punctate. Head thickly punctate, apical half of central lobe and apical margins of lateral lobes impunctate; lateral margins subreflexed. Antennæ fuscous, bases of the joints ochraceous; first joint very short, barely reaching middle of head; second longest; third, fourth, and fifth subequal in length. Pronotum thickly punctate and transversely subrugulose; lateral angles produced into strong, acute, slightly raised and recurved spines, cupreous in hue, lateral crenulated margins luteous. Pronotum thickly punctate and subrugulose, basal angles (narrowly) and apex cupreous. Corium very finely punctate, lateral margins (narrowly) and a narrow submarginal streak, extending about two thirds the length from base, ochraceous. Membrane fuscous, with the margins paler. Abdomen above ochraceous; ventral incisures fuscous; connexivum with a subquadrate greenish spot near base and at apex of each segment. Body beneath and legs ochraceous. Rostrum with the apical joint fuscous. Prosternum and posterior margins of metasternum coarsely punctate. Femora finely spotted with fuscous; stigmata black.

Long. 24 millim., lat. pronot. ang. 13 millim.

Eurydema rugosa, Motsch., var.

One specimen from this locality has the ground-colour luteous, instead of red as in all other specimens which I have seen.

Tropicoris metallifer, Motsch.?

Tropicoris metalliferus, Motsch. Bull. Mosc. xxiii. 4, p. 501 (1859).
Tropicoris Basnini, Osch. Bull. Mosc. xliii. 1, p. 128. 1 (1870).
Tropicoris metallifer, Stål, En. Hem. v. p. 106. 3 (1876).

Two specimens from this locality appear to agree well with the descriptions of the above authors and the supplementary notes of Stål, with the exception of the apex of the scutellum, which is concolorous.

Compastes obtusa, Walk.

Pentatoma obtusa, Walker, Cat. Het. iii. p. 560 (1868).

This species seems clearly referable to Stål's genus, though differing in general appearance from *C. boutanicus*, Dall., the type and only other recorded species. Walker's description of the species is defective, no mention being made of a transverse row of four small luteous spots near anterior margin.

Urochela luteovaria, n. sp.

Head ochraceous, with two elongate fuscous spots at base. Antennæ black; basal halves of fourth and fifth joints luteous; second joint slightly longer than first, third very short, fourth and fifth subequal and together about equal in length to second and third combined. Pronotum ochraceous, coarsely punctured with fuscous, with two transverse streaks on anterior portion of disk, and posterior half of lateral margins black; basal margin (narrowly), a central narrow longitudinal fascia commencing at base and extending to about middle, and anterior half of lateral margins luteous; lateral margins reflexed, lateral angles slightly prominent. Scutellum ochraceous, sparingly covered with very coarse and dark punctures. Corium ochraceous, finely and darkly punctate, basal margin and area, apical margin and area, and inner angle (narrowly) luteous; an irregular black spot at marginal base, and another of the same colour at apex, both contained in the luteous areas. Membrane fuscous. Abdomen above pale testaceous, connexivum luteous, with a series of subquadrate black spots. Body beneath pale ochraceous; a submarginal streak on prosternum, margins of pronotal angles, a round spot on each side of pro- and mesosternum, lateral margins of metasternum, a marginal segmental series of irregular spots, stigmata, a double series of irregularly arranged smaller spots on inner side of stigmata, and two small transverse streaks on base and about centre of second segment black. Femora ochraceous, spotted with fuscous, with the apices of that colour; tibiæ luteous, base and apex dark fuscous; tarsi luteous, apical joint dark fuscous. Rostrum ochraceous, apex fuscous, about reaching intermediate coxæ. Anal appendage armed with a sharp acute spine on each side.

Long. 12 millim., lat. pronot. ang. 5 millim.

V.—*Revision of the Lepidopterous Genus* Azelina, *with Descriptions of new Species in the Collection of the British Museum.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

The genus *Azelina* was founded in 1857, by M. Guénée, for the reception of a number of New-world Geometrites with the external aspect of the European genus *Odontopera*; to the latter group he added two African and one Brazilian species. He remarks with justice, "Il a beaucoup de rapports avec mon genre *Azelina*, et je ne serais pas étonné que, par la suite, quand beaucoup de nouvelles espèces se joindront à l'un et à l'autre, la séparation n'en devienne très-délicate." *O. edentaria*, which we have from Rio Janeiro, certainly might be placed with equal satisfaction in either genus; however, for the present I leave the question of the probable identity of these two groups, and proceed, in the first place, to criticise the material wrongly placed under *Azelina*, and, in the second place, to enumerate the remaining species.

The following species are wrongly placed in *Azelina* by Walker and others:—

"*Azelina*" *peplaria*=*Gonodontis peplaria*, Hübn., agrees far better with *Endropia*.

"*Azelina*" *neonaria*, Walk., is a *Hyperetis* close to *H. nyssaria* and nearly allied to *Selenia cæsionaria* (=*Macaria laticincta*).

"*Azelina*" *atropunctaria*, Walk., may be referred to *Endropia.*

"*Azelina*" *xylinaria*, Guénée, is referable to the genus *Meticulodes.*

"*Azelina*" *clelia*, Cramer, is an *Orsonoba.*

"*Azelina?*" *gabraria*, Walk., is an *Endropia.*

"*Azelina?*" *aretaria*, Walk., is a *Caripeta* close to *C. angustiorata.*

"*Azelina*" *ceriata*, Walk. MS., is much nearer to *Meticulodes* than *Azelina.*

"*Azelina?*" *apicitruncaria*, Herr.-Sch., has nothing in common with the genus; it is closely allied to (if distinct from) the genus *Hyperythra*, is conspecific with *H. agasusaria*, Walk., and the male of *Caberodes? bilbisaria*, Walk. It may be placed provisionally under the generic name *Thysanopyga*, proposed for it by Dr. Herrich-Schäffer.

"*Azelina?*" *perdica*, Cramer, is an *Angerona* barely distinct from *A. aimylusaria*, Walker.

"*Azelina*" *metagonaria*, Walk., is a *Macaria.*

"*Azelina*" *fœdaria*, Walk., is identical with *Endropia mestusata*, and possibly conspecific with *E. hypochraria*; the latter, however, seems distinct.

"*Azelina*" *immundaria*, Walk., evidently does not belong to the genus; but it will be necessary to see the type to decide to what group it is referable—possibly to *Thysanopyga.*

"*Azelina?*" *indecoraria*, Walk., is closely allied to *Pachycnemia*, with which it might provisionally be placed.

The following have been referred either to *Azelina* or *Gonodontis*, which Guénée regarded as synonymous with it:—

"*Gonodontis*" *antucaria*, Felder & Rogenhofer, which is probably a species of *Eurymene*, but certainly not an *Azelina.*

"*Azelina?*" *claustraria*, Felder & Rogenhofer, is a *Lagyra* or a nearly allied genus, and identical with *Andania scriptipennaria*, Walk.

"*Azelina*" *cyclodaria*, Felder & Rogenhofer, is evidently allied to *A. xylinaria*, Guénée, and therefore is not a typical *Azelina.*

"*Azelina*" *volckeniata*, Snellen, is *Clysia succedens* of Walker, and of course has nothing in common with *Azelina.*

"*Gonodontis*" *semilutearia*, Felder & Rogenhofer, is nearer to *Angerona* than to *Azelina.*

"*Gonodontis*" *nelsonaria*, Felder & Rogenhofer, is congeneric with my *G. felix.*

"*Azelina*" *maracandaria*, Erschoff, is more like a *Timandra* than an *Azelina*; but its coloration is more suggestive of the Larentiidæ.

"*Gonodontis*" *felix*, Butler, was never intended to be regarded as an *Azelina*. In naming this species I followed Felder. Whether the name *Gonodontis* can be retained for this and allied species I leave Mr. Kirby to decide in his forthcoming Catalogue of Moths; and at the same time I take this opportunity of thanking him for lending me his list of the species of *Azelina* collated from Walker's Catalogues and the 'Zoological Records' up to 1876; the remaining 'Records' and one or two species referred to other genera than *Azelina* I have looked up subsequently to going through Mr. Kirby's catalogue list.

List of Species.

1. *Azelina lustraria.*

Azelina lustraria, Guénée, Phal. i. p. 156. n. 242 (1857).

Rio Janeiro, Rio Jurua (*Trail*). B.M.

The example from the Amazons is rather redder in colour than those from Rio Janeiro: the species approaches in structure the genus *Meticulodes*.

2. *Azelina stuposaria.*

♀. *Azelina stuposaria*, Guénée, Phal. i. p. 160. n. 252 (1857).
Azelina fuscularia, Felder & Rogenhofer, Reise der Nov., Lep. v. pl. cxxiii. fig. 11 (1876).

♂ ♀, Rio Janeiro. B.M.

The male is smaller than the female; the obtuse apical and subapical denticles are very feebly indicated; and the secondaries are entire; the basal area of the primaries to the discal line is much darker and washed with lilacine, but the external area is distinctly paler and more flesh-tinted.

3. *Azelina Trailii*, sp. n.

♂. Allied to *A. stuposaria*. Primaries above with the basal third pale sandy brown, obliquely striated on the costa and transversely below the costa with grey; second third occupied by the central belt, which is reddish olivaceous, bounded by the ordinary lines, which are blackish; the inner line undulated, the outer line slightly sinuous, obtusely biangulated; a large ochreous spot just within the superior angle of the cell; reniform spot linear, grey, with a white dot on its upper half; an irregular and badly-defined external grey border to the central belt, followed immediately by three unequal black spots; external third testaceous, covered with little transverse blackish striations; apex dusky; one or two submarginal black dots; two or three dull rust-coloured spots on the disk: secondaries greyish brown, striated with grey; basal two thirds of abdominal border reddish; discal line abbreviated, blackish; a large patch of ochraceous at anal angle, extending from the abdominal margin to the third median nervule; a rust-red spot on the first median interspace; fringe testaceous: body above reddish olivaceous, the abdomen greyish at the sides. Wings below brownish grey, mottled with darker grey and ochreous; a white dot at the end of each cell; discal line white, indistinct on the primaries, zigzag and margined towards the abdominal border with black on the secondaries; apical area of primaries rust-red internally, blackish externally, a diffused white patch across the median interspaces: secondaries with the anal area stramineous, changing to ochreous towards the second median vein. Body below greyish brown. Expanse of wings 1 inch 8 lines.

Pariti, Rio Purus (*Dr. Trail*). Type B.M.

The wings of this species have the usual apical and subapical denticles to the primaries, but are otherwise entire as in *A. stuposaria.*

4. *Azelina saturata.*

♀. *Azelina saturata*, Walker, Journ. Linn. Soc. ix. p. 196 (1866); ♂, Felder & Rogenhofer, Reise der Nov. Lep. v. pl. cxxiii. fig. 33 (1876).

Bogota and Venezuela.

How Dr. Felder managed to identify this species I cannot comprehend; nor do I care to question the correctness of the identification. Without seeing the type, I should have despaired of even guessing at what Walker's species was like, since that author states that it is referable to a new section of the genus, whereas he included no less than eight distinct genera in what he regarded as the typical section. The species identified by Dr. Felder is moreover perfectly typical, although in pattern it somewhat resembles *A. anceta.*

5. *Azelina curvistrigaria.*

Pero curvistrigaria, Herrich-Schäffer, Zool.-mineral. Ver. Corr. Blatt, xxiv. p. 184 (1870).

Cuba.

Allied to *A. Hübneraria*, but said to be of a more cinnamon-brown colour and with a black lunule in each cell.

6. *Azelina detractaria.*

Nepitia detractaria, Walker, Cat. Lep. Het. Suppl. v. p. 1565 (1866).

Venezuela (*Dyson*). Type B.M.

This is a perfectly typical *Azelina*, although Walker says that it is "most allied to *Fascellina*."

7. *Azelina Hübneraria.*

Gonodontis ancetaria, Hübner, Samml. exot. Schmett. ii. Lep. v., Geom. i., Amplæ iii., Eusareæ A, Capaces 3, figs. 1–4 (1806).
Azelina Hübneraria, Guénée, Phal. i. p. 159. n. 249 (1857); Walker, Cat. Lep. Het. xx. p. 186. n. 1 (1860).

New York (*E. Doubleday*). B.M.
The two following may be fine varieties of this species:—

8. *Azelina honestaria.*

Azelina honestaria, Walker, Cat. Lep. Het. xx. p. 258 (1860).

Massachusetts (*Packard*). Type B.M.
The type had no locality attached to it; but a second specimen, labelled "*A. Hübneraria*," was received from Dr. Packard. No true *Azelinæ* appear to be included in the letterpress of that author's 'Monograph of the Phalænidæ of the United States.'

9. *Azelina stygiaria.*

Azelina stygiaria, Walker, Cat. Lep. Het. Suppl. 5, p. 1548 (1866).

North America. Type B.M.

10. *Azelina Behrensaria.*

Azelina Behrensaria, Packard, Proc. Bost. Soc. xiii. p. 386 (1871); Monogr. Phal. United States, pl. xi. fig. 60 (1876).

California.
Dr. Packard says that this is "at once known" (from *A. Hübneraria*) "by the broad fawn-brown central band on fore wings, contrasting with the pale granite ash-grey of the rest of the wings and body." As these are the exact characters of *A. Hübneraria*, I have little doubt that he supposes *A. honestaria* to be the typical form, and has redescribed the latter: this is indeed borne out by the figures on the plates of his 'Monograph;' but the latter are unfortunately not coloured.

11. *Azelina rectisectaria.*

Gonodontis rectisectaria, Herrich-Schäffer, Auss. Schmett. pl. lviii. fig. 325 (1850–69).
Azelina rectisectaria, Guénée, Phal. i. p. 157. n. 243 (1857).

Brazil.
Nearest to *A. zalissaria*.

12. *Azelina zalissaria.*

Azelina? zalissaria, Walker, Cat. Lep. Het. xx. p. 187. n. 4 (1860).

East Florida (*Doubleday*). Type B.M.

13. *Azelina nerisaria.*

Azelina? nerisaria, Walker, Cat. Lep. Het. xx. p. 188. n. 5 (1860).

St. Domingo (*Tweedie*). Type B.M.

14. *Azelina mollis,* sp. n.

♀. Primaries from the base to the discal line bronzy olivaceous, the base and costal border washed with pink; disk dull pinky brown; external border bronzy olivaceous, inclining to cupreous, tapering to the external angle; ordinary lines blackish, the "extrabasilar" or inner line quadrisinuate, arched; the discal line straight and oblique, double, and with a slender parallel greyish line immediately beyond it; a black dot at the end of the cell; apex acute, an acute subapical denticle, and an obtuse angle at the end of the second median branch: secondaries almost entire, dull pinky brown; the basal area feebly washed with bronzy olivaceous up to the discal line, which is nearly straight, blackish, and with a dusky diffused internal streak close to it; fringe bronzy brown; costal border sericeous white: thorax olivaceous, washed behind with pink; abdomen pinky whitish, with olivaceous dorsal streak. Primaries below white, the discoidal area and costa pinky brown; apex whity brown; external border olivaceous, diffused internally; three or four black-dotted white marginal spots; a diffused greyish discal streak: secondaries pinky brown, irrorated with black, with whitish abdominal border; a greyish transverse zigzag discal line, dotted with black, and becoming wholly black on the abdominal area; a small black discocellular lunule; a marginal series of small white spots: pectus testaceous; legs cream-coloured; venter pinky brown. Expanse of wings 1 inch 8 lines.

Rio Janeiro. Type B.M.

Allied to *A. zalissaria* of Walker.

15. *Azelina Buckleyi,* sp. n.

♂. Primaries above pale olivaceous, speckled with black, the disk and costa sordid white; the central belt darkest; the lines dark purplish brown, extrabasilar undulated, trisinuate internally, but interrupted at the median vein; discal line double, with pink centre and rusty-orange internal margin; a slight angulation at the lower radial vein; otherwise it is straight and oblique; a dark olivaceous line on the central belt and close to the discal line; a black dot at the end of the cell; a series of unequal black spots close beyond the discal line; one or two brownish spots placed obliquely upon the disk; a submarginal series of white-pupilled black dots; fringe tipped with rust-red: secondaries pale brownish olivaceous, speckled with grey; costal border whitish; a slightly sinuated brown discal line; a submarginal series of black dots: body whity brown, speckled with black; head and collar olivaceous; a white bar between the eyes. Wings below whity brown, speckled with black; a black dot at the end of each cell; a dark brown discal line, straight in the primaries, abbreviated and terminating in a large diffused rounded blackish patch at the base of the median interspaces; an oval white patch on the disk beyond it; apical area greenish; black submarginal dots and fringe as above; internal area sericeous white; discal line of secondaries crinkled; submarginal dots smaller and less numerous: body below pale sandy brown. Expanse of wings 2 inches 1 line.

Ecuador (*Buckley*). Type B.M.

Allied to the preceding and succeeding species.

16. *Azelina frigida*, sp. n.

♂. Allied to the preceding species, but altogether of a much paler ashy grey colour; almost white above; the lines as in the preceding species, excepting that they are placed nearer together; the centre of the discal line and its internal border pale buff; no brown oblique spots on the disk; fringe white at base, tipped with dark brown; submarginal black dots with white pupils, as in *A. Buckleyi*. Under surface silvery white, feebly washed with pinky brownish, excepting on internal area of primaries. Expanse of wings 1 inch 11 lines.

Two specimens. Rio Janeiro. Type B.M.

This is the palest species in the genus; it is of the same form as *A. Buckleyi* and *A. mollis*.

17. *Azelina hœdularia*.

Azelina hœdularia, Guénée, Phal. i. p. 158. n. 247 (1857).

Rio Janeiro. B.M.

Allied to *A. rapinaria*.

18. *Azelina variaria.*

Azelina variaria, Walker, Cat. Lep. Het. xx. p. 257 (1860).
Azelina spectrata, Walker, Cat. Lep. Het. xxvi. p. 1516 (1862).

Venezuela. Type B.M.

The original type was probably also received from Venezuela; but all trace of its habitat is lost, and consequently Walker was unable to give it.

19. *Azelina mathilda*, sp. n.

Primaries above pale brown, indistinctly striated with darker brown; ordinary lines very broad, particularly the outer line, which, below the first median branch, is expanded to the middle of the central belt, dark olive-brown; inner or "extrabasilar" line irregularly and widely zigzag; outer line (or band) slightly irregular, with undulated external edge, and enclosing a pale yellow spot on the upper radial interspace; a large ,-shaped spot and an oblique dash above it at the end of the cell; these markings are jet-black, with pale yellow margins; an ill-defined and interrupted zigzag discal line, the external area beyond which is slightly washed with cupreous; three black-edged submarginal white dots; fringe cupreous: secondaries grey, the veins on the disk cupreous, the costal border whitish; an irregular whitish-edged dusky discal line; a submarginal series of black dots, pupilled with white towards apex; fringe cupreous: thorax olivaceous; abdomen greyish. Under surface reddish brown; primaries with the internal area silvery white; costal border mottled with cream-colour; a white spot at the end of the cell, and a large diffused rounded white patch on the disk; discal line regular, slightly curved, blackish: secondaries irrorated with cream-colour, particularly towards the abdominal margin; a double spot at the end of the cell, and a very irregular discal line black, edged with cream-colour; pectus whity brown; legs cream-coloured; venter greyish. Expanse of wings 1 inch 8 lines.

Ecuador (*Buckley*). Type B.M.

Nearly allied to *A. variaria* of Walker, but quite distinct.

20. *Azelina semiusta*, sp. n.

Allied to the preceding species, from which it differs in having the primaries pale blue-grey, with the greater part of the central belt, including the inner borders of the ordinary lines, bright ferruginous; the inner line also much less irregular, considerably nearer to the base; no pale yellow spot on the outer line, but an abbreviated streak of black scales immediately beyond it; the incomplete zigzag discal line represented by three well-defined brown >-shaped markings; a band of black scales, interrupted by elongated red spots on the veins, running across the apical area and then along the outer margin: secondaries with the apical half washed with fiery cupreous; discal line much abbreviated, not extending above the third median nervule: thorax pale ash-grey, with the collar and a dorsal crest pale rust-red; abdomen grey, washed with reddish. Under surface darker and redder than in the preceding species; primaries with a white-edged 7-shaped black marking at the end of the cell; apex, as well as the discal patch, white; the discal line obsolete: secondaries with the black discocellular spot linear; discal line replaced by a very irregular series of whitish-edged grey spots: body below grey, clouded with reddish chocolate; legs chocolate-brown, mottled with cream-colour. Expanse of wings 1 inch 10 lines.

Ecuador (*Buckley*). Type B.M.

21. *Azelina stolidata.*

Azelina stolidata, Guénée, Phal. i. p. 158. n. 246 (1857).

Colombia.

Allied to *A. variaria.*

22. *Azelina habenaria.*

Azelina habenaria, Guénée, Phal. i. p. 159. n. 251 (1857); Walker, Cat. Lep. Het. xxvi. p. 1516 (1862).

♂ ♀, Rio Janeiro. B.M.

The description by Walker is that of an ordinary male example.

23. *Azelina rapinaria.*

Azelina rapinaria, Guénée, Phal. i. p. 157. n. 243 (1857).

Rio Janeiro. B.M.

Allied to *A. stygiaria.*

24. *Azelina vetustaria.*

Azelina ? vetustaria, Walker, Cat. Lep. Het. Suppl. 5, p. 1550 (1866).

St. Domingo (*Tweedie*). Type B.M.

There was not the slightest occasion for Walker to doubt the generic location of this species; and therefore he placed a note of interrogation after it; in other species, where there was not even an approach to the generic characters of *Azelina,* he unhesitatingly described them as members of the genus.

25. *Azelina Lindigi.*

Azelina Lindigi, Felder & Rogenhofer, Reise der Nov. Lep. v. pl. cxxiii. fig. 20 (1876).

Bogota.

26. *Azelina fusaria.*

Azelina fusaria, Walker, Cat. Lep. Het. xx. p. 256 (1860).

Brazil.

Seems nearly allied to *A. gonopteraria.*

27. *Azelina inconstans*, sp. n.

Primaries above silvery grey, irrorated with black; lines blackish; extrabasilar line deeply dentate-trisinuate; a conspicuous jet-black discocellular spot; discal line dark purplish brown internally, double, its outer edge blackish grey; a series of white dots on the veins along the centre of the discal line; the inner edge is also bounded by a series of more or less distinct sienna-red conical spots upon the nervures; these spots, however, are confluent just beyond the cell, and limited internally by three dusky spots; a series of black spots just beyond the discal line, and sometimes three spots in an oblique subapical series; apex whitish, a submarginal series of black dots more or less pupilled on their outer edge with white; fringe whity brown tipped with dark red-brown, or greyish tipped with black: secondaries shining sordid white, with a broad greyish external border, bounded internally by the discal line, which is nearly straight and blackish; a black discocellular dot; a diffused subapical dusky patch; a submarginal series of white-pupilled black dots: thorax greyish brown; abdomen whity brown, becoming silvery grey towards the anus. Wings below silvery grey, washed with pink and irrorated with black; a diffused blackish discal streak preceded by a series of black dots; a black dot on the discocellulars and a submarginal series; apex in all the wings white: primaries with a white diffused externo-discal patch continuous with the internal border, which is also white: secondaries with whitish abdominal area: body below whity brown, speckled with grey. Expanse of wings 1 inch 9 lines.

Two specimens. Rio Janeiro. Type B.M.

This seems to be allied to *A. fusaria.*

28. *Azelina amica*, sp. n.

Allied to the preceding species. Wings more strongly dentated, but of the same general coloration: primaries above with very similar pattern, excepting that the discal line is quite black, not double, and consequently not white-spotted upon the nervures, that the extrabasilar line is less deeply sinuated and placed nearer to the discal line, and that the black discocellular spot is wanting: secondaries sordid white, becoming grey towards the outer margin, but with no discal line; submarginal dots as in the preceding species. Primaries below silvery white, with brownish costal and external borders; a blackish dot at the end of the cell, and an abbreviated discal series; a snow-white apical costal spot; fringe blackish: secondaries pinky brown, gradually shading into silvery white towards the abdominal margin, speckled with black, and with a broad diffused apical external border; a black discocellular spot: body below white. Expanse of wings 1 inch 9 lines.

Rio Janeiro. Type B.M.

29. *Azelina gonopteraria.*

Azelina gonopteraria, Guénée, Phal. i. p. 160. n. 253, pl. vi. fig. 5 (1857).

♂ ♀, Rio Janeiro. B.M.

This seems to be the commonest and one of the most variable in tint of all the species in Rio Janeiro.

30. *Azelina repellaria.*

♀. *Azelina repellaria*, Guénée, Phal. i. p. 161. n. 254 (1857).

♂ ♀, Rio Janeiro. B.M.

The male is slightly greyer than the female, and in form more like *A. stuposaria*, the apical and subapical denticles of the primaries only being indicated.

31. *Azelina poaphilaria.*

Azelina poaphilaria, Guénée, Phal. i. p. 161. n. 256, pl. iv. fig. 5 (1857).

♂ ♀, Rio Janeiro. B.M.

Judging from the figure alone, I should not have retained this species in the genus; the insect, however, has well-defined though short denticles to the outer margin of the primaries and the usual angle at the extremity of the second median branch.

32. *Azelina imperfectaria.*

♂ ♀. *Azelina imperfectaria*, Guénée, Phal. i. p. 161. n. 255 (1857).

♀, Rio Janeiro. B.M.

33. *Azelina ochracea*, sp. n.

Primaries above from the base to the discal line ochreous speckled with grey and black, and with a subcostal inconspicuous shining greyish line; both of the ordinary lines double, the centre being grey and the edges black; the extrabasilar slightly oblique and trisinuate; the discal line, which is also preceded by a closely approximated black stripe, is oblique, its outer edge being very feebly sinuated between the veins; disk stramineous, crossed by a very indistinct brick-red streak bounded internally by a more or less distinct series of black dots just beyond the discal line; a conical distinct red spot just beyond the middle of the first median interspace; external area towards apex olivaceous; an incomplete submarginal series of black-edged white dots; fringe ochreous: scondaries stramineous, ochraceous at centre of abdominal area and disk, speckled with grey; discal line slightly irregular, black, bordered internally with slaty grey and with several small angular markings of this colour just beyond it; a grey discocellular spot; a submarginal series of externally white-edged black dots; fringe ochreous: body above ochreous, washed with pink. Primaries below cream-coloured, sericeous; costal border ochraceous, speckled with grey; lines of the upper surface grey, the extrabasilar indistinct; a black discocellular lunule; a greyish subapical marginal patch; fringe ochreous, with dark reddish outer edge: secondaries pale stramineous, the costal border and apical area washed with reddish ochreous; a zigzag grey discal line, becoming black on the abdominal area; a black discocellular spot. Body below pale ochraceous; legs cream-coloured, speckled with black. Expanse of wings 1 inch 8 lines.

Two specimens. Rio Janeiro. Type B.M.

34. *Azelina crocallaria.*

♂. *Azelina crocallaria,* Guénée, Phal. i. p. 162. n. 257 (1857).

♂, ♀, Rio Janeiro; ♀, Venezuela. B.M.

The female from Venezuela is very pale, but otherwise agrees with the typical form. The ordinary female, on the other hand, is altogether darker and browner than the male, but with exactly the same pattern.

35. *Azelina campinaria.*

Gonodontis campinaria, Herrich-Schäffer, Auss. Schmett. pl. lxxix. fig. 458 (1850–69).

Azelina campinaria, Guénée, Phal. i. p. 157. n. 244 (1857).

Brazil.

The body of this species seems to be exaggerated in the figure; it is hardly possible that it can be so large in nature.

36. *Azelina minima*, sp. n.

Allied to the preceding species, but with the general aspect of *A. clysiaria*. Primaries with trisinuate outer margin; dark sericeous brownish grey irrorated with black; costal border mottled with whitish; a rather broad irregular central ferruginous band bounded by the ordinary lines, which are blackish and subparallel to the subcostal vein, where the inner line turns inwards at an acute angle, which emits a spur downwards to the end of the cell, and is followed by a small ochreous spot bounded externally by a pure white crescent; fringe varied with cupreous: secondaries with an acute angle at the extremity of the second median branch; slightly paler brownish grey than the primaries, but transversely mottled with slightly darker grey; discal line indistinct, paler than the ground-colour; submedian vein streaked with reddish cupreous in the centre; an incomplete submarginal series of black dots: thorax olivaceous brown; abdomen pale brownish grey. Primaries below sericeous, grey, slightly silvery towards the inner and outer margins; costal area whity brown, striated with darker brown; an indistinct wavy abbreviated discal line from the costa; postdiscal white crescent as above; fringe whitish at the base; secondaries pale cupreous, brown striated with grey, the abdominal border white; a diffused grey discal belt, beyond which the external area is whitish: body below greyish; legs cream-coloured. Expanse of wings 1 inch 2 lines.

Six specimens. Rio Janeiro. Type B.M.

Section Polygonia, Guén.

37. *Azelina anceta.*

Phalæna-Geometra anceta, Cramer, Pap. Exot. iv. p. 136, pl. ccclx. C, D (1782).
Azelina ancetaria, Guénée, Phal. i. p. 158. n. 248 (1857).

Guayaquil. B.M.

Our example does not quite agree with Cramer's figure; so that it is just possible that the Surinam form may be distinct. Without specimens from both localities, however, it would be rash to separate them.

38. *Azelina commixtata.*

Azelina commixtata, Walker, Cat. Lep. Het. xxvi. p. 1748 (1862).

Port Natal (*Gueinzius*). B.M.

39. *Azelina fortinata.*

Polygonia fortinata, Guénée, Ent. Month. Mag. v. p. 41 (1868).

New Zealand, Otago. B.M.

40. *Azelina gallaria.*

Selenia gallaria, Walker, Cat. Lep. Het. xx. p. 185. n. 6 (1860).

New Zealand. Type B.M.

41. *Azelina denticulata*, sp. n.

Red-brown: primaries rather pale, the lines reddish chocolate; the inner line ⋛-shaped, with pale inner edge, outer line expanded internally into a band, covering, below the cell, about a third of the central belt, its outer edge slightly undulated, the greatest projection being on the interno-median interspace; this line or band is edged externally with pinky whitish; two oblique pale sericeous streaks across the disk, as in *A. lustraria*, *stuposaria*, and one or two other species; an incomplete submarginal series of black dots, more or less prominently pupilled with white: secondaries greyish with reddish ochraceous external border; costal border whitish; a submarginal series of black dots; discal line nearly straight, chocolate-brown, with slender whitish edge: thorax darker than abdomen, prominently crested. Under surface reddish brown; a slender, externally white-edged, black discal line, straight on the primaries, irregularly undulated on the secondaries: primaries with the submedian area grey, the median interspaces black towards the base, but crossed from the middle by a large pyriform white patch; internal area silky white; two or three submarginal dots with more or less prominent white pupils: secondaries with a large black spot with cream-coloured margin, and divided by veins of the same colour at the inferior angle of the cell; abdominal border and fringe pale buff; legs cream-coloured, streaked with dark brown. Expanse of wings 1 inch 9 lines.

Two specimens. Ecuador (*Buckley*). Type B.M.

The primaries of this species are slightly irregular, as in *A. poaphilaria*; but the secondaries are distinctly dentated, the margin from the third median branch to the anal angle bearing three well-defined and slightly incurved processes of equal length and width. The species therefore, although in pattern it most resembles *A. Hübneraria* and allies, seems by its structure to come nearer to *A. clysiaria*; it nevertheless differs somewhat in form from all described species.

Section approaching SYNEMIA.

42. *Azelina latrata.*

Azelina latrata, Guénée, Phal. i. p. 163. n. 259 (1857).

Brazil, Colombia.

43. *Azelina caninata.*

Azelina caninata, Guénée, Phal. i. p. 163. n. 260 (1857).

Colombia.

If I have rightly understood the description of the form of these two species, they must be allied to *A. clysiaria*, in which the primaries are biangulated as in typical *Synemia*, and the secondaries furnished with incurved marginal denticles at the extremities of the second and third median branches. Herr Snellen figures under this name (Tijd. Ent. xvii. pl. 2. fig. 4) a *Lycimna* allied to *L. succedens*.

44. *Azelina decisaria.*

Azelina decisaria, Herrich-Schäffer, Zool.-mineral. Ver. Corr. Blatt. xxiv. p. 185 (1870).

Cuba.

45. *Azelina clysiaria.*

Azelina clysiaria, Felder & Rogenhofer, Reise der Nov., Lep. v. pl. cxxiii. fig. 12 (1876).

Rio Javary, Rio Purus, Rio Solimões, Rio Jutahi (*Dr. Trail*). B.M.

The figure of this species is too pale in colouring and does not correctly represent the uncate character of the denticles on the inner half of the external margin of the secondaries.

46. *Azelina juruana*, sp. n.

Nearly allied to the preceding species, but considerably smaller, of a sandy testaceous colour speckled with black, with no distinct triangular yellowish costal patch on the primaries, but the oblique black dash commencing the "extra-basilar" line and the dark commencement of the discal line even more strongly defined, the red inner border of the latter line only indicated by a ferruginous spot beyond the transparent discocellular marking, and a second on the submedian vein; the apex with an irregular reddish-brown spot diffused externally, two or three olivaceous spots on the disk; a submarginal series of black dots, pupilled with white towards the apex; fringe grey: secondaries washed with rust-red towards the abdominal margin; discal line nearly straight, brown with a white edge; discocellular marking reduced to a transparent point; no orange or rust-red spots just beyond it as in *A. clysiaria*; a subanal ferruginous streak and an indistinct olive-brown subapical marginal spot, which, however, is sometimes absent; a submarginal series of black dots. Under surface sordid white, striated with grey; discocellular markings white with blackish edges; a zigzag discal brown line dotted with black, two or three dusky patches on the disk and a submarginal series of black dots as above: body below sandy whitish. Expanse of wings 1 inch 5 lines.

Rio Jurua, Amazons (*Dr. Trail*). Type B.M.

A very distinct and well-marked species of the form of *A. clysiaria*, and with the ordinary lines of the primaries similar.

Section Synemia, Guén.

47. *Azelina speciosata.*

Azelina speciosata, Guénée, Phal. i. p. 159. n. 250 (1857).

Ecuador. B.M.

Described from a male obtained in Colombia. The female is considerably paler in colour than the male. It is absurd to think of separating this species generically from *A. polygonaria.*

48. *Azelina guruparia.*

♀. *Azelina guruparia*, Felder, Reise der Nov., Lep. v. pl. cxxiii. fig. 21 (1876).

♂ Rio Jutahi (*Dr. Trail*). B.M.

The male is smaller than the female, with the coloration of the primaries more like that of Felder's figure of *A. saturata*, the apex being dark and the external area buff streaked with whitish.

49. *Azelina decora*, sp. n.

Allied to *A. speciosata*, with almost the same pattern, the primaries altogether redder; the olivaceous basal area replaced by purplish brown; the olive borders of the ordinary black lines narrower and darker; the pale patch on the internal area just beyond the discal line much narrower, grey bordered externally with white; the external third of the primaries bright cupreous orange, with the area nearest to external angle and a subapical patch slightly darker and speckled with grey; no white zigzag discal stripe: secondaries with the discoidal area dull ochreous, the costal and abdominal areas to the discal line cream-coloured mottled with grey; discal line whitish, arched, partly edged externally by the grey mottlings; external area bright ochreous outwardly, shading into orange internally, where it is mottled with grey; a marginal orange line spotted with dark grey. Body and under surface very like *A. speciosata*, excepting that the subapical semitransparent white spot is wanting. Expanse of wings 1 inch 7 lines.

Rio Janeiro. Type B.M.

50. *Azelina pumaria.*

Pergama pumaria, Felder & Rogenhofer, Reise der Nov., Lep. v. pl. cxxiii. fig. 15 (1876).

Espirito Sancto, Brazil; Rio Purus (*Dr. Trail*). B.M.

51. *Azelina polygonaria.*

Synemia polygonaria, Guénée, Phal. i. p. 164. n. 261 (1857) Herrich-Schäffer, Auss. Schmett. figs. 412, 413 (1850–58).

Brazil.

The two following species cannot belong to *Azelina*; they are described as having the "fore wings acute," the first with rounded exterior border and the second with the exterior border angular. The genus, though it occurs in New Zealand, is at present unknown from Australia.

Azelina inordinata.

Azelina inordinata, Walker, Char. undescr. Het. Lep. p. 74 (1869).

Australia. Melbourne Museum.

Azelina biplaga.

Azelina biplaga, Walker, Char. undescr. Het. Lep. p. 75 (1869).

Australia. Melbourne Museum.

Doubtful Species.

52. *Azelina asilasaria.*

Azelina asilasaria, Walker, Cat. Lep. Het. xx. p. 194. n. 24 (1860).

Rio Janeiro.

53. *Azelina amyclaria.*

Azelina amyclaria, Walker, Cat. Lep. Het. xx. p. 195. n. 25 (1860).

Brazil.

54. *Azelina*? *atrapesaria.*

Azelina? *atrapesaria*, Walker, Cat. Lep. Het. xx. p. 196. n. 27 (1860).

—— ?

Of this species no trace, either of the specimen or the printed label, appears in the cabinet; and as Walker has made no note in the Catalogue as to what he has done with it, I can only suppose that it is a species which he omitted to label when described, and which has consequently become the type of some species in another genus.

The following group is so close to *Azelina* that it may save the multiplication of synonyms to refer to it here.

Paragonia deustata.

Paragonia deustata, Felder, Reise der Nov., Lep. v. pl. cxxiv. fig. 8 (1876).

Chili.

Paragonia subornata.

Macaria ?? *subornata,* Walker, Cat. Lep. Het. xxvi. p. 1644 (1862).

Monte Video (*Darwin*). Type B.M.
Nearly allied to the preceding species.

VI.—*Supplementary Notes on the Flints and the Lithological Identity of the Chalk and Recent Calcareous Deposits in the Ocean.* By Surgeon-Major WALLICH, M.D.

It may be in the recollection of those who have read my former observations on the subject * that, in default of any available direct means of proving the lithological identity of the chalk and calcareous deposits of the Atlantic and other oceans, I was obliged to rely chiefly on collateral evidence in support of the view I advocated—namely, that the extraordinary contrast between the percentages of silica, supposed to characterize these two formations, does not in reality exist, but is altogether based on the fallacious standard employed in making the comparison. I maintained that the nearly total absence of disseminated silica now observable in the Chalk is not due to an almost infinitesimal quantity of that substance having originally been present in it when it rested as mud on the Cretaceous sea-bed, but to the fact of nearly the whole of the silica it then contained having been then and there eliminated from it through the agency of colloidal sponge-protoplasm. For a like reason I contended, that the large percentage of silica now met with in the surface-mud of the recent calcareous areas does not furnish a trustworthy index to the percentage which would be found were it possible

* "A Contribution to the History of the Cretaceous Flints," Quart. Journ. Geol. Soc., Feb. 1880; and "On the Origin and Formation of the Flints of the Upper or White Chalk," Ann. & Mag. Nat. Hist., Feb. 1881.

to obtain for analysis a specimen of the consolidated stratum resting at some depth below the surface, inasmuch as the excess present in the immediate surface-layer (*from which alone all our information has heretofore been derived*) represents, in reality, the aggregate contributions extracted from each freshly-deposited layer as it became gradually submerged beneath the layer that succeeded it. And, lastly, stating the case in another form, I concluded that, were it possible under existing conditions to compare with a portion of chalk a portion of recent calcareous mud obtained from a considerable depth * below the surface of the sea-bed, there would in all probability be no material difference in the relative percentages of silica derived from the two sources.

It subsequently occurred to me, however, that if my hypothesis concerning the causes which lead to the stratification of the flints is correct, the fossilized organic contents, so frequently met with in certain hollow nodules, would at once supply the requisite data for determining the relative quantities of silica in the two formations, especially as the alleged great excess of silica in *one* of these is so pronounced as to render an approximately accurate quantitative analysis—such as I might myself carry out—sufficient for the purpose contemplated.

The line of inquiry I marked out in order to put my hypothesis to the test of actual experiment was, to ascertain, if possible, what constant distinctions are traceable between the contents of those nodular cavities that have never, since their consolidation, been so perfectly closed as to cut off all communication whatever between their contents and the medium surrounding the nodules, and the contents of those cavities that have remained hermetically closed since that critical stage in their history when they became sufficiently consolidated to put every subsequent change in the lithological combinations formed amongst the enclosed materials beyond the pale of any supplementary accessions of materials from without, or any transfer of the originally included materials from within.

Then, taking as my point of departure the fact alluded to in my last paper on the flint question †, namely that the contents of hermetically-closed nodular cavities consist of absolutely intact portions of the organic material, *and even of the water*, of the ancient Cretaceous ocean, around which the highly

* By immediate surface-layer I mean from 6 inches to probably a foot and a half, beyond which there is no sufficient proof that any dredge, sounding, or probing-machine has ever yet penetrated.

† Ann. & Mag. Nat. Hist., Feb. 1881, pp. 178 and 201.

contractile, but as yet unconsolidated, nascent nodules had closed in so as to completely imprison them, I argued as follows :—Inasmuch as the stratified flints were formed at the immediate surface of the ancient sea-bed, from an already highly saturated combination of sponge-silica and sponge-protoplasm *, the portion of organic débris entrapped within the as yet unconsolidated masses of nascent flint *must*, in like manner, have been derived from the immediate surface-layer; and consequently, since the nascent nodules were, under the conditions specified, incapable of appropriating more silica from any source, or of transferring any of their own silica beyond their own boundary walls, whatever quantities of silica and carbonate of lime were originally present in the imprisoned masses, must have remained locked up, from the Cretaceous period down to our own time, in the cavities in which we now find them.

It will be seen hereafter that the examination made by me, in pursuance of the plan thus sketched out, of a very extensive series of carefully selected nodular flints, fully substantiates the main conclusions at which I had previously arrived on the basis of collateral evidence only.

As regards the abstract possibility of the walls of the nodular cavities (reduced as they occasionally are to a thickness not exceeding a third or even quarter of an inch †) being sufficient to prevent the dialytic translation of any of the mineral substances held in solution within them, it is, I presume, almost unnecessary for me to offer any further proof than the fact, well known to every mineralogist and chemist, that minute quantities of fluid have continued pent up in quartz, for periods, and under pressures, far exceeding those we have now to deal with. But, even apart from this fact, the condition in which we find the contents themselves, and the appearance presented by the perfectly unbroken walls of flint, tend to prove that no such dialytic translation of material has, or indeed could have, taken place. On this point, however, I shall have something more to say further on.

It has already been stated that my observations serve to establish the lithological identity of the ancient and recent calcareous formations. But they do more than this; they lend the strongest support to the view, if they do not absolutely prove, that the final stage arrived at, in the consolidation of the contents of the nodular cavities, is wholly dependent

* Quart. Journ. Geol. Soc., Feb. 1880, pp. 68–91.

† I mention these, not as indicating thicknesses present in the nodules the contents of which I have selected for analysis, but merely as the minimum compatible with safety.

on the presence, or exhaustion, of the water of the ancient ocean which was imprisoned along with the solid materials. It is upon the exhaustion of this water that each one of the various transitional stages of metamorphism in the materials —ranging from a partial replacement of the carbonate of lime by silica, to the production of a form of chert so homogeneous and white as closely to resemble porcelain—is brought to a final standstill; whilst between these two extremes is to be met with every intermediate stage of (what I may describe as) collateral metamorphism, including the production of chalcedony or jasper through an occasional excess of alumina and iron, of fibrous as well as granular silica, and, finally, of the purest crystals of quartz, crystallized out of the last expiring remnant of water holding in solution the last residuary particles of silica.

Of each and all of these transitional varieties of the material I have preserved representative specimens; and it is no exaggeration to say that each time I look at them some new fact seems to reveal itself in their wondrous history.

On the present occasion I will content myself with drawing attention to two of the facts that have been elicited. The first is, that in those nodular cavities in which the imprisoned contents have not already been reduced to an anhydrous condition—putting one in mind of our satellite the moon, without atmosphere, without vapour, without even a ray of the reflected light she receives—the whole of the changes above enumerated can be distinctly noted *as being either still in progress* or as having been cut short by the exhaustion of the water, to which alluusion has just been made.

The circumstances connected with the second fact on which I propose to touch, demand a few words of explanation. This I have all the more pleasure in supplying, since it enables me to make the interesting announcement, that the still mysterious little organisms to which I gave the name of coccospheres (discovered by me in 1860, amongst the rest of the organic débris*, in soundings in the North Atlantic), have very recently, and for the first time, been detected by Mr. J. T. Young in a fossil state. Mr. Young has already detected them in the Chalk series from various localities in the neighbourhood of London. They have, up to this date, been found by him "in the Chalk from Marlow, Pinckney's Farm (near Maidenhead), Charlton, Gravesend, the Grey Chalk from the boring at Meux's brewery, and the Glauconite beds (Upper

* As stated in a paper on the Polycystina in the Quart. Journ. Microscop. Soc. for July 1865, I discovered living coccospheres in abundance in the tropical seas on both sides of Africa in 1857.

Greensand) at Folkestone, but, most abundantly, in Grey Chalk from the Finchley Boulder-clay."

Mr. Young, knowing the interest taken by me in the matter, was good enough to acquaint me with his discovery soon after making it in April last, and to increase the obligation thus rendered, by presenting me with illustrative slides and specimens of the Chalk itself, intimating at the same time that I was at liberty to make any use I liked of the information. He thus enabled me not only at once to verify his observations, and, under the salutary stimulus afforded by his discovery, to detect coccospheres in two or three specimens of chalk I had by me, but, what was of still greater interest to me just now, owing to its opportuneness, to detect *silicified* coccospheres in the cavities of hermetically closed nodules obtained direct from the Upper Chalk, and also in a number of similarly closed hollow flints obtained, in the usual rolled and weathered condition, from neighbouring gravel beds!

It is at this point that the history of these still mysterious little structures becomes so intimately connected with the flint question as to warrant my laying greater stress on it than I should otherwise have done; for not only does it add another powerful link to the chain of evidence regarding the mineral identity of the chalk and recent calcareous deposits, but it conclusively attests the accuracy of the statement made by me when I first figured and minutely described the coccospheres *—namely, that, in common with the detached appendages of these organisms called "coccoliths," the *cell-wall of the coccosphere is consolidated by carbonate of lime* †, and hence, when not silicified, exhibits by polarized light the well-known distinctive cross. I may take this opportunity of mentioning that, as some doubts have been expressed as to the correctness of my view regarding the calcareous nature of the cell-wall of the structures in question, I have during the past twelve months carefully repeated my examination of them, and am now in a position to reassert its strict accuracy in every particular.

I have spoken of the lithological identity of the ancient

* "On some novel Phases of Organic Life at Great Depths in the Ocean," Ann. & Mag. Nat. Hist., July 1861.

† It is a remarkable fact, also pointed out in the paper just named, that I had never then (and I may here add that I have never since, either during my cruise in the North Atlantic in 1860 or during my subsequent examination of *preserved* specimens) observed a single collapsed or crumpled specimen. In the large oblong coccospheres found by me, in 1857, in the tropical ocean on both sides of Africa, one end of the structure "dehisces," as if truncated; but I do not recollect having ever seen it crushed or collapsed.

and recent calcareous formations. It should, however, be clearly understood that this term is only applicable to them both, as they undoubtedly present themselves to our notice, in connexion with occasional peculiarities depending upon conditions with which we are as yet very imperfectly acquainted. For example, the term "*Globigerine areas*" has been employed by more than one eminent writer as synonymous with an ideal standard of what recent cretaceous mud ought to be like. It is not, however, in the purest Globigerine areas that the deposit approaching nearest to the Upper or White flint-bearing Chalk is being deposited. But that a true flint-bearing cretaceous rock is being very generally deposited over certain areas of the ocean, differing from it perhaps as much, *in colour only*, as the latter differs from the Grey, but nevertheless lithologically identical with it, is, I am inclined to believe, quite certain. On the other hand, grave objections have been urged against this view on purely palæontological grounds, which may be as insuperable as the authority is high of the eminent geologists who entertained them. But having had some practical experience in deep-sea exploration, and being aware of what has been done in this direction by others during the last ten or twelve years, I cannot help considering it somewhat premature to affirm—because "not a single one of the characteristic Cretaceous genera of Mollusca, such as *Ammonite*, *Baculite*, *Belemnite*, &c., has been brought to light in the Globigerine areas, and nothing to indicate that the Cretaceous formation (speaking in a geological sense) is going on anywhere with that sort of persistency which is inferred by" some *—that the attainment of this or equivalent palæontological evidence is impossible. The fact is that no really appropriate means have heretofore been devised and perseveringly employed for determining the question; and, looking at it from a less debatable point of view, the most that can be said of the opportunities heretofore available for the detection of some of the missing palæontological links is—that the likelihood of their proving successful stands on a par with an attempt (were such to be indulged in by some zealous naturalist) to determine the precise nature and scope of the European marine fauna by dropping a thimble at every mile or two miles on the bottom of the area known as the British Channel.

It will have been observed from the foregoing remarks that I have adopted as the basis of my conclusions the fact that, since the substance of the chalk itself furnishes un-

* Extract from a letter of Sir Charles Lyell's to the author, dated January 24th, 1870.

questionable proof that the quantity of silica *now* present in it is so small as hardly ever to exceed 3 per cent., the close approach to uniformity between the demonstrable percentage of silica in the surface calcareous mud of the existing sea-bed and the *now* also demonstrable percentage in the contents of the hermetically closed nodular cavities (which must in like manner have been derived from the immediate surface mud of the cretaceous sea-bed) warrants the inference that the relative percentages in the equivalent "horizons" of the two formations are equal, and hence that this uniformity must, according to all reasonable probability, extend to every subjacent horizon.

In order to substantiate this inference, however, it is indispensable that some distinct and constant difference should be shown to exist between the mineral constitution of the material contained in such flint-cavities as have from the beginning remained perfectly closed, and those which have never been completely so. I may state that within the past six months I have carefully examined at least two hundred specimens of each kind and that, so far as the experience thus acquired enables me to speak with confidence, I am quite unaware of a single example in which the original organic carbonate of lime of the Foraminifera and other débris obtained from the closed cavities, has not been more or less completely, but never completely, replaced by the organic silica. I say never completely replaced because I have never yet seen any portion of the original calcareous material that yielded otherwise than very partially to the action of hydrochloric acid. As a rule the entire contents, without exception, are composed of chert —that is to say, of a chemical combination of carbonate of lime and silica in every proportion, from the state of nearly pure silica on the one hand, to the perfect form of chert already described by me at p. 49, *antè*, on the other; whilst in the contents of the only partially closed cavities, and notably in the deep external furrows present in some nodular flints, the silicification would seem rarely, if ever, to have proceeded to the same extent; and we find (what is never found in the perfectly closed cavities) calcareous organisms altogether unmetamorphosed. This is most strikingly manifest in the case of "coccoliths," and, as I have recently discovered, of the coccospheres, every one of the latter obtained from the closed cavities being, without exception, silicified to such a degree as to remain perfect in all their details after subjection to strong hydrochloric acid. The explanation of this is sufficiently obvious. In the one case the siliceous materials and included portion of colloidal protoplasm have had an unlimited quantity of carbonate of lime in the surrounding matrix to work upon, and an unfettered access to water. Hence they have virtually been in the same position they would have occupied if simply imbedded in the chalk itself, where they occur in multitudes.

In the other case the silica, carbonate of lime, and protoplasm are imprisoned within a closed wall of adamant, and have had to come to terms as best they could without the least extrinsic aid or interference.

It is moreover specially deserving of note that the occurrence of *silicified* coccospheres in the closed cavities furnishes the strongest presumptive evidence that they and the materials associated with them are of extrinsic origin, and are not, as it were, effete or residuary products derived from the nodular mass itself. For, obviously, these extremely minute structures would have been the first to succumb to silicification by replacement, and consequently to absorption and obliteration in the substance of the flint, had those now found in the nodular cavities ever formed part of it.

Another point upon which I lay great stress is the unmistakable evidence, already alluded to, of the various changes that take place amongst the imprisoned materials, continuing in operation, in certain cases, to the present day.

It is an important circumstance that, in such closed cavities as contain a large proportional quantity of water, the advance from the initiatory condition of the component materials associated with it *is at its minimum*—an apparently paradoxical assertion in view of what was said a few lines back, as to water being the determining agent in the chain of metamorphism under notice. It is, however, no paradox; for what happens is, that the larger the relative quantity of water the larger is the quantity of silica maintained in solution, and the less tendency is there in it to supplant the coexistent carbonate of lime. In this wise the carbonate of lime, obviously the more yielding of the two mineral elements throughout all these operations, is left alone for a longer period.

It is a very remarkable fact, moreover, that the water-containing cavities seem to be most common, and the quantity of water greatest, in those flints which have been obtained from gravel beds, and must therefore, during a very considerable period of their incarceration, have been subject to the mighty turmoil of some ancient coast-line. Unfortunately I have as yet neither had the time nor the appliances for analyzing this water. I can, however, state that it is perfectly clear and limpid when allowed to settle, has no perceptible saline taste, and evaporates with extraordinary rapidity on being laid bare to the atmosphere.

One of the conclusions I draw from the data afforded, is that the period at which perfect consolidation of a given stratum of flint takes place (leaving out of consideration at present the fissure-flint, which involves widely different issues, of which I may have something to say on a future occasion) is contemporaneous with the consolidation of the stratum of chalk underlying it; whereas the period of ultimate consolidation of the contents of the closed cavities would appear to be indefinite. Some have apparently become consolidated at the same time as the enclosing flint nodule. This would seem to have occurred in those cases in which there is no trace of cavity left—the materials, entrapped as almost solid lumps of mud, with no more water than was just sufficient to keep them in a stiff paste, having filled up the entire space and become finally merged as a solid core in the substance of the surrounding wall of flint. In other cases the materials would appear to have become consolidated after an indefinitely lengthened term, leaving central cavities devoid of fluid, and bounded either by a glistening mass of minute quartz crystals or of delicately mamillated chalcedony with an intervening layer of reddish or greenish jasper between the crystalline layer and the substance of the flint. Where water is present in a residuary cavity, so is some remnant of unconsolidated material. Of course, in the whole of the examples of which I have spoken in this paper, I have purposely left out of sight such nodules as have formed around a distinct portion of sponge-structure. They have a perfectly distinct history of their own.

I would here allude to an additional proof I have to offer of the contents of the hermetically closed cavities being in the strictest sense "*inclusions*," as distinguished from any solid material that may have formed part of the nascent flint mass itself. It consists in the important fact that, but for the superior cohesiveness (the "*idio-attraction*" of Mr. Graham) of the nascent nodular masses, and their stubborn refusal to mix with water, in no instance in which free water had been admitted along with solid material in any considerable quantity, as compared with the internal area of the cavities, would the finally consolidated mass be found (as it constantly is found, whether in a finely or coarsely granular state, or a compact and solid cherty mass) resting quite loosely within the cavity like the kernel of a hazelnut within its shell. Under no other possible or even conceivable condition than those resulting from the hermetical closure of the cavities from the beginning, would the imprisoned water have remained to this day unexhausted, even assuming what I believe to be impossible—that the said water, instead of having been directly obtained in the first instance from the Cretaceous ocean itself, had originally formed part of the "combined water"* of the nodule when in its still colloidal nascent condition. On the other hand, it is by no means improbable that, in every case, a limited portion of the contents of the nodular cavities has, during the yet unconsolidated state of the nodules, been expended in thickening, from within, the cherty lining of the interior of these cavities. But it is manifest that, although this would to the same extent diminish the quantity of included material, it could not exercise any material effect on the relative percentages silica and carbonate of lime left within the cavity.

Lastly, where any channel of communication existed between the interior of the consolidated nodular cavities and the outer world, through which water from without could have penetrated, it is evident that in the case of flint nodules obtained from gravel beds, or where a stratified layer of flints had been left exposed to atmospheric influences, such water must have carried along with it foreign substances in a minute state of division or in solution, and that these must have produced a distinctly observable effect upon the imprisoned masses. Under these circumstances, moreover, a means of egress as well as ingress would have been established, so as to permit of the escape of portions of the material from the interior of the nodular cavities, as well as the entrance of some of the materials from without—a state of things which could not for a moment deceive any experienced observer.

It will be seen that in my analysis I do not pretend to have arrived at strict accuracy, but have rested satisfied with supplying an approximate index to the relative proportions of *soluble* and *insoluble* materials only. It must be borne in mind moreover that, on the one hand, there is no question just now pending as to the quantity of residuary substances known to exist only in extremely minute proportions in the materials under examination, and, on the other hand, that silica and carbonate of lime constitute, as a matter of fact, at least from 90 to 95 per cent. of the mass. The point to be determined, therefore, is not whether more or less than from $\frac{1}{2}$ to 3 or, at the utmost, 4 per cent. of the silica present in the chalk is doubled, trebled, or even quadrupled in the material from the flint-cavities, but whether the silica present in the latter corresponds approximately with that met with in the calcareous mud of the existing sea-bed †.

* See a paper "On the Properties of Silicic Acid," by the late Mr. Graham (Proc. Roy. Soc. for June 1864).

† The analysis given below was made at my request, in February 1880, by Mr. W. F. Ward, of the Royal School of Mines. It is intended to

Now the quantity of silica in the recent mud has been variously estimated at from 20 to 30 per cent. of the mass, the carbonate of lime at from 50 to 60 per cent. All I now profess to accomplish is—to show *that my results*, as deducible from analyses of the material obtained from hermetically closed cavities, *correspond very much more closely with the percentages found in the recent calcareous mud than those erroneously supposed* (as I contend) *to represent the original quantity of silica contained in the chalk.* That I have done this much will, I think, be freely conceded. But in order still more firmly to establish my position, I must have such a detailed qualitative as well as quantitative analysis made of the quantity of carbonate of lime which is undoubtedly locked up in the cherty portion of the contents, and rendered temporarily insoluble by its combining with the silica to form the large residue included in my analysis under the head of *insoluble* matter.

There is another point that demands explanation. I have had to balance the percentages of material, as closely as I considered justifiable in the absence of further analytical data, in quite an opposite direction—that is to say, by showing that this large insoluble residue is not pure silica but *chert*, and that the chert found in the hermetically closed nodular cavities, and, indeed, in "the flint" generally, is here as elsewhere a compound of organic silica and lime, which unite, where an organic colloid is present, in almost indefinite proportions. Now the silica in the recent calcareous mud does not exhibit any appreciable trace of intermixture with carbonate of lime. In the contents of the nodular cavities the captive silica and lime have, during the lapse of ages of undisturbed seclusion (the existing conditions being precisely those most likely to favour their union), become closely combined,—the point at which any further combination between the materials was arrested having been the point at which they became *anhydrous*.

The chert of the flints is nearly altogether insoluble in hydrochloric acid. The most perfect form of chert met with

show the percentage of *silica* in seven samples of chalk which were taken by me at various levels from the face of a lofty cliff in one of the pits at Charlton:—

	per cent.
A	0·57
B	0·50
C	0·49
D	0·48
E	0·64
F	0·95
G	0·59

n the cavities is not soluble even in boiling nitrohydrochloric acid. Hence it appears to be not a mere mechanical combination of the lime and silica which produces the extreme hardness, whiteness, and homogeneousness of the porcelain-like form to which I have already called attention, but a truly chemical union between the two substances.

Under these circumstances I leave the analysis to speak for itself. At the same time I annex to it a purely arbitrary and provisional computation of the probable *average* amount of carbonate of lime that had entered into combination with the silica to form the large *insoluble* residue. One third may be too high or too low an estimate; but I am inclined to think it will eventually prove not very far wide of the mark. On these grounds I submit that I have made good the statement with which I opened this paper—namely, that the ancient and recent Cretaceous formations are lithologically identical.

It will be noticed that I have deemed it better, for the present at least, to adhere to the term "*silicification*" than to have continually to repeat the expressions *conversion into chert*, or flinty chert, or cherty flint, as the case may be—since one and all of these would, for the reasons already assigned, be too indefinite to serve any useful purpose. Our scientific vocabulary is already extensive enough to discountenance the addition to it of such a word as *chertification*. At the same time, I confess I do not quite see my way to avoiding it.

In selecting specimens of materials for analysis I have used every available precaution to ensure their having been obtained from really hermetically closed nodular cavities, and being in the condition best fitted to furnish trustworthy results.

The total number of specimens analyzed by me is ten. Of these, six were extracted from the cavities of nodules obtained from gravel beds and four from the cavities of nodules obtained from the Upper White Chalk. Two of those from the gravel beds, however, were analyzed, not for the purpose of comparison, but with a view to determine the source of their exceptionally rich sulphur tint. The number represented in the analysis is therefore reduced to eight.

			per cent.	per cent.	Taking into account 3 per cent. as the approximate quantity of carbonate of lime locked up in the *insoluble* residues, and adding it to the *soluble*, we have:—
From the Upper Chalk.	No. 1, 3, 4, 9	Average. Soluble in acid . .	$52\frac{17}{24}$	$68\frac{34}{72}$	carbonate of lime.
		Insoluble in acid .	$47\frac{7}{24}$	$31\frac{38}{72}$	silica.

				per cent.	per cent.
From the gravel beds.	No. 2, 5, 8, 10	Aveage.	Soluble in acid ..	$44\frac{55}{48}$	$63\frac{13}{126}$ carbonate of lime.
			Insoluble in acid	$55\frac{29}{84}$	$63\frac{113}{126}$ silica.

It only remains for me to express my hope of being able, on a future occasion, to enter more fully into the various remarkable changes which are observable in the materials enclosed within both the perfectly and the only partially closed nodular chambers. I also hope to be able to furnish a series of perfected analyses of the solid materials, and of that most interesting portion of the sealed-up nodular contents—namely, the water handed down to us from that grand old ocean,—all these details being inseparably connected with the flint-question as a whole.

June 16, 1881.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

May 11, 1881.—Robert Etheridge, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "Notes on the Fish-remains of the Bone-bed at Aust, near Bristol, with the Description of some new Genera and Species." By James W. Davis, Esq., F.S.A., F.G.S.

The fossil fishes described in this paper are from the Rhætic bed at Aust Passage. The stratum containing the fish-remains is rarely more than 9 inches thick, often considerably less, and is composed of rounded masses of hardened clay or marl, which, at the time of their deposition, were soft enough to receive the impressions of the coprolites and fish-remains. There are large numbers of coprolites and bones of fishes, as well as some remains of Saurians, mingled with each other indiscriminately. The fishes belong to the orders Plagiostomi and Ganoidei, some of the former being of considerable size. It is inferred, from the intermixture of Saurians and fishes, that the deposit is the result of shallow water existing near land, in which the fishes lived and the Saurians occasionally disported themselves.

Besides the fossil remains of the animals which lived during the deposition of the Aust beds, there are also others which appear to have been derived from the Mountain Limestone and the Coal-measures, representing such genera as *Psammodus*, *Psephodus*, *Helodus*, and *Ctenoptychius*. Fossil teeth of these genera occur scattered rather sparingly through the mass; they are very perfectly preserved, and do not show any signs of attrition. They must, however, be the result of the disintegration of older rocks, or the genera which they represent existed to a much later period than is generally supposed. The following new species were described:—*Ctenoptychius Ordii*; *Nemacanthus filifer*, Ag., varieties *a* and *β*; *Nemacanthus minor*; *Sphenonchus obtusus*; *Hybodus austinensis* and *pustulosus*; *Petalodus*?

2. "On some Fish-spines from the Coal-measures." By J. W. Davis, Esq., F.S.A., F.G.S.

The author described in this paper three species of a new genus of fossil fish from the Carboniferous formation, two of the species having been found in the Cannel Coal of the West Riding of Yorkshire, and the other in the Burghlea limestone, near Edinburgh. *Anodontacanthus* is a straight spine, offering many points of resemblance to some of the Pleuracanths: it has a similarly close-grained microscopical structure; the internal cavity opens terminally at the base of the spine; and it was not deeply implanted in the flesh of the fish. It, however, differs from all the Pleuracanths in being quite free from external denticles; its surface is plain or but slightly striated; whilst that of *Pleuracanthus* always possesses a double row of denticles, either ranged laterally along the exposed part of the spine or in some position between the lateral and posterior aspects of the spine. It is possible that evidence may be discovered which will render necessary the removal of these spines to the genus *Pleuracanthus*; but at present there is no evidence that such is advisable. All the specimens of *Pleuracanthus*-spine found associated with teeth or shagreen have been armed with the double row of denticles; and at present no evidence exists that spines without denticles were associated with remains of this genus. It is therefore considered best to institute a new genus for the three species, with the name *Anodontacanthus*, in allusion to its having no teeth or denticles.

3. "On some Specimens of *Diastopora* and *Stomatopora* from the Wenlock Limestone." By Francis D. Longe, Esq., F.G.S.

Mr. Longe showed and described some specimens of Bryozoa from the Wenlock Limestone of Dudley, which he compared with corresponding forms from the Oolite and later periods, and pointed out the close similarity of the Silurian with the later forms, in respect of the shape and dimensions of the cells, as well as in the habit of cœnœcic growth.

Alluding to some other Palæozoic forms, assigned to the Bryozoa under the generic names of *Berenicea* and *Ceramopora*, he pointed out the difference between the shape of the cells in these forms and those which he had described, and expressed a doubt whether they should be classed as Bryozoa at all.

On the other hand he referred to some specimens described by Professor Nicholson (Ann. & Mag. Nat. Hist. vol. xv., 1875) under the names of *Alecto auloporoides* &c., as having the true Bryozoan cell, and furnishing additional evidence of the existence, in the Silurian seas, of forms of Bryozoa which, though very abundant in the Oolite and all subsequent periods, were not generally supposed to have existed in the Palæozoic period.

4. "On a new Species of *Plesiosaurus* (*P. Conybeari*) from the Lower Lias of Charmouth, with Observations on *P. megacephalus*, Stutchbury, and *P. brachycephalus*, Owen." By Prof. W. J. Sollas, M.A., F.R.S.E., F.G.S., &c., Professor of Geology in University College, Bristol; accompanied by a Supplement on the Geological Distribution of the Genus *Plesiosaurus*, by G. F. Whidborne, Esq., M.A., F.G.S.

The greater part of this paper was devoted to the description of a remarkably fine specimen of *Plesiosaurus* from the *Ammonites-obtusus* zone of the Lower Lias, Charmouth. Its distinctive characters are as follows:—

1. The length of the skull is 19·75 in., taken from the anterior extremity of the lower jaw to the posterior margin of the quadrate.
2. There are sixty-six vertebræ, of which thirty-eight are cervical, twenty-one dorsal, two sacral, and five caudal.
3. The length of the neck is 83 in.; and the cervico-cephalic index is 24·1.
4. The length of the cervico-dorsal series is 136 inches; and the cervico-dorsal-cephalic index is 14·6.
5. The length of the centrum in the anterior cervical vertebræ is equal to the height, and greater than the breadth of the articular face. In vertebra xv. the measurements are—length 2 inches, breadth 1·5 inch, height 2 inches.
6. In the posterior cervical vertebræ the breadth of the articular face is greater than the length or height, but the latter two dimensions remain equal.
7. The neural spines increase in size up to vertebra xl., in which they measure 4·75 inches in length.
8. The neural spines are inclined backwards as far as vertebra lv.; past this, up to lvii., they are inclined forwards; but afterwards they again incline backwards.
9. The humerus and femur are nearly equal in length, the femur being slightly the shorter.

For the species the name of *P. Conybeari* is proposed. *P. Conybeari* agrees closely with *P. Etheridgii* in the relative length of head and neck; but it has eight more cervical vertebræ than the last-mentioned species. In the number of the cervical vertebræ it agrees with *P. homalospondylus*, but has a much larger cervico-cephalic index.

5. "On certain Quartzite and Sandstone Fossiliferous Pebbles in the Drift in Warwickshire, and their probable Identity with the true Lower Silurian Pebbles (with similar fossils) in the Trias at Bud-

leigh Salterton, Devonshire." By the Rev. P. B. Brodie, M.A., F.G.S.

The author notices some previous remarks upon these pebbles, which, in Warwickshire and elsewhere, either occur in the Trias or have been derived from it. To account for these, he supposed that there had been a more northerly extension of Silurian rocks than can now be detected in Central England. The Lickey quartzite has been supposed to have contributed some of these; but the author states that he has not found any one well-defined Llandovery species, but that the most characteristic are Lower Silurian. These pebbles are most abundant south of Birmingham, towards Warwick and Stratford-on-Avon. They agree lithologically with the Budleigh-Salterton pebbles; these, as it has been shown, are partly Lower Silurian, partly Devonian, partly Carboniferous. The author gives a list of species collected by him from the Warwickshire pebbles. Sixteen are present from the twenty-four Lower-Silurian forms found in Devonshire. Notwithstanding their identity, physical considerations forbid the supposition that they have been derived directly from that locality or Normandy; so that it is probable these Lower Silurian quartzite rocks once extended much further to the north.

BIBLIOGRAPHICAL NOTICES.

On the Structure and Affinities of the Genus Monticulipora *and its Subgenera.* By H. Alleyne Nicholson, M.D., D.Sc., F.R.S.E., F.L.S., Professor of Natural History in the University of St. Andrews. 8vo. Edinburgh & London: W. Blackwood & Sons, 1881.

This work is a further result of the continued palæontological researches of Prof. Nicholson, and although perhaps not so generally interesting as his previous volume on the Tabulate Corals, is not a less important contribution to the history of a difficult and variable group of Cœlenterata—the Monticuliporidæ, whose relations and affinities have of late years been the subject of investigation. In his previous work Prof. Nicholson only treated generally of *Monticulipora* and its immediate allies. The matter there given, greatly expanded and improved by more extended observations of his own and other authors', is incorporated in the present treatise.

The general history and literature of *Monticulipora* and the allied genera, including an analysis of the classification of Dybowski, is followed by a chapter on its comparative structure, in which the forms of the corallum, the differential structure of the walls of the corallites as compared with those in *Stenopora* and *Chætetes*, and the surface features are described; under the latter head are the "monticules" (circumscribed areas on the surface of the corallum, which are more or less elevated above the general level), from the presence of which the name of the genus is derived.

Another remarkable superficial feature is the "spiniform corallites," peculiar blunt spine-like structures placed in greater or less numbers round the calices; and these are regarded, for reasons assigned, not merely as appendages of the corallum, but as truly of the nature of peculiarly modified zooids or corallites—a view differing from that of Dybowski, who considered them of the same nature as the peculiar (intramural) canals which are found in various tabulate corals (see also Ann. & Mag. Nat. Hist. ser. 4, vol. xviii. p. 92). Besides these curious structures, microscopic examination brings out the important fact that the corallum of *Monticulipora* is *dimorphic*, consisting of two different sets of corallites, inhabited during life by two different sets of zooids; this is stated by the author to be analogous to the structure which Mr. Moseley has shown to exist in *Heliolites*, the interstitial tubes of which were previously regarded as vesicular cœnenchyma.

The third chapter treats of the development, affinities, and systematic position of *Monticulipora*, in which the author discusses and dissents from its Polyzoan affinities as advocated by Dr. Lindström; the resemblances and differences with *Heteropora* are compared, from which it is inferred "that the points of likeness between the two are by no means so weighty as the points of difference." The affinities of *Chætetes* and *Stenopora* are considered, and also the Helioporidæ.

After pointing out the strong resemblances between *Monticulipora* and its allies and various undoubted corals, principally among the Helioporidæ, Prof. Nicholson is inclined to regard the Monticuliporidæ as an ancient group of the Alcyonaria. With regard to the zoological position assigned to this group, it is evident, from the numerous references cited throughout the work, it was quite an unintentional oversight that the author did not notice that the *affinity* now adopted by him was proposed and clearly foreshadowed by Prof. Duncan ten years ago, in the third report on British fossil corals (Rep. Brit. Assoc. 1871, p. 135), where he places amongst the Alcyonaria *Chætetes*, *Monticulipora*, *Dania*, *Stellipora*, and *Labechia*, and states that the last two genera, together with *Dekayia*, are subgenera of *Monticulipora*, and that *Dania* cannot be separated from *Chætetes*.

Prof. Nicholson also does not appear to have referred to the valuable work of Milne-Edwards, 'Histoire des Coralliaires,' in which much information is given with regard to the so-called Tabulata, under the Chætetinæ (vol. iii. p. 269).

With regard to the subdivisions of the group, Prof. Nicholson proposes to arrange under the family Monticuliporidæ the following genera—*Fistulipora*, *Constellaria*, *Dekayia*, *Monticulipora*—the first three groups, for practical convenience, being retained as distinct *genera*, "in spite of the fact that they have no theoretic claim to such a rank." The last genus is again divided into five subgenera, *Heterotrypa*, *Diplotrypa*, *Monotrypa*, *Prasopora*, *Peronopora*; the general characters and detailed descriptions of the illustrative species of these subgenera occupy the last five chapters. The majority of the species selected for illustration are from the Silurian rocks of America, two are from Europe, and about four from Britain.

The series of well-executed woodcuts and plates illustrating the microscopic structure, copied from sections and drawings prepared by the author himself, together with the clear and elaborate descriptions, will render this work a valuable guide for future observers on a puzzling group of Palæozoic corals; for, as Prof. Nicholson observes, the subject is far from exhausted. The main object has been to record the characters of a number of partially known forms rather than to describe new species—a laudable object in the present state of Palæontology, where in certain groups, such as that now under consideration, the identification and recurrence of species in particular horizons are chiefly based on the characters of external form and aspect.

Note-Book of an Amateur Geologist. By J. E. Lee, F.G.S., F.S.A. 8vo. London: Longmans, Green, and Co., 1881.

Among the various contributions to geological literature, scarcely any having a similar object and tendency to the above work have appeared, excepting the 'Sections and Views illustrative of Geological Phenomena,' by De la Beche, published in 1830.

The facts collected in this volume embody the results of visits to some of the more interesting geological localities in this country and on the continent during the last fifty years; and the sketches and diagrams made on the spot are now given in more than two hundred plates with ninety pages of descriptive letterpress. The author has endeavoured to make the description of the sections and sketches as brief as possible—in fact, to let the sketches speak for themselves, so that any one with a geological eye will at once see why the section or sketch was drawn.

Among the various subjects illustrated we may notice the Lias and Trap rocks of Portrush, the chalk and basalt of the Giant's Causeway, the extinct volcanos and crater-lakes of the Eifel, the granite rocks of the Land's End, the parallel roads of Glenroy, various sketches of the Silurian, Devonian, and Carboniferous rocks, the moraines and glaciers of the Alps, the scenery and rocks of the Auvergne, the physical and geological features around Rome and Naples, the geological structure of parts of Sweden and Denmark, the contours produced by the weathering of different kinds of rocks.

Considering the range of time through which the work extends, one or two of the earlier descriptions might now perhaps be slightly modified and improved; among the later ones a further and more detailed account of the Faxoe beds would have been interesting, in showing the nature and relation of the strata and their fossils, of the Stevensklint and Faxoe limestones to the underlying white chalk with flints.

There appears to be some confusion about the crustacean figured on plate 204, from the Lower Greensand of Atherfield, and referred to *Mecochirus Pearcei*, M'Coy; the latter species is from the Oxford

Clay near Chippenham, and is described in the Ann. & Mag. Nat. Hist. (ser. 2, vol. iv. p. 172), having been previously named by Mr. Pearce *Ammonicolax longimanus*, and considered by him to belong to the hermit-crabs. The specimen figured on plate 204 is the *Meyeria vectensis*, Bell (Pal. Soc. 1862, pl. x.), the *Meyeria magna*, M'Coy. Without any pretensions to be a scientific treatise, the 'Note-Book of an Amateur Geologist' must be regarded as a useful, if not a necessary, appendage to other geological works, in affording a series of accurate sketches of the more interesting geological facts and phenomena collected by the author during many years of travel, and which, with the accompanying descriptive notes, may be considered worthy of being permanently recorded.

MISCELLANEOUS.

On the Embryogeny of the Ascidians of the Genus Lithonephria. By M. A. Giard.

The Ascidian that forms the subject of this note is very common at Wimereux on the lower surface of stones. It is very nearly allied to *Lithonephria complanata*, Alder and Hancock, and *L. decipiens*, Giard, but differs from the latter in its tadpole, which never presents prolongations similar to those of the embryos of the *Molgulæ*. I believe it to be identical with *L. eugyranda* (*Ctenicella*), Lac. Duth. The study of its embryogeny is facilitated by a physiological peculiarity which is rare in the simple Ascidians: the ova are incubated in the progenitive organism; so that we find a great number of different stages of evolution in a single individual.

I have resumed upon this species the investigation of the singular productions which issue from the ovum before the segmentation, and have received the name of *cells of the green layer*, or *granulosa-cells*. These observations absolutely confirm those I made some years ago upon the ovarian ova of *Molgula socialis* and several other simple Ascidians *.

The *granulosa-cells*, without any possible doubt, have an origin exterior to the ovule; they have emigrated from the follicle, or even from some other part of the ovary, and penetrated very early into the vitellus; they are by no means derived from the germinal vesicle, which takes no part in this process. The migratory cells bury themselves deeply in the vitellus, and may even apply themselves to the germinal vesicle; they are always easily discovered by means of very dilute acetic acid. These cells soon become inflated, present a distinct wall, and their contents divide into two, four, and six protoplasmic masses; then the wall disappears, and these masses are by degrees expelled at the surface of the ovum at the moment when, the latter being mature, we see the contractions of the vitellus commence. The action of acids forwards the expulsion of

* Association Française, Montpellier, 1879, p. 768.

the nuclei and the formation of the *granulosa*. I can only compare this series of phenomena to the migrations observed by Pflüger and Lindgren in the cells of the *granulosa* of the higher Vertebrata.

The presence of an abundant nutritive vitellus (of an orange colour) gives rise in our *Lithonephria* to a remarkable condensation of the embryogeny. I shall indicate only two particularly interesting stages.

At the stage VIII. the ovum presents four coloured endodermic cells and four colourless exodermic cells, arranged as in typical cases of epibolism.

At the stage XXXII., and even earlier, the ovum clearly displays the bilateral symmetry of the adult; at the nutritive pole we see six endodermic blastomeres, two large and four smaller ones. At the base of the two large ones six mesodermic blastomeres form a half-equator: three mesodermic spheres are situated to the right of the plane of symmetry, and three to the left; the spheres increase in size from this plane.

At the formative pole twenty cells constitute an exodermic hemisphere: twelve are arranged in two series of six on either hand of the meridian of symmetry; the others form two groups of four cells each, occupying the free space to the right and left between the endoderm and the exoderm.

The study of the segmentation shows that the six mesodermic blastomeres are derived from two spheres which themselves issue from the endoderm, and are situated symmetrically with relation to the median plane at the point of junction of the endoderm and exoderm.

The six mesodermic cells are afterwards covered by the exodermic cells in consequence of the progress of the epibolism; they also become more numerous; the half circlet contracts and acquires the form of a horseshoe. This is the rudiment of the chorda, so characteristic that it has struck all the authors who have paid attention to the embryogeny of the Ascidians; but in the ova with equal segmentation this rudiment appears much later.

I have often insisted upon the point that, in unequal segmentation from the stage IV., the ovum at the stage VIII., which is *physiologically* a *morula*, *morphologically* represents a *gastrula*. In the case now before us the ovum at the stage XXXII. is still *physiologically* a *morula*; *morphologically* it already posseses a middle layer (solid mesoderm), and represents a much more advanced stage of the Ascidians with dilated embryogeny. The embryogenetic condensation might therefore be defined *an advance of the morphological upon the physiological state of the embryo.*

Here, as in all known cases, the *solid mesoderm* produced by two cells derived from the endoderm at the periphery of the prostoma (circle of contact of the exoderm and endoderm) appears before the cavitary mesoderm (enterocœle, cœloma, &c.). The former gives origin to the skeletal and muscular organs; the other forms principally the hæmatic apparatus and the serous membranes properly so called.

As I have indicated elsewhere, striated muscular fibre cannot suffice to characterize either mesoderm, since, in the Tunicata, this element is met with at the same time in the tail of the tadpole and in the cardiac muscular layer (*Perophora*, *Phallusia*, *Ciona*).—*Comptes Rendus*, June 6, 1881, p. 1350.

North-Atlantic Echinodermata.
By MM. D. C. Danielssen and J. Koren.

MM. Danielssen and Koren describe some Starfishes collected in the late Norwegian expedition for the exploration of the North Atlantic.

1. *Asterias spitsbergensis* is a new species, of which several specimens were taken in Magdalena Bay, Spitzbergen, at a depth of 61 fathoms, on a bottom of dark grey clay, at a temperature of 2°·1 C. (=35°·8 F.). At the first glance it resembles *Stichaster roseus*; and in the structure of the dermal skeleton it presents characters approaching both *Stichaster* and *Asterias*, so that the authors were in some doubt to which of these genera it should be referred.

Asterias spitsbergensis has five arms; and the smaller is to the greater radius as $1:4\frac{1}{3}$. The arms are rather thick, not much constricted towards the base, somewhat obtuse at the apex, very convex on the back and sides, where they are beset with spines, which form regular longitudinal series on the sides, and irregular transverse rows on the back. Between the spines, both on the disk and arms, the skin is naked and occupied by tentacular pores. The lower surface is flat. The spines on the disk are larger and smaller; in the middle they are grouped circularly round the central anal aperture. The madreporic plate is oblong, very small, placed immediately above the angle of the arms, immersed in the skin and surrounded with spines. Ambulacral furrows bounded by three rows of strong spines, one turned in towards the furrow, another turned outwards, while the middle row has fewer spines, the ambulacral plates bearing alternately two and three. Outside the outer row is another series of spines, nearly as large as those of the furrow. These are surrounded by pedicellariæ on the outside of the base, while the innermost row has them on the inside; and beyond the outer row, more towards the dorsal surface, there are two rows of small spines also surrounded by pedicellariæ. The disk has no pedicellariæ; but the arms are covered with such organs of different forms. Towards the ambulacral furrows the calcareous pieces of the dermal skeleton become more regular in form and arrangement than elsewhere; they form two distinct longitudinal rows, and are imbricated. Those of the inner row are triangular, and have their inner margin in contact with two ambulacral and two adambulacral plates; their outer surface bears the spines forming the first row outside the furrow. They may be regarded as ventral marginal plates. The outer row are nearly T-shaped; their broad part is in contact with the ventral marginal plates, which they partly cover. They may be regarded as dorsal marginal plates, and bear two spines standing side by side, which form the second row outside the furrow. The colour is orange-yellow, with an intensely red eye at the end of each arm.

2. *Solaster glacialis*, also described as a new species, is known only by a single specimen dredged in N. lat. 72° 27′, E. long. 20° 51′, at a depth of 191 fathoms, on a bottom of sandy mud. Temperature 3°·5 C. (38°·3 F.). Its character is given as follows:—

Body 7-armed. Proportion of the smaller and greater radius as 1 : 3. Paxillæ on the back rather scattered, forming regular series on the arms. Interbrachial spaces beset with isolated spines, otherwise naked. A row of spines along the ambulacral groove. From every ambulacral piece there issue inwards towards the furrow from three to five longitudinally arranged spines, and outside the furrow a similar number of transversely arranged spines. There are twenty-eight small ventral marginal plates, bearing penicilliform paxillæ. The back is dark red, the ventral surface white.

3. *Asterina tumida*, Stuxberg.—Stuxberg's *Solaster tumidus*, described in 1878 from specimens from Novaia Zemlia, was taken at two stations, in N. lat. 67° 24′ and 74° 54′, E. long. 8° 58′ and 14° 53′ respectively, at depths of 452 and 658 fathoms, in water of a temperature below 32° F. Stuxberg's largest specimen measured 25 millim. across; and its larger radius was 14–15 millim. The expedition obtained one specimen measuring 75 millims. across, with a greater radius of 40 millim. The authors figure this starfish, which, however, they remove from *Solaster* and refer to *Asterina*, although only provisionally, as it differs from that genus in the dermal skeleton, which does not present the peculiar arrangement of the calcareous plates in the dorsal surface, in the great abundance of tentacular pores (which are distributed over the whole dorsal surface right to the margins both on the arms and the disk), and also in the concealed marginal plates and their form.

4. *Asterina tumida*, var. *tuberculata*.—A starfish, about which the authors are in doubt whether to treat it as a distinct species or as a strongly marked variety of the preceding, is described by them under the above name. Specimens were taken at two stations, respectively in 76° 22′ and 80° N. lat., and 17° 13′ and 8° 15′ E. long., at depths of 146 and 260 fathoms, with a bottom temperature of 30°–34° F. The colour, which in *A. tumida* is tile-red above, white with a yellowish tinge beneath, in the variety is yellowish red with pale yellow spots on the back and yellow on the lower surface; the madreporic plate and the anus are straw-yellow, and the eyes at the extremity of the arms orange-red instead of deep red. There are five arms, which are longer and narrower than in the type form. The proportion of the radii is as 1 : 2. The back is convex, the lower surface flat. On the back, besides the paxillæ, there are many separate round tubercles, closer together on the arms than on the disk. The madreporic plate is nearly round, nearly equidistant from the angle of the arms and the subcentral anus, but rather nearer the former; the ambulacral furrow has three rows of spines, one of which turns in towards the furrow; the margin is pretty strongly marked, and formed

by the ventral marginal plates, which are very distinct; the dorsal marginal plates are less striking; the plates corresponding to the tubercles of the dorsal surface are much thickened and round. In diameter the specimens range from 25 to 51 millim.

5. *Tylaster Willei*, named in honour of Captain Wille, is a new species representing a new genus of the family Asterinidæ, obtained at two stations, in 71° 25′ and 75° 12′ N. lat., and 15° 40′·5 and 3° 2′ E. long., at depths of 620 and 1200 fathoms on a clay bottom. Temperature −1° and −1°·6 C. (=30°·2 and 29°·1 F.).

Genus Tylaster.

Body convex, pentagonal. Arms short, robust. Skin of the back with no skeleton, but everywhere beset with fine isolated calcareous spines, between which are tentacular pores. Dorsal marginal plates rudimentary. Ventral marginal plates furnished with spines. The interbrachial space of the ventral surface has small calcareous plates arranged in an arched form and having one or more spines. Anus central. Two rows of ambulacral feet without spicules. No pedicellariæ.

Tylaster Willei.

Body convex on both surfaces. The smaller radius is to the larger as $1:1\frac{3}{8}$. Ambulacral papillæ in three series, of which the innermost are the longest. Ventral marginal plates furnished with three rows of spines. In the interbrachial space three curved rows of spines, with isolated spines between the rows. Back tile-red, ventral surface white. Anal aperture and madreporic plate yellow. The species is figured.

6. *Poraniomorpha rosea* is another new species representing a new genus of Asterinidæ, resembling *Porania* at the first glance, but in character approaching nearer to *Asterina*. A single example of this species was taken in N. lat. 61° 41′, E. long. 3° 18′·5, at a depth of 220 fathoms, on a bottom of mud and clay.

Genus Poraniomorpha.

Body 5-rayed, flat below, not very convex above. Anus subcentral. Both upper and lower surface covered all over with fine isolated calcareous spines. Margins sharp, formed by the ventral marginal plates alone, which bear spines. The dermal skeleton on the back consists of small, oval, calcareous pieces, forming a close reticulation with extremely small meshes; on the ventral surface of oblong, flat, calcareous pieces forming rows. No pedicellariæ; no spicules in the ambulacral feet.

Poraniomorpha rosea.

Radii in the proportion of $1:1\frac{2}{3}$. On each adambulacral plate five spines, of which two are directed inwards into the ventral furrow and form one row on each side; the other three form three rows outside the furrow. The ventral marginal plates bear from three to six short obtuse spines. The madreporic plate is sunk into the thick skin. Back rose-coloured; ventral surface yellowish red.

The authors remark that from their investigations upon the genus *Solaster* they are led to the conclusion that neither Müller and Troschel's division of the genus into *Crossaster* and *Solaster*, nor the new genus *Lophaster*, established for *Solaster furcifer*, can be sustained. Their reasons will be given in a forthcoming part of the general report upon the results of the expedition.—*Nyt Magazin för Naturvidenskaberne*, Bd. xxvi. (1881), pp. 177–194, tab. i. & ii.

On Dr. Karsch's Subdivision of the Phrynidia. By A. G. Butler.

My attention has just been called to a short paper in the 'Archiv für Naturgeschichte' for 1880, in which Dr. Karsch makes an effort to answer my criticism upon his previous memoir (see Ann. & Mag. Nat. Hist. ser. 5, vol. iv. p. 313); how far he has succeeded may be gathered from the following sketch of it.

Dr. Karsch commences where I left off, with the serious fact that his genus *Charon* was based upon the *Phrynus Grayii* of Gervais, the type of which he had never seen, and which I find does not possess the characters ascribed to this genus; and he says that I am illogical when I state that this fact necessitates the rejection of the generic name "*Charon*." Dr. Karsch proceeds to explain why this is so: he says that the specimens which he calls *P. Grayii* were so named by Dr. Gerstaecker, and they agree with Hoeven's figure of *P. medius*. If, then, the species described by M. Gervais is distinct, he proposes the name of *C. Hoeveni* for the *P. medius* of Hoeven, and regards the latter as the type of his genus. I must be very obtuse; for I fail entirely to see how this subsequent action on the part of Dr. Karsch proves me to have been illogical in rejecting a genus which, for all practical purposes, had no type at the time when I wrote my article.

In the second place, it may be a matter for grave question whether the genus *Charon* can be retained under that name, since the type is the *P. Grayii* of Gervais and not the *P. Grayii* of Gerstaecker or Karsch. When a man relies upon the authority of a friend, who, however learned he may be, has himself not examined the type of a species, and upon that species bases a new genus, he must be prepared to see it overturned. But Dr. Karsch says he thinks the type of *P. Grayii* may be a monstrosity, or it may have had its hind legs broken off and those of another species stuck on; or, in short, any thing may have happened rather than that the generic name *Charon* should be superseded; and, after a little cogitation, he convinces himself that something certainly has happened to this type, and concludes his paper thus:—" Figure 4 is the hind leg of *Charon*, and, indeed, of that species which is identical with *Phrynus medius*, Hoeven (nec Herbst), and which I believe must indicate *Phrynus Grayii*, Gerv."

The remainder of Dr. Karsch's paper is taken up with an attempt to convince arachnologists that the inconstancy of a generic character is no reason for not relying upon it, his plan evidently being to regard as monstrosities all specimens which do not answer to the generic diagnosis.

On the Influence of the Marine Currents in the Geographical Distribution of the Amphibious Mammalia, and particularly of the Eared Seals. By M. E. L. Trouessart.

In a memoir recently presented to the Academy Prof. Milne-Edwards has demonstrated the influence of the antarctic currents on the geographical distribution of the Penguins. By applying the same laws to the class Mammalia, and more particularly to the group of the Otaries (or seals with external ears), which have a mode of life analogous to that of the penguins, I have arrived at some very important results, which confirm, in the most complete manner, the views put forward by M. Milne-Edwards.

The Eared Seals, in the present geological epoch, seem, like the penguins, to be native to the Antarctic lands, whence they have spread towards the north. Carried by the blocks of ice which the regular currents detach every year from the great southern glacier, these animals have colonized the shores of Cape Horn, the Falkland Isles, the Cape of Good Hope, Kerguelen Island, New Zealand, and Australia—in one word, all lands situated in the south of the New and the Old Worlds. Humboldt's current, in the west, has carried them, like the penguins, as far as the Galapagos Islands, under the equator; but while this extreme limit has not been passed by the penguins, the eared seals, on the contrary, have penetrated into the northern hemisphere. They are found on the shores of California and in the north of the Pacific Ocean; but they have certainly not arrived there by the direct route; for these animals are absolutely unknown on the west coast of America, from Peru to the north of Mexico—a stretch of more than 20 degrees; and, besides, *the Otaries of the Galapagos Islands and those of California belong not only to different species, but to different genera.*

This peculiarity seems at first sight inexplicable; but if we note on a good map of marine currents, and according to the method introduced by M. Milne-Edwards, all the stations where eared seals have been observed, we can easily explain the route followed by these animals before reaching the northern part of the Pacific. It is not the too great temperature of the tropical regions, as might be supposed, but the *presence of contrary currents*, that has banished them from these regions.

The equatorial current of the Pacific Ocean north of the Galapagos Islands, and that of the Atlantic north of the Falkland Islands, are directed precisely in opposition to the migrations of the Otaries. Those of these animals which, having reached the island of Tristan d'Acunha, have then tried to gain the western coast of Africa, have been seized by this current and driven to the west, onto the coast of Patagonia.

Those which have taken up their abode at the Cape of Good Hope have never been able to come up along the eastern coast of the continent, on account of the Mozambique current, which drove them back incessantly towards the south. It is this that explains why the eared seals are wanting in all the Atlantic Ocean north of the Falkland Islands, as well as in the whole western region of the Indian Ocean. Thus there remains only the *eastern* part of this latter ocean; and it is evidently by this route that the migration under consideration was accomplished. Having arrived, as already stated, on the southern shores of Australia, the Otaries have come up gradually on the western coast of that continent, which they still inhabit at the present day. In the north they have arrived as far as Melville Island, off the coasts of Port Essington, where at least two species of this family are to be found.

We know that a secondary current, the direction of which is determined by that of the *monsoon*, puts the Indian Ocean in communication with the Chinese Sea. From April until October, *exactly at the time when the eared seals come up towards the north*, this current is directed towards the north-east and flows into the great basin of the Pacific. This current must have singularly facilitated the migrations of the Otaries, which have been performed through the passages of the Molucca Sea, or by the much broader and deeper course of the Straits of Macassar. Once in the Chinese Sea, these animals gained the coast of Japan; thence, with the help of the great current of Tessan (the *Kur-Sivo*, or "*black river*," of the Japanese), they make the tour of the North Pacific Ocean, following the shores of Kamtschatka, of the Aleutian Islands, and North America, arriving finally at the south of California, which is the extreme limit of this vast circuit.

The proof of this migration is furnished us by the genus *Zalophus*, which still occurs on both sides of the equator—namely at Melville Island, on the coasts of Japan, on those of California, and throughout the northern part of the Pacific Ocean.

Considerations of the same kind may apply to the dispersion of the true seals, which are almost exclusively quartered in the northern hemisphere.

Thus a species of the genus *Pelagius* (or *Monachus*) has recently been met with in the West-Indian Sea. Now hitherto this genus has been considered peculiar to the Mediterranean; but we know that the monk-seal (*Pelagius monachus*), the only species formerly known, has passed through the Straits of Gibraltar; it occurs on the north-west coast of Africa, and as far as Madeira and the Canary Islands. It is probable that some individuals of this species, having been seized on these coasts by the equatorial current which completes the circuit of the Gulf-stream, have been carried to the west as far as the West-Indian Sea, where they have constituted a new form (*Pelagius tropicalis*, Gill).

The geographical distribution of the sea-elephants (*Macrorhinus*) is more difficult to understand. It is the only true seal (comparable in this respect to *Zalophus*) which is found equally on both sides of the equator. In opposition to the opinion of Mr. Allen* I do not think that the starting-point of this type (at least considering it in the present epoch) can be placed in the northern hemisphere; for it is only found there now at one point of the coast of California, while these animals abound on all the coasts of the southern hemisphere. It is much more probable that it is from the island of Juan Fernandez, one of their principal stations in the Southern Seas, that these seals sent forth their colonies as far as California, making a long *détour* by the west of the Pacific Ocean. The Humboldt current and then the equatorial current have carried them as far as the Marianne Islands, skirting all the archipelagoes of Polynesia. From the Marianne Islands this same current has carried them eastward to the Sandwich and Revillagigedo Islands and to the coasts of California, where they constitute a distinct race (*Macrorhinus angustirostris*), now almost entirely destroyed by the wholesale slaughter to which they have been subjected.—*Comptes Rendus*, May 9, 1881, p. 1118.

On the Zoological Affinities of Halysites. By A. E. Verrill.

Of the so-called "tabulate corals" many genera have already had their zoological positions determined. Thus Agassiz, in 1847, ascertained the hydroid nature of *Millepora*; and his observations have been fully confirmed by Moseley and others. That *Pocillopora* and its allies, living and extinct, are true Madreporarian corals was shown by me in 1867. That *Favosites* and the related extinct genera are closely allied to the modern *Alveopora* and *Porites* was also demonstrated by me in 1872†. Moseley, while on the 'Challenger' Expedition, was fortunate in examining the animal of *Heliopora*. He proved that it belongs to the Alcyonaria, and referred to the same group various fossil genera, in some cases apparently without sufficient reason.

The affinities of the genus *Halysites*, the common "chain coral" of the Silurian, have hitherto been very doubtful. Within a few days Mr. H. T. Woodman has shown me a very remarkable specimen of this genus, in which the internal structure is beautifully preserved. In this example, which is a fragment several inches across, the large tubes contain twelve well-developed and regular septa extending to the centre. Their edges are slightly serrulate, and do not rise above the tubes. In other words, the structure is that of a true Madreporarian coral.

Mr. Woodman informs me that this specimen is a fragment from a large mass 8 to 10 feet across, and that "the larger part of the mass was like the common specimens, showing no rays; but here and there, in spots all over the face of the mass, the septa were as well preserved as in the fragment shown to you."—*Amer. Journ. Sci.*, June 1881.

* 'History of North-American Pinnipeds,' 1880, p. 751.
† Amer. Journ. Sci. iii. pp. 187–194.

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⁎ It is requested that all Communications for this Work may be addressed, post-paid, to the Care of Messrs. Taylor and Francis, Printing Office, Red Lion Court, Fleet Street, London.

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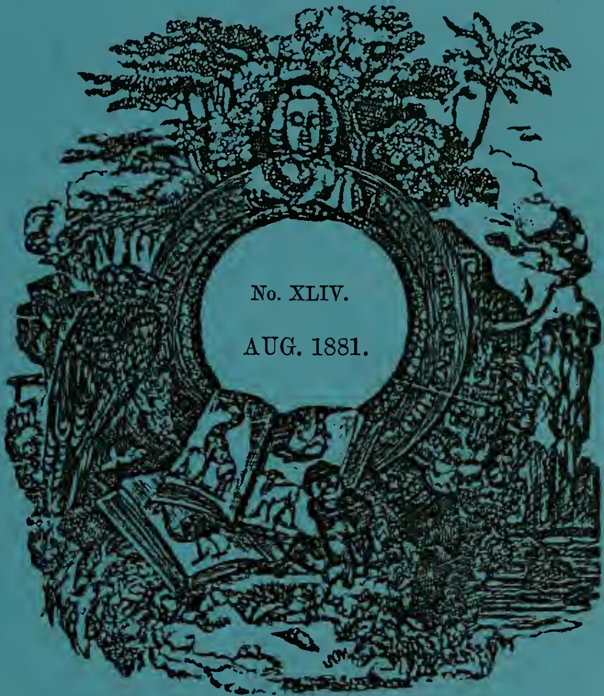

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ERRATA ('Annals,' July 1881).

Page 7, last line of the paragraph on *Steganoporella*, for *Lepralia* substitute *Membranipora*.
Pages 10 and 11, for *Haploporella* read *Monoporella*.

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[FIFTH SERIES.]

No. 44. AUGUST 1881.

VII.—*On the perfect State of* Prosopistoma punctifrons. By M. Albert Vayssière*.

[Plate X.]

The curious Arthropod that is the subject of this memoir was left, until within the last few years, in the class Crustacea, although its principal characters ought to have led to its being referred to that of Insects. It is, indeed, to this uncertainty as to its systematic position that it owes a part of the interest it has aroused.

From the extreme rarity of this animal the naturalists who had to refer to it have not always been able to verify the assertions of their predecessors. This insect was observed and figured for the first time in 1800, by Geoffroy, under the denomination of *Binocle à queue en plumet*, then by Latreille, who indicated it under the name of *Binocle pennigère*, and lastly by Duméril, who gave it the denomination of *Prosopistoma*, after having first of all called it *Binocle pisciforme*. A little later the learned Dean of the Sorbonne, M. H. Milne-Edwards, mentioned it at the end of his 'Histoire des Crustacés,'

* Translated by W. S. Dallas, F.L.S., from the 'Annales des Sciences Naturelles,' 6e sér. tome xi. (1881), pp. 1–16.

expressing some doubt as to the systematic position assigned to it by Latreille.

It was only in 1869 that my friend and collaborator, Dr. Em. Joly, having discovered its habitat in the Garonne, was able to ascertain and establish indisputably the true zoological affinities of *Prosopistoma*. The presence of tracheæ in this animal showed it to be an insect presenting numerous analogies with the larvæ of the amphibiotic Orthoptera, and especially with those of the family Ephemerina. Dr. E. Joly, in a series of memoirs published either by himself alone or in conjunction with his father, Prof. N. Joly of Toulouse, partially made known the characters of the animal, but could never succeed in witnessing its metamorphoses.

In 1878, having undertaken the whole anatomical part of a monograph on the genus, which M. Joly and myself will publish shortly, I was struck, during my first dissections, with the excessive concentration of the nervous system of this animal; and I was thus led to accept the opinion expressed by Mr. MacLachlan as to the probably permanent larval condition of this insect. Having also repeatedly observed that the genital glands sometimes presented a considerable development, I set myself, from that period, to seek for its *reproduction in the aquatic state*; and it was in pursuing this kind of investigation upon some individuals taken in the Rhone at the beginning of April this year (1880) that I was able to observe, first of all towards the end of the same month, the *change of skin* of these insects (which had not previously been noticed), and then on the 3rd of June the *metamorphosis into the perfect insect* of two of them*.

In this way the question the solution of which I had vainly sought during the two preceding years, was at last solved, although in a contrary manner to what I had expected.

These Arthropods therefore, in order to reproduce, followed the same course as the other Ephemerina, with which they were more intimately connected, not only by this fact, but also and especially by the more strongly marked Ephemerine facies which they present in the perfect state.

Before describing this last stage of the *Prosopistoma*, I think it right to say a few words as to the organization of the nymph, and to point out the analogies which exist between it and the nymphs of the genera *Cœnis* and *Bœtisca*.

What especially characterizes our insect in the aquatic state is the complete coalescence of the thoracic segments with the

* I immediately noticed this last fact, in a note which Prof. Blanchard was kind enough to present to the Academy of Sciences in the meeting of 7th June, 1880.

first segments of the abdomen, a coalescence which has superinduced a diminution of the respiratory parts and a more complete localization of those organs. In fact, instead of having, like the generality of the Ephemerina, a pair of respiratory organs or *tracheo-branchiæ* upon the sides of each of the first seven segments of the abdomen, and even presenting them upon other regions of the body (*Oligoneuria*, *Palingenia*), it possesses only five pairs of tracheo-branchiæ; and, further, the first two pairs, which are considerably modified, are of little service in the phenomenon of respiration, although by their movements they contribute to facilitate the physiological action of the following ones.

If, quitting *Prosopistoma* for a time, we examine the number and arrangement of the respiratory organs of the two types previously cited, in which an actual concentration is observed, we find:—

First of all in *Cœnis* or in *Tricorythus** (fig. 1) the tracheo-branchiæ, more or less modified, are reduced to six pairs. The first pair, which is completely isolated in relation to the others, consists of two fusiform bodies placed one on each side on the margins of the first segment; its physiological function must be almost null.

We then find five plates of different dimensions upon the sides of the second, third, fourth, fifth, and sixth segments of the abdomen†. The first consists of two very large and very strong plates destined to protect the following ones, which they can entirely conceal; these plates, which are of a horny consistency, present the same coloration as the integuments of the body; if they do not present digitations on their margins, each of them nevertheless possesses a small tracheo-branchial tuft at its point of insertion.

The other four pairs of respiratory organs are formed by

* It is especially by studying the nymphs of *Tricorythus*, for which I am indebted to the kindness of Dr. E. Joly, that I have been able to ascertain the arrangement of the respiratory organs, and to recognize the perfect similarity that exists in this stage between that genus and the genus *Cœnis*.

† I venture here to point out a small error which Mr. Eaton has left in his monograph of the Ephemerina (Trans. Ent. Soc. London, 1871). In giving the diagnosis of the genus *Cœnis* (p. 92) he says ". . . *Segmentorum abdominis* 1, 3, 4, 5, 6, 7 *branchifera*;" whereas it ought to be "*Segmentorum abdominis* 1, 2, 3, 4, 5, 6 *branchifera*." It is to the posterior margin of the second segment that the respiratory plate is articulated, and not to the margin of the third; for the latter bears the following tracheo-branchia, and so on to the sixth segment inclusive. The seventh segment of the abdomen has never shown me respiratory organs, as, indeed, might be expected, seeing that they could not be protected by the plate covering the four preceding pairs.

plates of much smaller dimensions, presenting numerous digitations on their margins. The respiratory functions being specially devolved upon these organs, it is a matter of course that they do not present the same consistence as the large plates; and their external envelope is even very delicate in the digitate parts.

While we have in this genus a very marked localization of the tracheo-branchial organs, such as is not observed in the commonest Ephemerina, we shall find in the next type a still greater localization, which has induced a concentration of various regions of the body. In fact in *Bœtisca* (fig. 2) we only find five pairs of respiratory organs, all of which fulfil the physiological function devolved upon them. These organs present the appearance of very delicate plates with more or less digitate margins. These plates are not protected, as in *Cœnis*, by one of their number modified for the purpose, but by a considerable development of the dorsal part of the thoracic integuments, which forms a prolongation reaching nearly to the sixth segment, thus giving origin to a sort of large carapace, under the shelter of which the respiratory apparatus performs its functions without running the risk of being damaged by contact with surrounding bodies. The movements executed in these tracheo-branchial plates give rise to a continuous current of water in this great cavity, which is directly in communication with the exterior at its posterior part and sides. The animal can even slightly raise this carapace, at the same time causing its abdomen to execute a movement in the opposite direction, and thus facilitate the introduction of the surrounding liquid.

There is no doubt that an equally great concentration of the various systems of the organism, and especially of the nervous system, is in correlation with this considerable localization of the respiratory apparatus, as also with the coalescence of the thoracic segments.

Let us return now to the examination of the same organs in *Prosopistoma punctifrons*. We observe an equally complete localization of the respiratory organs; but here the general concentration is more strongly marked (figs. 3, 4).

In the first place, the first thoracic segment or prothorax, which in the preceding Ephemerine (*Bœtisca*) was still somewhat distinct, is intimately soldered to the mesothorax without showing any traces of the union at the dorsal surface. The carapace formed by the prolongation of the dorsal integuments of the thorax cannot, in *Prosopistoma*, perform any movements, seeing that it is soldered to the neighbouring integuments by its lateral and posterior margins. The cavity which it forms, and which we shall designate the *respiratory chamber*, is put into communication with the exterior only by three apertures—one dorsal and median, two ventral and lateral. The water destined for respiration penetrates by the ventral apertures (fig. 4, v, v'), and, after having aerated the tracheo-branchiæ, issues by the dorsal opening. This current of water is produced by the movements of the first two pairs of respiratory organs. The two very elongated plates of the first pair are destined to cause the entrance of the liquid by the ventral apertures, while the two large quadrangular plates which form the second pair expel it by the dorsal aperture. The other three pairs of respiratory plates, which can only be detected by removing the quadrangular laminæ, present numerous digitations, which facilitate the interchange of gases *.

Of course the nervous system participates in this general concentration of the integuments of *Prosopistoma*. It consists :—(1) of a pair of cerebroid ganglia, closely applied to one another, and innervating the organs of the senses (eyes, ocelli, and antennæ); (2) of a single subœsophageal or pharyngeal ganglion, which furnishes numerous nerves to the various regions of the head; and (3) of a very voluminous thoracic ganglion, which represents of itself the whole ganglionic chain, and consequently sends forth nervous trunks to all parts of the thorax and abdomen. Upon the contour of this nervous mass we may sometimes observe swellings indicating the original existence of three pairs of thoracic ganglia and of one abdominal ganglion.

I think that the details I have just given as to the organization of *Prosopistoma* in the nymphal state, as well as the resemblance that can be set up between this insect and the nymphs of the two most nearly related genera, will be of service towards the ready comprehension of the importance of the modifications which I have ascertained to occur in the perfect insect, and to justify the uncertainty in which, like many other naturalists, I found myself as to the final state of this Arthropod.

It would appear that the metamorphoses of *Prosopistoma* into the *subimago* and *imago* must take place in the course of June; at least, as I have stated in my note to the Academy, this is the period at which I ascertained the fact, and a period nearly the same as that at which many Ephemerina are metamorphosed.

* It is very probable that the insect at its escape from the egg does not possess tracheo-branchiæ, and that respiration is effected for a certain time through the skin of the general surface of the body; the carapace must be more or less incomplete during this *larvular phase*.

The following are the modifications observed in the nymph when it is on the point of being transformed. During the whole of the aquatic period known to us the integuments of *Prosopistoma* present a very light chitine-yellow tint, nearly white if the insect has just moulted, and more or less marked at other times; but at the commencement of the transformation the colour becomes darker from day to day, and soon becomes very brown. It is especially in the posterior part of the carapace above the respiratory chamber that this coloration becomes very strongly marked, which is easily explained, as it is at this point that the wings are formed, and these, as we shall see hereafter, are iron-grey in the subimago.

At the end of about a fortnight, when the general colour becomes blackish, it is possible, under a low power, to observe by transmitted light the outlines of the perfect insect through the nymphal envelope; and it is then necessary to watch the animal, as the metamorphosis will soon take place. In two or three days one may see the animal cling to a stone partly out of the water, and divest itself of its nymphal integuments; and it is to be remarked that the metamorphosis takes place very early in the morning.

The two parts of the carapace begin to separate in the median line of the body, under the pressure from below upwards exerted by the animal; then the anterior margins of the same region and the posterior part of the cephalic integuments (the epicranium) also separate. The insect can then free its head and the whole of its thoracic part; the buccal organs and the legs escape easily from the nymphal envelope, owing to the state of atrophy in which they always are in the perfect animal. The *Prosopistoma* afterwards frees its abdomen; and at the same moment we see issue from it the wings, which, originally folded longitudinally in three parts, immediately acquire their definitive form. The insect can then take to flight, to go and rest on some point at a distance from the water; and there it divests itself of its subimago envelope.

I have been unable to observe this last metamorphosis of the adult *Prosopistoma*, the two female subimagos that I had having died soon after stripping off their nymphal envelope; it is quite possible that the females of this genus oviposit in the state of subimago, and do not attain that of imago. According to Mr. Eaton the females of various types of Ephemerina only present a single stage in the perfect state*.

* At the end of p. 42 of the Monograph of Ephemerina of the English naturalist (*loc. cit.*) we find the following phrase:—"In certain genera the subimago is the permanent aerial stage of the females."

The facies of *Prosopistoma punctifrons* in this state (fig. 7) resembles that of *Cœnis*; its body is a little shorter in proportion to its breadth, which gives the animal, when its wings are extended, a certain vague resemblance to some Diptera.

The general colour of the integuments of the subimago is reddish brown, darker on the dorsal than on the ventral surface, where the tint even becomes very light at certain points (at the insertions of the legs); the wings are of a pretty dark iron-grey, especially the first pair.

The coalescence of the different regions of the body no longer exists in so marked a manner in the perfect state; on the contrary they are very distinct. I now proceed to give a detailed description of each of them, and to show the importance of the modifications superinduced by the metamorphosis.

The head is slightly triangular in form. When seen from above, it shows in the middle an inflated part bounded in front and on the sides by a sinuous line. In front of this line is the median ocellus, which forms a slight projection beyond it; on each side of this we observe the antennæ, the points of insertion of which are rather on the ventral than on the dorsal surface; behind we see the lateral ocelli placed on each side of the cephalic prominence, at the points where the sinuous line already mentioned becomes confounded with the integuments. The compound eyes occupy quite the lateral parts of the base of the head (figs. 7, 8); in consequence of their position, they are equally visible whether the animal is viewed from the upper or the lower surface.

The ventral or inferior surface of this first region of the body (fig. 8) shows in front the points of insertion of the antennæ; the median ocellus, which, as just stated, is placed between these organs, is more or less distinct according to the inclination given to the body of the animal; further back there is a strongly marked line bounding the *clypeus*, which, in consequence of a special modification, terminates rather low down on the ventral surface. It is in the interior of the concavity formed by the margins of the clypeus that all the buccal organs are placed. The large *labium*, which led to the name of *Prosopistoma* being given to the nymphal state, from its resemblance in this species to a mask (see fig. 4), has become completely atrophied, and leaves exposed the rudiments of the *maxillæ* and *mandibles*; of all the buccal organs the *labrum* is the only one that has retained a well-defined form.

In the dorsal view of the animal (fig. 7) the thoracic region presents an exceedingly short prothorax, the anterior margin of which is slightly convex in the middle, while the posterior margin is a little concave. Then follow the mesothorax and the metathorax, which are closely soldered together and present in their middle an inflated portion, a sort of lozenge-shaped plate; this plate is divided, in the direction of the length of the body, into two equal and symmetrical parts, each of which presents on its inner margin a rather deep notch (which, however, does not go very far), and then posteriorly an emargination. On the lateral parts of this plate there are a series of nodosities and folds, symmetrically arranged on the two sides of the body, and serving as points of insertion for the wings; I think it would be tiresome to enter here into the description of these nodosities, and I shall only say a word or two about them further on in speaking of the wings.

The ventral surface of the thoracic region (fig. 8) shows in front the prothorax distinctly separated from the rest; upon the somewhat lateral parts are the points of insertion of the first pair of legs. These are separated from each other only by a rather wide prominence of a strong reddish-brown colour.

A portion of the mesothorax is distinct on this surface, although its lower two thirds are intimately united with the metathorax. The insertions of the legs of the second and third pairs upon the thorax are placed almost upon the sides of a large strongly chitinized plastron, which of itself constitutes the lower surface of this region of the body.

The abdomen remains to be mentioned. On the dorsal surface (fig. 7) this presents ten well-marked segments, except the first, of which the anterior margin is confounded with the metathorax; but on the ventral surface (fig. 8) it only exhibits eight, the boundaries of the first two having completely disappeared, and their union with the thoracic region being as intimate as possible.

The segments of the abdomen are not all of the same form and the same dimensions. Thus, when seen from the dorsal surface, the second, third, fourth, and fifth segments represent in form each a very wide trapezium; the sixth shows the same form, but reversed, the large base or lower base of the trapezium being in front, while the superior base is behind; it is also much longer than the preceding, but not so wide. The seventh and eighth segments are nearly rectangular, while the ninth presents the appearance of a reversed trapezium, of which the small base is much emarginate; finally, the last abdominal segment, that which bears the setæ, nearly forms a square.

These various segments, which are more convex on their dorsal than on their ventral surface, are not, however, all equally so; thus the sixth segment is a little more inflated than the preceding ones, and the ninth much more so.

The first five segments of the perfect insect represent those which, more or less soldered together, occupy in the ventral surface of the nymph all the space included between the last pair of feet and the lower part of the ventral apertures (fig. 4); the sixth is formed by that to the dorsal surface of which the extremity of the carapace is soldered; the seventh and eighth correspond to the first two free segments of the abdominal region of the nymph; the ninth has nearly the same form in these two states of *Prosopistoma*; for in both cases it performs nearly the same part, namely the protection of the last segment. The latter in the subimago is composed of a dorsal plate, which is homologous with the dorsal surface of the same segment in the aquatic insect, and of two atrophied plates which, placed over the setæ, represent the two plates of the ventral surface of this tenth segment in the larval and nymphal forms of the *Prosopistoma*. The mobility of these inferior plates is far from being so great in the perfect insect, seeing that the setæ have lost the faculty of withdrawing themselves completely into the interior of the penultimate segment. We have observed only four pairs of stigmata, placed on the sides of the dorsal surface of the third, fourth, fifth, and sixth segments; we believe, although we have not been able to ascertain it *de visu*, that there are also stigmata upon the second segment.

It remains for us to add to what has just been said on the form of the various regions of the body, that all the integuments are covered with simple hairs, more or less closely adpressed to each other according to the parts examined; these hairs are also abundant upon the surface of the appendicular organs.

We now proceed to examine the organs of the senses, the legs, the wings, and the setæ, which we have hitherto passed over.

Antennæ.—In the nymph the organs of touch are formed of six joints, which are unequal but have nearly the same form; this is no longer the case in the perfect state (fig. 13), in which the antennæ have only two very unequal joints and a flagellum. The basal joint, of a cylindrical form, is rather short; the second, on the contrary, is at least three times as long, inflated in the middle, and attenuated at the apex; both these joints are of a brown colour, and are also covered with a great abundance of hairs.

The flagellum, which is inserted at the extremity of the second joint, is of itself as long as the rest of the antenna; it is very slender; and its tegumentary envelope, which is destitute of hairs, presents a very pale brown colour.

Compound Eyes and Ocelli (fig. 12).—The compound eyes show a strongly marked black tint; they are inserted upon the outer, lateral margins of the head, nearly at the intersection of these margins with its base. They are hemispherical. On the dorsal surface of each of them, a little behind the middle, we observe a groove, which does not surround it completely. This peculiarity places these organs of vision in the section of *ascalaphoid compound eyes* of certain Ephemerina (*Leptophlebia*). The facets of these organs are not always hexagonal; they often present only four or five sides; or their outlines may even be irregular.

The *ocelli*, with their very convex cornea, are easy to distinguish even by the naked eye, owing to their whitish colour. The *lateral ocelli* are placed within and a little in front of the compound eyes; the *median ocellus*, as already stated, occupies the middle of the space between the antennæ, and is almost in the anterior margin of the head.

Legs.—The organs of locomotion are all atrophied in the perfect insect; this modification, which is observed in a great many other adult Ephemerina, must be in relation to the short duration of the life of the animal in this state; it is therefore very probable that, after copulation (and oviposition in the case of a female), *Prosopistoma punctifrons* speedily dies. We hope that future investigations will soon enable us to fill up this gap.

The legs are very unequal: the shortest are those of the first pair, and the longest belong to the third pair (fig. 14). The colour of these organs is very light brown, depending somewhat upon the thinness of the chitinous envelope, the surface of which also is but little clothed with hairs. The first two joints, *coxa* and *trochanter*, are pretty well formed in all the legs, and are even strongly developed in those of the first pair; the form of the *femur* of the anterior limbs is not much modified, whilst it is more or less modified and atrophied in the other legs. The last three portions, *tibia*, *tarsus*, and *claw*, are always deformed, and often actually twisted into a corkscrew, in all the legs.

In the figure of the insect seen from the ventral surface I have represented (fig. 8) only the first two joints of the first pair; in fig. 14 I have given a representation of one of the legs of the third pair under a power of about 50 diameters. In this last pair the general atrophy is more marked even than in the two others.

Wings.—The organs of flight are greatly developed in *Prosopistoma*, which is not surprising, considering the atrophy of the legs, and the necessity under which the insect in consequence finds itself, of flying throughout the whole of its perfect state.

It has already been stated that the wings are formed above the respiratory organs, in sheaths which only become developed a little while before the metamorphosis of the animal. The sheaths destined to produce the upper wings originate in the interior of the integuments which cover the tracheo-branchiæ—that is to say, under the posterior part of the chitinous envelope of the carapace; the hinder wings are formed in the interior of those two plates which, in the aquatic state of *Prosopistoma*, appear to be formed to protect the points of insertion of the first two pairs of tracheo-branchiæ (fig. 3, *f*). These plates must be formed very early in our animal; for I have always observed them in the same state of development in more than fifty individuals of all sizes. The upper wings, or wings of the anterior pair, affect the form of right-angled triangles, of which the hypotenuses are represented by the anterior margin; their inner margin, as in all Ephemerina, forms the shortest side (see fig. 7).

The longitudinal nervures of these superior wings are not numerous; and transverse nervures are entirely wanting. The base of the two strongest nervures (anterior nervures) constitutes, with a thickening of the margin of the wing, the principal part of the articulation with the two strongest projections observed on the sides of the thorax. Below the two anterior nervures we find three others which do not reach the articulation of the wing; the five following nervures, which succeed one another at nearly equal distances apart, as they approach the inner margin of the wing, terminate at the base of the wing, with the exception of the last, which is shorter and more delicate than the others. The anal nervure starts from a chitinous thickening of the basal region of the organ of flight, and terminates on the inner nargin, nearly at the point where this becomes rounded to form the posterior margin.

The wings of the second pair, of an oval form, are much smaller and more delicate (fig. 11); their principal point of insertion is upon the nodosity which may be noticed on each side of the metathorax at the level of the points of attachment of the last pair of legs. When the fore wings are extended, the apical extremities of the others slightly exceed the abdomen on each side; when the animal is in repose the ordinary position of the wings is the same that is observed in all the Ephemerina: they are placed vertically above the body, and a little inclined towards each other. The inner and posterior margins of these different wings presented long delicate hairs (fig. 10); but the surface itself of the wings was covered with very short and abundant hairs; the latter character occurs in all the subimagos of Ephemerina.

Setæ.—The setæ (fig. 17) are far from showing the same complication of structure in the perfect insect as in the nymph. They are borne by the last segment, in the cavity of which they can no longer shelter themselves, the apparatus destined to make them enter into the interior of the body having become atrophied, because, in the perfect state, it would be of no use to the insect to retract them; the last joint can still, however, in part withdraw itself into the ninth. We no longer observe traces of annulation on the surface of the setæ; and the hairs which clothe them are very short and very irregularly arranged.

I have carefully dissected the only two examples of the subimago that I have been able to procure. Both of them being females, I found in the interior of their visceral cavity a great quantity of eggs (about sixty in each). These eggs (fig. 5) were about ^{1} millim. in length; their form was distinctly ellipsoidal; their surface presented a multitude of pretty strong rugosities, into which the vitelline mass penetrated (fig. 6); and their colour was milk-white. These eggs, from their general external characters, and especially the absence of the hood or cap at their two extremities, greatly resemble those of *Cloë diptera.* After having freed the visceral cavity of all the eggs, I observed the empty state of the digestive tube and the atrophy of all the glandular organs of that apparatus, which had either completely disappeared, like the yellow hepatic layer of the stomach, or partially, like the Malpighian tubes.

The nervous system presented the same degree of concentration as in the nymph. It consisted of a pair of cerebroid ganglia, a cordiform subœsophageal ganglion, and a single large thoracic ganglion representing the whole of the ventral chain.

The tracheal apparatus consisted of two lateral trunks, sending forth numerous ramifications to all parts of the body, and connected with the four or five pairs of stigmatic apertures by means of very short secondary trunks.

As the perfect state of *Prosopistoma punctifrons* is now known, my collaborator, Dr. E. Joly, and myself intend changing the name of the animal, in order to conform to the entomological usage according to which the denomination of an insect should not be derived from a larval character, as is the case with *Prosopistoma*; and it is in the monograph of the genus, which we shall not delay to publish, that the definitive diagnosis of this Ephemerine under its new denomination will be found.

EXPLANATION OF PLATE X.

The numbers placed beside the figures express the enlargement in diameters.

Fig. 1. A nymph of *Tricoryphus* (sp. ?), × 5. *a*, rudimentary respiratory organ of the first segment; the chitinous plate, *b*, has been removed on one side to show the following respiratory organs.

Fig. 2. *Bætisca obesa*, seen from above and drawn from a nymphal envelope, in which the last segment and the antennæ were deficient, × 5.

Fig. 3. *Prosopistoma punctifrons*, nymphal stage, seen from above, × 12. The left half of the carapace has been removed to show, in front, the digestive tube partly concealed by the left lobe of the genital gland; behind, the interior of the respiratory chamber, in which is the sheath of the lower wing (*f*) concealing the points of insertion of the first two tracheo-branchiæ.

Fig. 4. *Prosopistoma punctifrons*, nymphal stage, seen from below, × 12. The last segment, with the setæ, has withdrawn into the ninth segment; at *v* and *v'* are the apertures which give the water access to the respiratory chamber.

Fig. 5. One of the ova found in the body of the subimago of *Prosopistoma*, × 120.

Fig. 6. One of the nodosities of this ovum, much enlarged, × 400.

Fig. 7. Female (subimago) of *Prosopistoma punctifrons*, seen from above, × 14. The stigmatic apertures may be seen on the right side of the third, fourth, fifth, and sixth segments.

Fig. 8. The same, seen from below, × 14. In order to avoid making this figure too complicated, I have not represented the legs of the second and third pairs, and I have left only the first two joints of those of the first pair.

Fig. 9. Base of the inner surface of an upper wing, × 30.

Fig. 10. Fragment of the posterior margin of the same wing, to show the multitude of hairs which cover both surfaces of the organs of flight, × 30.

Fig. 11. Lower wing, × 18.

Fig. 12. Right compound eye and lateral ocellus, in their respective position, × 30. 12 *a* is a hair from the integument of this region, much enlarged.

Fig. 13. Antennæ, × 60.

Fig. 14. Leg of the third pair, × 50.

Fig. 15. Ventral surface of the abdomen of the female subimago, × 35.

Fig. 16. One of the two plates forming the ventral surface of the last segment, × 80.

Fig. 17. The three setæ of *Prosopistoma* in the perfect state, × 80.

N.B. In several of the figures I have not represented the villosity due to the presence of the hairs which cover the integuments and the wings of the subimago.

VIII.—*Notes on Indian Land and Freshwater Mollusks.*—No. I. *On the Discrimination of the Sexes in the Genus* Paludina. By J. Wood-Mason, Deputy Superintendent, Indian Museum, Calcutta, on Special Duty in Assam.

While at Balaganj and Panchuganj, on the Kusiara river, in Central Sylhet, on my way to Cachar, I was struck by the marked difference in size presented by the shells of a species of *Paludina* which lay in thousands at the bottom of the broad and shallow ditches close to the river-bank: shells of two distinct sizes, a larger and a smaller (not, so far as I could see, graduating into one another), were observed. This difference of size evidently not depending upon age, but being probably sexual, I determined to investigate the matter as soon as opportunity offered.

On my arrival at Silchar my native collector brought me, amongst other freshwater mollusks, five specimens of a *Paludina**, belonging to a totally distinct species from the one observed at Balaganj and Panchuganj. Of these, three of the same size were smaller and rather less ventricose than the other two, which also agreed with one another in size. In order to ascertain whether any difference in the external form of the animals accompanied the obvious difference between their shells in point of size, I placed the specimens in a plate of water. In a few minutes the mollusks emerged from their shells; and I at once noticed that, while the acuminate tentacles of the two larger ones were both quite straight, the right tentacle in each of the three smaller ones was strongly bent outwards and inwards upon itself, or hooked and somewhat swollen, and rather more darkly pigmented than its fellow of the opposite side or than the tentacles of the larger ones—an observation which suggested the suspicion that in the former case one had to do with males, and in the latter with females.

To place the matter beyond all doubt, I dissected two of the smaller and one of the larger specimens; and I found in the genital gland and duct of the former two forms of spermatozoa in all stages of development, and in the uterus of the latter ova containing fully-formed embryo Gasteropods with foot, operculum, spirally-lined soft nautiloid shell, upturned proboscis, and all complete.

Considering it desirable that this observation should be verified by the examination of a larger series of examples, I sent the collector to the river for a fresh supply; and he soon returned with seventy-six specimens. These were placed in a basin of water and sorted, like those previously obtained, into two sets, according to the form of the right tentacle; each set was then carefully gone over to see that the sorting had been correctly carried out; and finally the sex of several individuals out of each set was determined by dissection and microscopic examination, with the result of completely con-

* I am indebted to my friend and colleague Mr. Geoffrey Nevill, C.M.Z.S., for the information that the name of this species is *P. crassa*, Hutton.

firming the conclusion already arrived at, namely that males can, in this species of *Paludina*, be distinguished from females by their smaller and less ventricose shells and by their right tentacle being hooked.

Of the seventy-six specimens thirty proved to be males, and forty-six females; the latter sex thus greatly predominated in the series collected; but whether this predominance would be maintained in a much more extensive series is to be doubted, especially as the tendency of most collectors of zoological specimens is to take the fine and to leave the small and juvenile individuals of a species. In each set there occurred only a single aged individual, with the apex of the shell much eroded. Of the forty shells classed as females a few young ones, with the peristome still thin and fragile, and in size equal to and less than males of average proportions, cannot be distinguished from these, and may possibly be immature males which have not yet acquired the hook to the tentacle; but all the rest can readily be distinguished from those classed as males. It is to be expected that individuals of one sex partaking of the characters of the other will occasionally occur, just as in the human species feminine men and masculine women, and in crustacea female crabs with male tails, are met with; and in such cases it may be difficult, if not impossible, for a conchologist to decide upon the evidence of the shell alone to which sex a specimen belongs.

The knowledge of this fact in the natural history of *Paludina* may prove useful to conchologists engaged in working out the fauna of regions or of rocks, such as the Intertrappean beds of the Deccan, in which the genus abounds; but it is far from probable that any other Gasteropodous genera will be found to present similar sexual differences, the large and swollen shell of females in *Paludina* being in obvious correlation with the viviparous habits universal in the genus but unknown in other Gasteropoda, being, in fact, necessitated by the great bulk gradually attained by the uterus as the eggs develop within it into hard-shelled young *Paludinæ*.

In the European *Paludina vivipara* a distinct penis is present, and, according to Owen*, "is closely connected with the right tentacle;" but in the Indian species the penis is altogether aborted, and its function has been transferred to the contiguous right tentacle, which has consequently become converted into a hooked copulatory organ. Analogous to this is the case of the Dibranchiate Cephalopoda, in which one or other of the arms, according to the genus, functions as a penis

* 'Lectures on the Comparative Anatomy and Physiology of the Invertebrate Animals,' 2nd ed. 1855, p. 564.

and is more or less considerably modified in form. And a more remote analogy is offered by male spiders, in which the tips of the pedipalps are curiously modified and perform the duty of conveying spermatophores to the genital aperture of the female.

My collector has since brought me, from a marsh in the immediate vicinity of the station, specimens of *P. bengalensis*, or a species closely allied thereto, in which also the right tentacle is hooked in the male.

Fig. 1.

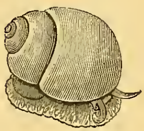

Fig. 2.

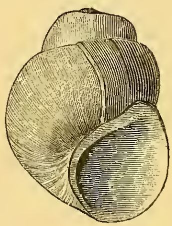

Fig. 3.

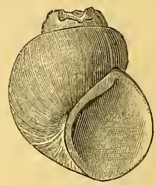

Fig. 4.

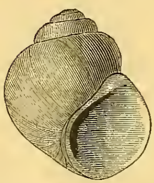

Fig. 5.

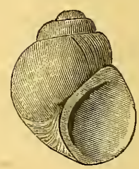

Fig. 1. View of a male *P. crassa*, to show the hooked right tentacle.
Fig. 2. Shell of an aged female of *P. crassa*.
Fig. 3. Shell of an aged male.
Fig. 4. Shell of a female in the prime of life.
Fig. 5. Shell of a male in the prime of life.

Obs. The animals of the two aged specimens have prolonged their body-whorl much beyond the old peristome, corresponding to that of the two in the prime of life.

Silchar, Cachar, April 2, 1881.

IX.—*Description of a new Volute from the South Coast of Australia.* By FREDERICK M'COY, F.R.S., Professor of Natural Science, University of Melbourne.

[Plate VII.]

Voluta Roadnightæ (M'Coy).
(Pl. VII. figs. 1 & 2.)

Descr. Broad fusiform; pullus at apex of spire very large, smooth, spheroidal, oblique, of about $1\frac{1}{3}$ turn; spire conical, apical angle 65°, of four whorls (besides the pullus); turns of the spire moderately convex; body-whorl obtusely angulated a little below the suture; whorls of the spire crossed by from sixteen to eighteen large obtusely flattened prominent ribs, most prominent towards suture, the intervening spaces between which vary from rather more, on the spire, to much less than their width, on the penultimate whorl; ribs becoming obsolete on body-whorl; sloping angulation of body-whorl and spire near suture marked with about ten cord-like subequal spiral ridges, with coarse parallel striæ between them, the intervening spaces twice as wide as the ridges; below or before the spiral striæ on body-whorl the surface is only marked by the obtuse irregular lines of growth, until near the anterior extremity, where about eighteen or nineteen spiral ridges similar to those near the suture appear. Outer lip moderately arched, obtusely thickened and reflected; respiratory notch at anterior end moderate. Three or four large oblique plaits on pillar, the hindmost but one largest; inner lip thin, glassy, spreading. Colour pale brownish creamy white, with acutely angular zigzag, longitudinal, sparse markings of rich raw-sienna brown.

Length 6 inches 5 lines; proportional length of body-whorl $\frac{70}{100}$, of penultimate whorl $\frac{18}{100}$, antepenultimate $\frac{8}{100}$, preceding whorl $\frac{4}{100}$; length of pullus $\frac{4}{100}$, width of pullus $\frac{7}{100}$; diameter of succeeding whorl at suture $\frac{10}{100}$; greatest diameter of body-whorl $\frac{52}{100}$.

This magnificent Volute was found by Mrs. Roadnight, to whom I have had the pleasure of dedicating it, three years ago, when I sent a description and figure for publication, which seem to have been lost, and a copy of which I now forward, as I have recently received several inquiries about this the most striking form among the many Volutes described of late years. In its great size and general aspect it somewhat resembles the fossil *Voluta Hannafordi*, M'Coy*, a fact which did not escape Mrs. Roadnight's notice. It differs, however, in being rather more slender, less angulated, without the conical tubercles of that species, and having the whorls of the spire crossed with narrower obtuse costæ. It is not nearly related to any recent species known to me.

Hab. Southern coast of Victoria, the type specimen having been found on the beach at the Lake's Entrance, Gipps Land.

EXPLANATION OF PLATE VII.

Figs. 1 & 2. Back and front views ($\frac{2}{3}$ natural size) of type specimen.

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* Prodromus of Palæontology of Victoria, decade i. pl. 6. fig. 1.

X.—*On some British Specimens of the "Kammplatten" or "Kammleisten" of Professor Fritsch.* By THOMAS STOCK, Natural-History Department, Museum of Science and Art, Edinburgh*.

[Plate VI.]

PROFESSOR FRITSCH of Prague, in his 'Fauna der Gaskohle und der Kalksteine der Permformation Böhmens' (Prague, 1880), describes† and figures‡, in connexion with *Ophiderpeton*, certain peculiar comb-like plates which he calls "Kammplatten" or "Kammleisten." The evidence of the association seems tolerably complete; for in fig. 1, pl. xx. (*op. cit.*), two detached plates are drawn beneath a group of the "Stäbchen" or scutes which defended the ventral region of the animal's body, and in fig. 5, pl. xx., a series of these plates is represented lying upon a well-preserved fragment of the creature. The series (? a double series), of which an enlarged drawing is given in fig. 6 (*loc. cit.*), consists of six elements, closely approximated to each other, but receding gradually in size from the most externally situated to those lying most towards the interior. Several detached plates are figured, from which it is possible to obtain a correct idea of their general contour and of the different appearances presented as they are viewed on their concave or on their convex surfaces. They are usually, though apparently not in all cases, pectinated along one edge of their more expanded portions; and their handles are in all cases, in the specimens figured, more or less bent inwards and directed towards the pectinated edges. They are ganoid externally, and therefore exoskeletal and probably dermal appendages. As to their origin, Prof. Fritsch suggests that they are perhaps modified ossicles of the ventral armour; and as to their function, that they "wahrscheinlich in der Kloakengegend als Hilfsorgane bei der Paarung dienten."

These curious bodies do not appear to have been preserved in the specimens upon which Prof. Huxley founded the genus§. Mr. T. P. Barkas, F.G.S., however, in a letter to the 'Geological Magazine' for January 1869, drew attention to and gave woodcut figures of two forms from the shale overlying the Low-Main coal-seam of the Northumbrian Coal-measures, which are certainly identifiable with Prof. Fritsch's

* Communicated by the Author, having been read before the Edinburgh Geological Society, May 1881.

† Band i. Heft 2, pp. 119–125.

‡ Plate xx.

§ "On a Collection of Fossil Vertebrata from the Yarrow Colliery," Trans. Roy. Irish Acad. vol. xxiv. 1867.

"Kammplatten," though Mr. Barkas ascribed them to *Ctenoptychius*. Mr. Barkas subsequently* named them *C. unilateralis*, and refigured them in a plate accompanying a communication to the 'Colliery Guardian'†, and in his Atlas of Carboniferous Fossils ‡.

During the past winter Mr. John Young, F.G.S., exhibited to the Natural-History Society of Glasgow§ a specimen from the Blackband Ironstone shales of the Airdrie coal-field, which he referred to the "Kammleisten" of *Ophiderpeton*, after comparing it with Prof. Fritsch's figures and descriptions. Forms of the same general description have been lately detected in the Edge coal series of our own neighbourhood—that is, near the base of the middle division of our Scottish Carboniferous system. Dr. Traquair's *Euctenius elegans*, founded upon specimens obtained from the Black-band Ironstone, worked at Burgh Lee, near Edinburgh‖, is evidently a "Kammplatte.' Dr. Traquair, who has, with great kindness, given me much help in the preparation of this paper, tells me that he had independently arrived at the same conclusion. My friend Mr. W. T. Kinnear, still more recently, has discovered undoubted specimens of "Kammplatten" at the same locality. On a small slab, which he has generously allowed me to keep for my collection, there is an entire plate; and close beside it there is the handle of a second. They are associated with a specimen of *Ctenoptychius pectinatus*, Ag., which is a common fossil at the locality.

I am greatly indebted to my friend Mr. Joseph Taylor, of Shire Moor, for the opportunity of studying three comb plates from Newsham. Mr. John Ward, F.G.S., of Longton, has also kindly allowed me to see some good specimens from the same locality. They do not appear to be rare on the horizon of the Low-Main seam; but they have not yet been recorded elsewhere except at the Scottish localities mentioned. Probably as attention is directed to them it will be found that they are not unfrequent in the Carboniferous rocks of this country. The animals to which they belonged seem to have ranged from the Permian (in Bohemia), through the Coal-measures (in Northumberland and Lanarkshire), down to the base of the Carboniferous Limestone series (in Midlothian).

* In 'Scientific Opinion.'

† 'Colliery Guardian,' March 10, 1871.

‡ Atlas to 'A Manual of Coal-measure Palæontology,' Lond. 1873.

§ Note in 'Science Gossip,' Feb. 1881, p. 44.

‖ "Notice of new Fish Remains from the Blackband Ironstone of Burgh Lee, near Edinburgh," Geol. Mag. no. 199, dec. ii. vol. viii. no. 1, pp. 34–37.

The series which Prof. Fritsch figures* is probably incomplete. From the figure it would appear that it was single; but in his description† he says that it is double, consisting of three elements on each side facing each other. In the figure, too, the edges of the plates appear to be crenulated rather than pectinated—an appearance which must be due to fracture, if the detached plates which he figures really belong to the same species. I must confess that I do not feel satisfied on that point. If his figure 6 really represents any considerable fragment of this problematical apparatus, it seems to me that it would be safer to take that as a guide to the limitations of specific diagnosis than to attempt to graduate into each other from scattered evidence plates so divergent as those represented, for example, by his figures 2, 9, and 10. Of course, without seeing the actual specimens and the whole of Prof. Fritsch's excellent material, it would be unsafe to speak very confidently on the matter; but after an attentive study of his descriptions and figures, and after examining the British specimens, I should be inclined to think that his figures 2, 8, and 13 represent one series, his figures 6 and perhaps 9 another, and his figure 10 possibly a third. At any rate, if the whole of these are to be referred to a single category, I cannot see any reason for excluding his figures 11 and 12 from the same category. The divergence is no greater; yet he considers that they represent a distinct species.

Three additional species of *Ophiderpeton* are described from other evidence; and there seems proof of the existence of a fourth. This fact alone might have warranted, one would have thought, a freer separation of the "Kammplatten" into forms of specific equivalence.

If the series referred to is taken as a guide to the investigation of the value of specific characters, it will be seen that the amount of variation is slight between the constituent elements. Slight differences of form, accompanied by differences in size and in the number of the pectinations, are all the variation that can be detected. The difficulty, however, is increased in detached specimens by the different aspect presented as they are seen on their concave or convex surface. Sometimes they lie on their side with the pectinated edges buried in the matrix; and many of them appear to have undergone distortion. The British forms that I have been able to examine appear to be distinct from those discovered in Bohemia. All the forms that I have seen may be referred to three, or more probably four, distinct series; and

* *Op. cit.* pl. xx. fig. 6. † *Op. cit.* p. 122.

of these two, or perhaps three, have been recognized by previous observers. Mr. Barkas's* figures in the 'Geological Magazine' † apparently represent members of two distinct series. Fig. 1 may be identifiable with the specimen that I have drawn on Pl. VI. fig. 1. The pectination is coarser, however, and the teeth less numerous. Fig. 2 may possibly be referable to my No. 2 (Pl. VI. fig. 2). Mr. Barkas's figures, however, are a little roughly drawn; and I have not been able to see the original specimens. An examination of these might perhaps show that they are distinct. These two specimens were named, I believe, *Ctenoptychius unilateralis*. I have not been able to see either the figures or description of *Ctenoptychius marginalis*, Barkas; nor have I yet seen any specimens in collections so labelled. I cannot, therefore, say whether it is a "Kammplatte" or not. The doubt which I am thus unfortunately obliged to leave surrounding Mr. Barkas's work is of the less importance, as there does not appear to be any immediate necessity of distinguishing the different forms by names. Well characterized fragments or perfect specimens of the animals that bore them may be discovered at any moment with the comb plates attached; and it is perhaps better to wait till the connexion can in this way be satisfactorily established before giving names to their scattered fragments.

The unexpected revelation of these singular bodies in connexion with a genus of Labyrinthodonts, if they do really belong to the genus ‡, makes it probable that as the history of other and allied genera is gradually elucidated, variously modified dermal structures will be disclosed, of whose existence we are at present in ignorance.

Description of the British Specimens of "Kammplatten" in the Cabinets of Messrs. Taylor and Ward and in my own Collection.

No. 1 (Plate VI. fig. 1, nat. size).—Length 1 inch. Handle less than one half of the entire length, thick, gradually tapering to a blunt point. The lamella gradually rises to a

* Mr. Barkas has kindly supplied me with the reference to 'Scientific Opinion,' but omitted to give me the volume and page. I am also indebted to him for a plate from the 'Colliery Guardian,' giving figures of two specimens, apparently the same as those represented in the Geol. Mag. (*vide infrà*). As I have not been able to see 'Scientific Opinion' (a rather obscure and now defunct publication), I am unable to discuss Mr. Barkas's contributions to our knowledge of these bodies as fully as I could wish.

† Geol. Mag. vol. vi. p. 43.

‡ A microscopic examination would help to settle the point.

plane slightly elevated above that of the handle, then slightly sinks again towards its termination. It is 7 lines long, and nearly 2 broad. The variation in the width is slight. The edge looking towards the handle is finely pectinated, the teeth numbering about sixty.

Horizon. Low-Main seam, Coal-measures, Northumberland.

Locality. Newsham.

Collection of Mr. Taylor.

No. 2 (Plate VI. fig. 2, twice nat. size).—In shape this specimen is not unlike a tadpole. On an interesting slab lent me by Mr. Ward there is one of them associated with two forms which are referable, I think, to my No. 3. The association is probably an accident, and does not point, I think, to any serial affinity.

Length 8 lines. Handle bent and probably slightly distorted, longer than the lamella. Lamella 3 lines long; width, where greatest, a third of the length. Shape an elongated ellipse, marked with about twenty-three irregularly-shaped shallow pits or punctures along the middle of the convex area in the direction of the length. Teeth about thirty, but not easily counted.

Same horizon, locality, and collection as the last.

No. 3 (Plate VI. fig. 3, $\frac{3}{2}$ nat. size).—Length 1 inch. Handle nearly straight, slender, and a little longer than the lamella. The shape of the latter cannot be well ascertained. It lies on its side, with the pectinated edge buried in the matrix. It is distinct from the preceding, but is probably part of a series similar to that described under No. 4.

Same horizon, locality, and collection as the preceding.

No. 4 (Plate VI. fig. 4, nat. size).—Three specimens are upon this slab. The smallest may be referable to my No. 2, the largest to No. 3. The shape of the third cannot be ascertained, as it is much broken. The largest plate is $1\frac{1}{4}$ inch in length, and describes a double curve. The lamella is nearly 4 lines broad at its widest part, and is fringed on one edge by a row of minute teeth, numbering nearly a hundred. By the closeness of the pectination it comes near to my No. 1. As more abundant material becomes available a gradation between the two forms may be established. In the meantime, however, it appears best to separate them.

In the collection of Mr. Ward. Same horizon and locality as the preceding.

No. 5 (Plate VI. fig. 5, twice nat. size).—Length ½ inch. Handle stout. Lamella about a third of the whole, 2 lines broad at the broadest part, somewhat elliptical in shape, convex on one side, concave on the other, armed with about fifteen stout closely-placed teeth, which are longest in the centre, gradually diminishing in length on both sides. This plate somewhat resembles my No. 2; but the teeth are much stouter, more erect, and have no definite space between their bases, as most of the previously described forms have. In these characters it approaches the Bohemian examples, and also somewhat Mr. Barkas's figures in the 'Geological Magazine' (*loc. cit.*), if the latter correctly represent his specimens. Dr. Traquair has kindly allowed me to examine his specimens of *Euctenius*; and there can be no doubt of the identity of the two.

Found by Mr. W. T. Kinnear in the ironstone of Burgh Lee, near Edinburgh, and now in my collection.

XI.—*On some Mammals from the North-west Frontier of Kashmir.* By J. Scully.

The following notes are founded on a small but interesting collection of mammals made by Major J. Biddulph during the course of last year in Astor, Gilgit, Yassin, and Deosai—districts in the extreme north-west part of Kashmir or on the frontier of the state in that direction. A note on the mammalian fauna of the first three places above mentioned, with a slight sketch of their physical aspects, will be found in a paper written by me in Proc. Zool. Soc. 1881, p. 197; of Deosai, which I have not visited, I quote the following description from Mr. F. Drew's 'Jummoo and Kashmir Territories,' p. 376 (1875):—

"Deosai is a plateau, a mass of high land, surrounded by yet higher mountains. The centre of it lies 25 miles south-south-west from Skārdū *, while the nearer edge is only 10 miles from that place. There is a ring of mountains, irregular, but still of a general circular form, the diameter of which from crest to crest of the ridge is about 25 miles. These mountains make a rugged serrated barrier of a height of from 16,000 to 17,000 feet. Within this ring is flat, though not completely flat, country, made up of plateaus more or less separated by flat valleys a few hundred feet below

* Skārdū or Iskardo is the capital of Baltistan (Little Thibet), and is situated in lat. 35° 22′ N. and long. 75° 27′ E.

them in level. This flat part varies in height from 12,000 to 13,000 feet, according as we measure a valley or an intermediate plateau, or according as we take the measure away from or near to the mountains."

The collection sent to me by Major Biddulph comprises well-preserved specimens of eight species, on each of which I proceed to make a few remarks.

Martes foina (Erxl.).

Male, Gilgit (5000 feet), October.

Length of head and body 18 inches, tail 10, hairs at end of tail 3, hind foot from heel *s. u.* 3·05, fore foot *s. u.* 2·03, length of ear 1.

Dark brown above and below, the feet and tail nearly black. On the throat and breast a large white patch reaching to the forearms, in the central part of which there are several irregular brown spots. Face and chin earthy brown, palest on the cheeks; ears brown, with complete white margins. The underfur, on all the parts which are brown, is brownish grey. The exposed feet-pads fleshy; claws dusky at base, whitish at tip.

The following are the dimensions of the skull:—

	metre.
Total length from occiput	·080
Inferior margin of foramen magnum to incisors	·071
Posterior margin of bony plate to incisors	·037
Greatest breadth across zygomatic arches	·047
Greatest breadth of brain-case	·038
Least breadth of brain-case behind postorbital processes	·021
Length $\frac{pm.\,4}{}$	·010
Breadth $\frac{pm.\,4}{}$ anteriorly	·005
Breadth $\frac{m.\,1}{}$	·008
Length $\frac{m.\,1}{}$ externally	·004
Length $\frac{m.\,1}{}$ internally	·006
Length of mandible (condyle to symphysis)	·052
Height of mandible to coronoid process	·024
Length $\frac{}{m.\,1}$	·010
Length $\frac{}{m.\,2}$	·004

This specimen is considerably darker and more richly coloured than any specimens of *M. foina* hitherto obtained from Gilgit. In a large series of Beech-Martens from that locality which I have examined there is much variation in the length, softness, and colour of the fur, while the underfur varies from white to brownish grey. There can be little doubt that *M. leucolachnea*, Blanford ('Scientific Results of Second Yarkand Mission,' Mammalia, p. 26, 1879), and *M. intermedia*, Severtzoff (Ann. & Mag. Nat. Hist. 1876, xviii. p. 46), are merely varieties of *M. foina*, and not entitled to specific rank.

Mustela temon, Hodgson.

Adult specimen, Chashi, Yassin (9500 feet), August.

Head and body 9·5 inches, tail 5·5, hairs at end of tail 0·65, nose to ear-orifice 1·45, length of ear from orifice 0·45, hind foot from heel *s. u.* 1·55, fore foot *s. u.* 0·75.

General colour above tawny brown, darker on the head; tail like the back, but tinged with rufous and slightly paler on the lower surface, tip darker brown than the rest of the organ. Limbs externally like the back, but white over the toes. Lips and chin white, rest of lower surface pale yellow.

Measurements of skull:—

	metre.
Length from inferior margin of foramen magnum to end of premaxillaries	·045
Greatest breadth across zygomatic arches	·028
Greatest breadth of brain-case behind posterior termination of zygoma	·025
Least breadth of brain-case behind postorbital processes	·011
Length of bony palate from symphysis of premaxillaries	·022
Length from posterior margin of anterior palatine foramina to hind margin of palate	·018
Breadth of palate between inner tubercles of $\frac{pm.\ 3}{}$	·008
Length of $\frac{pm.\ 3}{}$ along outer margin	·006
Breadth of $\frac{m.\ 1}{}$	·004
Length of mandible from condyle to symphysis	·028
Height of mandible to coronoid process	·013

This weasel is probably the same as the animal included by Dr. Severtzoff in the "Mammals of Turkestan" (Ann. & Mag. Nat. Hist. 1876, xviii. p. 45) under the name of *Fœtorius alpinus*. I employ the specific name given by Mr. Hodgson, for reasons mentioned in Proc. Zool. Soc. 1881, p. 203.

Lutra vulgaris, Erxl.

A young otter captured at Gilgit on the 3rd June, at an elevation of 5000 feet, seems to be referable to *L. vulgaris*. The following is a description of the specimen:—

Head and body 15·5 inches, tail 7·8, nose to ear-orifice 3, length of ear from orifice 0·6, hind foot from heel *s. u.* 2·9, fore foot *s. u.* 2.

Head above and body greyish brown, on the head, upper part of neck, and sides of body with some pale hairs intermixed with the brown ones; the underfur grey. Tail brown above, greyish white below, and blackish brown at tip above and below. Lips, sides of face, and whole under surface greyish white, the underfur greyish brown; lower lip, chin, and centre of throat cream-coloured.

Sciuropterus fimbriatus, Gray.

An example of this flying squirrel, captured at Gilgit in August, at an elevation of 6000 feet, measures:—

Head and body 7·8 inches, tail 9, hairs at end of tail 1·7, nose to ear-orifice 2, length of ear from orifice 1·2, hind foot from heel *s. u.* 2, fore foot *s. u.* 1·3.

This specimen differs a little from the others collected in the district in being whiter below and in having a patch of black on the middle of the back.

Arctomys caudatus, Jacq.

In the collection is a specimen of a young marmot captured in the Deosai plain, at an elevation of 12,000 feet, in July, which is clearly referable to this species. The following is a description of the specimen:—

Head and body 9 inches, tail 3·7, hairs at end of tail 1·8, hind foot from heel *s. u.* 2·3, fore foot *s. u.* 1·5, nose to anterior canthus 1·2, nose to ear-orifice 2·2, length of ear from orifice 0·5.

The nose and lips are black; a black ring surrounds the eye. The top of the head, sides of face and body, and rump yellow tawny; on the nape there is a distinct black band, cowl-like, sharply separating the tawny-coloured head from the back, which is mixed tawny and black, the latter colour predominating; on the whole upper surface and sides the fur is black at the base. Whole lower surface tawny yellow, washed with rufous on the centre of the throat and breast; limbs tawny, slightly washed with rusty and nigrescent on the toes. Tail tawny on basal two thirds, with a central black stripe on the lower surface; distal third of tail black, with yellow tips to some of the hairs.

This example is of interest in several respects. It shows that the coloration of the young animal closely resembles that of the adult, the black cowl on the nape being characteristic;

as in the adult, the length of the tail, including the hairs at the tip, is more than half the length of the head and body. Further, the determination of the species of marmot living on the Deosai plateau, hitherto doubtful, may now be considered settled. Lastly, the specimen described above shows conclusively that the young marmot from Turkestan, referred by Dr. Severtzoff to *A. caudatus* (Ann. & Mag. Nat. Hist. 1876, xviii. p. 50), could not have belonged to that species. The proportions there given are not those of the species under consideration: *A. caudatus* with a tail "8 inches 5 lines" would have the head and body about 17 inches long, not "14 inches 2 lines;" moreover Severtzoff's description of his marmot, where he says that "the head was darker and blackish" in contrast with the general colour of the animal, is exactly the reverse of what obtains in *A. caudatus.*

Mus sublimis.

Mus sublimis, Blanford, Scientific Results of the Second Yarkand Mission, Mammalia, p. 51 (1879).

The following is the description of a mouse collected by Major Biddulph in the Astor district, in September, at an elevation of 11,000 feet:—

Head and body 2·8 inches, tail 4, hairs at end of tail 0·15, nose to ear-orifice 0·8, length of ear from orifice 0·4, hind foot from heel *s. u.* 0·73.

Colour above sandy brown, below greyish white, the colours not very distinctly separated. Fur soft and long, about 0·3 on the middle of the back; all except the tips both above and below slate-grey, the terminal portions of the hairs being fulvous or brown above, and whitish below. On the upper surface numerous long fine black hairs are intermixed with the shorter fur. Face rather paler than the back, the whiskers brown at base and white for the greater portion of their length. Ears well covered with fine hairs, and uniform rich brown. Feet well clad with shining silvery-white hairs; tail covered with short bristly hairs, pale brown above, lighter below. The tail tapers gradually from base to tip, and is nearly half as long again as the head and body; the hind feet are long, with the hinder tubercle large and elongated.

The following are measurements of the imperfect skull of this specimen:—

	metre.
Breadth of frontal region between orbits	·004
Breadth of muzzle in front of infraorbital foramen	·003
Length of nasals..........................	·007

	metre.
Length of anterior palatine foramina	·0035
Length of bony palate from incisors to opening of posterior nares	·008
Length of bony palate behind anterior palatine foramina	·0035
Length of row of upper molars..............	·0035
Distance between anterior molars and incisors.	·005
Breadth of palate between anterior molars....	·003
Length of mandible from condyle to symphysis	·011
Length of row of lower molars..............	·004

The specimen above described agrees fairly with Mr. Blanford's description of *M. sublimis* (loc. cit.); only the tail is nearly an inch longer than in the only example known of that species, the type, a female obtained by the late Dr. Stoliczka at Tankse, west of the Pankong lake in Ladak, at an elevation of 13,000 feet. My specimen, which was obtained miles away from any habitation, is probably a male, and doubtless belongs to the species described by Mr. Blanford. Of the better-known Indian mice this species comes nearest to *Mus urbanus*, but is distinguished by its proportionally longer tail and much longer feet. The habits of the two species are very different.

Lagomys macrotis, Günther.

A specimen obtained near Gilgit, in July, at an elevation of 7500 feet, measures:—

Head and body 7·2 inches, nose to anterior margin of eye 0·92, nose to ear-orifice 1·95, length of ear from orifice 1, hind foot from heel *s. u.* 1·25, fore foot *s. u.* 0·75, hair on middle of back 0·7.

This example agrees fairly with the type of the species; the forehead and crown are rufous. It differs from a specimen obtained in the Gilgit district in October (P. Z. S. 1881, p. 207) in the tips of all the hairs on the back being fulvous, and in not having a rufous gorget.

Lagomys Roylei, Ogilby.

A specimen of *Lagomys* from Deosai (12,000 feet), collected in July, is obviously distinct from the preceding species.

Colour above greyish brown, much mixed with black on middle of back, and rufous on forehead and nape; sides of face and body rufous; lower surface whitish. The fur throughout is dark slate-grey, the tips being rufous on the forehead, nape, and sides of the body, and greyish white on the lower parts; on the back the hairs have fulvous-brown rings near their ends, and black tips. The extremities are clad with pale isabelline hairs above, and ashy-coloured ones below; the feet-pads are black and the claws dusky. The ears are rounded, dusky in colour, and sparsely clad with ash-coloured hairs.

Length of head and body 6·1 inches, nose to eye 0·75, nose to ear-orifice 1·35, length of ear from meatus 0·87, hind foot from heel *s. u.* 1·1, fore foot 0·52, length of hair on middle of back 0·65.

The following are measurements of the skull of this specimen:—

	metre.
Total length	·039
Breadth across zygomatic arches	·021
Length of nasal bones	·013
Width of nasal bones behind	·0045
Width of nasal bones in front	·0053
Width of frontal between orbits	·005
Length of palatine opening	·011
Antero-posterior diameter of bony palate	·002
Width of palate between last pair of molars	·007
Length of series of upper molars	·008
Length of lower jaw from angle to symphysis	·025
Height to condyle	·016

This specimen is, I believe, correctly referred to *L. Roylei*, notwithstanding the difference in coloration and size from the typical example. The type seems not to have had any rufous patches on the fur; but the presence or absence of rufous colours in this genus seems to be of no specific importance. The Deosai *Lagomys* agrees well in size, colours, and cranial characters with an example from Sikkim in Mr. W. T. Blanford's collection.

XII.—*Contributions to our Knowledge of the* Spongida. *Order* II. Ceratina. By H. J. Carter, F.R.S. &c.

[Plate IX.]

Class SPONGIDA.

Order II. Ceratina.

On reconsideration of the order Ceratina ("Notes Introductory to a Study of the Spongida," 'Annals,' 1875, vol. xvi. pp. 134, 135), which was proposed, among others, after an examination of *all* the specimens of Sponges then in the British Museum, I find, since having gone over, in a similar manner, those of the late Dr. Bowerbank, which by purchase have been added to the Museum, that I have something to alter in and add to, respectively, the characters of the three families into which the Order has been divided.

Family 1. **Luffarida.**

As regards the general characters of the first family, viz. the Luffarida, I have little to state more than that the digitate, branched forms, which may be hollow or solid, closely resemble those of the digitate Chalinida in having, when solid, the vents in plurality scattered over the branches, and when tubular or hollow, single only, at the ends of the branches respectively; also that, in addition to the other forms mentioned, they may be thick and fan-shaped,—thus pointing out, in both instances, that form in the Spongida is not to be depended on alone in specific description, while as to size, under favourable circumstances, there seems to be no limit; for the specimen of *Luffaria Archeri*, Higgin, vulg. "Neptune's Trumpet" ('Annals,' 1875, vol. xvi. p. 223), found by Dr. Archer at Belize, and presented to the British Museum by Mr. Thomas H. Higgin, F.L.S., of Liverpool, is 5 feet 5 inches long and $4\frac{1}{2}$ inches thick in its greatest diameter, which is about a foot from the mouth, as I am informed by Mr. Stuart O. Ridley, F.L.S., of the British Museum, to whom I am indebted for these measurements.

Geographically the Luffarida, which appear to abound in the seas between the two Americas, *ex. gr.* Caribbean Sea (De Fonbressin et Michelotti), are also to be found on the S.W. coast of Australia (Bowerbank collection, from George Clifton, Esq.) and in the Levant (British Museum, from Admiral Spratt).

Family 2. **Aplysinida.**

Here the distinction from the Luffarida is chiefly in the relative size of the granular axis to the thickness of the horny fibre, which is the opposite to that in the Luffarida, where the horny element is greatest, and thus the fibre rendered more or less rigid; while that of *Aplysina*, on the contrary, by its thickness, becomes more or less flaccid (Pl. IX. figs. 10, 11), to which may be added, perhaps, a more or less massive lobate form generally, spreading laterally rather than vertically.

Having entered into the history of the Aplysinida preparatorily to describing the species *A. corneostellata*=*Darwinella aurea* ('Annals,' 1872, vol. x. p. 101 &c., pl. vii.), I need not repeat any part of this here; but among the late Dr. Bowerbank's sponges I found some more specimens, from the S.W. coast of Australia and Ceylon (Trincomalee) respectively, which require notice.

Thus, among those from the S.W. coast of Australia is one which, on account of its black colour, nodulated form, and doughy consistence (now hard from dryness), closely resembles the type specimens of *A. aërophoba* from the Adriatic Sea, sent to the British Museum by Prof. Oscar Schmidt; but the "fibre" is different, inasmuch as it is not cylindrical although branched, but scanty and made up of several small incompletely developed fibrils longitudinally fasciculated in an irregularly fluted form (Pl. IX. fig. 1, *h*); so that, in the *transverse* section, it presents a crenulated outline, agate-like, in which the horny laminæ do not entirely surround the axial substance of the different fibrils indicated (fig. 1, *i*), thus constituting a confused composite structure of ill-developed and ill-formed horny material contrasting strongly with the simple, single, perfectly cylindrical fibre of other species (fig. 11). Besides this, it differs from *A. aërophoba* in the presence of dark black-purple pigmental cells (figs. 1, *f*, and 3, *a*), which are so abundant throughout the specimen as greatly to obscure the scantily developed fibre. What the colour when fresh might have been I cannot say; for *A. aërophoba* also, although nearly black in the dried state, is, according to Schmidt's diagnosis, "greenish yellow" when fresh. That the Australian is the same as that which I have noticed under the name of "*Aplysina purpurea*" in my first report on the Manaar specimens ('Annals,' 1880, vol. vi. p. 36), I have no doubt; but having had a very poor supply of the latter for description, this, of course, is correspondingly imperfect. Now, however, I find that not only some of the Australian specimens, but that from Trincomalee, to which I have alluded ('Annals,' *ibid.*), are all of the same species, and among them furnish sufficient for the following amended description.

Aplysina purpurea. (Pl. IX. figs. 1, *a–i*, and 2, *a–c*.)

Form of specimen pyramidal, somewhat compressed, cactus-like externally, light (Pl. IX. fig. 1, Ceylon), or nodular, compact, and heavy (fig. 2, Australia). Colour black-purple. Surface, in the Ceylon specimen, even minutely reticulated in relief (fig. 1, *c*, and 2, *b*) in the dried state, interrupted irregularly by large puckered monticular or cactiform elevations (fig. 1, *b*) more or less obtuse on the summit, where, in a granular form, still darkened by the pigmental cells of the dermis and on a level with the latter, may be seen the termination of the fasciculated fibre in a truncate-like condition (fig. 1, *d*), or, in the Australian specimens, nodular instead of monticular elevations, &c. (fig. 1, *a*, *b*). Pores not seen. Vents scattered here and there in the dermal sarcode (fig. 1, *a a*). Internal structure cellulo-cavernous in the Ceylon species, more compact in the Australian ones. Dermal sarcode fibrous below, charged abundantly with purple pigment-cells above, which also extend throughout the sarcode, but do not enter into the composition of the horny fibre. Pigmental cells now (in the dried state) compressed and oval, but more inflated and globular, probably, when fresh, consisting of a transparent colourless (?) cell-wall containing several spherical granules which are opaque and purple in colour, together with a nucleus (figs. 1, *f*, and 3, *a*); the whole frequently burst and the purple granules let free into the sarcode, where some at least seem to grow into forms respectively like that of the parent. Horny fibre scanty, not simply cylindrical although branched, but composed of a plurality of more or less imperfectly formed fibrils fasciculated longitudinally so as to present an irregularly fluted surface (fig. 1, *h*), the whole together possessing in the transverse section (fig. 1, *i*) an irregularly crenulated figure, agate-like in the linear outline of the horny laminæ, which therefore do not always completely encircle the granular axis of the fibril to which they belong, although this substance occupies their concavities respectively; also, in the Ceylon or Trincomalee specimen, a great number of amber-coloured "horn-cells," whose composition and gradational growth longitudinally would appear to indicate that from such the fibre originated (fig. 1, *g*). Size of specimen from Trincomalee (which is pyramidal and compressed in shape, with a kind of shoulder in the form of another pyramidal lobe on one side) 5 inches high, with a base 5 inches long and 2 inches thick; that of the largest Australian specimen (for there are two, massive and irregular in form) 4 inches long, $2\frac{1}{2}$ inches broad, and $1\frac{1}{4}$ inch high. (Pl. IX. fig. 1 represents the upper *half* only of the Ceylon specimen, natural size.)

Hab. Sea-bottom on hard surfaces.

Loc. Coast of Ceylon and S.W. Australia.

Obs. As the full-grown specimens of a sponge frequently differ in form, so the Ceylon specimens of the species are cactiform on the surface and cellulo-cavernous in the interior, while the Australian ones are nodular on the surface and more compact internally. How far the doughy compactness of the latter may arise from partial decomposition and drying afterwards, I am unable to state, for the specimens being filled with sand, appear to have been washed about in the waves on the beach some time before they were picked up for preservation.

Pigmental Cells and Origin of the Sponge-Ovule.
(Pl. IX. figs. 3–9.)

The so-called "pigmental cells," which are by no means confined to the order Ceratina, are in most species of *Luffaria,* as well as in *Aplysina,* striking objects under the microscope, from their dark opaque carmine-purple colour, sharply defined outline, and compressed elliptical or globular form, averaging about 1-2000th inch in diameter (fig. 3, *a*); but in a dried specimen of a digitate branched species of *Luffaria* from the West Indies, in the British Museum (which is of a pinkish-brown tint), as, indeed, in the well-preserved specimen in spirit from the Levant, presented to the British Museum by Admiral Spratt, they are not so deeply coloured, although in other respects they present the same appearance (fig. 3, *b*); while in the European species of *Aplysina,* viz. *A. carnosa* and *A. corneostellata,* they are not only still lighter, but much less defined in their outline, possessing an elongate irregularly stellate form, in which the ray-like processes of the cells, more or less prolonged into thread-like forms, seem to be connected with each other. This is well seen in a large globular well-preserved specimen in spirit of the "fine Turkey sponge" of commerce (*Spongia officinalis*) from the Black Sea, where, on the upper surface, they are dark purple in colour, becoming *colourless* towards the base; and in another, but dry specimen, of the same kind of sponge from the West Indies, on which the dermal sarcode is *absolutely black,* the colour fades off gradually where extended into the sarcodic lining of the larger excretory canals, until, beyond a certain distance inwards, it disappears altogether, thus apparently indicating that, as in plants, the colour is deepest where the cells are most exposed to the light, and *vice versâ*: yet this can hardly be the case always; for the dark-purple pigmental cells are almost as abundant in the flesh of *Aplysina purpurea* and *Ianthella* (which will presently be described) internally as in the dermal sarcode.

In no instance have I found the pigmental cells so large or so defined as in *Stelletta aspera* and *Dercitus niger* (fig. 8), where they are elliptical or globular, and average 1-170th inch in diameter, contain a large colourless nucleus (fig. 8, *a*), and are otherwise filled with a great number of brown spherical granules (fig. 8, *b*), each of which is also nucleated and averages 1-6000th inch in diameter ('Annals,' 1871, vol. vii. pp. 7 and 4 respectively, pl. iv. figs. 14 and 6). The "granules" are just as brown and large in *Chondrilla sacciformis*, but in this, as well as in *C. nucula* (where they are smaller), have no definite arrangement, being grouped together irregularly in small parcels of four to twelve granules, each without any appearance of *cell-wall* whatever (fig. 9). Similarly composed are the pigment-cells of the Ceratina, to which I have alluded as "so-called," because in no instance have I been able to demonstrate a *cell-wall* by chemical reagents, any more than in *Amœba*; hence all that can be stated in this respect is that the nucleus and granules appear to be suspended in a sarcodic substance which, in some of the Ceratina, and in *Stelletta aspera* &c., has a definite elliptical or globular form *like* that of a "cell;" while the "parcels" of granules in the two *Chondrillæ* just mentioned have no defined form at all, and but for their being thus congregated might be generally distributed throughout the filamentous trama (fig. 6), of which the substance of these sponges is chiefly composed, for the colouring effect which they produce.

Again, if we return to the pigmental or coloured cells of *Aplysina carnosa* &c. and *Spongia officinalis*, they will be found to possess the irregularly stellate form mentioned, in which the ray-like processes are prolonged into pseudopodial appendages that unite with each other. This is particularly well seen in fresh specimens and those which have been preserved in spirit of *Dysidea* (*Spongelia*) *fragilis* (fig. 4), where, although colourless, or nearly so, on the surface as well as in the interior, these cells are the centres of a network of pseudopodial reticulation which spreads throughout the sponge, and is so soft and delicate that, on drying, the whole structure is irretrievably lost in the gum-like consistence which it then assumes.

Thus the well-defined pigmental cell with its deeply coloured purple granules, as well as the stellate form with its lighter ones, may be fairly assumed to have been produced by evolution from a pseudomorphous *uncoloured* condition; while, on the other hand, the dermal cell, when more elongated, might lead not only to the elliptical form (fig. 5), but to the fusiform filamentous element (fig. 6), of which the general structure of *Chondrilla* &c. is chiefly composed, whereby, still possessing its contractile or polymorphic power, the whole mass might, in combination, be subjected generally or partially to this motive influence; for change of form cannot be effected without motion.

Here it should be remembered that all the soft parts of a sponge are polymorphic, and that, as they are all evolved from a single cell at the commencement, they are only parts of the same unit modified to meet their respective requirements (figs. 5, 6). Hence it has appeared to me that while the cells (spongozoa) of the ampullaceous sacs (Geisselkammer) are uniciliate and take in food, there may be others scattered through the parenchyma which have no cilium and are more particularly *ova-bearing*, whereby the presence of the ova in the midst of the parenchyma, and not in the ampullaceous sacs, might be explained. That there are sponge-cells there under an amœboid form (that is, without cilium), but with pseudopodia, which are interunited and capable of taking in food (carmine, fig. 7), has been pointed out by Metschnikoff in *Halisarca Dujardinii* (Zeitschrift f. wiss. Zoologie, Bd. xxxii. p. 372, Taf. xxi. fig. 4), after which my illustration is taken.

The presence or absence of the cilium in the sponge-cell (spongozoon) is of no account; for, although provided with one when first liberated under water from the ampullaceous sac, the cilium may be seen to soon shrink back into the cell itself, which in its turn supplies the locomotive power by polymorphism, creeping about like an *Amœba*. This power of being able to put forth or retract the cilium I have long since pointed out in *Acineta tuberosa*, Ehr. ('Annals,' 1865, vol. xv. p. 287, pl. xii. figs. 9–11), as being worth remembering in a physiological point of view generally.

Returning once more to the "pigmental cells," it is remarkable that, although chiefly confined to the surface and outer part of the large excretory canals, they are not always so; for in *Ianthella*, as will be seen hereafter, they are not only present in the sarcode generally, but also enter largely into the composition of the horny fibre, both the dermal sarcode and the fibre being analogous in their skeletal uses according to the requirements of the case—thus affording an external skeleton in *Geodia* (the petrous crust), and an internal one in the fibrous sponges (viz. the "fibre").

Moreover the colouring-matter, which appears to be born on the surface of the granules, often becomes separated from them and diffused throughout the sponge, leaving the granules themselves more or less colourless (in fact, just as they might be if not exposed to the light); or the diffusion might be confined to the sarcode of the pigmental body suspending the granules, and thus the former present a defined outline similar to a cell-wall, especially when dry.

Aplysina fusca. (Pl. IX. fig. 11, *a–f.*)

There is another species of *Aplysina* in the Gulf of Manaar, of which I could only give a short description on account of the limited supply; but it also appears to grow on the south-west coast of Australia, as a specimen among the late Dr. Bowerbank's sponges indicates. In size this specimen does not exceed 2 inches in diameter; thus, although sufficient for identification, it adds very little to my description of *A. fusca* in the first Report of the Manaar specimens (*loc. cit.* p. 36). The dried sarcode, too, presents the appearance of dry thick glue, and contains *no* purple pigmental cells, although an equal number of such cells without pigment (that is, nearly colourless) are especially congregated towards the surface, together with large cylindrical fibre (fig. 11), whose branches, intertympanized by the sarcode, give rise to a cavernous internal structure much coarser and larger than that of the Manaar specimen. On account of the large size of the fibre, averaging in its greatest thickness 1-24th inch in diameter, wherein the horny laminæ (fig. 11, *b*) are comparatively loosely united to each other and the granular axis very large (fig. 11, *a*), it affords a convenient object for microscopical dissection and examination of these elements, of which the former (that is, the horny laminæ), when viewed edgewise in a transverse section, appear to be composed of cells (especially the outer ones), like those of *Ianthella* (fig. 14), but of course without colour, and therefore very faintly foreshadowed. To this fact I shall have to allude again in the next article.

Aplysina inflata, n. sp.

Cylindrical, somewhat curved, hollow, closed at each end, rendered more or less irregular by the presence of mammiform bud-like projections here and there. Colour dark brown tinged with purple, becoming greenish black-grey after much exposure. Surface ciliated or fringed by the projection of the filamentous ends of the fibre beyond the reticulation of the interior. Vents large, scattered here and there over the surface, and terminating singly at the summit of each of the mammiform projections. Pores not seen. *Internally* hollow, bladder-like; wall very thin, composed of a single layer of reticulated fibre, whose interstices are tympanized by the sarcode, which, in the dried state, are translucent. Fibre round, aplysinoid (that is, more or less flaccid from the large size of the granular core or tube compared with the thickness of the kerasine wall); kerasine fibrillous in structure longitudinally, especially after much exposure and, perhaps, drying in the sun. Size 4½ inches long by 1½ inch in diameter.

Hab. Marine. Attached to a bivalve shell.

Loc. Coast of S.W. Australia, Freemantle.

Obs. The chief character of this species is its inflated bladder-like structure and consequently thin wall, together with its filamentous surface and the fibrillous composition of the fibre after exposure.

Aplysina compacta, n. sp

There is still another specimen from the south-west coast of Australia in the Bowerbank collection, which, although much worn and only $2\frac{1}{2}$ inches in diameter each way, bears evidence of an altogether different species. The mass in form is irregularly lobed; black in colour, with an irregular although smooth surface; the sarcode charged throughout with intensely black-purple pigmental cells, and the fibre small, short-meshed, reticulated, and abundant, so that the internal structure is more compact than cavernous. On account of its massive amorphous state and the granular core of the fibre prevailing greatly in size over the thickness of its horny investment, I have named it "*Aplysina*;" but otherwise the fibre, from its uniformity in size and short uniform reticulation, yellow colour when denuded of the black sarcode, and great abundance, simulates that of *Luffaria*; so slightly do some of the species of these families differ from each other!

Family 3. **Pseudoceratida.**

Here I must at once correct an error which partly led me to propose the formation of this "family," viz. the impression that an Aplysian fibre internally might be combined with a spiculiferous one on the surface; hence I named the supposed species "*Aplysina chalinoides*," gave this as part of the character of the "family" ('Notes' &c., *loc. cit.* p. 132 &c.), and placed it among the typical illustrations (*ibid.* p. 192); but on examining it more particularly I found out that it was a tubular digitate *Chalina*, in which the acerate spicules of the fibre *internally* had become absorbed, leaving a granular axial tube or core with horny exterior, of a dark amber-colour, exactly like that of *Aplysina*, while the small fibre of the surface still retained its spicules. Hence "*Aplysina chalinoides*" must be expunged, as well as that part of the character relating to it, in the diagnosis of the Pseudoceratida (*loc. cit.*), viz. "or passing into a dermal layer of proper spicules like that of the Rhaphidonemata,"—a misleading change, which is not confined to one species of *Chalina* only, but may occur in others of a similar kind, and has thus been mentioned to prepare the student for dealing with it accordingly.

Aplysina capensis, n. sp.

This is the species to which I have alluded in my "Key to the Classification of the Spongida" (*loc. cit.* p. 192) as one of those illustrating the Pseudoceratida, whose description having been promised in the third part of my "Notes," is for convenience here given, as follows:—

Form massive, lettuce-like, foliate; leaves, fronds, or laminæ continuous, plicate, thin, erect, proliferous; sessile. Colour pink or mulberry-purple. Surface uniformly papillated by a thick incrustation in the form of a reticulated structure in relief, wherein the interstices correspond to depressions and the knots to papillæ, from the summits of which respectively the attenuated terminal end of a fibre for the most part projects. Incrustation composed of foreign bodies—*ex. gr.* quartz-grains, fragmentary sponge-spicules, frustules of Diatomaceæ, &c. Pores and vents respectively situated in the "depressions" of the incrustation, which are tympanized at the bottom by the dermal sarcode *alone*. Internal structure cellular; cellular cavities formed by the sarcode intertympanizing the intervals between the branches of the fibre. Sarcode dark purple when dry, pink by transmitted light, charged more or less with pink but not opaque dark purple cells: colour diffused, not confined to the cells; many foreign bodies in the sarcode, viz. quartz-grains &c. Fibre amber-coloured, branching, reticulated longitudinally by intertransverse portions, more or less flaccid when dry, from the small amount of horny element and the large size of the axial tube or core, which here and there also contains foreign bodies, *ex. gr.* quartz-grains &c. Size variable, that of the specimen about 2½ inches in diameter all ways; a little broader than high, and somewhat expanded towards the top.

Hab. Marine, on hard objects.

Loc. Port Elizabeth, Cape of Good Hope.

Obs. This species, which is placed among the Pseudoceratida on account of the presence of foreign bodies here and there in the fibre, seems to be allied to *Aplysina carnosa* and *A. corneostellata*, as well as the British species *A. nævus*, dredged on board H.M.S. 'Porcupine' between the north of Scotland and the Färöe Islands ('Annals,' 1876, vol. xviii. p. 229, pl. xii. figs. 1 *c* and 2). *Aplysina capensis* is remarkable for the great variety of sponge-spicules and Diatomacean frustules in its incrustation, indicating the great variety also of Sponges and Diatomaceans that must exist in the locality where it grew; while the pink colour which characterizes it, being due to the presence of the dermal sarcode more or less among the white foreign bodies, becomes much darker in the dried sarcode internally where it is without them (No. 1, reg. no. 71. 5. 12. 1, Brit. Mus.).

Ianthella, Gray.

This sponge is placed among the Pseudoceratida for having, like the foregoing, foreign bodies here and there in its fibre. The genus was first established by the late Dr. J. E. Gray (Proc. Zool. Soc. Lond., Jan. 14th, 1869, p. 49), although long before specialized by Pallas, followed by later authors under the names respectively of *Spongia basta* ("Vox basta pannum grossius significat") and *S. flabelliformis* (see Gray *l. c.*). There are three thin specimens in the British Museum under a glass case, bearing my "running no." 529. The central one, which is the largest, viz. *Ianthella flabelliformis*, Pall., registered "42. 6. 16. 5," is fan-shaped, 11 × 9 inches; and on either side are two others, one of which, bearing the name *Ianthella basta*, Pall., has no number, and the other, called by Dr. Gray "*I. Homei*," is registered 57. 11. 18. 200. The former of these two is vase-shaped, 8 inches high and 5 inches in diameter at the mouth, with a hole at the bottom, indicating that it also was fan-shaped first, and then, as usual, became converted into a vase-shape by approximation and union of the opposite borders, except at the bottom, where the "hole" or incompleted union now exists; the latter is but a flat, thin, fan-like fragment about 5 × 6 inches in diameter.

For this genus, as before stated, the late Dr. Gray proposed the name of "*Ianthella*;" and the three specimens to which I have alluded, which are noticed in his paper under the names respectively of *I. flabelliformis*, *I. basta*, and *I. Homei*, are generically and specifically described; but there is nothing stated of their histological character, which character renders the genus as remarkable as it is unique among the Spongida. I allude chiefly to the composition of the fibre, in which the dark purple pigmental cells of the sarcode generally are so numerous in each horny lamina, that the latter not only appear to have been produced by them, but the fibre throughout, when viewed under the microscope by transmitted light, presents in colour one of the most beautiful objects that can be conceived, on account of the contrast between the clear, transparent, amber-looking horny laminæ and the purple pigmental cells in them, rendered bright carmine by transmitted light (Pl. IX. figs. 12–14).

All the specimens come from the Indian Ocean; and they do not appear to be uncommon, although the unique histological structure to which I have alluded has not, to my knowledge, been heretofore pointed out by any one but myself.

I found one small, rugged specimen without label among the late Dr. Bowerbank's collection of sponges; but it appears to have come from the south-west coast of Australia or the Indian Ocean; and although only a fragment (consisting of the remains of two thin fronds united at their base) altogether measuring about 5×3 inches, the fibre and dry black-purple sarcode filling up the interstices of the thin lattice-like structure are quite sufficient for identification, while the former, from its large size, here 1-12th inch in diameter at the base of the specimen, seems to ally it to *I. Homei*, Gray; yet, as Dr. Gray states (*l. c.*) that the latter "chiefly differs from *I. basta* in the network appearing to be thicker and stronger," and "is only a young and partly-developed specimen," while *I. basta* has received its designation also from the *coarseness* of its fibre, being like "bast," it may be that future observation will identify the two, which thus differ from the more finely-fibred latticed one, viz. *I. flabelliformis*. The fibre, however, of Dr. Bowerbank's specimen not only appears to be coarser but more oblique in the interstices of its reticulation than that of *I. flabelliformis*, which, on the other hand, is more quadrate. As its histological character will be more particularly mentioned in the "Development of the Fibre in the Spongida" generally, which I propose to consider in the next article, there is no occasion for entering into it more at length here.

The generic description given by Dr. Gray (*loc. cit.* p. 50) may, however, be rendered more complete by adding to it the following histological characters, viz.:—"Sarcode charged with dark purple pigmental cells, especially numerous on the surface and in the horny laminæ of the fibre, which appear to be secreted by them (fig. 12). Core of the fibre granular, grey or colourless, often enclosing foreign bodies, but no pigmental cells."

XIII.—*On the Development of the Fibre in the* Spongida.

By H. J. Carter, F.R.S. &c.

[Plate IX.]

For a familiar example of the fibrous structure in the Spongida the sponge, of commerce may be instanced, as consisting of nothing else, all the soft parts having been abstracted, leaving only a resilient mass composed of what will henceforth be called "fibre," while the horny material of which the fibre is chiefly composed will be termed "kerasine" (κέρας), "resembling horn, horny, corneous."

To all who are acquainted with this fibre, it must appear no less true than inexplicable how it can be so formed as in most cases to become axiated or cored with foreign bodies, or by spicules formed by the sponge itself.

Tracing, then, the development of the fibre through the different orders of my proposed classification of the Spongida ("Notes" &c. *loc. cit.*), we find that there is none in the Carnosa (ex. gr. *Halisarca*); that it makes its appearance in the Ceratina (*Luffaria*), where it is composed of horny laminæ axiated by a granular core; that foreign bodies appear within this core in the Psammonemata (*Hircinia*), and in the Rhaphidonemata (ex. gr. *Chalina*) spicules formed by the sponge itself, which are equivalent to the "foreign bodies" in this respect; and so on throughout the other orders, where the spicules are held together by more or less kerasine.

With reference to the presence within the fibre of foreign bodies or spicules developed in the sponge itself, it might at once be assumed that this *must* have preceded the formation of the laminæ of horny material which enclose them, and that these bodies *must* have been placed there by that developmental intelligent power whose existence in every organized product is only known to us by its manifestations.

Our object, however, is not to endeavour to find out what this power is, which may be said to be able to do any thing with every thing and every thing with any thing so far as we can see, but to observe the nature of the material and the sequence of its adaptation in the formation of the fibre.

With this view it is first necessary to briefly define the elementary composition of the material of which the fibrous sponges are composed; and this may be divided into the soft and hard parts—the "soft parts" consisting of a transparent granuliferous substance (polymorphic when alive), in which are suspended nucleated granuliferous cells more or less alike but of different functions, the ampullaceous sacs, the sperm-sacs, and the ova when developed, all together usually called the "sarcode" or "parenchyma" ("syncytium," Häckel*). But of these, the part of most conse-

* How far the whole of this may not be composed of a congeries of polymorphic cells or bodies, and the transparent granuliferous substance itself ('Annals,' 1849, vol. iv. p. 91, pl. xiv. fig. 2, *d d*) a united mass of them, in which their individualization can be no more distinguished than

quence to remember here is the "transparent granuliferous substance" ("sarcodine" and "granula," Häckel), as this is the primordial element of the single ovicell or ovum from which by evolution all the rest is developed; whilst the "hard parts" consist of the grey or colourless granular core (fig. 10, *a*), which may also contain foreign bodies or spicules developed by the sponge itself, according to the species, and of the horny laminæ or kerasine (fig. 10, *b*), which together form the fibre.

Now, if we examine microscopically the fibre of *Luffaria*, the axial structure will be found to consist of the granuliferous core just mentioned, which, being comparatively soft and colourless or of a light *grey* colour, contrasts strongly with the external part, which is horny, concentrically lamellated, and of a transparent brown or *amber* colour. Both these structures are sharply differentiated; and in thin transverse sections the axial one becomes so separated from the horny cylinder that it may be picked out and easily examined under a high magnifying-power (say 450 diameters), when the granuliferous substance of which it is composed closely resembles the "granuliferous transparent substance" of the sarcode, while the granules, which are yellowish and opaque, appear to be spherical (? *cellulæ in embryo*), and become, when dyed with red aniline, much deeper in colour than the rest (Pl. IX. fig. 11, *f*).

Thus the question arises whether the horny layers of the fibre are formed by successive additions to its interior through the granuliferous substance, or whether they are supplied by the sarcode or parenchyma externally.

If we follow the axial substance of the interior, say in the Psammonemata, where the fibre for the most part is cored with foreign bodies, it will be found that the axial substance encloses these bodies, which, indeed, are incorporated with it, and the same with spicules in the Rhaphidonemata &c., so that the granuliferous core might be inferred to exist *before* the horny part of the fibre was supplied; while if we examine the purple sponge (viz. *Ianthella*) to which I have alluded in the concluding part of the preceding article—wherein the nucleated cells of the sarcode, taking on a pigmental action, become strikingly defined by their opaque deep purple colour rendered carmine and translucent by transmitted light

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that of two *Amœbæ* under similar circumstances, future observation must determine. I have already pointed out that the "investing membrane," or dermal sarcode, of *Spongilla*, in which the *pores* are situated, is thus composed ('Annals,' 1857, vol. xx. p. 24, pl. i. figs. 1, *bbb*, 6 & 7).

under the microscope—the horny laminæ may be seen to be almost wholly composed of them in a more or less flattened state, corresponding with the thinness of the lamina in which they are imbedded (figs. 12, *b*, and 14, *b*); while in one specimen, viz. that from Dr. Bowerbank's collection before mentioned, where the cells and their coloured contents have so disappeared as to leave *nothing but their empty cavities*, the horny laminæ present nothing but a reticulated structure of kerasine (tinged with carmine from the escape and diffusion of the colouring-matter), and the axis consists of the colourless or grey granuliferous substance already described. Again, if by taking a very early development of this fibre, in which it is very thin, we lessen the number of the horny laminæ one after another down to the axial granuliferous substance, the *last horny layer* (fig. 13, *b*) will be found to possess comparatively very few pigment-cells, where it rests immediately on the granular core, which, on the other hand, contains none (fig. 13, *a*).

So that, in fact, we are reduced to the conclusion that the horny laminæ were not only deposited on the grey granuliferous axis, but the horny material itself was formed by the *pigmental cells*, which would become substantiated if the horny laminæ generally (that is, in all other sponges) presented this cellular structure in an equally evident degree; but they do not; on the contrary, the higher the magnifying-power that is put upon them in most other sponges but *Ianthella*, the more homogeneous their composition appears to be. Even in the Luffarida and Aplysinida, where the pigment-cells are as purple and as defined as in *Ianthella* itself, there is not a vestige of them to be seen in the horny laminæ.

Thus we are compelled, so far as the *purple* pigmental cells are concerned, to attribute the formation of the horny laminæ either to the grey granuliferous substance of the *axis* on the one side, or to the granuliferous transparent sarcode of the general parenchyma on the other—either to the addition of the laminæ internally from the axis, or externally by some other agency.

Studying the early development of the axial substance, which, being so like the granuliferous transparent portion of the sarcode or parenchyma, can hardly be distinguished from it, in the absence of the horny laminæ, it is not uncommon to find in the Aplysinida *separate* globular horn-cells more or less elongated and branched, arrested on their way to the formation of fibre, and thus rendered abnormal products, in all of which the grey granuliferous material occupies the axis (fig. 1, *g*); so that I have long since termed such bodies "horn-cells" ('Annals,' 1873, vol. ii. p. 6, pl. i. fig. 7, *d d*). Moreover the fibre may present interiorly towards its termination a number of conical lines indicative of a succession of layers arranged after the manner of a bud (*ibid.* 1872, vol. x. p. 107, pl. vii. figs. 5–7), but added to the surface and not produced, as in the vegetable bud, from the axial substance. Hence the horny laminæ would appear to be deposited on the granuliferous axis by the sarcode or parenchyma, although by what element of it in particular there is no evidence to show.

So far, then, we may infer that the axial substance is polymorphic and can enclose extraneous bodies, foreign or formed by the sponge itself, as the case may be, thus supplying the mould or core, and determining, in the first place, the position and extent of the kerasine fibre, which is afterwards deposited on it by the sarcode or parenchyma to complete the formation of the fibre.

However acceptable this view may be in the main, it should be remembered that the axial substance under the microscope is very like the "transparent granuliferous sarcode" of the sponge generally, and therefore that it may possess the means of covering itself with a layer of kerasine in the first instance, although the sarcode of the sponge generally may supply the subsequent ones, since in many of the Hydroida the horny sheath *must* be formed by the *core*, for there is no other soft substance externally, although where there is a fleshy layer externally, as in *Hydractinia*, the horny structure produced by the "horn-cells" in the first instance may be subsequently thickened by it ('Annals,' 1880, vol. v. p. 455).

I have stated that the horny laminæ of sponge-fibre *generally* do not present a vestige of cell-structure; and in no instance, except *Ianthella*, are they composed of *coloured* pigmental cells; but I have also noticed in my description of *Aplysina fusca* (antè) that, when viewed on their edges in a transverse section, the horny laminæ *here do* present a faint *colourless* appearance of cellular structure, especially in the outer layers, which seem to lose it and become more homogeneous as they become older or more internal, evidencing, as in the specimen of *Ianthella* from Dr. Bowerbank's collection, that it is formed by cells which in the fully-formed laminæ are obliterated; while if this be the case generally, then it may be inferred that the horny laminæ are produced from horn-secreting cells in the parenchyma. Where the pigmental cells of *Ianthella* are empty, as in the instance to which I have just alluded, the cellular structure of the fibre is manifest; but it is still, as before stated, tinged of a carmine colour by the pigment having passed into the kerasine. The faint lineation of the colourless cellular structure in the fibre of *Aplysina fusca* (fig. 11, *b*, *c*), although too indistinct for representation, nevertheless presents somewhat of the appearance in form of that of *Ianthella* in the transverse section (fig. 14, *b*). I should also mention that in the abortive (?) horn-cells of *Aplysina purpurea* many of the granules of the axial substance often present a dark purple colour like those of the pigmental cell, and that, in size, the smallest horn-cell hardly exceeds the dark pigmental cell itself (fig. 1, *f*), in which, too, the dark purple granules are most distinct; so that it seems as though the horn-cell originated in the pigmental one; and yet there are no *dark-purple* pigmental cells to be seen in the horny fibre of *A. purpurea* as in *Ianthella*, although the sarcode of the former is equally charged with them (see a description of the pigmental cell, *antè*, p. 104).

As the spicules formed by the sponge itself have been mentioned among the "hard parts" of which the skeletal structure is composed, it may not be without interest to add here that they appear to be developed in a similar way, although certainly, in some instances at least, first originated in nucleated cells and then ejected into the sarcode or parenchyma for completion ('Annals,' 1874, vol. xiv. p. 100, pl. x. figs. 3–15, and pl. xxi. figs. 26, 27); also that, occasionally, arrested spherical, elliptical, and elongated forms of the spicule are present analogous to the "horn-cells" above mentioned (fig. 15). This is particularly the case in a specimen of *Dictyocylindrus laciniatus* from the Mauritius, to which I have before alluded ('Annals,' 1879, vol. iii. p. 297), as it is with the "horn-cells" in the specimen of *Aplysina purpurea* from Trincomalee. Further, it may be observed that the *ornamental* parts of the spicule are the last parts added to its structure (*ex. gr.* the small spines on the anchoring-spicule of *Hyalonema*, 'Annals,' 1873, vol. xii. p. 371, pl. xiv. fig. 9, *f*, &c.), and that the horny fibre is frequently accompanied by a foreign body attached to its surface by an extension over it of the last formed horny lamina, indicating in either instance that the sarcode or parenchyma, at least, has the power of producing both substances ('Annals,' 1872, vol. x. pl. vii. fig. 4, *f*).

Analogous, however, as the sequential growth of the fibre and the spicule in the sponges may be, they are not homologous, any more than the bones and ligaments in the higher animals; and but for a single instance, viz. that published in 1865 by Fritz Müller in *Darwinella aurea* (Archiv f. mikroskop. Anatomie, Bd. i. p. 344, Taf. xxi.), wherein some of the fibre has a stellate or rayed form, there is not another recorded instance in which there is the slightest resemblance of the horny fibre to the thousand and one known forms of spicules which exist among the sponges. And even here Fritz Müller's "favourite" hypothesis (*loc. cit.* p. 351), viz. that in evolutionary development a horny form of the sponge-spicule precedes the siliceous and calcareous ones, is not borne out by the facts that in the first order, viz. the Carnosa (according to my classification), the first family, viz. the Halisarcida, possesses neither fibre nor spicules, that the second family, viz. the Gumminida, possesses spicules but no fibre, and that it is not until we reach the Ceratina and other orders that the *fibre* is developed. So with the development of the sponge from the ovule, the spicules of the species are already seen in the embryo, while the fibre does not appear until the embryo has become fully developed into the young sponge ('Annals,' 1874, vol. xiv. pls. xxi. and xxii. fig. 34, respectively).

Again, if I am right as to the sequential way in which the fibre and the spicule are formed, the core or axis receives in the one as well as in the other its respective coverings *at once*, and not by transition; that is, the kerasine alone is deposited in the former and kerasine suspending silex in the latter. Thus Schmidt's statement, in 1866, that the siliceous spicule, when deprived of its silex by fluoric acid, leaves a horny form ("Hornnadel," Spong. Adriatisch. Meeres, 2nd Suppl. p. 21), by no means confirms Fritz Müller's hypothesis, as was intended, which, in an evolutionary point of view, as before shown, is not substantiated by either phylogenetic or ontogenetic development.

Moreover I have studied *Darwinella aurea* myself independently, as my naming a specimen *Aplysina corneostellata*, which came from the N.W. coast of Spain, will show, and find that to identify the stellate development of the fibre with the spicules ("Nadeln") of a sponge requires a stretch of imagination which the anatomical facts, forms, and measurements that I have long since published ('Annals,' 1872, vol. x. p. 101, pl. vii.) do not justify, any more than the phylogenetic and ontogenetic development to which I have just alluded. Hence I do not think that the term "Hornnadeln" should be applied to this fibro-stellate structure.

I can see no more analogy between the fibre and the spicule than that above mentioned. They are as distinct from each other as the ligamentous structures and bones of the human subject, where, under normal conditions, the former never become the latter nor the latter the former.

Thus, then, my study of the development of the fibre leads me to the inference that the granular core is able to produce a kerasine layer at first, but that subsequent ones are added by some other agent of the sarcode or general parenchyma; while the kerasine is supplied by the pigment-cells in *Ianthella* simulated by faint cell-structure in *Aplysina purpurea*, but in no other instance that has come under my observation have I been able to see this.

Other facts bearing upon the fibre and the spicule respectively might be mentioned here with advantage, viz. that the interior of a Rhaphidonematous fibre may have the whole of its spicules removed by absorption, and the core so transformed into a simple granuliferous tube, while the horny part still remains unaffected, that it becomes almost identical with the fibre of *Aplysina*, and that, too, while the acerate spicules in the circumferential fibre remain intact, as I have before mentioned (p. 109)—which led to my calling the specimen "*Aplysina chalinoides.*"

Again, it is not uncommon to find the core-spicules in both the Rhaphidonemata and Echinonemata only *partly* absorbed, although the horny fibre in this case also remains perfectly intact. Here the spicule is often obliterated, all but the central canal and a single fragment of its entire calibre in the centre, whereby it presents the form of a spindle—which at first appears to be a new form, but is subsequently proved, by the presence of others in different degrees of absorption, to be otherwise, and the true form of the spicule thus found out.

Nor is it uncommon to find the central cores of spicules themselves so enlarged that the siliceous portion is more or less reduced to a mere continuous film while its extremities are still *closed.*

All this points out that the spicules within the fibre and the internal part of the spicule itself may undergo absorption without any evident contact with the element by which they may be surrounded.

I have said nothing of the glassy fibre of the vitreous Hexactinellida, because it, *mutatis mutandis*, is the same as the horny fibre; and, of course, in the Lithistina there is no fibre at all, where its office is supplied by the interlocking of the filigreed extremities of the branches of the spicules.

EXPLANATION OF PLATE IX.

Fig. 1. *Aplysina purpurea*, from Trincomalee. Upper half of the specimen, natural size. *a a*, vents; *b*, monticular elevation, magnified 2 diameters; *c*, reticular subdermal structure; *d*, dermal termination of fibre; *e*, group of pigmental and horn-cells; *f*, pigmental cells; *g*, horn-cells (scale 1-48th to 1-6000th inch);

h, fragment of the fibre, lateral view; *i*, the same, transverse section (diagrams).

Fig. 2. The same, from S.W. Australia. Fragment, natural size. *a*, lobule, magnified; *b*, subdermal reticulation; *c*, dermal termination of fibre.

Fig. 3. Pigmental cells of the Ceratina. *a*, dark opaque purple; *b*, light-coloured pinkish brown.

N.B. The opaque purple pigmental cells in this illustration are made *generally* dark for contrast, or as they appear under a low magnifying-power; otherwise their elementary composition is similar to that of the light-coloured pinkish-brown ones, with the exception of the pigment.

Fig. 4. Pigmental cells of *Dysidea fragilis = Spongelia*.

Fig. 5. The same, elongated, ? muscular.

Fig. 6. Filaments of the trama in *Chondrilla nucula* and *sacciformis*; ? filiform cells.

Fig. 7. *Spongilla*. Sponge-cells of the parenchyma containing fragments of carmine. *a*, carmine, after Metschnikoff (Zeitschrift f. wiss. Zoologie, Bd. xxxii. Taf. xxi. fig. 4).

Fig. 8. *Stelletta aspera* and *Dercitus niger*, pigmental cells of. *a*, nucleus; *b*, granules.

Fig. 9. *Chondrilla sacciformis*. Pigmental granules, in irregular groups as they occur, viz. without cell-definition.

N.B. Figs. 3–9 inclusive are on the scale of 1-24th to 1-6000th inch.

Fig. 10. *Luffaria*. Fragment of the fibre, to show the relative size of its component elements. *a*, granular axis; *b*, horny laminæ.

Fig. 11. *Aplysina fusca*. Fragment of the fibre, to show the relative size of its component elements. *a*, granular axis, tubular, membranous; *b*, horny laminæ; *c*, transverse section; *d*, granular axis; *e*, horny laminæ; *f*, fragment of granular axis, greatly magnified; *g*, transparent sarcode; *h*, granules.

Fig. 12. *Ianthella*. Fragment of the fibre, lateral view. *a*, granular axis; *b*, horny laminæ, chiefly composed of pigmental cells.

Fig. 13. The same. Fragment of small fibre, lateral view. *a*, granular axis; *b*, first horny lamina bearing a few pigmental cells.

Fig. 14. The same. Transverse section of the fibre, showing the horny laminæ and their pigmental cells edgewise. *a*, granular axis; *b*, horny laminæ.

N.B. Figs. 10–14 inclusively are all diagrams.

Fig. 15. *Dictyocylindrus laciniatus*, Mauritius. *a*, abortive development of the spicule; *b*, cells of the parenchyma. (Scale the same as that of fig. 1, *e*, for analogical contrast.)

XIV.—*On an Organism which Penetrates and Excavates Siliceous Sponge-spicula* (Spongiophagus Carteri). By Prof. P. Martin Duncan, F.R.S., Pres. Royal Microscop. Soc., &c.

In a communication which I made to the Royal Microscopical Society on June 8, 1881, the presence of green-coloured cells on siliceous sponge-spicula, in relation to minute penetrations into their axial canals, was asserted. The occurrence of a granular plasma of the same tint within enlargements of the axial canals was noticed; and the penetration and erosion were stated to be due to the organism. The cells which were observed within hollows on the surface of spicula, and also on perfect spicula in positions where erosion from without inwards could readily occur, were very small,—not more than $\frac{1}{7000}$ inch in length, and very much less in height. Their dimensions, however, corresponded to those of certain circular patches with hollowed-out bases, which are the first stages of the penetration through the spicule down to the axial canal. The penetration of the spicule down to the central canal is followed by the growth of the organism, which appears to erode the silica and enlarges the canal in a most remarkable manner.

After a while the spicule suffers solution of its continuity by the thinning from within, and the thinnest flakes present a granulated appearance.

Since writing that communication I have observed siliceous sponge-spicula, obtained from great depths, which are affected by an organism whose cells are much larger and whose penetrations therefore are wider and much more visible. On the head of a large spinulate spicule I found many circular pits, each containing an organic mass without definite cell-wall, and yet granular and green in colour by transmitted light. These pits are shallow and are $\frac{1}{2000}$ inch in diameter. Similar pits and of the same dimensions are seen on other spicula; but they are deep and resemble cylindrical tubes with hollowed-out bottoms. Some reach the axial canal, which has become enlarged. The penetrations contain granular organic substance; and so do the enlarged axial canals. The walls of the enlarged axial canals are frequently very irregularly eroded and look "worm-eaten;" the hollows are, moreover, green with the very visible granular matter.

Thus there are two dimensions of the penetrations. The first kind of cell found on the spicula resembles somewhat the simple zoospores of *Achlya penetrans*, nobis (Proc. Royal Soc. vol. xxv. pl. vi.); the second is larger; and in both there is a decided green tint. No ramifications of the penetrating cylindrical tube occur; and it pierces perpendicularly to the surface of the spicule, or, it may be, slightly aslant.

The presence of pits on the surface of sponge-spicula was noticed by Kölliker as a peculiar degeneration of the structure. Dr. Carter described and figured pits in the outer part of a spicule, and distinctly referred them to the action of a vegetable cell, in the Ann. & Mag. Nat. Hist. ser. 4, vol. xii. p. 457, pl. xvi. figs. 8, 9. None of the pits seen by my friend reaches the axial canal; but some of them terminate in globular excavations.

It is evident that the assimilation of the organic substance in the sponge-spicule by the vegetable organism produces the destruction of the siliceous structure; and probably the colloid silica unites with the protoplasm of the destroyer and forms an organic compound with it.

Large cells and small nucleus-like cells operate, producing penetrations of corresponding diameters through the spicula down to the axial canal. The vegetable growth occurs there; and the amount of erosion does not appear to be in relation with the size of the primary penetration.

The organism is not an *Achlya*; and all that can be said is that it consists of cell-like bodies without very definite cell-walls, but evidently with a very delicately limiting texture surrounding a granular greenish plasma, and that there is much free and non-cellular plasma with bodies like small nuclei, the whole having a faint green tint. I have named this very lowly organic substance (which is probably a plant) *Spongiophagus Carteri*.

XV.—*Contributions towards a General History of the Marine Polyzoa*. By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Plates I.–V.]

[Continued from p. 14.]

Family **Escharidæ** (part.), Smitt.

LEPRALIA, Johnston (part.).

Lepralia cleidostoma, Smitt, var. *orbicularis*.

This form differs from Smitt's species in having a rather large circular avicularium, placed on an elevation at one side of the orifice and looking towards it, instead of a pointed avicularium. The oœcium of *L. cleidostoma* is described as striated; that of the present variety is usually smooth and silvery; but I have met with one which was distinctly marked by radiating lines or slight ribs. On the whole I can see no sufficient reason for separating the two forms.

Loc. Bass's Straits, abundant in the dredgings. [Florida (*Pourtales*).]

Lepralia Poissonii, Audouin. (?=*Escharella setigera*, Smitt.)

This species was figured by Savigny in his work on Egypt, and seems to have been little noticed since his time. Its remarkable peculiarity is the line of spines fringing the base of the cell for about half its length. It is not uncommon in Capt. Warren's dredgings, on shells, Retepores, &c.

Porella, Gray.

Porella marsupium, MacGillivray.
(Pl. I. fig. 6.)

This species is nearly related to the British *P. minuta*, Norman. MacGillivray does not notice the tooth on the lower margin, which is sufficiently conspicuous; nor does he describe the shape of the orifice; but, on the whole, there is ground, I think, for identifying the form which I have figured with his species. The whole surface is sometimes punctured; in other cases there is only a row of perforations round the edge.

Loc. Bass's Straits, on shells &c., extremely common in the dredgings.

Smittia, Hincks.

Smittia Landsborovii, Johnston, var. *purpurea*.

This differs from the English form in colour, being commonly of a rich purple. It exhibits another peculiarity which I have not met with before in this species: the oœcium is "hooded;" and in the fertile cell the peristome gives off two processes in front, which meet across the orifice, leaving a circular opening, through which the avicularium is visible *. These, however, are merely varietal differences.

Smittia reticulata, J. MacGillivray, var.

The *avicularium* always placed *on one side* of the sinus, close to the peristome, directed downwards, elongate (sometimes of great length); the mandible of much the same width throughout, rounded at the extremity.

In all essential characters this form agrees with the normal *S. reticulata*; but the avicularium is modified in shape, and is constantly placed in a different position. In the usual form it is situated centrally immediately below the sinus, and is furnished with an acute mandible. Though the variation is comparatively trifling, it affects very materially the appearance of the species.

The normal form also occurs.

* As in *Microporella ciliata*, var. *personata*.

Mucronella, Hincks.

Mucronella porosa, n. sp.
(Pl. I. fig. 5.)

Zoœcia elongate and rather narrow, or of a shorter and more ovate form, moderately convex, rising towards the orifice, depressed towards the base; orifice ample, suborbicular, somewhat flattened below, with a broad tooth inside the inferior margin, and a sharp denticle on each side; immediately below the tooth a large massive mucro, swollen at the base, bearing on one side an *avicularium* with rounded mandible directed upwards; a small *avicularium* (also rounded) on the margin at one side of the mucro; walls of cell strongly calcified; surface thickly covered with rather large deep pores, in older states reticulate. *Oœcium* large, rounded, of considerable width, thickly and minutely granulated or reticulate, slightly flattened in front, white and silvery.

Loc. Off Curtis Island. [Singapore or the Philippines, on coral (*Miss Jelly*).]

Mucronella teres, n. sp.
(Pl. II. fig. 5.)

Zoœcia ovate, quincuncially arranged, convex, divided by deep sutures, in which an inconspicuous line is traceable, punctured round the edge, the cell-wall rising towards the orifice, which is borne on a short neck; surface perfectly smooth, whitish; orifice suborbicular, a tooth inside the lower margin; the peristome carried up into a small central mucro in front, on the inner side of which is a slight nodular projection; six spines round the upper margin. *Oœcium* globose, smooth, somewhat recumbent, two spines showing on each side in front of it.

Loc. Off Curtis Island, on shells.

Allied to the British *M. ventricosa* and a characteristic example of the simpler type of structure for which this genus was originally founded. It is a question whether the *Mucronella* group might not properly be divided; but any revision should be based on a more extended study of foreign species than has yet been made.

Mucronella spinosissima, n. sp.
(Pl. III. fig. 2.)

Zoœcia small, lageniform, the peristome elevated, suberect, forming a neck; surface perfectly smooth, subhyaline, a row of punctures round the edge; orifice suborbicular, a broad tooth on the lower margin; the rim of the elevated peristome set round with about eight spines; the front margin carried up into a tooth-like mucro. *Oœcium* globose, smooth, recumbent. *Avicularia* none.

Loc. Off Curtis Island, on *Retepora* and *Flustra dissimilis.*

Mucronella tricuspis, n. sp.
(Pl. III. fig. 1.)

Zoœcia ovate, moderately convex, separated by shallow sutures, hyaline, smooth or slightly roughened; orifice transversely elliptical, three tall spines on the upper margin, in front closed in by a screen-like elevation, which in the centre rises into a dentate process rounded at the top, and on each side of it into a projecting lobe, a furrow down the middle of it; on each side of the cell, about halfway down it, a raised *avicularium*, with a slender pointed mandible directed outwards. *Oœcium* globose, smooth, silvery, with a projecting rim round the opening, the avicularia of the neighbouring cells flanking it on each side.

Loc. Off Curtis Island, on shells &c., very common.

A very marked and abundant form. I cannot find any description of it in the works of Australian writers, though it is difficult to believe that it has escaped observation. It is not amongst the forms figured by MacGillivray in his work on the Victorian Polyzoa.

Rhynchopora, Hincks.

Under this name I have constituted a genus* for the reception of the remarkable form *Lepralia bispinosa* of Johnston. Amongst Capt. Warren's dredgings a species occurs which has many features in common with the last named, but which seems to be distinct. Reserving for the present all questions respecting the genus, I shall describe it provisionally as

Rhynchopora longirostris, n. sp.

Zoœcia pyriform, ventricose above, narrowing off and depressed towards the base, quincuncially disposed, rather coarsely granulated, with a line of perforations round the edge; orifice (primary) transversely elliptical, perfectly simple; secondary orifice, formed by the elevation of the peristome, subelliptical or irregular in shape and of large

* Hist. Brit. Mar. Poly. vol. i. p. 385. I am indebted to Miss Agnes Crane for pointing out to me that the name *Rhynchopora* had already been appropriated to a genus of Brachiopods; so that a substitute must be found for it.

size, the margin frequently bearing a number of short spinous processes, which give it a jagged outline; within the lower lip a large bluntly pointed process which stretches across on one side almost to the margin, and forms with it a kind of loop; immediately behind this process a massive mucro, which bears on its inner aspect an *avicularium*, with a short triangular mandible directed upwards; commonly on the front of the cell a raised avicularium, with a very long mandible, rounded at the apex and usually pointing downwards. *Oœcium* rounded, shallow, smooth, often subimmersed, the opening closed in by a calcareous operculum.

Loc. Off Curtis Island, on *Retepora*.

This form has many points of resemblance to *R. bispinosa*, a species which is very liable to variation; but the differences are striking and somewhat significant, and it seems right that it should have a separate name. The shape of the cell can be observed best on the growing edge, before calcification has proceeded far. In an early stage it is distinctly pyriform, very ventricose at the upper part and depressed below; the surface is smooth. In later stages the surface is covered with a granular crust, the cells lose their distinctness, the original orifice is concealed by the elevation of the peristome, and a large opening is developed above it of somewhat irregular shape. The oral avicularium differs materially from that of *R. bispinosa*: in the latter it is placed transversely immediately below the orifice, and is borne on a mound-like swelling, below which the mucro is situated; in the present case it occupies the inner aspect of the mucro itself, which rises immediately behind the spur-like process on the inferior margin. The latter appendage is larger and more prominent than that of *R. bispinosa*, and of a different shape. Another distinctive feature of this species is the presence, usually in great numbers, of the elongate avicularia, which are somewhat elevated and placed on the front of the zoœcium. The mandible is slightly expanded at the base, but throughout the greater portion of its length is narrow and of uniform width, terminating in a blunt extremity. These appendages are very conspicuous, and are so numerous as to give a peculiar character to the zoarium (Pl. IV. fig. 8). The primary orifice seems to want the slightly sinuated lower margin which has been noticed in *R. bispinosa*. The latter species also occurs in Bass's Straits.

Family **Celleporidæ.**

Cellepora (part.), Fabricius.

Cellepora granum, n. sp. (Pl. III. fig. 8.)

Zoœcia erect, ovoid, smooth, distant, those of the uppermost stratum more or less separated by the cells of the one below it; orifice quite terminal, suborbicular, with a very marked pointed sinus; peristome elevated around it and carried up in front into a tall central rostrum, which bears at the top on its inner aspect a small oval *avicularium*; peristome on each side of the rostrum rising into a point. *Oœcium* rounded, smooth, a flattish semicircular space on the front bounded by a raised edging and traversed by radiating lines. *Zoarium* forming small subglobose patches.

Loc. Off Curtis Island, common.

Family **Selenariidæ**, Busk.

Lunulites, Busk.

Lunulites incisa, n. sp. (Pl. IV. figs. 1–3.)

Zoarium conical, well raised; beneath flat, divided into lobes round the edge, porous. *Zoœcial orifices* occupying a kind of furrow between the lines of *avicularia*, separated by short spaces, depressed, the cell-wall rising around them, elliptical, with a narrow well-marked sinus on the lower margin. *Avicularia* short, suberect, pointed; mandible probably triangular, turned in different directions.

Loc. Bass's Straits.

This fine species probably belongs to the same group as the *L. cancellata* and *philippensis* of Busk, which agree with it in the cancellated structure of the zoarium, and should no doubt be dissociated, as suggested by Busk, from the other members of the genus. The diagnosis in the British-Museum Catalogue of the two species just named, however, does not give any detailed account of the structure of the orifice; and it is therefore impossible to determine their exact relation to the present form.

In the specimens of *L. incisa* which I have examined the mandibular portion of the appendages is wanting; but, from the form of the fixed base (beak), there can be no doubt that they are avicularia; and if so, in this respect the species differs from the other recent forms, and agrees (so far) with *Conescharellina* of D'Orbigny.

The present form is ranked under the genus *Lunulites* provisionally. We are not yet in a position to discuss the affinities and systematic place of the various members of the Selenarian group.

Suborder Cyclostomata.

Family **Tubuliporidæ.**

Tubulipora, Lamarck.

Tubulipora capitata, n. sp.
(Pl. IV. fig. 9.)

Zoarium white, wholly adnate, composed of a number of capitate or clavate portions, which originate one from the other by means of a slender, stem-like base, and form a linear series, slightly branched. *Zoœcia* slender, minutely speckled, with a circular orifice, disposed radiately on the expansions, the anterior half erect. *Gonocysts* consisting of an irregularly shaped inflation of the surface, thickly covered with minute puncta, freely produced, sometimes as many as three on an expansion.

Loc. Bass's Straits, on shell.

This seems to be a distinct species; several specimens have been examined, which all exhibit the same remarkable habit of growth. The free production of gonocysts appears to be a distinguishing character; they form a succession of transverse swellings on the surface of the zoœcial expansions.

Additional.

Family **Membraniporidæ.**

[The remarkable form which is described below has the true Membraniporidan cell, the characteristic Flustrine habit (though without the flexible membrano-calcareous zoarium), and the marginal rib, which is the distinguishing feature of the *Flustramorpha* of Gray. It seems to occupy a somewhat intermediate place between *Flustra* and *Membranipora*. I shall hope to discuss its systematic place hereafter, and leave it provisionally amongst the *Membraniporæ*.]

Membranipora roborata, n. sp.
(Pl. II. fig. 3.)

Zoarium erect, calcareous, bilaminate, compressed, the stem expanding slightly upwards, divided and subdivided dichotomously into narrow segments, a thickened rib along the margin, composed of tubular fibres laid closely together, which at the base form a considerable tuft of rootlets. *Zoœcia* quincuncially arranged, ovate, often running out to a point below; margin thin, smooth, two short and rather stout spines above; aperture ovate, occupying the whole front, with a membranous covering, depressed, the cell-wall surrounding it minutely granular, expanded below; above each cell two raised and pointed *avicularia* placed side by side, the mandible directed downwards. *Oœcium* mitriform, flattened and smooth in front, surrounded by a thickened border, which rises into a blunt point in the centre.

Loc. Off Curtis Island, abundant in the dredgings.

The tubules which constitute the rib along the edge of the zoarium (as in *Eschara flabellaris*, Busk) are given off from the side of the marginal zoœcia; they strengthen, and support, and hold together the rigid but slender stem and branches, and secure a certain amount of flexibility to the whole structure; at the base they run out into a multitude of (*quasi*) root-fibres.

Note on Catenicella.

In Capt. Warren's collection there is a fair representation of the characteristic Australian group of the Catenicellidæ; and amongst the forms occurring there are two or three which I cannot identify with any described species; but as I have not been able as yet to obtain all the papers dealing with this tribe they must be reserved for future examination.

VII FOREIGN MEMBRANIPORINA (third series).

Membranipora, De Blainville.

Membranipora amplectens, n. sp. (Pl. III. fig. 7.)

Zoœcia pyriform, disposed in single series, which bifurcate at intervals; surface smooth, frequently a line of minute pores on each side, extending from the aperture to the bottom of the cell; aperture oval, occupying more than half the front, with a membranous covering; margin smooth, slightly thickened, two spines at the top, two on each side, and a tall vibraculoid spine, calcareous, with a corneous joint at the base, immediately below the aperture. No *avicularia*. *Oœcium* borne on a special cell, which is always situated in the fork between two branches, elongate, rounded at the top, composed of a number of flattened pieces or ribs placed close together, which spring from the opposite sides and unite in the centre, a line (marking the junction of the ribs) passing from the top of the ovicell to the opening.

Loc. Australia, creeping over an alga (*Miss Jelly*).

This species is allied to *M. pilosa*, but differs from it in many points. Its most marked characteristic is the very curious ribbed ovicell, which occupies a fixed place in the colony and is borne on a cell embraced by the branches which are given off at intervals from the extremity of the single lines. The oœcium is formed by an extension of the aperture upwards, giving rise to an elongate-oval area bounded by a slightly raised margin. On the latter are developed seriatim the rib-like processes, which ultimately unite along a central line, and constitute the marsupial chamber. These must be regarded as a modification of the spines of the zoœcial aperture. When closely examined the wall of the oœcium is seen to be composed of *spine-like ribs, united laterally by a calcareous expansion*, but often slightly disjunct at the base. In this species, therefore, the marsupium is formed of the upper portion of the zoœcial aperture (which is much extended in the ovicelligerous cell), roofed in by a number of marginal spines, which meet and are soldered together at the extremities, and are united along the sides by a calcareous lamina. It is a very simple modification of certain elements of the zoœcium, by which the latter is divided into two chambers—one for the polypide, the other for the embryo.

Membranipora velata, n. sp.
(Pl. V. fig. 3.)

Zoœcia ovate, pyriform, or hexagonal (somewhat irregular in shape), distinctly quincuncial, placed close together; aperture occupying the whole front (except in the pyriform cells), ovate, the cell-wall around it slightly roughened or crenate, with a membranous roofing stretching across it on a level with the margin, which it overspreads. *Avicularia* sessile, on a distinct area, scattered amongst the zoœcia, always wedged in between two cells at their upper extremity; beak not prominent; mandible pointed, flattened, directed obliquely upwards. *Oœcium* very shallow and inconspicuous, just covering the extremity of the cell. *Zoarium* presenting a flat uniform surface of a dark brownish colour, caused by the overlying membrane.

Loc. Santa Cruz, California, on shell (*Miss Jelly*).

The brownish appearance of the zoarium, which is due to the extension of the membranous front wall over the margin of the cells, is a distinguishing character. There is much irregularity in the shape of the cells; in many cases they are prolonged below, and become distinctly pyriform. Their arrangement is very regularly quincuncial.

The avicularia are remarkably depressed and scarcely rise above the surface.

Membranipora circumclathrata, n. sp.
(Pl. V. fig. 1.)

Zoœcia ovate, running to a point below, quincuncially arranged, distant, the interspaces areolated; aperture slender-oval, occupying about three fourths of the front, and closed in entirely by a membranous wall; margin slightly thickened, crenate, bearing a line of small holes; immediately below the aperture a pointed *avicularium*, elevated on a very prominent rising or boss, sloping upwards, the mandible directed straight outwards or turned obliquely. *Oœcium* rounded, smooth, a raised rib across the front a little above the opening; surmounted by an avicularium, which is sometimes of very large size, with an elongate acute mandible pointing obliquely upwards, sometimes of the usual form.

Loc. Santa Cruz, California, on shell (*Miss Jelly*).

The striking characteristics of this attractive species are the areolated space which surrounds the cells * and the very prominent avicularia. Whether the marginal holes indicate the position of as many spines in the perfect state I am unable to say; there is no trace of these appendages in the specimen which I have examined.

Membranipora variegata, n. sp.
(Pl. V. fig. 2.)

Zoœcia ovate, often running to a blunt point below, placed closely together, quincuncial, with a thick, rounded, and minutely granulated border; aperture occupying the whole of the front, slightly contracted above and expanded below, with a membranous covering; four tall spines at the top, a little below them a very stout subclavate spine on each side, and below these again about six very slender sharply-pointed spines, which bend inwards over the area and converge towards the centre; all these appendages with a dark-coloured base. *Avicularia* none. *Oœcium* (?).

Loc. Santa Cruz, on shell (*Miss Jelly*).

An examination of the marginal zoœcia in a colony shows that the cell-wall is pierced by a number of large oblong foramina, placed side by side and separated by a very narrow band

* In the *M. circumcincta* of Heller the zoœcia are separated by a reticulate or areolated interspace.

of calcareous matter. There may be about fifteen or sixteen of these openings round the cell, each of them occupying a kind of recess in the wall. In some cases a slender acuminate spine originates near the base of one of the larger spines above, and projects outward instead of bending over the aperture.

VIII. FOREIGN CHEILOSTOMATA (Miscellaneous).

Family **Bicellariidæ**.

DIACHORIS, Busk.

Diachoris distans, n. sp.
(Pl. V. figs. 4–6.)

Zoœcia elongate, slender, not expanded below, distant, suberect, entirely open in front; two long tapering spines at the top, and about four on each side, of which the uppermost pair is very small, and the pair below it usually larger than all the rest, the lower third of the margin destitute of spines; connecting tubes six in number, long; on one side of the cell a large *avicularium*, usually placed below the third spine, projecting considerably behind towards the base; a long straight back extending from the projection to the beak, which is slightly bent at the point; mandible triangular, surface smooth and shining. *Dorsal surface* smooth, destitute of spines, with a round tubular projection at the upper extremity of considerable size, from which the radical appendage originates. *Oœcium* (?).

Loc. South Africa (*Miss Jelly*).

This form resembles in some respects the Australian *D. spinigera*, MacGillivray; but there are not unimportant points of difference, and on the whole I believe they are rightly accounted distinct.

The cells of *D. distans* are of an elongate type and considerably larger than those of *D. spinigera*; they lie wider apart, the connecting-tubes being of more than ordinary length, and are very decidedly suberect. The spines are not only fewer in number, but different in character from those of the kindred species. The small half-rudimentary pair just below the top of the cell is very constant, and contrasts strikingly with the tall stout pair immediately following. In *D. spinigera* the lateral spines, which generally extend to the bottom of the cell, are much more uniform in character.

But the most marked differences are found in the avicularia. There are normally two of these appendages in *D. spini-*

gera, which are placed nearer the top of the cell than that of *D. distans*; they also differ in form (Plate V. fig. 6 compared with fig. 7), and are especially remarkable for the length of the free portion of the beak. The mandible becomes much attenuated towards the apex.

Diachoris intermedia, n. sp.
(Pl. V. fig. 8.)

Zoœcia small, elongate, open in front, the aperture narrowing slightly downwards, decumbent, three (or two) denticles at the top of the cell, and a small spinous process at each side in a line with the lower margin of the oral valve; on each side a small *avicularium*, placed at a very short distance below the top; beak short and slightly bent. *Dorsal surface* perfectly smooth and destitute of spines; each cell connected by short tubular processes with four others, two terminal and two lateral, the latter originating at opposite points on the side-wall a little above the middle. *Oœcium* (?).

Loc. Tasmania, on an alga (*Miss Gatty*).

This is a minute species, and is interesting as in some measure a transition form between the genera *Diachoris* and *Beania*. The simple plan of the zoarium allies it to the latter genus, while in the decumbent cell armed with avicularia it resembles the former. The species described by Mr. Ridley from the Straits of Magellan as *Chaunosia fragilis* * approaches still more nearly to *Beania*; its polypide, however, is said to be furnished with a gizzard, and it may possibly be entitled to generic rank. Its affinities are much more with *Beania* than *Diachoris*.

Diachoris hirtissima, Heller, form *robusta*.
(Pl. V. figs. 9, 9 *a*.)

Zoœcia large, suberect, boat-shaped, expanded below, and narrowing off rather abruptly towards the oral extremity into a kind of neck, entirely open in front; three very large acuminate spines at the top, and four tall stout ones immediately below them placed two at each side, flanking the oral valve; below these again four or five tall spines, originating just outside the margin, from the base of which spring as many slender spinules, which bend over the aperture; at one side near the top an *avicularium*, subglobose, with a very small and slightly projecting beak and a broad mandible; connecting-tubes extremely short, six in number. *Dorsal surface* smooth,

* Proc. Zool. Soc. 1881, p. 45.

entirely destitute of spines, the radical appendage springing from about the centre. *Oœcium* (?).

Loc. Algiers, under stones (*J. Y. Johnson*).

It is with considerable doubt that I rank this fine *Diachoris* as a form of Heller's species. On comparing it with a specimen of the latter from the Cape-Verd Islands many differences between the two are apparent. The cells of the present form are fully a third larger than those of the normal *hirtissima*, and are more erect; the spines with which they are furnished are much less numerous. In *D. hirtissima* the dorsal surface bristles with these appendages; behind the triplet at the top of the cell are placed a number of tall slender spines, which extend for some distance down the back. Others are scattered over the dorsal surface, and are frequently forked. In the present variety the back of the cell is entirely destitute of spines. The spinules which bend over the aperture are usually more numerous in the normal form than in the variety; and the spines generally are more delicate, and the whole habit less robust. The terminal triplet, from its size, is a really striking feature in the Algerian specimens.

I have seen no avicularia on the normal *D. hirtissima*; in the variety *robusta* they are present, but not numerous. They are peculiar in shape, and unlike the usual capitate forms, being almost globose and having a very short rudimentary beak. In this species the connecting-tubes are extremely short, and the cells consequently lie very closely together; the dorsal surface presents an appearance very much resembling that which I have described in *Membranipora radicifera* ('Annals' for July 1881).

Family **Myriozoidæ**.

Schizoporella, Hincks.

Schizoporella insignis, n. sp.
(Pl. V. fig. 10.)

Zoœcia ovate, distinct, quincuncially arranged; surface perfectly smooth, of a greyish colour; a raised line enclosing a large part of the front, and carried above the orifice; within it a row of perforations, and immediately outside of it a row of small disks surrounded by a white line; orifice large, peristome not raised, arched above, the lower margin slightly curved inward, with a central sinus, narrow at the opening and below subcircular, the cell-wall carried up immediately below the sinus into a prominent ridge-like umbo. *Oœcium* (?).

Loc. Africa (*Miss Jelly*).

In this beautiful species the oral sinus is almost circular and is connected by a narrow gap with the true orifice. It suggests very forcibly the special pore of the Microporellidæ. As bearing on the morphological relations of this portion of structure, an observation by Mr. Ridley is interesting. He has noticed a Myriozoidan stage in the development of a Porinidan cell, in which the pore had not yet become isolated, but was connected by a gap with the orifice *.

CORRIGENDUM.

Epicaulidium pulchrum, mihi.

I have to plead guilty to a strange oversight respecting this beautiful form. When I gave it the above name ('Annals' for Feb. 1881) it had quite escaped my recollection that it was long ago described and accurately figured in Ellis's posthumous work, edited by Solander, under the name of *Cellaria tulipifera*. A chance reference to the plates of this work (which I had not consulted for a long time) at once revealed to me my mistake, and has enabled me to make this early confession and correction of it.

Lamouroux reproduced in his 'Exposition' Ellis's figure; but he ranged the species amongst the Sertularians, and referred it to his genus *Pasythea*. Both De Blainville and Lamarck gave it generic rank, the one as *Tuliparia* ("*Tulipaire*"), the other as *Liriozoa*; but Lamarck has changed (without any sufficient warrant, as it seems) Solander's specific name.

EXPLANATION OF THE PLATES.

Plate I.

Fig. 1. *Membranipora vitrea*, n. sp.
Fig. 2. *Membranipora pyrula*, n. sp.
Fig. 3. *Schizoporella tumida*, n. sp.
Fig. 4. *Monoporella* † *nodulifera*, n. sp.
Fig. 5. *Mucronella porosa*, n. sp. 5 *a*. Oœcium.
Fig. 6. *Porella marsupium*, MacGillivray.
Fig. 7. *Cribrilina tubulifera*, n. sp.
Fig. 8. *Cribrilina speciosa*, n. sp. (This figure and fig. 5 are drawn to the same scale, and are much less highly magnified than the rest.)

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* "Polyzoa, Cœlenterata, and Sponges of Franz-Joseph Land," Ann. & Mag. Nat. Hist. for June 1881, p. 448.

† This genus stands as *Haploporella* in the text; but Mr. Waters tells me that this name has been applied to a genus of fossil Foraminifera.

Plate II.

Fig. 1. *Schizoporella acuminata,* n. sp.
Fig. 2. *Monoporella lepida,* n. sp.
Fig. 3. *Membranipora* (?) *roborata,* n. sp. (provisionally named).
Fig. 4. *Schizoporella triangula,* n. sp. 4 *a.* The oœcium.
Fig. 5. *Mucronella teres,* n. sp.
Fig. 6. *Membranipora radicifera,* n. sp. 6 *a.* Dorsal surface of the zoœcium. 6 *b.* Cluster of the radical tubes.

Plate III.

Fig. 1. *Mucronella tricuspis,* n. sp.
Fig. 2. *Mucronella spinosissima,* n. sp.
Fig. 3. *Membranipora punctigera,* n. sp.
Fig. 4. *Caberea grandis,* n. sp. 4 *a.* Seta of the vibraculum, showing its remarkable length. 4 *b.* One of the large avicularia.
Fig. 5. *Porina gracilis,* Lamx. 5 *a.* The same, natural size.
Fig. 6. *Cribrilina monoceros* (?), MacGillivray. 6 *a.* One of the large marginal avicularia.
Fig. 7. *Membranipora amplectens,* n. sp.
Fig. 8. *Cellepora granum,* n. sp. 8 *a.* The same, natural size.

Plate IV.

Fig. 1. *Lunulites incisa,* n. sp. Zoœcia, magnified.
Fig. 2. *Lunulites incisa,* n. sp. Portion of the underside of the zoarium, showing the lobate margin and the cancellated structure of the centre.
Fig. 3. *Lunulites incisa,* n. sp., nat. size.
Fig. 4. *Membranipora inarmata,* n. sp.
Fig. 5. *Membranipora inornata,* n. sp.
Fig. 6. *Membranipora hexagona,* Busk (for comparison with the preceding).
Fig. 7. *Rhynchopora longirostris,* n. sp. A group of young zoœcia.
Fig. 8. *Rhynchopora longirostris,* n. sp. Zoœcia and elongate avicularia from the centre of the colony, less highly magnified.
Fig. 9. *Tubulipora capitata,* n. sp.

Plate V.

Fig. 1. *Membranipora circumclathrata,* n. sp.
Fig. 2. *Membranipora variegata,* n. sp.
Fig. 3. *Membranipora velata,* n. sp.
Fig. 4. *Diachoris distans,* n. sp.
Fig. 5. *Diachoris distans,* n. sp. Dorsal surface.
Fig. 6. *Diachoris distans,* n. sp. Avicularium.
Fig. 7. Avicularium of *Diachoris spinigera,* MacGillivray.
Fig. 8. *Diachoris intermedia,* n. sp.
Fig. 9. *Diachoris hirtissima,* Heller, form *robusta.* 9 *a.* Avicularium.
Fig. 10. *Schizoporella insignis,* n. sp.

XVI.—*Observations on* Aulastoma heluo. By Robert Templeton, Esq.

[Plate VIII.]

The leech I am about to describe (*Aulastoma heluo*) is the common horse-leech of the north of Ireland, and may probably be more widely distributed. It may be collected in sufficient abundance two miles south of Belfast, on the moist banks of drains and wet ditches communicating with the river Blackwater between Stockman's Lane and the meadows in rear of the industrial school. It is found under stones, clumps of very coarse tangled grass or weedy masses, during the summer months; it seldom remains long in the water or pools of the ditches; when swimming it becomes lengthened out and very flat. It is gluttonously voracious, greedily gorging itself with earthworms, aquatic larvæ, small sticklebacks, and various thin-shelled *Helices*, *Planorbes*, *Limnææ*, &c. In size it reaches to $2\frac{1}{2}$ inches in length; the body is widest behind ($\frac{1}{2}$ inch nearly), the margin curvilinear; thence it narrows gradually to the head, which is small ($\frac{1}{16}$ inch); the sides of the body are rounded, the dorsum slightly convex, its colour very dark olive-green, almost greenish black, the belly greyish ash-colour. There are lighter-coloured specimens, which have a tinge of brown or yellow; but these are exceptional. Selecting a model specimen, the colour appears tolerably uniform, a little lighter and brighter down the middle line of the back, and the rings, of which there are ninety-five quite distinct, are readily made out. The sexual organs are between the twenty-fifth and twenty-sixth rings and the twenty-ninth and thirtieth rings. Let a small piece of plate-glass be now placed on the back, so that the entire surface may lose the rounded form given to it by the rings, become quite flat, and no longer glisten, a very handsome arrangement of longitudinal lines is exhibited; these lines, four in number on each side of the middle of the back, have a very patchy look, are very dark, but usually a little less deeply tinted in the middle, so that each of the lines often looks distinctly double; they are interrupted at the passage from ring to ring. The innermost of these sets of four lines, enclosing a moderately narrow space running the entire length of the back, and of rather brighter hue than the rest of the dorsum, may be subdivided into nineteen definite lengths of five rings, with the same configuration over and over again repeated from head to tail. Within these five rings the first little bit of the bounding-line, extending over two rings, is quite straight and parallel to its fellow of the opposite side; then follows a curved portion, a nearly semicircular arch, engaging three rings, the concavity of those of opposite sides directed towards each other. The recurrence of this peculiar conformation every five rings gives a very pretty appearance to the back of the leech. The two next, or intermediate longitudinal lines, conform in a degree to this curved character of the innermost line; not so the outermost, which, very near the margin, adapts itself to it. This line seems made up of a continuous series of minute patchy triangles, the bases towards the edge, the apices directed inwards. The narrow ledge left between the bases of these triangles and the extreme margin of the body is in some specimens tawny yellow, never, however, distinctly marked. The belly is dashed with patchy markings scattered loosely along the sides.

The eyes (ten in number) are disposed in a quasiparabolic curve conforming closely to the outline of the head and but a short distance from the margin of the head; they are arranged in pairs upon the rings. The first pair, side by side on the first ring, are much the largest, and are a diameter and half of either eye, asunder. The second pair of eyes, of lesser size than the preceding, appear to form with them a gentle curve; they are placed somewhat to the rear of the second ring. The third pair, lesser still, the eyes decreasing in size gradually from front to rear, are on the third ring, a slight degree behind the middle. A ring is now skipped, the fourth pair being rather in front on the fifth ring. Another ring is skipped, the fifth, last, and smallest being very minute and close to the front of the seventh ring.

The anal sucker, not large, quite round, looking downwards and backwards, gives an oblique appearance to that end of the body.

The upper lip projects over the mouth; this latter is quite oval, and opens into the gullet, which is capable of great expansion. The folds which are described and figured by M. Moquin Tandon in the cross section of the head cannot be readily made out in the vertical section. At the extremities of the three largest of these folds is the site of three whitish caruncles; and in front of each of these, he states, is a small jaw bearing fourteen teeth; I have searched for these in vain. Some specimens were sent to my friend Dr. Carte, the able superintendent of the Natural-History Department of the Museum of Art and Science in Dublin; he could find them no more than myself. He found the three whitish tubercles, but nothing bearing the slightest resemblance to jaws or teeth.

M. Moquin Tandon, in his second edition, speaking of the genus *Aulastoma*, says :—" Si je n'ai pas parlé de ces organes, quand j'ai publié la première édition de cet ouvrage, ce n'est pas, comme dit Duvernoy, parce qu'ils sont caduques, mais parce que je n'avais pas su les voir." In a note he adds, " M. de Blainville n'a pas été plus heureux que moi."

A page or two further on we find :—

" Dans l'*Aulastoma* les mâchoires sont presque parallèles, écartées et non enfoncées dans des plis de la membrane buccale ; elles paraissent portées par l'extrémité antérieure des trois plis les plus grands de l'œsophage. Ces mâchoires sont fort peu comprimées.

" On remarque aussi, sur leur bord libre, une rangée des denticules, en forme de V renversé ; mais ces saillies sont moins nombreuses, moins serrées, plus grosses, et plus obtuses que dans les Hæmopis et les Sangsues. Chaque mâchoire présente environ quatorze denticules. On pourrait comparer ces organes aux dents molaires des animaux vertébrés." (' Monographie,' 1846, p. 91.)

This last remark, which appears to be entirely at variance with the figures given in his plate, had for me a peculiar interest, since on one occasion, when examining a decomposing specimen, I discovered three minute bodies of elongated form in the exact site, each with slight double curvature, like an italic ʃ, pointed at the distal extremity, open at the other, and sufficiently dense to form a bed for greenish-brown flattish bodies, fourteen in a double row, scarcely at all projecting, and smaller and rounder at the ends, but so disposed collectively as to bear a certain resemblance to the crown of a molar tooth. An exact copy of the sketch taken at the time is given at fig. 5. Often looked for, I have never seen any thing like them since.

Another and very pretty leech (*Glossiphonia sexoculata*) is to be found in the rivulets running from the Hollywood hills into Belfast Lough.

EXPLANATION OF PLATE VIII.

Fig. 1. *Aulastoma heluo.*
Fig. 2. The arrangement of the lines on the back.
Fig. 3. Their coalescence at the head.
Fig. 4. The configuration of the eyes.
Fig. 5. Molar teeth?
Fig. 6. Vertical section of the head.

XVII.—*A Note on the Characters of the Genus* Crossaster, *with the Description of a new Species.* By F. Jeffrey Bell, M.A.

I had hoped to accompany the description of the new species of *Solaster* which forms the body of this note by an investigation into the distinctive characters of the apparently three generic types which have been associated together under Forbes's name *Solaster*; but I find from a late number of the 'Nyt Magazin' that the two eminent Norwegian naturalists, Messrs. Danielssen and Koren, are about to publish some observations on this point. I shall therefore deal very briefly with one or two characters of these forms, and shall exhibit the respect which I feel for the workers just named by deferring to their right of speech.

The time has certainly come when greater care must be taken in referring species to the genus *Solaster*. Even if we allow that Müller and Troschel were justified in placing *S. endeca* and *S. papposus* in the same genus, there can be no doubt that Prof. Verrill has done good service to the correct estimation of generic differences by establishing the genus *Lophaster* * for the *S. furcifer* of Düben and Koren; while, lastly, there can be no doubt that the *S. tumidus* of Stuxberg† is more correctly placed with the genus *Asterina*, as is now proposed by Messrs. Danielssen and Koren in the essay to which I have just referred.

Although Lütken, Sladen, and Agassiz have all entered into some discussion of the question, and have all been inclined to separate *S. endeca* and *S. papposus* into different genera, the absolute characters which distinguish them seem never to have been distinctly formulated. The last-named writer expresses himself very strongly on the unnatural alliance; for he says ‡, "From an examination of the hard parts it is evident that *Solaster papposus* and *Solaster endeca* should not be included in the same genus, having really nothing in common except the great number of arms."

This remarkable statement has been searchingly dealt with by Dr. Viguier §, who undoubtedly has the better position in the controversy on the facts called in evidence; but that excellent investigator seems to me to have not fully weighed

* Am. Journ. Sc. (3) xvi. p. 216.

† Œfv. K. Vet. Akad. Förh. Stockholm, 1878 (1879), no. 3, p. 31.

‡ Mem. Mus. Comp. Zool. v. no. 1 (1877), p. 98.

§ Arch. de Zool. Exp. vii. p. 139.

all the facts which can be made out with regard to these two forms, which he retains in one genus.

I will here only direct attention to the gradation in characters, which, till the publication of Messrs. Danielssen and Koren's studies, induces me to regard *Solaster*, *Crossaster*, and *Lophaster* as distinct genera.

When we examine the actinal surface of a ray of *S. endeca* we observe that, externally to the transverse set of spines which runs near the ambulacral groove, there is a series of special plates bearing a comb of spines: though in a sense marginal, these plates are quite confined to the actinal surface; from the dorsal view one would not have the least suspicion of their existence. It is not so with *C. papposus*; for in it the modified marginal plates are set on the upper part of the side of the ray, and form a regular series of dorso-marginal plates. Coming lastly to *Lophaster*, we find that the "differentiated marginal plates" of which Prof. Verrill speaks exhibit a striking advance on what has been seen in *Solaster* or in *Crossaster*: there are now two sets, one dorso-marginal and one ventro-marginal.

A gradational series so well marked does, I submit, afford very considerable support to the view that the three forms in question belong to distinct though allied genera.

Crossaster neptuni, n. sp.

Arms ten: $R=50$, $r=25$.

A species of the character of *C. papposus*, but distinguished from it by the absence of the glassy spines on the paxillæ and by the smaller number, larger size, and greater regularity of the paxillæ themselves.

The spines in the single adambulacral row which fringes the groove are generally placed by threes on each plate; near the actinostome, however, four spines may be found on a plate; the spines are short and stout. About five or six similarly rather stout spines are found in each set of the transverse rows; they are not spread out in fan-shape, as they are in *S. papposus*. The interbrachial space is small, and has scattered over it pairs or triplets of short spines, just sufficiently numerous to relieve it from an appearance of bareness. The outer free edge of this space (interbrachial angle) is occupied by a collection of small spines arranged in form of a double tooth-comb; there are about twelve of these special bundles of spines; and they, as they pass outwards, rapidly mount to the dorsal edge of the arm, to which they give a very characteristic appearance. The double tooth-comb arrangement soon yields to a more irregular disposition, and the spinelets form rather a fasciculus or bundle set on a rounded base; there are no glassy spines in connexion with these bundles, which, as they approach the tip of the arm, gradually diminish in size.

Along the middle line of each ray, and even as far as the centre of the disk, it is quite easy to detect the regular arrangement of the chief paxillæ. About twelve of these can be made out in each row; and they add much to the distinctness of the several rays.

In addition to this row of specially large and conspicuous paxillæ, two sets at least of smaller ones are to be made out on either side of each of them. Similarly the somewhat wide spaces between each of the more important paxillæ are occupied by smaller paxillæ. The rest of the abactinal surface, whether on the free portion of the rays or on the disk itself, is occupied by single spines, by spines a few together, or by papulæ; but none of the spines are either long or sharp.

The single madreporic plate, which is situated a little way from the centre of the disk, is of a moderate size and sufficiently easy of detection.

Ecuador. Coll. B.M.

The single specimen from which this description has been drawn up has been at least twenty-five years in spirit; it is of a creamy-yellow colour. It was collected by S. O. Goodridge, Esq., R.N., and formed part of the Haslar collection.

XVIII.—*Notes on Longicorn Coleoptera.—Revision of the* Ærénicides *and* Amphionychides *of Tropical America.* By H. W. Bates, F.R.S., F.L.S.

With the exception of three genera—*Oberea*, *Tetraopes* (northern forms, spreading across the Mexican frontier partly into Central America), and *Phæa*—all the true Saperdinæ of Tropical America belong to Lacordaire's "groupes" Amphionychides and Ærénicides. These are distinguished from temperate and Old-World forms of *Saperda* not by any constant peculiarity of structure, but a combination of characters and the occurrence in many of the genera of special features not existing in any other groups of the subfamily. In these remarks it will be understood that I recombine the original *Saperdæ* and their allies with the *Phytœciæ*, placed in Lacordaire's system so wide apart, and form with them a subfamily Saperdinæ, equivalent to the true Lamiinæ, Niphoninæ, Acanthoderinæ, &c., and that I exclude the groups Calliides, Gryllicides, and Hébestolides of Lacordaire as foreign to the *Saperda* type. This seems to be the arrangement most in accordance with nature and with our present knowledge of this difficult and numerous group of Longicorns,—the division into tribes with simple and tribes with toothed claws breaking down completely in the genus *Glenea* (belonging to the true *Saperdæ*), of which we now know so many species (*Gl. lepida, cinerea, amboynica*, &c.) possessing toothed claws in the male, and the three "groupes" above mentioned, in spite of their toothed claws, receding completely from the *Saperda* type in many other points of structure. Lacordaire's elaborate classification of the Longicornia, in fact, fails here, as it does elsewhere, from his too close adherence to technical system, by which he unconsciously sacrificed natural affinity in striving to secure absolute definitions.

The Amphionychides and Ærénicides are closely allied to the Phytœciides of the Old World, having, like the typical species of that group, tarsal claws with very few exceptions bifid, *i. e.* their basal tooth pointed and as long or nearly as long as the stem of the claw. Some of the Ærénicides approach the *Phytœciæ* so closely that they are scarcely to be distinguished from them, having a similar structure of prosternum and similar unretracted head and notched middle tibiæ; but the gradation is so insensible between these and the rest, in which the middle tibiæ are simple and the prosternum contracted, with the head retracted * or resting in its lower part on the strongly exserted anterior haunches, that we are compelled, in spite of systematic reasons, to keep the whole of the forms together. In the Amphionychides there are no disparate elements; it may be said, indeed, that here the tropical American type of *Phytœcia* reaches its highest development, receding entirely from the Old-World type. The head is in all strongly retracted, the tibiæ simple, the antennæ, the shape, and clothing of the body different from the *Phytœciæ*, and the species branching out into a variety of beautiful and eccentric forms unlike those of any other Saperdinæ. In nearly all of them the elytra have a distinct raised rib or carina, separating the dorsal surface from the sides or *epipleuræ*, which latter are usually of great elevation. This is also a distinctive feature in Gleneides, the tropical division of the Old-World *Saperdæ*; and the two

* Lacordaire used the term "retractile" for this peculiar relation of head to prosternum; but the term is objectionable from its ambiguity, its obvious meaning being the power of withdrawal of the head within the thorax. I have myself used the word with this signification in the 'Biologia Centrali-Americana,' Coleoptera, vol. v.

groups Gleneides and Amphionychides may be therefore looked upon as to some extent representative forms.

The researches of entomological travellers during the twelve years that have elapsed since Lacordaire's classification was published have immensely increased the amount of material in these groups at the disposal of the student. The total number of species mentioned by Lacordaire was 83; in the list which terminates the present memoir I enumerate 220, including the new species which I here describe from my own collection; and there are doubtless many other species still undescribed in public and private museums. The new species do not furnish any fresh element rendering indispensable a modification of Lacordaire's division into two groups; but they bridge over the gap which divided them in the state of our knowledge at that time, so that neither the retracted head nor the carination of the elytra can now be said to afford reliable group-characters; in fact they are of little more than specific value in some of the genera. It is convenient, however, for the present to retain the two groups. Two of the genera, *Pretilia* and *Sphallonycha*, break the uniformity of the groups in the structure of the tarsal claws, having the basal tooth short and broad; but they cannot be withdrawn without necessitating the institution of two other groups for their reception, the two genera differing from each other greatly in the form of the elytra and head, although agreeing in the dentation of the claws. *Zenicomus* (Thomson) I remove from the Amphionychides, with which it agrees in none of its principal characters. It is in fact a member of the Calliides group, and is scarcely different generically from *Chereas*. On the other hand I include *Amillarus* (Thomson), which Lacordaire, overlooking its true affinities, placed in a widely different part of his system. The tarsal claws in this genus have undergone a remarkable modification of position, the long basal teeth being soldered to the stems of the claws and closely joined at the base, so that the claws have become "*divergents*" instead of "*divariqués*" as in the rest of the Saperdinæ. There can be no doubt, I think, that *Amillarus* is closely related to *Erana*, especially to such species as *E. dispar*, in which the sexes differ similarly in form and colour. Its longer prosternum and free head, however, necessitate our including it in the group Ærénicides.

New Genera and Species.

Group 1. ÆRENICIDES.

APHILESTHES.

Corpus elongatum, robustum, lineare, subdepressum, dense breviter pilosum. Caput exsertum ; oculi magni, convexi ; frons brevissima et angusta, infra paullo retracta. Antennæ corpore multo breviores, a basi ad apicem subtus sparsim ciliatæ, articulo tertio cæteris haud longiore. Thorax valde transversus, medio rotundato-dilatatus. Elytra parallela, apice singulatim rotundata, paullulum convexa, absque carinis. Prosternum ante pedes vix elongatum, concavum, coxis conicis valde exsertis. Episterna metathoracica latiuscula, parallela. Tibiæ intermediæ fortiter emarginatæ.

The head is similar in shape to that of the typical *Æreniccæ*, the forehead being scarcely prolonged below the voluminous eyes. The mouth, however, is not so distant from the anterior haunches as in *Ærenica*, owing to the shorter and more concave anterior part of the prosternum and the long exserted coxæ. The terminal ventral segment in the female is very large, and broad at the apex, with an impressed central line.

Aphilesthes rustica.

Rufo-fusca, pube cinereo-flava dense vestita et breviter erecte pilosa ; thorace lateribus late elytrisque marginibus anguste flavis ; femoribus supra et geniculis rufo-testaceis.
Long. $8\frac{1}{2}$ lin. ♀.

Merida, Venezuela (*Göring*).

Antodyce juncea.

Linearis, gracillima, fusco-castanea, capite, thorace, antennis, vitta lata elytrorum marginali (longe post humerum subito incipiente et usque ad angulum suturalem continuata) melleo-flavis, elytris ante medium maculis duabus rotundatis (transversim positis) lituraque curvata fasciæformi ante apicem testaceo-albis ; thorace angustissimo, dorso tuberoso, episterno vitta lata fusca ; elytris apice obtuse rotundatis, dorso subtilissime punctulatis ; pedibus fulvis, fusco-lineatis ; ventre piloso ; antennis gracilibus, pilosis.
Long. $4\frac{1}{2}$ lin. ♂.

Brazil.

Ærenica spissicornis.

Linearis, obscure fusca, tomentosa et breviter pilosa, thorace vittis angustis tribus elytrisque utrinque signaturis tribus (prima basali postice suturam versus curvata, secunda laterali-mediana arcuata tertiaque subapicali a sutura versus marginem obliquata) fusco-cinereis; thorace breviter cylindrico, postice paullo angustato; elytris apice conjunctim subacuminatis, sed obtusis, sublineatim punctulatis; antennis corpore brevioribus, crassis, dense undique (subtus longius) pilosis, scapo quam articulus tertius paullo longiore.

Long. $5\frac{1}{2}$–$7\frac{1}{2}$ lin. ♂ ♀.

Paraná, Brazil.

Similar in general colours to *Ærenica canescens* (Klug), but differing in the pale markings of the elytra being linear, forming on each three elongated and oblique or curved streaks, and also in the remarkably thickened antennæ. Although the scape is shorter than in the type species (*Æ. hirticornis*), it bears the same relative proportion to the other joints. The middle tibiæ are entire; in *Æ. canescens*, according to Klug's figure, they are notched.

Ærenica leucippe.

Robusta, ochraceo-fulva, subtiliter tomentosa, thorace vitta dorsali (postice dilatata), elytris macula ante medium elongata triangulari suturali communi, altera utrinque vittæformi ante apicem corporeque subtus vitta laterali cretaceis; thorace elongato, cylindrico, postice vix angustato; elytris apice acuminatis et utrinque longe spinosis, dorso sparsim subgrosse punctatis (punctis fuscis); antennis crassis, filiformibus, pilosis; scapo brevi, quam articulus tertius paullo breviore.

Long. 9 lin.

Paraná, Brazil.

Ærenica porosa.

Robustior elytrisque latioribus, atro-fusca, tomento subtili cinereo-ochraceo vestita; thorace cylindrico, scabroso-punctato; elytris apice rotundatis, angulo suturali producto acuto, dorso punctis magnis nitidis sublineatim impressis, interstitiis (versus basin) punctulatis; antennis haud pilosis, subtus sparsim breviter ciliatis; tarsis articulo unguiculari ut in *Æ. hirticorni* valde elongato, gracili, sed unguiculis ramo interiore multo breviore.

Long. $8\frac{1}{4}$ lin. ♀.

Venezuela.

Apagomera.

Corpus cylindricum, angustum. Caput post oculos dilatatum, subtus haud retractum, frons brevis. Thorax cylindricus, basi angustatus vel constrictus. Elytra parallela, apice conjunctim rotundata, absque carinis lateralibus. Antennæ filiformes, robustæ, longe ciliatæ. Coxæ anticæ minus exsertæ.

The type of this genus is *Saperda triangularis* of Germar. It differs from the allied genera *Erana* and *Essostrutha* in the head being not retracted in repose, the prosternum in front of the anterior haunches being of considerable length, and the front of the head much shortened; the anterior coxæ differ also from the just-cited as well as all other genera allied to *Amphionycha* in being much less exserted and conical, the prosternum being in correlation wider between the sockets. In its robust filiform antennæ it agrees with *Essostrutha.*

Apagomera triangularis.

Apagomera triangularis, Germar, Ins. Spec. Nov. p. 493 (*Saperda triangularis*); Perty, Del. An. Art. Bras. t. 19. fig. 12.

Rio Janeiro, Brazil.

Apagomera suturella.

Cylindrica, gracilis, niger, griseo-pubescens; thorace fascia antica lateribusque flavis, linea dorsali et sutura elytrorum canis; corpore subtus vitta laterali fulva; thorace cylindrico subelongato, postice angustato; elytris subcrebre punctatis; antennis supra breviter pilosis, articulo tertio quam scapus paullo breviore et quam articulus quartus vix longiore; tibiis intermediis distincte emarginatis.

Long. 4 lin. ♂.

Paraná, Brazil.

Although closely related to *A. triangularis* by the form of the head, prothorax, and prosternum, this species recedes in points of structure which might be regarded as generic, viz. the much shortened third antennal joint and the notched middle tibiæ.

Apagomera azurescens.

Robustior, cylindrica, nigra, pube tenui sericeo-grisea vestita, macula thoracis utrinque rotundata aurantiaca; capite (♀) subgloboso; thorace brevi, transverso, medio utrinque tuberoso; elytris subsparsim punctulatis; antennis articulis secundo ad quintum subtus dense et longe ciliatis.

Long. 5 lin. ♀.

Brazil.

The *Amphionycha azurescens* of Dejean's Catalogue. In the short and laterally tumid thorax this species differs greatly from the type of the genus.

Eulachnesia.

Eulachnesia, Bates, Trans. Ent. Soc. 1872, p. 231.

This genus belongs to the Ærenicides by the non-retracted head, the lower part of which, in the typical species, is decidedly remote from the anterior haunches; and the prosternal process is in correlation visible between the moderately exserted coxæ. The anterior part of the prosternum, however, is concave, showing an approach to the structure distinctive of the true Amphionychides; and the lateral carina of the elytra is more or less clearly indicated. These typical species are connected by insensible gradations with others which have the same form of elytra and antennæ, but the head much more strongly retracted, and well-developed elytral carinæ. There are therefore no constant characters separating the two groups.

Eulachnesia cobaltina.

Elongata, postice modice attenuata, nigra, pube vel squamulis tenuibus pallide viridi-cæruleis tecta, vertice vittis tribus, genis vitta utrinque lata (per thoracem continuata), thorace plaga dorsali antennisque nigris; genis (infra vittam nigram) prosternoquo utrinque vitta alba, in elytrorum basi aurantiaco-fulva, postice oblique ducta; capite valde exserto, vertice prolongato; elytris ante apicem curvatim angustatis, apice sinuato-truncatis et bidentatis, dorso punctulatis, costulis duabus carinaque laterali haud elevatis; antennis utroque sexu corpore multo longioribus, filiformibus, robustis, infra usque ad apicem breviter ciliatis.

Long. 6–7 lin. ♂ ♀.

New Granada.

Much resembling *E. sapphira* in colours, but differing in many points of structure: the head is much more elongated and voluminous; the elytra taper in a gradual curve to the apex instead of rectilinearly; and the raised dorsal lines and carinæ are only feebly indicated by the limiting punctures; lastly, the antennæ have beneath a much shorter and less dense fringe of hairs. The male example before me has the elytra almost entirely fulvous, probably owing to the abrasion of the fine blue scales.

Eulachnesia calliste.

Longissima, postice gradatim valde attenuata, nigra, subtus aureopubescens, capite thoraceque vitta lata laterali flava, elytris dimidio basali testaceo-flavo, dimidio apicali violaceo-nigro polito, sutura flavo-pubescente, antennis, pedibus et metasterni episterno fulvis; capite longe exserto, vertice convexo; thorace dorso nitido, convexo; elytris apice sinuatim truncatis, angulis productis, versus basin lineatim punctatis, apice lævibus, carina laterali versus basin tantum elevata; antennis infra longe subdense ciliatis, articulo tertio longissimo.

Long. 8 lin. ♂.

Near Cuzco, Peru.

Eulachnesia æquatoria.

Elongata, linearis, subtus nigro-ænea, nitida, tenuiter cinereo-pubescens, capite thoraceque nigris velutinis (hoc disco subæneo-nitido), vertice vittis quatuor, genis utrinque una, thoraceque una laterali alteraque inferiore albis; elytris fulvo-rufis, subtiliter pubescentibus, macula magna communi submediana ænescenti-nigra; capite minus exserto, subtus paullo retracto; thorace cylindrico, medio paullulum dilatato, dorso convexo inæquali; elytris apice sinuatim truncatis utrinque bidentatis, dorso costulis utrinque duabus, interstitiis crebre punctulatis, carinis lateralibus utrinque duabus; antennis infra longe subdense ciliatis, articulo tertio longissimo.

Long. 6–7 lin. ♂ ♀.

Ecuador (*Buckley*).

Eulachnesia viridipennis.

Sublinearis, postice paullo angustata, viridi-ænea, subtus dense cinereo-pubescens, elytris sericeo-nitentibus, epipleuris violaceis marginibus aureo-pilosis, capite thoraceque supra nigris, vertice lineis duabus thoraceque utrinque una laterali flavis, fronte cinerea; antennis pedibusque fulvis, illis articulorum apicibus a tertio saturatioribus: capite modice exserto, quam thorax latiore, subtus vix retracto; thorace cylindrico, medio paullo dilatato; elytris apice sinuatim truncatis utrinque bidentatis, dorso sparsim punctulato, carina laterali obtusa sed distincta, apicem fere attingente; antennis longe ac minus dense ciliatis, articulo tertio longissimo.

Long. $5\frac{1}{2}$ lin. ♂.

Macas, Ecuador (*Buckley*).

Group 2. Amphionychides.

Sphallonycha.

Corpus cylindricum, modice elongatum, erecte pilosum. Caput thorace multo latius, pone oculos prominulos gradatim angustatum, fronte convexa modice elongata, infra angustata, subretracta. Thorax relative magnus, elongatus, subcylindricus, medio paullo dilatatus, dorso tuberoso. Elytra parallela, apice sinuato-truncata, angulo suturali distincto, exteriore dentato; dorso sublineatim sparsim punctata, carina laterali subobtusa, carina accessoria distante, longiore. Tarsi breves, articulo quarto curto, unguiculis basi intus dilatatis subdentatis. Prosternum, coxæ anticæ, et antennæ ut in *Amphionychis* typicis.

A new genus, rendered necessary for *Amphionycha roseicollis* (Bates) on account of its departure from the group-character in the form of the tarsal claws. On superficial observation the claws seem destitute of teeth, as in *Saperda*; but on close examination the thickened base of each is observed to be separated from the stem of the claw by a notch not far from the base, leaving a moderately acute basal tooth. The structure thus does not differ essentially from that of certain species of *Phytœcia*, e. g. *P. femoralis* (Muls.). In all other points of structure, however, *Sphallonycha* belongs strictly to the *Amphionycha* group, in which the peculiar form of the head and the relatively great length and tuberculation of the thorax would entitle it to generic distinction independently of the form of the claws.

There is great resemblance in general form, as well as in the dentation of the claws, between this genus and *Pretilia*; but the degree to which the head is retracted differs considerably in the two genera; and the elytra are destitute of carinæ in *Pretilia*, and distinctly carinate in *Sphallonycha*. Thus all the leading characters on which Lacordaire relied in his classification here break down utterly.

Sphallonycha roseicollis.

Sphallonycha roseicollis, Bates, Ann. & Mag. Nat. Hist. ser. 3, xvii. p. 430 (*Amphionycha roseicollis*).

Upper Amazons.

Alampyris.

Alampyris, Bates in Godman and Salvin's Biologia Centrali-Americana, Coleoptera, v. p. 218.

In this genus, numerous in species in Mexico and Central America, the head is retracted nearly as in *Amphionycha*, but the exserted anterior haunches are scarcely so closely approximated. The majority have no trace of elytral carinæ; and in those where they are present they are obtuse and sometimes much abbreviated, with epipleuræ of slight elevation. The true position in the group is very difficult to fix.

Alampyris planipennis.

Valde elongata, vix convexa, nigro-fusca, dense erecte pilosa, thoracis linea laterali indistincta, elytrorum sutura vittaque laterali albo-testaceis, marginibus albo-tomentosis; thorace sparsim, elytris crebre punctulatis absque carinis, lateribus post medium paullulum explanatis; palpis et femoribus testaceo-variis. ♂ abdomen nigrum; ♀ segmentis tertio et quarto utrinque pallide flavis tomentosis.

Long. 6–7 lin. ♂ ♀.

South Brazil.

Calocosmus janus.

Fusco-niger, subnitidus, pectore medio, abdomine femoribusque fulvo-testaceis; fronte vix convexa, pilosa, crebre punctata; thorace antice grosse sparsim punctato, limbo et postice plus minusve rufescente, cylindrico, lateribus medio obtusissime tuberculatis; elytris humeris prominulis, apice rotundatis, supra punctulatis.
Long. 5–5½ lin. ♂ ♀.

Cuba.

Calocosmus semimarginatus.

Fulvus, subnitidus, tenuiter pubescens, sparsim setosus; elytris purpurascenti-nigris, basi, sutura et lateribus usque medium anguste fulvis; tibiis et tarsis antennisque nigris, harum articulis quarto et quinto basi fulvis; elytris subacute conjunctim rotundatis, sublineatim punctulatis, carinula laterali paullulum distincta.
Long. 4 lin. ♂.

Santiago, Cuba.

TETANOLA.

Corpus elongatum, postice gradatim acuminatum, sparsim setosum, vittis nudis politis. Caput (cum oculis) thorace ♂ ♀ haud latius, inter antennas depressum, fronte modice elongata, quadrata, infra retracta. Thorax cylindricus, prope basin paullulum contractus. Elytra valde elongata, postice acuminata, apice fere acuta, dorso planata, sparsim tenuiter lineato-punctata, carina laterali recta, obtusa, usque ad apicem continuata. Antennæ ♂ ♀ corpore breviores, sparsim ciliatæ.

The acuminate elytra and extension of the lateral carina (although as an obtuse ridge only) to the apex constitute the chief characters of this genus. The smooth and shining integumental stripes of the upper surface are also a peculiarity which distinguishes it from the *Amphionychæ*.

Tetanola polita.

Subtus fulva, tenuiter pubescens, lateribus nigro-fuscis; supra nigro-vel fusco-castanea, elytrorum basin versus rufo-castanea, polita, capite, vitta laterali prothoracis, elytrorum lineis tribus (suturali et laterali ad apicem conjunctis, interiore ante apicem desinente) flavis; thorace tomentoso, disco postice tuberculo polito; antennis cinereo-fuscis, scapo fulvo-nitido; pedibus fulvis, geniculis tarsisque nigris.
Long. 7½–8½ lin. ♂ ♀.

Ecuador (*Buckley*).

OCHROMIMA.

Facies *Megalopi* (trib. Phytophagorum). Corpus breve, oblongum, postice angustatum, erecte pilosum. Caput latissimum, retractum, inter oculos paullo depressum, fronte elongata sed infra valde angustata, pilosa; ore parvo, mandibulis paullo exstantibus. Tubera antennifera longe barbata. Thorax trapezoidalis, a basi usque ad marginem anticum recte angustatum. Elytra convexa, apice conjunctim rotundata, carina laterali flexuosa, epipleuris altis. Antennæ corpore longiores, usque ad apicem longe ciliatæ.

This new genus is necessary for the reception of *Amphionycha megalopoides*, which differs in form and in some points of structure quite as much as *Chrysaperda* from the rest of the *Amphionychœ*. The only example at present known appears to be a male.

Ochromima megalopoides.

Ochromima megalopoides, Bates, Ann. & Mag. Nat. Hist. ser. 3, xvii. p. 427 (*Amphionycha megalopoides*).

Santarem, Amazons.

CHRYSAPERDA.

Corpus oblongum, convexum, erecte pilosum, nitidum, absque plagis tomentosis. Caput exsertum, inter antennas anguste depressum (tuberibus antenniferis elevatis), ♀ vertice valde convexo, fronte elongata, infra paullo dilatata, oculis parvis rotundatis. Thorax valde transversus, antice angustatus, medio transversim convexus. Elytra oblonga, medio angustata, ante apicem rotundato-dilatata, apice late truncata, angulo exteriore dentato, dorso planata, postice citius declivia, epipleuris altissimis (postice altioribus) carina laterali acutissima paullo curvata, supra declivatatem apicalem subito terminata. Antennæ corpore vix longiores, undique setosæ, scapo elongato gradatim clavato, articulo tertio longissimo, quarto ad sextum (præcipue in ♀) paullo incrassatis, apicalibus attenuatis.

Resembles species of the genus *Megalopus*, tribe Phytophaga. Most of the generic characters are but an exaggeration of what is seen in one or other of the species of *Amphionycha*; but in combination, as we find them here, they seem to warrant the institution of a separate genus.

Chrysaperda metallica.

Flava, vertice plaga magna (orbitam ocularem includente) nigra nitida; elytris (margine angusto laterali fasciaque latiore apicali flavis exceptis) cyaneis vel viridi-æneis, nitidis; antennis flavis, scapo basi et supra, articulis secundo et tertio (apice excepto) et septimo ad undecimum nigris; elytris subcrebre punctulatis.

Variat metasterno nigro-fusco, thorace supra rufo, antennarumque articulis primo ad tertium vix infuscatis.

Long. $4\frac{1}{4}$–$5\frac{1}{4}$ lin. ♂ ♀.

Ecuador (*Buckley*), Chanchamayo, Peru (*Dr. Thamm*).

[To be continued.]

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

May 25, 1881.—Robert Etheridge, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "On the Discovery of some Remains of Plants at the Base of the Denbighshire Grits, near Corwen, North Wales." By Henry Hicks, M.D., F.G.S. With an Appendix by R. Etheridge, Esq., F.R.S., Pres. Geol. Soc.

Traces of these fossils were first observed in 1875, by the author, in Pen-y-glog quarry, about two miles east of Corwen. Further research has resulted in the discovery of more satisfactory specimens, which have been examined by Messrs. Carruthers, Etheridge, and E. T. Newton. Among them are spherical bodies resembling the *Pachytheca* of Sir J. D. Hooker, from the bone-bed of the Ludlow series, supposed to be Lycopodiaceous spore-cases; also numerous minute bodies, stated by Mr. Carruthers to be united in threes and to agree with the forms of the microspores of Lycopodiaceæ, both recent and fossil; and some fragments which may belong to these plants, and others probably belonging to plants described by Dr. Dawson from the Devonian of Canada under the name of *Psilophyton*. The above testify to the existence of a very rich land-flora at the time. Mixed up with these, however, are numerous carbonaceous fragments of a plant described also by Dr. Dawson from the Devonian of Canada, which he referred to the Coniferæ, but which is, according to Mr. Carruthers, an anomalous form of Alga. The former called it *Prototaxites*; the latter renamed it *Nematophycus*. Numerous microscopical sections, showing the beautiful structure of this interesting plant from the specimens found at Pen-y-glog, have been examined by Mr. Etheridge and Mr. Newton; and their conclusions agree with those of Mr. Carruthers. The evidence seems to show that at this mid-Silurian period the immediate area where the plants are now discovered must have been under water, and that the mixture of marine and dry-land plants took place in consequence of floods on rapid marine denudation. The author indicated that the land-areas must have been to the south and west, chiefly islands surrounded by a moderately deep sea in which Graptolites occurred in abundance. The position of these beds may be stated to be about 2000 feet below the true Wenlock series, and about the horizon of the Upper Llandovery rocks.

2. "Notes on a Mammalian Jaw from the Purbeck Beds at Swanage, Dorset." By Edgar Willett, Esq. Communicated by the President.

Excavations were undertaken last summer in this locality (Durlstone Bay, Swanage), where, rather more than twenty years since, the jaws of sixteen new species of Mesozoic Mammalia were found by Mr. Beckles. These, though less successful than the former, resulted in the discovery of the larger part of the right mandibular ramus of a marsupial, about $1\frac{1}{2}$ inch long. Six teeth are preserved *in situ*. This specimen was described and its affinities discussed by the author. He referred it to the genus *Triconodon*, described by Prof. Owen in his monograph (Palæont. Soc. 1871). The peculiarity of this specimen is that it has four teeth having the form of true molars, while those previously found have only three. *Triacanthodon*, indeed, has four true molars; but between it and the specimen described there are some important differences of detail. The dental peculiarity may be explicable on either of two hypotheses suggested to the author by Prof. Flower; and he thinks it better to refer it to *Triconodon mordax* than to attribute it to a new species of the genus.

June 8, 1881.—Robert Etheridge, Esq., F.R.S., President, in the Chair.

The following communication was read:—

"The Reptile Fauna of the Gosau Formation, preserved in the Geological Museum of the University of Vienna." By Prof. H. G. Seeley, F.R.S., F.L.S., F.G.S.; with a Note on the Geological Horizon of the Fossils, by Dr. Edward Suess, F.M.G.S.

The collection of Reptiles described in this paper was obtained at Neue Welt, near Wiener Neustadt, by tunnelling into the freshwater deposits which there yield coal. A part of the collection was described by Dr. Bunzel in 1871; but the author's interpretation of the fossils rendered a reexamination of the whole collection necessary. All the species hitherto discovered are new, and, with the exception of those referred to *Crocodilus*, *Megalosaurus*, *Ornithochirus*, and *Emys*, are placed in new genera. Nearly all the bones are more or less imperfect.

The *Iguanodon Suessii*, of Bunzel, was referred to a new genus, *Mochlodon*, characterized by the straight anterior end of the ramus of the lower jaw, and by the vertical bar in the middle of the teeth of the lower jaw. There appear to be two teeth in the ramus. The tooth referred to the upper jaw has several uniform parallel vertical bars. A small parietal bone, referred by Bunzel to a Lizard, is considered by the author to belong probably to the same species; and, with some doubt, he associated with it the articular end of a small scapula.

Bunzel's *Struthiosaurus austriacus* was redescribed by the author, who indicated that the bones of the base of the brain-case, regarded by Bunzel as the quadrate bones, really belong to the occipital region, which necessitates a different interpretation. The foramina along the base of the skull were also described as presenting one of the characteristics of the Dinosaurian order. The base of the skull of *Acanthopholis horridus* was described, to show its relation to the above type, with the view of demonstrating its Scelidosaurian affinities.

The greater part of the remains were referred by the author to a new genus, *Cratœomus*; some of these had been figured by Bunzel as "Crocodili ambigui," and others as belonging to *Scelidosaurus* and to a new Lacertilian genus, *Danubiosaurus*. To *Cratœomus* he referred mandibles, teeth, vertebræ from all parts of the column except the sacrum, dermal armour, and the chief bones of the limbs. Two species were distinguished, *C. Paulowitschii* and *C. lepidophorus*. The former, which is much the larger, was named in honour of M. Paulowitsch, who voluntarily superintended the work at Neue Welt. The author stated that he regarded these animals as carnivorous, and that, unlike the typical Wealden Dinosaurs, they were not Kangaroo-like in habit, but had strongly developed fore limbs, as indicated in the proposed generic name.

Two teeth belonging to *Megalosaurus* were described as representing a new species, *M. pannoniensis*, characterized by the crown being shorter and broader than in previously described forms. A fragment, regarded by Bunzel as the thoracic rib of a Lizard, was interpreted as the distal end of the femur of a Dinosaur, and named *Ornithomerus gracilis*. The lower jaw, described by Bunzel as *Crocodilus carcharidens*, of which a maxillary bone also occurs, was made the basis of a new genus, *Doratodon*, probably Dinosaurian, judging from the lateral position of the apertures of the skull and the characters of the teeth. The genus *Rhadinosaurus* was founded upon the humerus and femur, the latter having been regarded by Bunzel as the dorsal rib of a Crocodile; the species was named *R. alcimus*. *Oligosaurus adelus* was described as presenting Lacertilian characters in combination with some Dinosaurian peculiarities. The remains include the humerus, femur and scapula, and two vertebræ, which were regarded by Bunzel as fœtal vertebræ of a Dinosaur. The genus *Hoplosaurus* was founded on some vertebræ, fragments of limb-bones, and dermal armour; it shows, with distinctive peculiarities, a certain resemblance to *Hylæosaurus*.

A procœlian Crocodile was represented by many parts of the skeleton—some figured by Bunzel as Lacertilian, others as Crocodilian. It is remarkable for having a buttress supporting the transverse process in the lumbar region. The author calls it *Crocodilus proavus*.

The specimen figured by Bunzel as the ilium of his *Danubiosaurus anceps* was stated by the author to be a costal plate of a large Chelonian, in which, apparently, the margins of these plates remained separate through life. Skull-bones believed to belong to the same animal are strongly sculptured. The author named the species *Pleuropeltus lissus*. Three or four species of Emydians were said to be indicated by isolated plates, the largest of which was named *Emys Neumayri*.

The only specimen referable with certainty to a Lizard is a small vertebra of elongated form, regarded as indicating a new genus and species, named *Spondylosaurus gracilis*. Of Pterodactyls there are but few remains; but these certainly represent two genera. The author only describes one species, to which he gives the name of *Ornithochirus Bunzeli.* There are, in all, probably ten genera of Dinosaurs and five genera of other groups, making fifteen in all.

The paper was supplemented by a note by Prof. Suess on the geological relations of the beds at Wiener Neustadt to those of the Gosau valley, in which he comes to the conclusion that they are older than the true Turonian deposits, and especially older than the zone of *Hippurites cornu vaccinum.*

June 22, 1881.—R. Etheridge, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "Description of a new Species of Coral from the Middle Lias of Oxfordshire." By R. F. Tomes, Esq., F.G.S.

The species of Coral described in this paper was referred by the author to the genus *Thamnastræa* and the subgenus *Synastræa*, under the name of *Thamnastræa Walfordi*, in honour of its discoverer, Mr. E. A. Walford. The specimen was from the *spinatus*-beds of the Marlstone at Aston-le-Walls, Oxfordshire. Like *Thamnastræa Etheridgei*, previously described by the author (Q. J. G. S. xxxiv. p. 190) from the Middle Lias of Oxfordshire, this species presents the same subgeneric characters as *T. arachnoides* of the Coral Rag of Steeple Ashton; and the author remarks upon the fact that the only species known from the English Lias resemble Corallian rather than Inferior-Oolite forms.

2. "Note on the Occurrence of the Remains of a Cetacean in the Lower Oligocene Strata of the Hampshire Basin." By Prof. J. W. Judd, F.R.S., Sec. G.S. With a Note by Prof. H. G. Seeley, F.R.S., F.G.S.

The author referred to the rarity of remains of marine Mammalia in the Lower Tertiaries of Britain, the only recorded species being *Zeuglodon Wanklyni*, Seeley, from the Barton Clay. The single specimen in his possession was obtained at Roydon, about a mile and a half north of Brockenhurst, where the beds exposed in the brickyard consist of sandy clays crowded with marine fossils, and resting upon green freshwater clays with abundance of *Unio Solandri* belonging to the Headon series. The author briefly referred to the question of the horizon of these deposits, which he regards as belonging to the same great marine series as the beds of Brockenhurst and Lyndhurst, which he holds to be Tongrian or Lower Oligocene.

The Cetacean vertebra obtained by Prof. Judd was stated by Prof. Seeley to be a caudal vertebra, probably the eighth, but not later than the twelfth, of a species belonging or closely related to the genus *Balænoptera*, and especially approaching *Balænoptera laticeps*, a species of the North Sea which appears to range to Japan. Prof. Seeley regarded it as representing a new species, which he named *Balænoptera Juddii.*

3. "Description of a Peat-bed interstratified with the Boulder-drift at Oldham." By G. H. Hollingworth, Esq., F.G.S.

The author described a deposit of peat interstratified with Boulder-drift, exposed in a railway-cutting at Rhodes Bank, Oldham. The depth of the section was only 14 feet; and it showed:—

1. Soil	8 to 10 inches.
2. Boulder-clay, with beds and strings of peat	2 to 6 feet.
3. Main bed of peat, containing mosses, exogenous stems, and beetles	2 inches to 1 ft. 9 in. (average 15 inches).
4. Fine blue clay (floor)	2 inches to 1 foot.
5. Current-bedded coarse sand and fine gravel	4 inches to 2 feet.
6. Boulder-clay.	

The mosses in the peat are of northern type.

4. "Silurian Uniserial *Stomatoporæ* and *Ascodictya*." By G. R. Vine, Esq. Communicated by Prof. P. Martin Duncan, F.R.S., F.G.S.

For the genus *Stomatopora* the name *Alecto* has priority; but as that had previously been applied to a member of the class Echinodermata, the author preferred the later name. Species of the genus have also been described under the generic name *Aulopora*. The author has received from Mr. Maw more than two hundredweight of washed *débris* of Wenlock shale, about thirty pounds of which, from twelve localities, he has examined. It contains a moderate amount of Polyzoan remains, generally water-worn. The author described the following species—*Stomatopora inflata* and *dissimilis*, *Ascodictyon stellatum* and *radians* (with a variety *siluriense*), and discussed the characters of the genera.

5. "On a new *Comatula* from the Kelloway Rock." By P. H. Carpenter, Esq., M.A., Assistant Master at Eton College. Communicated by the President.

The specimen, to which the author's attention was called by R. Etheridge, jun., Esq., is in the national collection; he proposes for it the name *Actinometra calloviensis*. The specimen is from the Kelloway rock, of Sutton Benger; the whole diameter is 15 mm.; diameter of centrodorsal 6 mm. Three species of this genus are already known from the British Jurassic rocks: two are only known from their centrodorsals, which are each different from that of *A. calloviensis*; the third is *A. cheltonensis*, from the Inferior Oolite, known only by its radials and basals, which are different from those of the present specimen. To this *Antedon Picteti,* from the Valangian of the continent, has some resemblance. It is, however, a true *Actinometra*, differing chiefly from existing forms in retaining its primary basals without their having undergone transformation into a rosette.

6. "Descriptive Catalogue of Ammonites from the Sherborne District." By Sydney S. Buckman, Esq. Communicated by Prof. J. Buckman, F.G.S., F.L.S., &c.

In this paper the author gave a list of the Ammonites from the Inferior Oolite of the neighbourhood of Sherborne, in which he enumerated about 47 species, and stated that he had about 50 more which appear to be undescribed; fully one half have the mouth-termination perfectly preserved. The author indicated the zones into which the rocks furnishing these Ammonites could be divided, as shown at Oborne, near Sherborne, at Wyke quarry, and at Bradford Abbas, and indicated the characteristic fossils of each; he also gave the principal synonyms of the species referred to, and discussed some of their characteristic peculiarities.

BIBLIOGRAPHICAL NOTICES.

Journal and Proceedings of the Royal Society of New South Wales for 1879. Vol. xiii. 8vo. Sydney, 1880.

Astronomy, Geology, Zoology, Meteorology, and Microscopy supply the chief matter of this vol. xiii. of the 'Journal and Proceedings of the Royal Society of New South Wales.' The Rev. J. E. Tenison-Woods's illustrated Monograph of the Genus *Distichopora,* Dr. Hector's comparison of the geological formations of New Zealand with those of Australia, H. C. Russell's account of the Wentworth hurricane (with a chart), and his description of the "Gem" cluster in Argo, are good examples of Australian scientific work, and, with the other contents of the volume, will be found to be highly useful contributions to science and general knowledge. We must add that the Anniversary Report by the Vice-President, the Hon. Professor Smith, gives a most genial and noteworthy biography of the late Rev. W. B. Clarke, including a careful *résumé* of his geological labours.

Proceedings of the Bristol Naturalists' Society. New series, vol. viii. part 1, for 1879. 8vo. Bristol, 1880.

Dr. S. P. Thompson contributes a most interesting account of some optical illusions, especially as concerns the "strobic circles," with suggestive explanations as to the causes of these illusions. Dr. Beddoe treats of the Ethnology of the Hindoo-Koosh; H. Charbonnier of specimens of the Pomarine Skua killed in England; A. E. Hudd of the Local Lepidoptera (part 3); W. J. Sollas of the Structure and Life-history of a Sponge (*Sycandra raphanus*); A. Leipner of Prolification in *Cyclamen persicum*; and C. Bucknell of the Local Fungi (part 3). Thus, touching the highest and the lowest in Biology, the Society fulfils its part in Natural History, supplementing the above with E. Wethered's valuable paper on Underground Temperature and G. F. Burder's Table of the Rainfall at Clifton in 1879.

Proceedings of the Yorkshire Geological and Polytechnic Society. New series, vol. vii. part 3, for 1880. 8vo. Leeds, 1881.

Excepting the Marquis of Ripon's Presidential Address on the objects, work, and progress of the Society, and a paper by W. P. Sladen on the Structure of the Asteroidea, with special reference to their ancestral relationship, this part iii. for 1880 is mainly composed of geological notes and memoirs, mostly with local bearings. The Raygill Fissure, the Creswell Caves, the Glacial Deposits near Bridlington and elsewhere, the Geology of Cleveland, the Fault in the Flamborough Chalk, Bones of *Ctenodus*, and the Fossil Fishes of the Coal-fields in Yorkshire are here treated of more or less fully.

MISCELLANEOUS.

On some remarkable fossil Fishes from the Devonian Rocks of Scaumenac Bay, in the Province of Quebec. By J. F. Whiteaves.

Immediately after my paper on the Canadian *Pterichthys** was written, Mr. A. H. Foord, of the Geological Survey of Canada, went down to the Baie des Chaleurs, and spent two months and a half of the summer of 1880 in a careful and systematic examination of the fish-bearing beds of the Devonian rocks of the north bank of the mouth of the Restigouche river. The exact locality at which the *Pterichthys canadensis* was found is not the Baie des Chaleurs proper, but Scaumenac (sometimes written Escuminac) Bay, Restigouche Harbour, in the county of Bonaventure. On the shores of this bay a series of shales, sandstones, and conglomerates, now known to be of Devonian age, are overlain, apparently unconformably, by the red sandstones and conglomerates of the "Bonaventure Formation."

From these Devonian rocks Mr. Foord succeeded in obtaining a

* "On a new Species of *Pterichthys*, allied to *Bothriolepis ornata*, Eichwald," &c., Amer. Journ. Sci. xx. p. 132, August 1880.

large and interesting collection of fossil fishes. Fully four fifths of the entire number of specimens in this collection are referable to the genus *Pterichthys*, which at this locality seems to be represented by only one species, *P. canadensis*. Some of these are nearly perfect, and want only the fins proper and the tail, while others are mere isolated plates or detached portions of the pectoral spines. One of the specimens shows that the Canadian *Pterichthys* had two labial appendages or barbels attached to the front margin of the head. These barbels are almost exactly similar in shape to those indicated by dotted lines in the ideal representation of the genus *Pterichthys* on plate vi. of the 'Monographie des Poissons fossiles du Vieux Grès Rouge,' which Agassiz claims to have seen in his *P. latus*; but in *P. canadensis* the barbels are very close together at their bases. In two other specimens of a *Pterichthys* collected by Mr. Foord two remarkable, flattened, conical dermal processes are plainly visible on the helmet, one on each side of the orbital cavity. Posteriorly each process appears to fit into the angle formed by the junction of the prelateral with the nuchal and postlateral plates, while anteriorly they are each directed obliquely outward and forward across the prelaterals, which they partly cover. In one of the specimens the dermal processes, which are ornamented with a sculpture precisely similar to that of all the other plates, are half an inch long and $2\frac{1}{2}$ lines broad near their base. They taper gradually from their base to an obtuse point, and are pressed close to the surface of the helmet.

In addition to these remains of *Pterichthys*, there are examples of eight or nine species of fossil fishes in Mr. Foord's collection, which belong to at least seven genera. The following is a brief description of the most striking characters of six of these species, the affinities of the remainder not having yet been satisfactorily ascertained:—

Diplacanthus.

Two specimens, one showing scales and longitudinally-grooved fin-spines, and the other a large portion of the body of a small smooth-scaled *Diplacanthus*, very like the *D. striatus* of Agassiz, and possibly identical with that species.

Phaneropleuron curtum, sp. nov.

Four crushed and distorted but nearly perfect examples and several fragments of a new species of *Phaneropleuron*, which differs from the *P. Andersoni* of Huxley, from the Old Red Sandstone of Dura Den, in its smaller size and in its much greater height or depth as compared with its length. *P. Andersoni* is represented as being about five and a half times as long as high, whereas in the largest specimen of *P. curtum* yet collected, which is 6 inches long, the length is not much more than twice the height.

Eusthenopteron Foordi, nov. gen. et sp.

The name *Eusthenopteron** is proposed for a supposed new genus, which resembles the *Tristichopterus* of Sir Philip Egerton in the shape and ornamentation of its scales and cranial plates, in the circumstance that the fin-rays of its anal and second dorsal fins are both supported by three osselets articulated to a broad interspinous apophysis, and in some other important particulars. But the vertebral centres of *Tristichopterus* are said to be ossified, and the osselets which support the rays of the lower lobe of the tail are described as "springing from eight or nine interspinous bones," whereas in *Eusthenopteron* the vertebral centres are not ossified, and the caudal osselets are articulated to the modified hæmal spines. In *Eusthenopteron*, too, the osselets and interspinous bones of the anal and second dorsal are larger than those of *Tristichopterus*, and different also in their shape and relative proportions.

The species, which is named after its discoverer, Mr. A. H. Foord, may be recognized by its large size (it appears to have attained to a length of 2 feet or more) and by its narrowly elongated and acutely pointed first dorsal fin.

Glyptolepis microlepidotus, Agassiz.

A single nearly perfect specimen of a small-scaled *Glyptolepis* which cannot at present be distinguished from the above-named European species.

Glyptolepis ———.

A second species of *Glyptolepis*, apparently allied to the *G. leptopterus* of Agassiz, is indicated by a number of large detached scales, nearly an inch in diameter, which are associated with slender rib-bones, an operculum, and a fragment of a jaw with teeth on the same small slabs of shale.

Cheirolepis canadensis, nov. sp.

Four exquisitely preserved specimens, two of which are nearly perfect, of a large *Cheirolepis*, which resembles the *C. macrocephalus* of M'Coy and the *C. Cumingiæ* of Agassiz in the size, contour, and sculpture of the scales of the body and fins, but which seems to differ from both in the relative position of its fins. In *C. canadensis* the ventrals are separated from the pectorals by a short interval and from the anal by a much longer one. In *C. macrocephalus*, on the other hand, the ventrals are represented by M'Coy as being nearer to the anal than they are to the pectorals, while in *C. Cumingiæ*, according to Hugh Miller, "the large pectorals almost encroach on the ventrals and the ventrals on the anal fin."

A more detailed description of these species will be found in the current number of the 'Canadian Naturalist' †.

* From εὐσθενής, stout, and πτέρον, a fin.
† Vol. x., new series.

The existence of fossil plants as well as of fish-remains in the Devonian shales and sandstones of Scaumenac Bay was noticed by Dr. Abraham Gesner in 1842; and from these rocks Mr. Foord also obtained four species of ferns, which have recently been reported on by Principal Dawson.

The analogies between the fossil fauna of the fish-bearing beds of Scaumenac Bay and that of the Old Red Sandstone of Scotland and Russia are very striking. *Pterichthys canadensis* is still doubtfully distinct from the *Bothriolepis ornata* of Europe; the fragments of a *Diplacanthus* obtained by Mr. Foord have apparently much the same characters as the *D. striatus* of Agassiz; and the genus *Phaneropleuron* can now be shown to occur in the Devonian rocks of Canada as well as in those of Scotland. *Eusthenopteron* has many features in common with *Tristichopterus*; one species of *Glyptolepis* from Scaumenac Bay seems to be identical with the *G. microlepidotus* of Agassiz, from Lethen Bar, while the other bears a general resemblance to the *G. leptopterus* of the same author; and, lastly, *Cheirolepis canadensis* is certainly very closely allied to two Scotch species.

These Devonian rocks at Scaumenac may have been of freshwater or estuarine origin; for no traces of any marine invertebrata have yet been detected in any of them, and the fossil fishes which they contain are invariably found associated with land plants.—*Amer. Journ. Sci.*, June 1881.

Migrations of the Poplar-Aphis (Pemphigus bursarius, *Linn.*). By M. J. Lichtenstein.

In August of last year* I had the honour to announce to the Academy that the Aphis of the woody galls of the poplar (*Pemphigus bursarius*, partim, Linn., sub *Aphis*), placed under a bell glass on its escape from the galls, upon a plant of *Filago germanica*, produced young which, having in their turn acquired wings, had furnished sexual insects, laying in abundance upon fragments of poplar-bark placed within their reach in my study.

These sexual forms, which had no rostrum, copulated and furnished numerous fecundated ova. I say numerous, because the females themselves were very numerous; for each of them, like all the Pemphiginæ of which I know the sexual forms, has only a single ovum in its body.

The copulation is preceded by several moults, which appear to me to be four in number. Although they had no mouth, and consequently could not feed, these little animals increased in size, like seeds put to soak. The male dies first, after having fecundated several females. When the female arrives at the moment of oviposition, we see issuing from her body very numerous white filaments,

* See 'Annals,' November 1880, p. 404.

which surround the egg, which is thus enclosed in a pith-like envelope of a secretion resembling spiders' threads. The secretory organs consist of two circlets of spinnerets placed on the sides of the abdomen, at the point occupied by the cornicles in the true Aphidinæ.

These eggs, kept through the winter, began to hatch in the first days of April; I then transported the fragments of bark bearing these little animals to a young poplar placed for the purpose in my garden, and upon which I had ascertained that there were no galls last autumn. This operation was effected in the first days of the month of April, before my departure to the meeting of the French Association at Algiers. On my return I hastened to look at my little tree, and found it garnished with small galls of *Pemphigus bursarius* (easily recognized by their position at the base of the young buds) already as large as green peas.

The test and counter tests having thus proved successful, I think that I may affirm that *Pemphigus filaginis* is only the gemmiparous and pupiferous form, *i. e.* the third and fourth forms of *Pemphigus bursarius.*

It may perhaps be objected that, the poplar being in the open air and incapable of being covered with a bell glass, some error may still be possible; but this seems to me difficult. Nevertheless I am already preparing plants of *Filago*, which I shall keep shut up and under bells until the month of July, so as to make a rearing in the room, sheltered from all external influences.

Moreover I have sent some of the same eggs which I have used in the above experiments to Mr. Riley at Washington, and to Mr. Monell at the Botanic Garden of St. Louis (Missouri); I am expecting information from them; and if I can give rise to the same galls on the poplar in America, this will be an unanswerable argument.—*Comptes Rendus,* May 2, 1881, p. 1063.

Metamorphosis of Pedicellina. By M. J. Barrois.

Most authors have hitherto supposed that the larva of *Pedicellina* passed directly into the adult by simple elongation of its lower part (the extremity of its aboral face), which became drawn out to form the peduncle. In 1877 I gave figures showing that matters did not go on in quite so simple a manner, and that, notwithstanding the great resemblance of the two forms, the larvæ of *Pedicellina,* like all the others, were subject to a period of very profound modifications. I was not then able to trace these modifications; but my recent thorough investigations of the subject enable me now to give a description of the passage, based upon observed facts.

I. *Fixation.*—The fixation takes place by the oral pole, and not, in accordance with the extant hypothesis, by the extremity (aboral pole) of the body.

II. The digestive tube, accompanied by a portion of the vestibule, undergoes a rotation from in front backwards. In consequence of this phenomenon the intestine loses the horizontal position with apertures directed downwards, which it at first possessed, and passes gradually through two other positions :—1, one vertical with apertures directed towards the posterior surface of the larva (which, as in the Escharinæ, becomes the anterior surface of the adult); the other horizontal and with apertures directed upwards.

The first position represents a state precisely analogous to *Loxosoma*, with the anus above and the œsophagus below; the second is that of *Pedicellina.*

III. While the digestive tube is undergoing this rotation, the vestibule divides into three distinct parts:—1, the inferior one, which bears the circlet, and of which the elements come to form the gland of the foot, which is also visible at a certain epoch in the *Pedicellina*; 2, the superior one, which follows the digestive tube and becomes isolated to form the tentacular chamber; it is this portion that will give origin to the tentacles; it afterwards places itself in relation with the exterior by means of a cleft-like invagination of the ectoderm; 3, the median portion, which becomes degenerascent to give origin to the mass of globules, which at first fills the cavity of the peduncle, and each of which afterwards becomes converted into a stellate cell of the supposed colonial nervous system.

IV. There remain the two enigmatic organs of the ectoderm (organs of sense) which a recent author (Hatschek) represents as playing so important a part. These, in my opinion, are nothing but provisional organs; they are both thrown up upon the dorsal surface, where they finally disappear by degrees. No doubt we must recognize in the two setæ described by Salensky upon the dorsal surface of *Loxosoma crassicauda* the remains of the anterior organ of sense, which, according to my investigations, comes to occupy this position.—*Comptes Rendus*, June 27, 1881, p. 1527.

On the Structure of the Oothecæ of the Mantides, *and the Hatching and first Moult of the Larvæ.* By M. C. Brongniart.

Several groups of Articulata surround their eggs with a common protective envelope. Sometimes it is in the body of the female itself that this agglomeration is effected (Blattina); sometimes, on the contrary, the female constructs the protective shell and deposits her eggs in it (Spiders, *Hydrophili*, Mantina).

Several authors, such as Pagenstecher, Roesel, Prof. E. Perrier *, and M. Henri de Saussure †, have studied the egg-cases or *oothecæ* constructed by the *Mantes*. In May last I brought from Algeria some oothecæ of *Mantes*; and I have thus been able to witness the emergence of the young larvæ.

The egg-cases of the *Mantes* are deposited upon branches of shrubs or upon stones. The structure differs but little in the diffe-

* Ann. Sci. Nat. Zool. 5e sér. xiv. (1870).
† Mission Scientifique au Mexique, 1872.

rent species. Outside, the ootheca is of a greyish-brown colour. It is generally pyriform, with the smaller extremity upwards; it appears to be strongly furrowed transversely. If we make a section in the direction of these furrows, we observe that the eggs are contained in a circular median chamber. Each of the large exterior furrows corresponds to a story; and an ootheca contains some twenty stories.

This median chamber is surrounded by frothy envelopes without eggs, the arched layers of which correspond to the succession of stories of the central chamber. Each story of this chamber is divided into two cells by a thin antero-posterior partition, and communicates in front with the exterior by a sort of flattened neck, the edges of which, in the form of scales, are bent and laid one over the other; that is to say, they are imbricated.

The eggs in each cell are symmetrically arranged, in such fashion that the portion of the egg which will constitute the extremity of the abdomen is applied to the wall, whilst the heads are turned forward obliquely and are all brought close together. Consequently the larvæ, to get out, will only have to advance straight forward, without any turning. Each central cell contains a dozen of eggs; there are about twenty-four on each story, each contained in a sort of gummy alveolus; the cells at the two extremities of the case contain a smaller number. This egg-case, which is at first transparent and frothy, solidifies and becomes impermeable to such a degree that it may be immersed in water without wetting the eggs.

To construct its egg-case the insect employs its abdomen and elytra. Clinging to the branch of a shrub, the Mantis secretes a frothy, slightly transparent liquid, which it holds up by means of the extremity of its elytra. By this means it can construct the first stories of its egg-cases in the form of a spherical hood by means of the regular movements of its abdomen, which kneads the frothy substance and spreads it in successive layers with the assistance of the cerci. The eggs are expelled by the abdomen, together with a certain quantity of frothy liquid, which will form the alveolus. The ootheca gradually acquires a darker colour and becomes harder.

After the copulation, which generally takes place in September, the female builds her ootheca. The eggs hatch in May and June. Last month I witnessed the emergence of the larvæ from the oothecæ that I brought with me. Each larva, while still soft, advances towards the aperture of its cell in order to issue from it.

M. de Saussure explains the emergence of the larva in the following manner:—"The little larva has now to escape from the cell in which it is enclosed; and *as it is too weak to make use of its feet*, nature comes to its assistance by means of a peculiar artifice. The surface of its body is clothed with a chitinous substance, upon which are developed some spines directed backward. By giving its abdomen an undulatory movement, the spines serving as a support against the walls of the cell, the larva travels towards the operculum in the same way that an ear of rye, by the aid of its spiny beards, can travel over a piece of cloth which is set in vibration." The comparison employed by M. de Saussure is quite correct; but the spines are not, properly speaking, upon the abdomen; they are situated on the cerci, which have the form of two large mamillæ. Moreover the legs are covered with strong spines, which likewise assist the young larvæ to travel in their alveolus. The larvæ of the upper part of the case are the first to issue, although these eggs were the last laid. Sometimes the lid of the cell closes again before the larva has completely issued and it perishes. Those which succeed in quitting the ootheca, instead of falling to the ground, are sustained in the air by the aid of two very long and very slender silky threads, fixed on the one hand to the extremity of each of the cerci, and on the other adherent to the inner and posterior wall of the shell of the egg. Very soon all the little larvæ thus suspended from the ootheca form a sort of bunch. They remain for some days in this state; and when the first moult has taken place, their cast skins remain suspended from the ootheca.

If these young larvæ were to fall to the ground in such a feeble state, they would become the prey of their enemies. After the moult they manifest their voracity by falling upon the small insects they meet with, and they are very active.

The silky threads which sustain these young larvæ have been regarded as the representatives of the cerci; but in the larvæ contained within the egg the cerci already exist, and are formed, as I have already indicated, by two short rods covered with spines.

It often happens that, in order to change the skin, the larvæ of these insects are obliged to attach themselves to the branches by means of filaments. These long silky threads seem to have no other purpose but to enable the larva to effect its first moult secure from all dangers.—*Comptes Rendus*, July 11, 1881, p. 94.

Observations on Cladocoryne floccosa.
By M. Duplessis.

M. Duplessis's memoir on *Cladocoryne floccosa* (Bull. Soc. Vaud. des Sci. Nat. 2e sér. tome xvii. pp. 108–118) furnishes us with complete information upon a curious type of Hydroids which is the sole representative of a distinct family. The distribution of the tentacles, their dichotomous branching, and their knobbed terminations would seem to bring *Cladocoryne* into the family Cladonemidæ or into that of the Clavatellidæ. But in both these families the polypes produce Medusæ, while the genus *Cladocoryne* is larviparous. It approaches the family Corynidæ by the constitution of its genital capsules and by the arrangement and form of its tentacles; but it is the only larviparous genus in which the latter organs are branched. Unless we were to modify the diagnosis of the Corynidæ we must therefore form a family Cladocorynidæ, including the single genus *Cladocoryne*, to which two species belong—namely *Cladocoryne floccosa*, Rotch, from the Mediterranean and Atlantic, and *C. pelagica*, Allm., which has hitherto been found only in the Atlantic. This second species, instead of being littoral and from the bottom, has, as its name indicates, a pelagic existence. M. Duplessis thinks that perhaps we ought to approximate to the latter another pelagic form described as a new genus by F. E. Schultze from specimens collected at Trieste upon Fuci.—*Bibl. Univ., Arch. des Sci. Physiques et Nat.*, July 15, 1881, p. 98.

Observations on the Structure of Dictyophyton *and its Affinities with certain Sponges.* By R. P. Whitfield.

In the Chemung group of New York and in the Waverley beds of Ohio and elsewhere there occurs a group of fossil bodies which have been described under the name *Dictyophyton*, but the nature of which, I think, has not been properly understood. In the 'Sixteenth Report on the State Cabinet of Natural History of New York,' p. 84, in the remarks preceding the generic description, they are referred to the vegetable kingdom, with the opinion expressed "that they are Algæ of a peculiar form and mode of growth," a reference which I think their nature does not warrant.

If we examine the figures of the various species described, given on plates 3 to 5 *a* of the above-cited work, it will be seen that these bodies are more or less elongated tubes, straight or curved, cylindrical or angular, nodose or annulated, and that they have been composed of a thin film or pellicle of network, made up of longitudinal and horizontal threads which cross each other at right angles, thereby cutting the surface of the fossil into rectangular spaces, often with finer threads between the coarser ones. When the specimens, which are casts or impressions in sandstone, are carefully examined, it is found that these threads are not interwoven with each other like basket-work or like the fibres of cloth, nor do they unite with each other, as do vegetable substances; but one set appears to pass on the outside and the other on the inside of the body. The threads composing the network vary in strength, and are in regular sets in both directions, while the entire thickness of the film or substance of the body has been very inconsiderable. In one species, the only one in which the substance filling the space between the cast and the matrix has been observed, it appears to be not more than a twentieth of an inch in thickness, and is ochreous in character. This peculiar net-like structure does not seem to be that of any known plant; nor does their nodose, annulated, cylindrical, or often sharply longitudinally angular form, with nearly perfect corners, indicate a vegetable structure; moreover it is not a feature likely to be retained in a soft yielding vegetable body of such extreme delicacy and large size, while drifting about by the action of water, in becoming imbedded in the sand of a sea-bottom, but would rather indicate a substance of considerable rigidity and firmness of texture.

In examining the structure of *Euplectella* it is found to be composed of longitudinal and horizontal bands similar to those above described, with the additional feature of sets of fibres passing in each direction obliquely across or between the longitudinal and horizontal sets, but not interwoven with them; so that the longitudinal series forms external ribs extending the length of the sponge, and the horizontal series inside ribs or bands; and they appear as if cemented to each other at their crossings. The oblique threads, besides strengthening the structure, cut across the angles of the quadrangular meshes formed by the two principal sets of fibres, and give to them the appearance of circular openings, making the structure much more complicated than in *Dictyophyton*. The addition of oblique fibres in *Euplectella* is the most noticeable difference between the two forms; but if placed horizontally and longitudinally between the primary sets they would produce precisely the structure seen in *Dictyophyton*.

As yet we have no positive evidence of the nature of the substance which composed the fibres in *Dictyophyton*. The only cases known, so far as I am aware, of the preservation of the substance of the fossil are that mentioned above, where the space between the matrix and the cast is occupied by a ferruginous body, a material which so often replaces siliceous organisms in a fossil state, and specimens of *D. Newberryi* from Richfield, Ohio, on which there occur slight patches of a carbonaceous substance, but not sufficient to warrant the conclusion that it ever formed a part of the structure, even in the opinion of the author of the genus, who supposed these organisms to have been of vegetable origin, especially as they are associated with numerous fragments of terrestrial plants. I am therefore led to the opinion, from their firmness of texture, as evinced by the strong markings left in the rock and the almost perfect retention of their original form, that they were of a siliceous nature. Still in this opinion I may be mistaken, and it must be left for future discovery to determine; but that they were of the nature of sponges and not of plants I feel very confident.

The form given by Professor Vanuxem in the Geological Report of the Third District of the New York Survey, and also figured in the Sixteenth Report above cited, I think would also better conform to this idea than to that of a vegetable origin, although its broad flattened bands may be something of an objection.

The name *Hydnoceras* was originally applied by T. A. Conrad to designate a species of this genus (Journ. Acad. Nat. Sci. Philad. vol. viii. 1st series, p. 267), but was discarded on account of its objectionable signification, though, if the view here suggested prove correct, the later appellation is almost as objectionable.—*Amer. Journ. Sci.*, July 1881.

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[FIFTH SERIES.]

No. 45. SEPTEMBER 1881.

XIX.—*On the Penœidea.* By C. Spence Bate, F.R.S. &c.

(A Critical Examination of the typical Specimens of the Penæidæ of Milne-Edwards, preserved in the Museum of the Jardin des Plantes, and a Synopsis of the Species of Penæidea in the 'Challenger' Collection.)

[Plates XI. & XII.]

In the collection of Crustacea brought home by the 'Challenger' there is a very considerable number of species of *Penœus* and nearly allied genera. Believing these to constitute one of the most distinct and natural groups of the class, I have endeavoured carefully to determine the various forms that distinguish the genera and species of the extremely interesting tribe Penæidea.

The tribe itself differs from all others of the class in the structure of the branchiæ, in having the third pair of pereiopoda chelate and in most genera the anterior two pairs also, with long carpi and subequally chelate hands; but the posterior two are never chelate.

The sexual characters of both male and female are peculiar. The first pair of pleopoda is single-branched, the base carrying on each side in the former a large curtain-like membrane that is attached by a small pedicle near the base of the first joint and meets its fellow at the centre, where they are united by a number of small hook-like processes that Sars has called "*cincinnuli*;" this membrane (which I propose to call "*petasma*," from its curtain-like character), when at rest, lies folded up in a manner peculiar to each separate species.

The second pair of pleopoda, like all the others posterior to it, is two-branched, besides which there is in the male a rudimentary branch attached to it that varies much in different species, which variations, without being very important, are yet valuable addenda for the determination of closely approximating forms. The other pleopoda gradually decrease in length posteriorly.

In the female the vulvæ are situated at the extremity of open projections on the third (that is, the posterior of the chelate) pair of pereiopoda; and, in most instances, in the family Penæidæ the organs face each other and almost touch in the median line. Posterior to these a ventral plate of varying form and appearance, according to species, lies between the last two pairs of legs; connected with this, varying also in form with species, a large mass of brown membranous material is attached: in some species large and fan-like in shape, in others it is an irregular oval disk; but what relation it has to the true history of the animal, observation has yet to determine.

The first pair of pleopoda, as in the male, is single-branched, and the *petasma* is reduced to a rudimentary process; and the second pair of pleopoda does not carry a small additional branch. Add to this the singular fact that among all the specimens in the 'Challenger' collection, as well as those in the British Museum and the typical collection of the Jardin des Plantes, there is not a single specimen in which the female has either ova or the remains of ovisacs attached to the hairs of the pleopoda—a circumstance which, compared with the great frequency with which ova in all stages are found in nearly every genus of the class besides, is highly suggestive, either that the Penæidea are viviparous, or that the young like those of some fish, are hatched floating in the sea.

What form the *Brephalus* may take is yet to be determined: it may be what Fritz Müller has pronounced it to be; but whether it be a *Nauplius*, a *Zoëa*, or a *Megalopa* must be decided by future observation.

After comparing the specimens in my possession with the descriptions in the works of the best-known carcinologists, such as Milne-Edwards, De Haan, Dana, Stimpson, Heller, &c., I examined the collection in the British Museum, under the care of Mr. Miers, who has recently drawn up a "synoptic table of the species of *Penæus*," which was published in the 'Proceedings of the Zoological Society of London,' March 5, 1878. I came to the conclusion that it was desirable to see the typical specimens on which Prof. Milne-Edwards determined the forms that he published originally in his 'Histoire Naturelle des Crustacés,' vol. ii. pp. 403–430.

In the collection of the Jardin des Plantes, with the cooperation and assistance of Prof. Alphonse Milne-Edwards, I was enabled to identify all the old types still preserved in the Museum except *Penæus styliferus*, which, I fear, has got mingled with others or the label lost in the hasty removal of the specimens to some underground cellars during the unhappy period of the Communistic ascendency in Paris.

It is at the suggestion of Prof. A. Milne-Edwards that this memoir is written; and my intention is to adhere as nearly as possible to the text of the 'Histoire des Crustacés,' making such further additions as appear to me to be necessary for the ready identification of the species, together with figures of such as have not already been published of the typical forms.

The tribe Penæidea contains several genera; but of those tabulated in the 'Histoire des Crustacés' certainly *Stenopus*, *Oplophorus*, *Ephyrus*, and *Pasiphœa* must be excluded.

Sicyoniidæ.

Sicyonia, Edw. Branchiæ dendrobranchiate, but arranged in plates. Scaphocerite angular.

Penæidæ.

Penæus (Fabricius), in which the first pair of antennæ are shorter than the carapace.

Penæopsis (A. Milne-Edwards), in which they are longer.

Solenocera (Lucas), in which they are longer and have one of the rami flattened and concave longitudinally.

Haliporus, n. gen. Body more slender.

Hemipenæus, n. gen. Rostrum straight, short; five podobranchiæ present.

Aristeus, Duvernoy. Rostrum long; five podobranchiæ.

Hepomadus, n. gen. Damaged; four podobranchiæ.

Benthesicymus, n. gen. Rostrum short and crest-like; five podobranchiæ.

Gennadas, n. gen. Like last, with less arborescent branchiæ.

Euphema, Edwards. Young Peneid.

Sergestidæ.

Sergestes, Edw. First pair of pereiopoda not chelate, second and third chelate, fourth and fifth not chelate.

Petalidium, n. gen. Four branchial plumes only, and four single foliaceous branchial plates.

Acetes, Edw. Like *Sergestes*; fourth and fifth pairs of pereiopoda wanting.

EUCOPIIDÆ, Dana.

Eucopia, Dana. Gnathopoda developed as pereiopoda; five anterior pairs subchelate; two posterior "vergiform."

Chalaraspis, Willemoes-Suhm. Like *Eucopia*, but has only the posterior pair non-chelate.

Sicyoniidæ, Edwards.

The genus *Sicyonia* has been clearly defined by M. Milne-Edwards, and illustrated by excellent figures of *S. sculptus* and *S. carinatus* in the 'Annales des Sciences Naturelles' for March 1830; but the general form of the animal and the texture of its external covering do not correspond with the character of *Penæus* in any single feature, except that the third pair of pereiopoda is chelate. Added to this, the branchiæ differ considerably in structure also. Although the structure is dendrobranchiate in form, it varies typically from that seen in *Penæus* and allied genera by having the ultimate rami foliaceous (flat and scale-like) instead of being cylindrical.

These points (that is, the external appearance combined with the altered branchial condition), in my opinion, warrant the establishment of a distinct family for the true classification of the genus.

SICYONIA, Edw.

Sicyonia sculpta, Edw.

Inhabits the Mediterranean, Milne-Edwards's specimens having come from the Bay of Naples. That in the 'Challenger' collection was taken off St. Vincent, in the Cape-Verd Islands.

Sicyonia carinata, Olivier, Edw.

Is recorded by Milne-Edwards from the coast of Rio Janeiro.

The 'Challenger' specimens were taken in shallow water at St. Thomas's, in the West Indies.

Sicyonia lancifer, Olivier, Edw.

I have little doubt that this species is the same as *S. cristata* of De Haan ('Fauna Japonica,' p. 190, pl. xliv. fig. 10).

The 'Challenger' specimen is undoubtedly *S. cristata* of De Haan; but it agrees with Olivier's description of *S. lancifer* in all points, excepting that Olivier says that the latter has five or six teeth posterior to the line of the frontal margin, whereas in our specimen, as well as in De Haan's, there are properly only four. But when we consider how general were the descriptions given of animals a few years since, and even now by some writers, I think it highly probable that Olivier reckoned in the number behind the frontal margin the unusual and prominent tooth that projects anteriorly from the first somite of the pleon.

Olivier's specimen was procured from the Indian seas; although the habitat is omitted in the 'Histoire des Crustacés,' it is given by Edwards in a note to the species in the 'Annales des Sciences Naturelles.' De Haan's was from Japan; and the 'Challenger' took it south of New Guinea in about 28 fathoms of water.

Sicyonia lævis, n. sp.

Surface of the animal smooth. Rostrum armed with five teeth, dorsal carina with two. Hepatic tooth small. Pleon slightly carinated. Telson as long as the outer plates of the rhipidura.

This species can only be mistaken for *S. parvula* of De Haan, but differs from it in being more slender, in having the rostrum without a tooth on the lower margin, and in having the apex terminating in a slender bidentate point.

Length 1 inch.

Taken north of New Guinea, at a depth of 150 fathoms of water.

Penæidæ.

The genera in this family are laterally compressed; furnished with a long rostrum. Gills dendrobranchiate, branches filamentous. Eyes well developed. First pair of antennæ biramose, furnished with a *protarsema* on the inner side, and a *stylocerite* on the outer. Mandible having a two-jointed *synaphipod*. First three pairs of pereiopoda subequally chelate. Carpus long, &c.

First pair of pleopoda single-branched, and in the male furnished with a *petasma*.

PENÆUS, Fabricius.

Body compressed. Rostrum carinate. Ophthalmopod biarticulate. First pair of antennæ having the dorsal surface deeply excavated to receive the eye, and furnished on the inner side with a fixed inarticulate branch or *protarsema*, and on the outer with a sharp spine or *stylocerite*. The flagella are never longer than the carapace; and the second pair of antennæ carry a long *scaphocerite*. The pereiopoda have the first three pairs subequally chelate, with the hand not broader than the carpus, each increasing in length posteriorly. Posterior two pairs are simple, and all carry a basecphysis or branch attached to the basis joint. The pleopoda gradually decrease in length posteriorly; and the branchiæ are arranged as follows:—

Pleurobranchiæ	.	1	1	1	1	1	1
Arthrobranchiæ	2	2	2	2	2	1	.
Podobranchiæ	.	.	.	.	.	.	.
Mastibranchiæ	1	1	1	1	1	1	.
	h	*i*	*k*	*l*	*m*	*n*	*o*

Penæus caramote (Risso).

This species is described by Milne-Edwards as being armed with a dozen teeth on the upper margin of the rostrum and one on the lower, situated a little in advance of the eyes; whereas the figure which represents it in plate xxv. fig. 1 has only seven teeth on the upper margin of the rostrum and three on the lower, which is incorrect. The figure is reduced to about one third of the natural size.

On each side of the central dorsal crest a deep furrow extends from the anterior margin to close to the posterior, terminating before reaching it; and a third longitudinal groove, less deep but more elevated, separates these two in the posterior half of the carapace, and continues from the posterior margin to the base of the rostrum. A very short tooth is situated on the anterior border of the carapace just above the base of the first pair of antennæ. The eyes are very large and short. The terminal filaments of the first pair of antennæ are extremely short, being shorter than the last two joints of the peduncle. Basis of the three anterior pairs of legs armed with strong teeth. Telson armed on each side with three spines, of which the middle is the strongest.

Length about 7 inches.

Inhabits the Mediterranean.

Penæus canaliculatus (Olivier).

Is extremely like *P. caramote*, but is distinguishable by the rostrum being less elevated towards the base and more ciliated upon the superior border, by the absence of a tooth from the base of the third pair of legs and of spines from the telson.

Length about 5 inches.

Taken at the Celebes and the Isle of France.

Independent of the above differential description of Milne-Edwards, it may be observed that this species has only nine teeth on the upper margin of the rostrum, while *P. caramote* has twelve; that the deep channel on each side of the dorsal carina has the margins parallel, whereas in *P. caramote* the line is waved and the channels broader posteriorly.

The specimen taken as the type by Milne-Edwards in the collection that I examined was labelled from the island of Mauritius.

There are specimens in the 'Challenger' collection from the Fiji Islands and Port Jackson that correspond closely in their general aspect with the typical form. They are, however, smaller in size, and vary somewhat in the aspect of the ventral plate of the female. In Japan a larger form is known, specimens of which are in the British Museum as well as in the Jardin des Plantes; but these, like those in the 'Challenger' collection, are females, and carry a pair of large fan-like membranous processes issuing from the anterior extremity of the ventral plate, the object of which I have not been enabled to determine; neither have I been able to procure or see a male specimen corresponding with this variety. Should it not be the same, I propose to call it *P. japonicus.*

Penœus brasiliensis, Latreille.

There was no specimen of this species in the collection when M. Milne-Edwards wrote, he having taken his information from Latreille. Milne-Edwards distinguishes it from *P. canaliculatus* by the presence of three teeth on the inferior margin of the rostrum. Mr. Miers, in his "Notes on the Penæidæ" (P. Z. S. 1878, p. 306), says that there are two spines on the first pair of pereiopoda and one on the second, and that the telson has no marginal spines.

Inhabits the Atlantic, off Brazil.

Penœus velutinus, Dana.

This species, as described and figured in the United States' Exploring Expedition, is covered throughout with a very short velvety coat. Rostrum straight, lanceolate, somewhat ascending from the base, dentate to the apex; seven teeth equidistant, and one posterior; lower margin entire, straight, ciliate. Dorsal surface not carinated or sulcate posterior to the rostral crest. Second and third pairs of pereiopoda subequal. Telson armed with minute spinules on either side.

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

The habitat of the type is the Sandwich Islands.

Specimens in the 'Challenger' collection from various localities in the Australasian archipelago correspond closely with Danà's description and figure, and, I have no doubt, are the same species, but are generally about twice as large. They may readily be distinguished from closely approximating forms by the petasma on the left ventral side of the male being longer than that on the right, and by the form of the ventral plates between the coxæ of the two posterior pairs of pereiopoda of the female (which is too complicated to be followed in a verbal description, but which will be illustrated in the memoir on the subject in the 'Challenger' reports), and two long ventral teeth between the second pair of pereiopoda.

Penæus setiferus, L. (Pl. XI. fig. 1.)

The specimen of this species in the collection of the Museum of the Jardin des Plantes is a male animal, and is the type of Milne-Edwards's description. It has the rostrum as long as the scaphocerite, straight and styliform at the extremity, and armed with two teeth on the lower and nine or ten on the upper margin, which is prolonged posteriorly in the form of a slight crest to half the distance between the frontal and the posterior margins of the carapace; and on each side of the rostrum a small ridge reaches nearly to the stomachic region. There is no little tooth above the ophthalmopod, which is long and supports a large eye. The antennal filaments are about half the length of the peduncle which carries them. The flagellum of the second pair of antennæ is excessively long; and there are no spines on the lateral margin of the telson.

Length about 7 inches.

It is often found in very considerable numbers at the embouchures of the rivers of Florida. That in the collection is labelled "Guadaloupe."

An examination of this species shows that the outer flagellum of the first pair of antennæ has the small articuli obliquely arranged, and the upper margin of each produced into a sharp posteriorly directed tooth. I have not seen this structure in any other species, and I believe it is a sexual character only.

The petasma attached to the first pair of pleopoda is longitudinally folded as a double tube.

Telson dorsally grooved longitudinally, and terminating in a sharp point; lateral margins without spines, but thickly furred with hair.

Milne-Edwards has grouped this species among those that have no groove in the median line between the base of the rostrum and the posterior margin of the carapace. This is by no means a definite character of specific value, inasmuch as it exists in some species in the female and not in the male.

Penæus monoceros, Fabricius.
(Pl. XI. fig. 2.)

Rostrum straight and ciliated on the lower margin; from the point the crest is a little elevated posteriorly, and armed with nine teeth, of which the posterior is a little more distant than the rest, and situated near the centre of the stomachic region. The terminal flagella of the first pair of antennæ are short, being less long than the last two joints of the peduncle. Legs short; and there are no spines on the margins of the telson.

Length about 3 inches.

Inhabits the coasts of India.

The typical specimen is labelled from Bombay. It is a female, and offers no decided character in the arrangement of the posterior ventral plates of the pereion, from which I presume that it is not a fully adult-formed specimen. Dana figures the cephalon of a specimen from Singapore (?) about 5 inches in length; but it appears to differ little, in the parts that he has figured, from his own species *P. velutinus*, excepting that in the latter the rostrum is pointed a little upwards instead of horizontally straight as in the type of *P. monoceros*, which differs from the specimen above described only in having a few spines on each side of the telson.

Penæus indicus, M.-Edw. (Pl. XII. fig. 5.)

The rostrum is described by the author as being straight, styliform at the extremity, reaching beyond the distal extremity of the peduncle of the first pair of antennæ, and surmounted posteriorly by a crest which continues nearly to the third part of the carapace. Eight or nine teeth surmount the dorsal margin; and four or five are situated on the lower. The flagella of the first pair of antennæ are slender and are a little longer than the peduncle of the same. In general characters this description resembles *P. setiferus*.

Length about 6 inches.

It inhabits the coast of Coromandel.

The typical specimen is labelled from the coast of Coromandel, and is a female. It is described as having the "rostre droit," whereas the specimen has the extremity of the rostrum slightly elevated. In all other parts the description faithfully agrees with the specimen.

So closely does this species coincide with the figure given by Heller of his *P. tahitensis* ('Reise der Fregatte Novara,'

p. 121) that I think they are the same; unfortunately Heller describes the inferior margin of the rostrum as being "edentulous," whereas his figure 2, plate xi., shows there are three teeth on the lower margin.

Penæus carinatus, Dana, also, it appears to me, belongs to this species, the only distinction being that Dana and Heller's species have three teeth on the lower margin, and the type of *P. indicus* has four or five; but these are not distinctly portrayed, and are more elevations than distinct teeth.

Undoubtedly the number of teeth on the rostrum is a very constant feature in normal and well developed forms, and may be relied upon as representing some important structural character in the animal. Occasionally, however, some forms exhibit an effort to abnormally increase or diminish the number; but whenever this is the case the teeth exhibit generally an imperfect and enfeebled condition. This appears to be the case with the type specimen; and I am induced to think that they are merely varieties of the following species.

There are other specimens in the collection labelled "*P. indicus*," some of them from the coast of Coromandel; but these bear the impress of having been named by others than the veteran author of the 'Histoire des Crustacés;' they agree more nearly with *Penæus setiferus* of the West Indies, and require a closer examination than I devoted to determine them specifically.

Penæus monodon, Fabricius.

This species is extremely like *P. indicus*; but, according to Milne-Edwards's definition, the rostrum only presents three teeth on the lower margin, and the flagella of the first pair of antennæ are shorter.

Length of types of Milne-Edwards 3 inches; of Fabricius 7 inches.

Hab. Indian seas.

The type specimens are all small and immature animals; but there are larger specimens in the collection that agree with Fabricius's description as referred to by Edwards. A close analysis of this species compared with *P. indicus* makes me very dubious of any truly specific character, beyond the "much shorter length of the flagella of the first pair of antennæ," and there being only three teeth on the lower margin of the rostrum.

I am induced, from the great resemblance in the form of the ventral plates in the females, to accept the conclusion that *P. indicus*, Edw., *P. monodon*, Fabricius, *P. semisulcatus*, De Haan, *P. tahitensis*, Heller, *P. carinatus*, Dana, and *P. esculentus*, Haswell, are varieties of this species (*P. monodon*).

The ventral plate, which varies considerably in form in the females of most species, consists in this of two halves of a circular disk, the straight side being longitudinally in the median line, the margins of which are curved upwards (Pl. XII. fig. 5, *v p*).

The petasma in the male consists of a longitudinal tube formed by the two plates being united together along the anterior surface, whereas it is open posteriorly. I have only had the opportunity of examining male specimens of those in the 'Challenger' collection.

The type specimens of the males of *P. indicus* and those of *P. monodon* in the collection of the Jardin des Plantes were too small for the full development of the parts.

Penæus affinis, Milne-Edwards.
(Pl. XII. fig. 6.)

This species resembles *P. indicus*, from which it may readily be distinguished by the absence of teeth upon the inferior border of the rostrum, the shortness of the eyes (which scarcely pass the external margin of the scaphocerite), and the form of the dactylus on the posterior two pairs of pereiopoda, which are extremely slender and not sensibly flattened.

Length about 5 inches.

Inhabits the coast of Malabar.

There were several specimens in the same bottle, labelled from Malabar; and they evidently show that Milne-Edwards drew up his description from a female, with which it coincides; but among them were also several males, and these differed from the others in essential features; so that, had they not been found associated, I should have considered them typical forms of distinct species.

The male has a peculiar notch or excavation on the anterior margin of the ischium of the fifth pair of pereiopoda (Pl. XII. fig. 6, *o*); surmounting the notch is a slight prominence or tubercle. Another notch or excavation surmounted by a distal prominence is situated at the base on the outer margin of the external plate of the rhipidura (Pl. XII. fig. 6, *v*); in both sexes the telson is dorsally grooved, and terminates in a long and slender style-like extremity.

The ventral plate of the female is heart-shaped and depressed in the centre; and the petasma in the male terminates in a cross piece that will be better appreciated from examination than from any description.

In a second bottle, labelled "India," is a single female specimen that I take to be *P. sculptilis*, Heller. It resembles *P. affinis* in every detailed appearance, except that it has posterior to the rostral crest a carina flattened at the summit, with traces of a longitudinal groove in the median line, and, moreover, it has two fine sutures resembling fractures on each side of the carapace. One, the longer, commences just above the orbital tooth on the frontal margin, and traverses the surface of the carapace longitudinally in a waved line to near the posterior margin; the other is at the infero-lateral margin of the carapace, near the centre of the branchial region. There is also a small suture on the infero-lateral margin of the first somite of the pleon; but all these I have observed as a condition in other species.

The *Penæus monoceros* (*ensis*) of De Haan is undoubtedly, I think, a female specimen of *P. affinis.*

P. affinis (*barbatus*) of De Haan I consider to be *P. velutinus* of Dana.

P. Hardwickii of Miers differs from *P. affinis* in having the tooth over the gastric region apparently broken, and the apex of the rostrum a little more curved upwards.

Penæus fissurus, n. sp.

Like *P. monoceros*, but has only six teeth on the rostrum and one on the gastric region. Pleon carinated from the posterior portion of the third somite. Fourth, fifth, and sixth somites produced to a small dorsal tooth at the posterior margin in the median line. Telson armed with a strong tooth on each side.

Taken at a depth of 50 fathoms south of New Guinea.

There are three remarkable fissures that I have observed in other species also traversing the carapace from the orbital to near the posterior margin, and from the lateral margin of the carapace vertically across the branchial region on each side.

Penæus rectacutus, n. sp.

Rostrum horizontal, straight and sharp, armed on the upper surface with eleven or twelve teeth and one on the gastric region. Lower margin straight and fringed with cilia. Dorsal surface of the pleon carinated on the fourth, fifth, and sixth somites, which last terminates in a posterior tooth.

Taken in about 100 fathoms of water among the Philippine Islands.

Penæus brevicornis, Milne-Edwards. (Pl. XI. fig 3.)

Rostrum very short, scarcely passing the eyes, elevated to a crest near the base, styliform, armed with six teeth on the upper and smooth and straight on the lower margin. Flagella of the first pair of antennæ slender and short, about half the length of the peduncle.

Length about 3 inches.

Inhabits the coasts of India. Taken off Madras by Sir Walter Elliot.

The specimens in the Museum are labelled "Bombay." The female does not exhibit any distinctly formed ventral plate, from which I presume that it has not attained its full development. The male has the petasma approximating that of *P. affinis*, yet with characters sufficiently distinguishable to determine the species.

Penæus avirostris, Dana (United States' Exploring Expedition, p. 603), belongs, I think, to this species. It appears to be a full-grown specimen.

Length 5 inches.

It inhabits the coast near Singapore.

Penæus Philippii, n. sp.

Rostrum horizontal and straight in the male; slightly depressed over the distal extremity of the eye and again raised in the female; six or seven teeth on the upper surface of the rostrum, and one on the gastric region. Eye large, ovate, half the length of the rostrum. First pair of antennæ with the peduncle not longer than the rostrum. Flagella about half the length of the peduncle. Telson furnished with three spines on the lateral margin. Male having the petasma folded, long and narrow, somewhat like *P. velutinus*, but has the plate on the left side, which is the longer of the two, rolled over anteriorly. The female has the ventral plate longitudinally divided and bilobed.

This species was taken off the Philippine Islands in about 100 fathoms of water. I have dedicated it to Philippi, who has written of the family; hence the specific name.

Penæus anchoralis, n. sp.

Rostrum horizontal on the upper margin; eight teeth on the rostrum and one distant on the gastric region. Lower margin smooth and gradually ascending in a curved line to the apex. The frontal margin is armed with a small supraorbital, and with antennal and hepatic teeth. The third, fourth, and fifth somites terminate in a small dorsal carinate tooth. Telson unarmed; but a small notch looks as if, in unworn specimens, a small spine might exist on each side.

Length $3\frac{1}{2}$ inches.

Taken south of New Guinea in 28 fathoms of water.

In the male the species may readily be recognized by the petasma being folded in a form much resembling that of an anchor, of which the flukes fall laterally over the basal joint of the two posteror pairs of pereiopoda. In the female the ventral plate (of a somewhat hexagonal form) lies between the base of the penultimate pair of pereiopoda, behind which a cup-like depression exists.

Penæus telsodecacanthus, n. sp.

Carapace with five teeth on the rostrum and one distant on the gastric region. Sixth somite of the pleon produced to a small dorsal carinate tooth. Eye large. Telson long, pointed, armed on each side with five articulating spines.

Length 3 inches.

Taken in the channels of the Japanese islands in from 8 to 10 fathoms of water.

Penæus serratus, n. sp.

Rostrum slightly arched, serrated with twelve or more small teeth between the apex and the frontal margin, and one more conspicuous on the gastric region. Lower margin ciliated, each hair having a defined point of attachment. Telson long, narrow, and pointed, laterally armed near the distal extremity with a rigid tooth on each side.

Length about 4 inches.

Taken off the Fiji Islands in about 300 fathoms of water.

The specimens of this species are much damaged: the flagella of the first pair of antennæ are not perfect; but they appear to be slender and not longer than the peduncle. In other respects this species closely resembles that which M. A. Milne-Edwards has named *Penæopsis serratus*, from a specimen taken in the Gulf of Mexico, but which has the flagella of the first pair of antennæ longer than the carapace, for which he proposes to make a new genus, *Penæopsis*. I have not yet met with any specimens in the collection of the 'Challenger' corresponding with this definition, that do not belong to the genus *Solenocera* of Lucas; so that I have not had an opportunity of examining the branchial apparatus to feel quite certain that the genus is a good determination; I have therefore used the same specific name, to show their close approximation of form.

Genus Penæopsis, A. Milne-Edwards, MS.

Like *Penæus*, but with the flagella of the first pair of antennæ longer than the carapace and cylindrical.

This genus is proposed by M. Alphonse Milne-Edwards for those *Penæi* which do not belong to *Solenocera*. It is founded on a species not yet described that he has seen in the collection of the U.S. Mexican-Gulf exploration, but which so closely corresponds with *Penæus serratus* from the Fiji Islands, that, if they are not separated by the length of their antennæ, they appear to be identical; and I have accordingly adopted the same specific name.

Penæopsis serratus, A. Milne-Edwards, MS.

Length about 4 inches.

Taken in the Gulf of Mexico.

The gradual approximation of the length of the flagella of the first pair of antennæ, as seen in specimens of *Penæus caramote* on the one hand, where they are so short as to be easily overlooked, to that of *Penæopsis*, where they are half the length of the animal, is so gradual that it is difficult, however convenient it may be, to determine where the genus can naturally be separated; and without any other distinguishing feature it can only be accepted as provisional.

Penæopsis styliferus, Edwards.

The type of this species appears not to be preserved; or at least we could not identify it. M.-Edwards says that the filaments of the first pair of antennæ are cylindrical; it therefore cannot, like the other two species arranged by M.-Edwards in his second division of the genus *Penæus*, belong to the genus *Solenocera*.

Length 4 inches.

Taken in the neighbourhood of Bombay.

Penæus Dobsoni, Miers (Proc. Zool. Soc. March 5, 1878), appears to differ from *P. styliferus* only in the slightly different length of the flagella of the first pair of antennæ; and, with the exception of the peculiar feature of the fifth pair of pereiopoda (which the author considers to be a condition of the female, and which appears to be abnormal), I see nothing to separate this species from *P. styliferus* as described by Edwards.

Hab. West coast of India.

Genus Solenocera, Lucas.

Milne-Edwards separated the genus *Penæus* into two divisions, the second of which contained "those having the terminal flagella of the first pair of antennæ longer than the carapace," and established in it three species—*P. membranaceus*, *P. crassicornis*, and *P. styliferus*.

The last of these three species I was not able, with the assistance of the accomplished curator, M. A. Milne-Edwards, to find, the label probably having been lost in the hasty removal of the specimens during the unhappy siege and communistic occupation of Paris.

The first two belong to the present genus, established by M. Lucas ('Annales Soc. Entomologique de France,' Février 1849, p. 215, pl. vii. no. 11) on *Penœus siphonoceros* of Philippi (Archiv für Naturgesch. p. 190, pl. iv. fig. 3, 1840), which he named *Solenocera Philippii*, from a specimen that he captured off the coast of Algiers.

Solenocera differs from *Penœus* in having the flagella of the first pair of antennæ not only longer than the carapace, but having one branch broader than the other and hollow on the inner side, so that the less robust flagellum may rest longitudinally in the larger, and by having four teeth on each side of the carapace, one at the outer orbital angle, one supraorbital, one hepatic, and one near the antero-inferior angle of the carapace.

The branchiæ also differ from those of *Penœus* in having two arthrobranchial plumes attached to the penultimate pair of pereiopoda, and one arthrobranchial and one podobranchial plume attached to the first pair of gnathopoda, and may be tabulated as follows:—

Pleurobranchia	.	1	1	1	1	1	1
Arthrobranchiæ............	1	2	2	2	2	2	.
Podobranchia..............	1	.	.	.	.	.	.
Mastibranchia	1	1	1	1	1	1	.
	h	*i*	*k*	*l*	*m*	*n*	*o*

Solenocera membranacea, Fabr.

Milne-Edwards describes this species as being carinate for the entire length of the carapace. The extremity of the rostrum is a little turned upwards, and is very short, not extending beyond the eyes, with five or six teeth on the upper surface, and ciliated on the lower. Eye large and short, the flagella of the first pair of antennæ being much longer than the carapace, one slender and cylindrical, the other broad, flat, and ciliated on the inner side. Telson long and styliform, grooved on the upper surface, the margins of which terminate on each side in a sharp-pointed tooth.

Length about 3 inches.

Inhabits the Mediterranean.

Solenocera Philippii, Lucas, appears to me to be the same species; but, according to the author's figure, the extremity of the larger flagellum of the first pair of antennæ terminates more abruptly than it appears to do either in *S. membranacea* or the specimen preserved as the type of Lucas's species.

Solenocera crassicornis, Milne-Edwards.

The specimen is labelled "Bombay," and corresponds with the author's description, to which may be added the presence of four teeth that are to be found on the anterior extremity of the carapace, and are of generic value.

There are specimens from the sea between Borneo and the Philippine Islands, taken at 250 fathoms, in the 'Challenger' collection; and Sir Walter Elliot has taken it at Waltair, on the Madras shore of India.

Solenocera Lucasii, n. sp.

Rostrum short and with seven teeth, of which the last two are more distant and situated above the gastric region. Eye not large; larger branch of flagella of first pair of antennæ tapering; posterior pair of pereiopoda long; dactylus compressed. Telson shorter than the inner plates of the rhipidura.

Length 3 inches.

Taken south of New Guinea at about 130 fathoms.

HALIPORUS, n. gen.

General appearance more slender than *Solenocera*, appendages longer and more slight. Second pair of gnathopoda as long as and stouter than the pereiopoda. Flagella of the first pair of antennæ long, subequal, cylindrical. Telson long and narrow, laterally compressed.

Haliporus curvirostris, n. sp.

Carapace covered with minute spines; dorsal median line dentate. Rostrum curved, being posteriorly and anteriorly depressed. Telson armed with two or three small teeth at the sides.

Length about 3 inches.

Taken in mid Pacific at 2375 fathoms.

Haliporus lævis, n. sp.

Having no lateral teeth on the carapace, six teeth on the rostrum, and two on the gastric region. Rostrum straight.

Length about 2 inches.

Taken in mid Atlantic at a depth of 2500 fathoms.

Haliporus neptunus, n. sp.

Carapace smooth. Rostrum armed with six teeth, and two on the gastric region. Petasma folded so as to resemble two tridents, one on each side.

Length 3 inches (male).

Taken among the Celebes Islands in about 600 fathoms of water.

Haliporus obliquirostris, n. sp.

Rostrum elevated from the base obliquely upwards, armed with five teeth, and two larger ones on the gastric region. Telson sharp, as long as the plates of the rhipidura, and armed with two immovable teeth, one on each side.

Length about 3 inches (female).

Taken off Kermadec Island.

I should have considered these to be the females of *H. neptunus*, but for the separation of their habitats by so great a distance—no female being found with the former, and no male with the latter.

Genus Hemipenæus, n. g.

Rostrum horizontal, shorter, or, at all events, not longer, than the peduncle of the first pair of antennæ. Ophthalmopod single-jointed, furnished with a small tubercle. First pair of antennæ with the flagella unequal, one exceedingly short and implanted near the base of the third joint, the other very long and situated at the extremity. Branchial arrangement as follows :—

Pleurobranchia	.	.	1	1	1	1	1	= 5
Arthrobranchiæ	.	2	2	2	2	2	.	= 10
Podobranchia	1	1	1	1	1	.	.	= 5
Mastibranchia	1	1	1	1	1	.	.	(5)
	h	*i*	*k*	*l*	*m*	*n*	*o*	20+(5)

Hemipenæus spinidorsalis, n. sp.

Rostrum straight, sharp, styliform, armed with two teeth on the posterior and one on the gastric region, and one long spine-like tooth on the dorsal surface of the third somite of the pleon directed backwards. Appendages long and slender.

Length about 3 inches.

Taken in the South Atlantic, near the island of Tristan d'Acunha, in 1900 fathoms of water.

Hemipenæus speciosus, n. sp.

Rostrum anteriorly depressed, armed with three teeth on the upper surface, one of which is posterior to the frontal margin, the other two near together on the rostrum. Ophthalmopod long and slender. Eye scarcely larger than the diameter of the stalk. Pleon unarmed, sixth somite terminating posteriorly in an angle.

Length about $2\frac{1}{2}$ inches.

Taken in the Atlantic off the coast of South America, at a depth of 2650 fathoms.

Hemipenæus virilis, n. sp. Aristæus

Rostrum straight, armed with three teeth, posterior small and distant. Carapace smooth. Pleon having the posterior margin of the fourth and fifth somites produced in the median line to a small tooth. Ophthalmopod short. Eye large, orbicular.

Length about 4 inches (male).

Taken near the Philippine Islands at a depth of 255 fathoms.

Hemipenæus dubius, n. sp.

Rostrum straight, equal in length to the peduncle of the first pair of antennæ, armed on the lower side with four small teeth situated on the distal half, and eight upon the upper, equidistant from each other, between the apex and the gastric region. Dorsal surface elevated to a crest above the line of the frontal margin. Pleon smooth, sixth somite terminating in a small tooth posteriorly projected. Eyes large.

Length about 3 inches (male).

Taken among the Philippine Islands at a depth of less than 20 fathoms of water.

Genus Aristeus, Duvernoy.

This genus was established by M. Duvernoy in the Annales des Sc. Nat. for 1841, vol. xv., from a specimen taken in the Mediterranean which Risso had previously named *Penæus antennatus*, under the mistaken supposition that the structure of the branchiæ was essentially different from that of *Penæus*. But although the structure is the same, as pointed out by Dana and confirmed by Mr. Miers, the arrangement of the branchial plumes is essentially distinct, as may be seen if the following Table be compared with that of *Penæus*.

Pleurobranchia	1	1	1	1	1	1	1	= 7
Arthrobranchiæ............	1	2	2	2	2	2	.	= 11
Podobranchia..............	1	1	1	1	1	.	.	= 5
Mastibranchia	1	1	1	1	1	1	.	= (6)
	h	*i*	*k*	*l*	*m*	*n*	*o*	23+(6)

If this Table be compared with that of *Penæus*, it will be found that there are podobranchial plumes attached to the five anterior appendages of the pereion (that is, to the two pairs of gnathopoda and the three anterior pairs of pereiopoda), whereas in *Penæus* there are none; and if comparison be made with Duvernoy's figure of the branchial arrangement, it will be seen that he represents no mastibranchial lash attached to the penultimate pair of pereiopoda, whereas the specimens that have come under my examination in the 'Challenger' collection show that there is a large mastibranchial plate. In discussing this point with M. A. Milne-Edwards, he contended that the presence or absence of an appendage such as this, unless it were corroborated by some external evidence, was a very doubtful specific character, and one that was of no value in the history of descent when not otherwise illustrated.

Still it appears to me that a feature relating to the economy of the animal of so important a character, if constant, must be of specific value; so that its generic connexion must depend upon its constant character in allied specific forms. If on further examination I am enabled to determine a series of species in which the mastibranchial lash is constant, however much in other respects they may resemble *Aristeus*, they must, in our present state of knowledge, be arranged as a distinct genus; and as I think this can be done, I propose provisionally the name of *Plesiopenæus* for such as have the mastibranchial plate attached to the penultimate pair of pereiopoda, which is not present in the figure given by Duvernoy (~~"Crustacés de Nice,"~~ Ann. des Sc. Nat. vol. xv. 1841).

Aristeus antennatus, Risso.

Rostrum styliform, reaching a little beyond the extremity of the peduncle of the first pair of antennæ, and with three strong teeth on the dorsal surface at the base. Pleon smooth, fourth and fifth somites produced to a point on the dorsal surface in the median line, but not elevated or produced into a tooth.

Hab. Mediterranean, at a great depth (*Risso, Duvernoy, Johnson*), Algiers.

Penæus Edwardsianus of Johnson (Proc. Zool. Soc. 1867, p. 897) undoubtedly belongs to the same species.

Aristeus armatus, n. sp.

Rostrum styliform, as long again as the peduncle of the first pair of antennæ. Three long teeth near together above the frontal margin. Third, fourth, and fifth somites of the pleon dorsally produced into a laterally compressed tooth; sixth somite carinate. Telson armed on each lateral margin with foui small spines. Ophthalmopod long. Eye not large.

Flagella of second pair of antennæ twice the length of the animal.

Length 8 inches.

Taken among the islands of the Australasian archipelago, in the North Pacific, and South Atlantic, at a depth of from 1900 to 2050 fathoms.

Aristeus semidentatus, n. sp.

Rostrum styliform, straight, armed on the upper margin with two teeth near together in front, and one further behind the frontal margin. Posterior dorsal margin of the fourth, fifth, and sixth somites produced to a small tooth. Eye orbicular. Ophthalmopod slender.

Length $3\frac{1}{2}$ inches (female).

Taken south of the Philippine Islands.

Aristeus tomentosus, n. sp. ♀ of A. virilis

Surface covered with a short fur. Rostrum scarcely as long as the peduncle, armed with three short distal teeth. Pleon having a small tooth at the posterior dorsal margin of the fourth, fifth, and sixth somites. Eye large, orbicular.

Length 6 inches (female).

Taken south of the Philippine Islands.

Aristeus rostridentatus, n. sp. Plesiopenaeus

Rostrum long, elevated, curved, armed on the upper margin with ten or twelve teeth, the posterior of which is situated on the gastric region. Third and following somites of the pleon furnished with a small tooth at the posterior dorsal margin. Ophthalmopod short. Eye orbicular, on a slender ophthalmopod. Flagellum of second pair of antennæ about six times the length of the animal.

Length about 6 inches.

Taken near the Fiji Islands at a depth of about 300 fathoms.

Genus Hepomadus, n. g.

There are only two specimens of this genus; they are of distinct species; and both are injured. The rostrum of each is broken; but the larger specimen has a slender tooth on the dorsal surface just behind the frontal margin. But the structure of the branchiæ differs from that of either *Penæus* or *Aristeus* in having the ultimate branches longer and in having the mastibranchial lash of the penultimate pair of pereiopoda rudimentary, in having only four podobranchial plumes, and in having all the pleurobranchiæ small except the posterior, as shown in the accompanying Table.

Pleurobranchia	1	1	1	1	1	1	1
Arthrobranchiæ	1	2	2	2	2	2	.
Podobranchia	1	1	1	1	.	.	.
Mastibranchia	1	1	1	1	1	.	.
	h	*i*	*k*	*l*	*m*	*n*	*o*

Hepomadus glacialis, n. sp.

Dorsal surface of the carapace elevated into a carina that terminates at the cardiac region. Pleon armed with one large tooth at the dorsal median posterior margin on the third somite, and one little one on the fourth and fifth. Ophthalmopod long, furnished with a small tubercle near the base on the inner side. Eye small, not much larger than the diameter of the stalk.

Length about 8 inches (female).

Taken in mid South Atlantic at a depth of 1875 fathoms.

Hepomadus inermis, n. sp.

Dorsal surface unarmed. Pleon smooth. Telson not half the length of the outer plate of the rhipidura. Rostrum (broken off).

Length about 4 inches.

Taken in middle of South Pacific at a depth of 2550 fathoms.

Genus Benthesicymus, n. g.

Structure of the integument submembranous. Rostrum short, compressed, crested. Ophthalmopod flattened, furnished with a conspicuous tubercle or secondary eye. Eye not large. First pair of antennæ with the flagella subequally long, the upper more robust than the lower, not longer than the carapace. Mandible carrying a two-jointed appendage, second joint short and pointed. Second pair of gnathopoda terminating in a sharp-pointed dactylus. Pereiopoda long, slender, feeble. Branchiæ with the ultimate branches longer than in *Penæus*, and arranged as in the following Table:—

Pleurobranchia	.	1	1	1	1	1	1
Arthrobranchiæ	2	2	2	2	2	2	.
Podobranchia	1	1	1	1	1	.	.
Mastibranchia	1	1	1	1	1	1	.
	h	*i*	*k*	*l*	*m*	*n*	*o*

Benthesicymus crenatus, n. sp.

Rostrum straight, pointed, dorsally elevated into a laterally compressed crest, armed with three small teeth, and one behind the crest on the gastric region. Cervical suture deeply fissured. Posterior margin of the fourth somite of the pereion crenated, fifth produced to a small tooth in the dorsal median line. Pleopoda very long.

Length 8 inches (female).

Taken in mid Pacific at a depth of 2600 fathoms.

Benthesicymus altus, n. sp.

Rostrum pointed, crest armed with two teeth. Dorsal surface smooth. Ophthalmopod as long as the rostrum. Eye small. Flagella of first pair of antennæ half as long as the animal.

Length about 3 inches.

Taken several times between Australia and Japan, between 350 and 1400 fathoms.

Benthesicymus brasiliensis, n. sp.

Rostrum pointed, crest armed with two small points. Third somite of the pleon dorsally terminating in the median line with a small laterally compressed tooth; fourth and fifth somites carinate and terminating in a smaller tooth; sixth carinate. Telson long and narrow, but not so long as the lateral plates of the rhipidura.

Length about 5 inches.

Taken several times in the Atlantic and Pacific oceans, the finest specimens occurring off Brazil at 1100 to 2440 fathoms.

Benthesicymus iridescens, n. sp.

Rostrum short, not more than half the length of the ophthalmopod; crest armed with one small tooth.

Length about 4 inches.

Taken in South Atlantic, near the island of Tristan d'Acunha, in 1900 fathoms of water.

Genus Gennadas, n. g.

Like *Benthesicymus*, but much smaller; peduncle of the first pair of antennæ longer and stouter; the dactylus of the second pair of gnathopoda is spatuliform, instead of being cylindrical and sharp; and the first pair of pereiopoda is shorter and, compared with the others, more robust. The structure of the branchiæ is also modified.

This genus approximates nearer than any other to the little crustacean named *Penæus* (*Kolga*) *speciosus* in Salter and Woodward's map of fossil Crustacea; hence the generic name (from γεννάδας, of a noble race).

Gennadas parvus, n. sp.

Rostrum short, pointed; crest armed with one tooth, and behind the crest a little point. Ophthalmopod short. Pereiopoda slender. Pleopoda long. Telson short.

Length scarcely 1 inch (male).

Taken off Japan in 2425 fathoms.

This small species is undoubtedly an adult male; for the petasma attached to the first pair of pleopoda is large and well developed, while two button-like plates, larger than are found in animals of much greater size, are attached to the second pair of pleopoda. These are seen only in well matured males.

It has been taken frequently in both Pacific and Atlantic oceans, in from 1240 to 2550 fathoms, and once in the deep trawl-net in the Pacific.

Genus Euphema, Edwards.

There is a specimen in the 'Challenger' collection which belongs to this genus; but I think that it is only a very young and immature form of some species of *Penæus*. It corresponds nearly with the figure of the fourth stage in the development of *Palæmonetes vulgaris* as given by Mr. Walter Faxon in his plates on the development of the latter species in vol. v. no. 15 of the 'Bulletin' of the Museum of Comparative Zoology at Harvard College, U.S., 1879, excepting that our specimen has the third pair of pereiopoda chelate. The rostrum is curved upwards, and is not denticulated along the margin. The large tooth upon the dorsal surface of the second somite of the pleon is waved and turned upwards; and the fourth, fifth, and sixth somites terminate posteriorly in a small tooth.

Length little more than $\frac{1}{4}$ inch. Edwards's specimen is 8 lines.

Both were taken in the Atlantic Ocean.

I give our specimen no name, feeling sure that it is a young Penæid, probably of the genus *Aristeus*.

Genus Pasiphæa.

Neither by the description of M. Milne-Edwards nor the figures of Risso and Savigny can this genus be retained in the group or family of the Penæidæ or allied forms.

If the species in the 'Challenger' collection belong to this genus, as I believe they do, the branchial plumes are developed on the type of the Phylobranchiata. On this point also the figures of Michael Sars are insufficient; and he says nothing about the branchiæ in his 'Bidrag til kundskab om Christiania-Fjordens Fauna,' 1868.

Sergestidæ.

The genera in this family yet require more extended research and observation. The specimens in the 'Challenger' collection are numerous, but, coming mostly from deep water, are in a very injured condition. The first pair of pereiopoda is not chelate; but the succeeding two pairs are, and the fourth and fifth are simple.

Genus Sergestes, Edwards.

Has the fifth pair of pereiopoda smaller than the fourth, a small leaf-like plate attached to three somites, and the branchiæ arranged as follows:—

Pleurobranchiæ	1	1	1′	1′	1′	2	.
Arthrobranchia	.	.	.	.	.	.	.
Podobranchia	.	.	.	.	.	.	.
Mastibranchia	1	.	.	.	.	.	.
	h	*i*	*k*	*l*	*m*	*n*	*o*

Sergestes Kröyeri, n. sp.

Like *S. Frisii* of Kröyer, but is about 3 inches long; it is a female, and has the cervical fossa well defined on the dorsal surface. Rostrum a small anteriorly directed crest-like tooth. Ophthalmopod half the length of the first joint of the first pair of antennæ, large, orbicular. First pair of pleopoda long and unbranched, fifth pair short and biramose. Telson as long as the inner plate of the rhipidura.

Length 2½ inches.

Taken off Kermadec Island in about 500 fathoms of water.

This species has two well-developed pleurobranchiæ attached to the penultimate somite of the pereion, two to the antepenultimate, one plume and a leaf-like plate to the next three somites, and one plume and a rudimentary mastibranchial plate to the first pair of gnathopoda.

Sergestes prehensilis, n. sp.

Like the preceding, but has no cervical fossa, and has the rostral crest larger and more sharp. The first pair of pereiopoda is shorter than the succeeding, and has an organ for grasping at the last articulation between the ultimate and penultimate joints, such as Kröyer shows to exist in *S. Ed-*

wardsii at the penultimate articulation. Telson shorter than inner branch of rhipidura.

Length about 2 inches.

Taken off Japan in about 500 fathoms of water.

Sergestes japonicus, n. sp.

Like *S. Kröyeri*, female, but has the ophthalmopod nearly as long as the first joint of the first antenna. Eye small.

Length about 3 inches.

Taken south of Japan, in about 350 fathoms.

This species has two pleurobranchial plumes attached to the penultimate somite of the pereion, one and a foliaceous plate to all the preceding, and a rudimentary mastibranchial plate attached to the first pair of gnathopoda.

Sergestes diapontius, n. sp.

Resembles *S. ancylops* of Kröyer, but differs in the rostrum being not horizontal, but directed upwards and forwards. Telson as long as the outer plate of the rhipidura. Ophthalmopod as long as the first two joints of the first antenna. Eyes round. One of the flagella of the first pair is half as long as the animal, and twice the length of the peduncle. It differs from *S. brachyorrhos*, Kröyer, in having the lateral margin of each somite of the pleon terminating in a sharp tooth, and in the length of the telson.

Length 1 inch.

Taken in towing-net in the Atlantic.

Genus Petalidium (πεταλίδιον, a small leaf).

This genus is very imperfectly known to me, owing to the damaged condition of the specimen. As far as I know it externally corresponds with *Sergestes*; but the structure and arrangement of the branchiæ are different. The structure can only be described by figures; but the arrangement is as in the following Table:—

Pleurobranchia	.	1′	1′	1′	1′	.	.
Arthrobranchia	.	.	.	.	.	.	.
Podobranchia	.	.	.	.	.	.	.
Mastibranchia	.	.	.	.	.	.	.
	h	*i*	*k*	*l*	*m*	*n*	*o*

Between the somites of the pereion corresponding with each branchial plume is an interstitial foliaceous leaf; hence the generic name.

Petalidium foliaceum.

Cervical suture well defined. Rostrum elevated into a crest that has one distinct rostral tooth and posteriorly a rudimentary point.

Length about 3 inches.

Taken in South Indian Ocean at a depth of about 2100 fathoms.

Genus Acetes, Edwards.

I have not had the advantage of examining critically any species of this genus; but it appears to differ from *Sergestes* in the absence of the two posterior pairs of pereiopoda; but whether the third and fourth pairs terminate in minute chelæ, as in *Sergestes*, I am not able to determine. Milne-Edwards has figured and described them, as he has those of *Sergestes*, as being filiform, which they appear to be by the assistance of an ordinary lens; but more critical examination shows that they are minutely chelate, as determined by Kröyer.

The branchial apparatus, so far as I am aware, has not been examined by any one.

Acetes indicus, Edwards.

I am not aware that this animal has been noticed since described by M. Milne-Edwards in 1829 at the Académie des Sciences de Paris; yet it must be very abundant in our seas, and Sir Walter Elliot notes on his collection made at Madras that "a very large *Dicerobalis eroogoodoo* was taken at Waltair in 1825, 21 feet in length and 25 broad. Its stomach was filled with myriads of this little crustacean, which was carried away in basketfuls by the fishermen, and thousands were left scattered on the shore."

Information such as this appears to be suggestive of the desirability of surveying the ocean in mid water as well as at its bottom and surface.

Eucopiidæ, Dana.

Genus Eucopia, Dana.

Gnathopoda developed in the form of true legs. Posterior two pairs of pereiopoda "vergiform."

Eucopia australis, Dana.

Eucopia australis, Dana, U.S. Expl. Exp. p. 609, pl. xl. fig. 10.

Hab. New Holland. Taken from the stomach of a penguin.

Genus Chalaraspis, Willemoes-Suhm.

Chalaraspis, Willemoes-Suhm, Trans. Linn. Soc. 2nd ser. Zool. vol. i. p. 37.

This genus approximates closely to *Eucopia* of Dana, if it be not identical. The only distinction appears to be in *Eucopia* having the posterior two pairs of pereiopoda filiform, whereas *Chalaraspis* has only the posterior pair filiform. But Dana says that his specimen, which was taken from the stomach of a penguin, had the last "four partly broken."

Willemoes-Suhm says "the last pair of pereiopods . . . very hairy and without branchiæ. Three branches of branchiæ on the base of the gnathopoda and first four pereiopoda, two of which are covered by the carapace." These branchiæ he figures as dendrobranchiate. Dana remarks of his species *Eucopia australis*:—"Branchiæ attached to the base of thoracic legs, irregularly foliaceous, in many folds."

Chalaraspis unguiculata, Willemoes-Suhm.

Length 35–37 millim.

Taken in the South Atlantic in from 350 to 2500 fathoms of water. "Common, with as wide a geographical as bathymetrical distribution."

EXPLANATION OF THE PLATES.

Plate XI.

Fig. 1. *Penæus setiferus*, L., male. *c*, portion of flagellum of first pair of antennæ; *p*, petasma and base of first pair of pleopoda; T, telson.

Fig. 2. *Penæus monoceros*, Fabricius, female.

Fig. 3. *Penæus brevicornis*, Milne-Edwards, male. *p*, petasma and base of first pair of pleopoda.

Fig. 4. *p*, petasma and first pair of pleopoda of *Penæus Bocagei*, Johnson, male.

Plate XII.

Fig. 5. *Penæus indicus*, M.-Edwards, female. *v p*, ventral plate.

Fig. 6. *Penæus affinis*, M.-Edwards, male. *m, n, o*, third, fourth, and fifth pereiopoda; *v*, outer plate of rhipidura.

XX.—*Notes on Longicorn Coleoptera.—Revision of the* Ærénicides *and* Amphionychides *of Tropical America.* By H. W. Bates, F.R.S., F.L.S.

[Continued from p. 152.]

Amphionycha.

Amphionycha, Leseleuc in Guérin, Mag. Zool. 1844, t. 138; Lacordaire, Gen. Col. ix. p. 890 (1872).

After the withdrawal of its more aberrant constituents, this genus still remains exceedingly numerous and polymorphic. It comprehends all species of cylindric or linear form, with cylindrical or at most slightly rounded thorax and high elytral epipleuræ surmounted by carinæ, and antennæ in which the joints are slender and filiform, sparsely ciliated beneath, chiefly along the basal half, and with the third joint conspicuously longer than the following. The head is retracted beneath, often to a remarkable degree, the mouth resting on the strongly exserted anterior haunches, and the prosternum greatly contracted; but the occipital development varies greatly, this part in some species being much elongated and exserted, in others retractile nearly up to the eyes within the thorax. The relative volume of the head is often a sexual character, the head in the male being small or normal, triangularly depressed between the antennæ, and in the female enlarged and gibbous, with plane and elongated forehead and much elongated mandibles. The species in many cases admit of combination in natural groups, which I have indicated in the catalogue at the end of this paper.

Amphionycha charis.

Breviter subcylindrica, castaneo-fulva, subtiliter tomentosa, thorace vitta utrinque laterali (postice angustata), scutello et elytris utrinque maculis quatuor (prima obliqua suturali basin versus, secunda discoidali post medium, tertia parva subsuturali posteriore, quarta minuta laterali) cretaceis; antennis scapo articulisque cæteris apice nigris, pedibus melleo-flavis; subtus pro- et mesosterno vitta lata laterali abdominisque segmento primo macula magna laterali, secundo et tertio maculis parvis, cretaceis: capite lato, inter antennas paullo depresso, fronte magna, fere plana; thorace lateribus rectis; elytris apice rotundatis, dorso vix convexis, basin versus punctulatis, carina laterali flexuosa.

Long. 6 lin. ♀.

Ecuador (*Buckley*).

Amphionycha albiventris.

A. chariti proxime affinis, at differt corpore subtus omnino cretaceo etc. Oblongo-cylindrica, castaneo-fulva, tenuiter ochraceo tomentosa, thoracis lateribus (striga angusta episterni excepta) cretaceis, scutello, elytris maculis utrinque sex (prima parva basali, secunda magna suturali basin versus, tertia paullo minore rotundata discoidali post medium, quarta transversa lata fasciiformi prope apicem, quinta et sexta marginalibus) cretaceis; antennis omnino rufo-castaneis; pedibus melleo-flavis: capite lato, fusco, genibus postice canis, fronte magna fere plana; thorace cylindrico, ante basin paullo constricto; elytris apice rotundatis obtusissime subtruncatis, carina laterali flexuosa.

Long. $6\frac{1}{2}$ lin. ♀.

Venezuela.

Amphionycha leucodryas.

A. chariti et *albiventri* proxime affinis, at differt forma multo angustiore. Gracilis, fulvo-castanea, corpore subtus (medio nigro-fusco excepto) cretaceo; supra macula utrinque post oculum, thorace toto (linea angusta dorsali et altera utrinque episternali exceptis), scutello elytrisque utrinque maculis sex (prima minuta indistincta basali, secunda maxima quadrangulata suturali, tertia rotundata discoidali post medium, quarta prope apicem suturali quadrata, quinta et sexta parvis marginalibus) cretaceis; antennis melleo-flavis, apicem versus fuscescentibus, scapo nigro; pedibus melleo-flavis: capite parvo, inter antennas concavo et impresso-lineato, fronte convexa; thorace cylindrico, ante basin paullo constricto; elytris apice rotundatis, obtusissime truncatis, carina laterali flexuosa.

Long. $4\frac{1}{2}$ lin. ♂.

New Granada.

In its slender form similar to *A. sexguttata* (Lucas) of the same group, which, however, is only 7 millim. long, and has the chalky-tomentose markings of its elytra reduced to six rounded spots.

Amphionycha tribalteata.

Gracilis, tomento niveo compacto vestita, elytris fasciis angustis tribus carinulaque laterali castaneis, prima carinulam haud attingente; antennis griseo-nigris; pedibus melleo-flavis: capite (♂) inter antennas haud depresso, fronte fusca; thorace cylindrico, basi valde depresso, paullo angustato, punctis disci duobus, altero utrinque laterali, nigris; elytris apice rotundatis, carina laterali flexuosa.

Long. 5 lin. ♂.

Chanchamoyo, Peru (*Dr. Thamm*).

Amphionycha læta.

Parva, gracilis, rufo-fulva, albo-tomentosa, antennis fulvis, pedibus albo-testaceis; thorace lineis duabus, elytris fasciolis duabus, denudatis: capite inter antennas vix concavo, fronte convexa, pilosa; thorace fere cylindrico; elytris obtuse truncatis, apicem versus interdum nigrescentibus; antennis quam corpus dimidio longioribus laxe ciliatis.

Long. 4 lin.

New Granada, Venezuela, and Peru.

A common insect long known in collections under the name I have adopted.

Amphionycha spilota.

A. scalari (Pasc.) similis. Parva, supra alba, elytris marginibus fasciisque utrinque quatuor suturam haud attingentibus claviculos simulantibus (prima prope basin magis curvata) nigris; thorace vitta laterali (e medio ramum in discum emittente) et maculis medianis duabus (prima juxta marginem anteriorem, secunda dorsali) nigris: capite inter antennas depresso, fascia verticis fronteque nigris; antennis (♀) corpore dimidio longioribus, fulvo-rufis, articulis primo et secundo nigris, tertio ad quintum apice fuscis; subtus cinereo-nigra, lateribus albis; pedibus fulvis. Long. 4 lin. ♀.

Rio Grande do Sul, Brazil.

Closely resembling *A. scalaris* (Pascoe) from New Granada and Panama. The black markings of the elytra are in the same position; but the four belts are narrower near their commencement at the black border, and are dilated at their termination at a short distance from the suture; the epipleuræ are black and shining, except that there is a white spot under the shoulder and another after the first black fascia. The lateral carina is more strongly elevated than it is in *A. scalaris.*

Amphionycha sexlineata.

Major, cylindrica, cretaceo-tomentosa, elytris utrinque lineis tribus parallelis (a basi usque longe ultra medium continuatis) maculisque tribus transversis prope apicem nigris; fronte nigra opaca; capite postice punctis quatuor, thoraceque punctis sex sic (: : :) dispositis, nigris; antennis nigris; corpore subtus cinereo-nigro, vitta lata laterali cretacea; pedibus fulvis: capite inter antennas paullo concavo, oculis infra magnis; thorace breviter cylindrico; elytris apice obtusissime truncatis, carina laterali subrecta. Long. $8\frac{1}{2}$ lin. ♀?

Constancia, Rio de Janeiro (*Rev. Hamlet Clark*).

Amphionycha theaphia.

E majoribus: elongata, postice attenuata, tomento compacto albo-sulphureo vestita, vitta laterali ab oculo usque ad elytrorum apicem ducta (dentes duos in dorsum elytrorum emittente), linea tenui verticis et thoracis dorsi fronteque tota umbrinis; corpore subtus albo-sulphureo, vitta centrali pedibusque umbrinis; antennis umbrinis, articulis primo et secundo nigris: capite inter antennas (♀?) depresso, fronte abbreviata vix convexa, oculis maximis; thorace paullo elongato, cylindrico, basi constricto, lateribus ante stricturam subtuberculatis; elytris versus apicem angustatis subacuminatis, apice breviter truncatis, carina laterali nulla, epipleuris verticalibus tenuiter tomentosis, punctulatis. Long. $9\frac{1}{2}$ lin. ♀?

Ecuador (*Buckley*).

Amphionycha dilaticeps.

Brevis, subcylindrica, postice angustata, fulvo-rufa, pedibus melleo-flavis, antennis apice fuscis; thorace lateribus, elytris utrinque maculis vel fasciis duabus magnis (una ante, altera post medium) albo-tomentosis: capite vix exserto sed latissimo et fronte longissima, mandibulisque valde elongatis; oculis ut in gen. *Tetraope* divisis; thorace antice lato, postice angustato, dorso gibboso, basi constricto; antennis basi ciliatis, scapo longissimo, clavato; elytris apice rotundatis, carina laterali acuta, valde flexuosa.
Long. $4\frac{1}{2}$ lin. ♀.

Santa Marta, New Granada.

Amphionycha dimidiata.

Elongata, subcylindrica, flava, elytrorum dimidio apicali, pectore abdominisque apice, nigris: capite angusto, retracto, inter antennas declivi (tuberibus antenniferis elevatis), fronte convexa, epistomate nigro, occipite maculis tribus, genibus utrinque una, nigris; thorace antice angustato, basi latiore, disco anteriore maculis duabus, episternis utrinque una, nigris; elytris parallelis, apice late rotundatis, dorso versus apicem subito declivi, carinis lateralibus utrinque duabus; antennis (♀) corpore multo brevioribus, gracilibus.
Long. 8 lin. ♀.

New Granada.

Amphionycha bisellata.

Cylindrica, nigra opaca, thorace supra (macula rotunda dorsali margineque anteriore medio exceptis), elytris fascia recta subapicali metasternoque macula utrinque laterali flavis: capite subtus valde retracto, inter antennas depresso, fronte brevi, plana; thorace transverso, medio rotundato, ante basin fortiter constricto; elytris parallelis, convexis, apice late obtuse rotundatis, carina laterali obtusissima, epipleuris altis; antennis quam dimidium corporis paullo longioribus, sparsim ciliatis.
Long. 8 lin. ♀?

Macas, Ecuador (*Buckley*).

A peculiar species in form, colour, and clothing, but not sufficiently different to be separated generically from *Amphionycha*, its peculiarities being those of *A. dimidiata* carried a little further. The lateral carina is marked as a distinct angle separating the dorsal surface of the elytra from the epipleura; but it does not form a rib; or if it does, the elevation is concealed by the dense black pile of the elytra. The yellow colour of the thorax and apical belt of the elytra is associated with pilosity of a very peculiar nature, which I have not noticed in any other species; it resembles the texture of a blanket or sponge, and is formed of coarse loosely-felted short hairs.

Amphionycha suturata.

Modice elongata, cinereo-nigra, thorace dorso (vitta mediana postice dilatata excepta), elytris sutura et lateribus (haud usque apicem) fronteque vittis duabus albis; pedibus et antennis fulvis, tibiis tarsisque apice, scapo articuloque tertio, quarto apice, quinto ad undecimum totis nigro-fuscis: capite inter antennas concavo, fronte convexa, vertice nudo grosse punctato; thorace antice angustato, angulis posticis prominulis; elytris apice obtuse rotundatis, dorso punctulatis, carina laterali simplici, subrecta, elongata; antennis (♂) corpore dimidio longioribus.
Long. $5\frac{1}{4}$ lin.

Brazil.

Amphionycha pubicornis.

Angustior, cylindrica, passim setosa, castaneo-fusca, subtiliter cinereo pubescens, capite, thorace antice, elytrorum sutura marginibusque et pedibus (tibiis tarsisque fuscescentibus) testaceo-fulvis, thorace utrinque linea obliqua antennarumque articulis quarto et quinto albo-testaceis: capite inter antennas profunde concavo, fronte valde convexa, vertice ♂ plano, ♀ valde convexo, geni dilatatis, mandibulis magnis; thorace antice angustato, post medium paullulum dilatatato, deinde iterum angustato, angulis posticis prominulis; elytris apice truncatis, angulo exteriore dentiformi, dorso lineatim punctulatis, carina laterali subrecta apicem fere attingente.
Long. 4 lin. ♂ ♀.

Lower Amazons (*H. Smith*).

Although very closely allied to *A. suturata*, this species differs in many important points. The depression between the antennæ exists in both sexes, and takes the form of a very deep fovea. The erect pubescence extends over the whole body, including legs and antennæ, fine erect hairs clothing the latter organs on all sides from base to apex, but replaced underneath the basal joints by the usual long cilia characteristic of the genus. The sexual differences in the size and convexity of the head and development of the mandibles it has in common with many allied species.

Amphionycha postilenata.

Subcylindrica, nigro-fusca, subtiliter pubescens, vix pilosa, fronte, thorace fasciaque postica elytrorum sulphureis, elytris apice griseis: antennis tenuibus, scapo elongato paullulum clavato, articulo tertio valde elongato, infra sparsim longe ciliato; scapo subtus, articulo tertio quartoque basi fulvo-testaceis; capite antice modice convexo, inter antennas late concavo, apud oculos quam thorax multo latiore; thorace medio rotundato-dilatato, angulis posticis productis acutis; elytris apice obtusissime truncatis, carina laterali subrecta; palpis flavis; corpore subtus griseo, femoribus subtus flavo-testaceis.

Long. $5\frac{1}{4}$ lin. ♂.

Rio Janeiro, Novo Friburgo.

Allied to *A. colligata*, Redt. (*clathrata*, Dej. Cat.).

Amphionycha rectilinea.

Gracilis, supra planata, erecte pilosa, griseo-nigra, capite antice, thorace lateribus elytrisque marginibus et apice canis; femoribus et tibiis melleo-flavis: capite (♂) inter antennas depresso, macula frontali, altera post oculum et vertice, nigris; thorace breviter cylindrico, medio rotundato-dilatato, angulis posticis productis acutis; dorso plaga magna (medio linea cinerea) vittaque marginali nigris; elytris apice subacute conjunctim rotundatis, carina laterali acutissima, recta, apicem fere attingente; antennis (♂) corpore dimidio longioribus, pilosis, articulis primo ad sextum infra ciliatis.

Long. 4 lin. ♂.

Minas Geraes, Brazil.

Amphionycha longipennis.

Linearis, valde elongata, subplanata, sparsim pilosa, cinereo-nigra, fronte, linea laterali thoracis, sutura marginibusque elytrorum flavo-cinereis; femoribus basi testaceo-flavis: capite (♂) parvo, inter antennas late et valde concavo; thorace antice angustato, basi latissimo, angulis posticis productis acutis, medio paullulum rotundato, dorso punctato, nitido; elytris relative elongatis, parallelis sed lateribus apicem versus paullo dilatato-explanatis, apice sinuato-truncatis, dorso subcrebre punctulatis, carina laterali acutissima subrecta, apicem fere attingente; antennis nigris, articulis basi anguste (quartoque medio) flavo-testaceis.

Long. 6 lin. ♂.

Rio Macas, Ecuador (*Buckley*).

Amphionycha fenestrata.

Nigra, elytris utrinque medio macula alba oblonga suturam haud attingente: capite ♀ lato, inter antennas plano, occipite valde convexo; ♂ normali, inter antennas concavo; genis albis; thorace curto, medio paullo dilatato, ♀ basi constricto, supra inæquali; elytris apice singulatim rotundatis, crebre punctulatis, carina laterali recta, acuta, mox ante apicem subito terminata; antennis utroque sexu corpore paullo longioribus, sparsim ciliatis, articulo tertio quam quartus ♂ paullo, ♀ multo longiore.

Long. 5 lin. ♂ ♀.

Rio Janeiro, Novo Friburgo.

A species remarkable for the sexual differences in the head, thorax, and antennæ.

The male agrees in many respects with the genus *Isomerida*, whilst the female has the characters of *Amphionycha*; the antennæ of the male, however, are sparsely ciliated, and not furnished with tufted pencils of hair as in *Isomerida*. The whole insect is deep black, except a streak under each eye and on the epistome, and a large oblong spot on each elytron, which are hoary white.

Amphionycha fuscipennis.

Cylindrico-oblonga, flavo-testacea (abdomine metasternoque interdum fuscis), capite antennisque nigris, elytris piceo-fuscis, tenuiter pubescentibus, thorace tomento compacto flavescente tecto: capite (cum oculis) quam thorax utroque sexu vix latiore, inter antennas concavo, fronte convexa; thorace medio utrinque prominulo, antice leviter angustato, postice subconstricto; elytris convexis, ante apicem subito declivibus, apice late subtruncato-rotundatis, dorso seriatim punctulatis, carina laterali subrecta, longe ante apicem terminata; antennis nigris; pedibus nigris, femoribus (apice exceptis) flavis.

Long. 5–6 lin. ♂ ♀.

Yungas of La Paz, Bolivia (*Buckley*); Chanchamayo, Peru (*Dr. Thamm*).

The Peruvian specimens have the under surface of the body wholly pallid; in one from Bolivia the abdomen and sides of the metathorax are blackish. The Bolivian specimens are 5 lines long, that from Peru 6.

Amphionycha fulvicornis.

Modice elongata, nigra, antennis melleo-fulvis, scapo apice, articulisque secundo et apicalibus fuscis; thorace vitta (antice dilatata) laterali alba: capite ♀ magno, occipite valde convexo; ♂ normali, inter antennas concavo; thorace basi valde constricto, disco nitido; elytris apice rotundatis, supra crebre punctatis; carina laterali recta, apicem fere attingente; antennis utroque sexu corpore paullo longioribus, sparsim ciliatis, articulo tertio quam quartus ♂ paullo, ♀ multo longiore.

Long. $4\frac{1}{2}$–5 lin. ♂ ♀.

Rio Janeiro, Novo Friburgo.

In structure similar to *A. fenestrata*, and agreeing with that species in the sexual differences as to the size of the head and the length of the third antennal joint. In colours it is totally different.

Amphionycha discicollis.

Robusta, rufo-testacea, vertice utrinque post oculum elytrisque (sutura et apice exceptis) fusco-nigris, griseo tenuiter pubescentibus, thorace medio plaga magna nigra nitida: capite (cum oculis) quam thorax utroque sexu vix latiore, inter antennas depresso; thorace antice paullo angustiore, disco quinquetuberculato; elytris elongato-oblongis, convexis, ante apicem paullo subito declivibus, apice subtruncato-truncatis, dorso punctulatis, carina laterali recta acuta, longe ante apicem terminata, carinula accessoria carinæ parallela, minus elevata sed longius prolongata; antennis nigris, scapo subtus et apud apicem rufo, articulo quarto albo; pedibus nigris, femoribus vel totis vel subtus tantum flavis.

Long. $7\frac{1}{2}$ lin. ♂ ♀.

Ecuador (*Buckley*).

Amphionycha rubra.

Oblongo-cylindrica, postice angustata, rufa, antennis nigris: capite (♂) magno, exserto, infra retracto, inter antennas depresso, vertice valde convexo, fronte elongata, planata, oculis parvis; thorace breviter cylindrico; elytris apice late truncatis, angulo exteriore paullulum producto, medio dorso planato, apice declivi, carina laterali subrecta, abbreviata, carina accessoria flexuosa, longiore.

Long. 6 lin. ♀.

Novo Friburgo, Rio Janeiro, Brazil.

Amphionycha urocosmia.

Gracilis, flavo-testacea, subnuda, metathorace (medio), abdomine elytrisque dimidio apicali nigris, his plaga magna subapicali cano-tomentosa; antennis (♀) corpore longioribus, cinereo-nigris, articulo quarto flavo; capite exserto, inter antennas planato, fronte convexa, lateribus paullo rotundatis; thorace cylindrico, basi constricto; elytris apice subsinuatim truncatis, angulis productis, dorso sublineatim punctulatis, epipleuris nitidis, carinis duabus æqualiter acutis.

Long. $4\frac{1}{2}$ lin. ♀.

New Granada.

[To be continued.]

XXI.—*On a Collection of Crustacea made by Baron Hermann-Maltzam at Goree Island, Senegambia.* By Edward J. Miers, F.L.S., F.Z.S.

[Plates XIII., XIV., XV., & XVI.]

The collection that forms the subject of the present Report, which will be continued in the two succeeding numbers of the 'Annals,' is of very considerable interest, as having been made in a locality hitherto scarcely visited by the carcinological collector, and also on account of the number of new and remarkable forms it contains.

All the species collected, except *Penæus brasiliensis*, were dredged in Goree Bay, at a depth of about 9–15 fathoms (18–28 metres), on a bottom partly shelly and partly muddy, and were brought to the British Museum by Baron Hermann-Maltzam. Dr. Günther, Keeper of the Zoological Department, recognizing the scientific value of this collection, intrusted it to me for description; and a complete set of the species obtained has been retained for the British Museum.

Although (so far as I am aware) the only species heretofore described from Goree is the *Pilumnus africanus* of M. Alph. Milne-Edwards, a considerable number of species have been recorded from other localities on the West-African coast, and from the Cape-Verd and Canary Islands and Madeira, by Leach, Webb and Berthelot, Dana, Stimpson, Milne-Edwards, and other naturalists, reference to whose works will be found in the following pages; and a very close affinity will be shown to exist between the crustacean fauna of West Africa and that of the Mediterranean region, through the island groups above mentioned. In the determination of this affinity I have been much aided by the collections made at Madeira by the Rev. R. B. Watson and at the Canaries by the late R. MacAndrew, Esq., and by them presented to the British Museum.

A very distinct but less marked relationship is also traceable between the West-African Crustacea and those inhabiting the western shores of the Atlantic (particularly the West Indies); and some few of the species collected have even an Oriental distribution. One only has as yet been recorded from the Cape of Good Hope (*Pilumnus verrucosipes*, Stimpson).

At the end of the paper will be given a systematic list of the genera and species, with the geographical distribution as far as known at present.

I have added descriptions in footnotes of a few species from neighbouring localities in the British-Museum collection.

Baron Hermann-Maltzam is himself engaged in working out the interesting series of Mollusca collected; but the few shells inhabited by Paguridæ and referred to below have been determined for me by my colleague Mr. E. A. Smith.

Decapoda.

Brachyura.

Stenorhynchus rostratus (Linn.).

Several small specimens, both males and females, are in the collection; the length of the cephalothorax of the largest to tip of rostrum is only about 7 lines (15 millim.).

In all of these specimens the rostrum is very short, the epistome and basal antennal joint are without spines, and the anterior legs nearly smooth; the long vertical spines on the gastric and cardiac regions of the carapace are in most of these specimens more developed than in the numerous European specimens of *S. rostratus* in the collection of the British Museum.

An adult male in the collection—length of carapace about $8\frac{1}{2}$ lines (18 millim.)—differs from the foregoing and from typical specimens of *S. rostratus* in having the anterior legs or chelipedes armed with numerous spinules on the upper and lower edges of the arms, wrists, and hands, which joints are ordinarily in *S. rostratus* smooth or simply granulated; the fingers, which are dilated and laterally compressed, are smooth, and when closed have between them, near the base, a wide hiatus. A specimen collected by W. S. Kent, Esq., during the 'Norma' Expedition, in Vigo Bay (which, however, has the rostrum broken), and one from Belfast Bay, dredged in 20 fathoms (*W. Thompson, Esq.*), present similar characters.

This variety differs from *S. ægyptius*, *S. Czernjawskii*, and *S. longirostris* in the very short rostrum and by the absence of the minute spines at the base of and upon the basal antennal joint, and may be designated var. *spinulosus*.

Herbstia violacea.

Micropisa violacea, A. M.-Edwards, Nouv. Archiv. Mus. Hist. Nat. iv. p. 50, pl. xvi. figs. 3–6 (1868).

To this species I refer a series of small specimens (both males and females). Length of the largest about 9 lines (19 millim.), breadth about 7 lines (nearly 15 millim.).

The spines of the carapace show great variation in the degree of their development. In all the specimens I have examined the chelipedes have the inner margins of the fingers smooth, not denticulated. Specimens are in the British Museum (preserved dry) from the West-African coast.

Pisa carinimana.

Pisa carinimana, Miers, Ann. & Mag. Nat. Hist. (ser. 5) iv. p. 11, pl. iv. fig. 6 (1879).

Several specimens are in the collection, of both sexes and different sizes; none are as large as the type from the Canaries (*R. MacAndrew, Esq.*), which (rostrum included) measures 7 lines in length (15 millim.); the largest specimen in the Senegambian collection has a total length (rostrum included) of only 6 lines (13 millim.), breadth little over 4 lines (9 millim.).

Some of the specimens preserved in spirit are of a beautiful rose-colour with yellowish patches, others yellowish brown; but there are apparently no other differences observable between the two varieties. Only in adult males are the specific characters drawn from the anterior legs or chelipedes to be made out. In the females not only are these characters undistinguishable, but also the tubercles on the gastric and branchial regions are commonly obsolete; the transverse tubercles of the gastric region (which are very obscure in the type) are not to be made out in the series now before me, and ought to be erased from the specific description.

Lambrus (*Parthenopoides*) *massena*, Roux.

A good series of specimens of both sexes is in the collection, which I refer here. Colour in spirit varies from yellowish brown to reddish.

This species varies very considerably in the form of the rostrum and the amount of tuberculation of the carapace; and it is possible that some of these differences may be of specific importance.

In what I shall regard as the typical, because the commonest, condition of the species, with which I believe *L. rugosus*, Stimpson, from the Cape-Verds, to be probably identical, the front is very prominent, triangulate, and acute or subacute; the gastric, cardiac, and branchial regions very convex and tuberculated; one tubercle on the summit of each of these regions is more prominent than the rest; the interregional depressions in the carapace and the sides towards the lateral margins of the branchial regions are nearly smooth. The chelipedes have the merus or arm rather slender and elongated, strongly tuberculated above, palm with but few granules or tubercles on its flattened upper surface (exclusive of the marginal teeth).

Length and breadth of a specimen from Goree a little over

7 lines (15 millim.); length of the larger (right) chelipede when fully extended 1 inch 2½ lines (31 millim.).

There are in the Museum collection examples from the Mediterranean and Sicily.

In two specimens, length and breadth of largest about 7½ lines (16 millim.), which otherwise do not differ much from the foregoing, the prominent tubercles of the gastric, cardiac, and branchial regions are developed into blunt spines, a similar spine exists near the distal end of the upper surface of the arm, and the upper surface of the palms is strongly granulated and tuberculated; they may be designated var. *spinifer*.

In another set of specimens from Goree Island, which appear entitled to rank as a distinct variety, the front is much less prominent, more deflexed and rounded at its distal end, the regions of the carapace less convex and less prominently granulated, with the interspaces and the sides towards the lateral margins also more or less granulated; arm generally shorter. They may be designated var. *atlanticus*.

The five specimens I have seen are females. Colour in spirit more or less reddish; length of the largest a little over 7 lines (15 millim.); breadth 8 lines (over 17 millim.). Length of larger chelipede when extended about 1 inch 1 line (nearly 28 millim.).

Another adult female differs from any of the preceding in having the carapace almost altogether destitute of tubercles or spines; some very small and obscure granulations exist on the branchial and cardiac regions and on the interspaces between them and on the posterior margin; the upper surface of the hands is nearly smooth. In the less acute rostrum and in general form this specimen nearly resembles the preceding variety, of which it is probably an extreme condition. The colour is a nearly uniform deep red. Length of carapace about 6½ lines (14 millim.); breadth about 7 lines (15 millim.). Length of larger chelipede when fully extended about 1 inch (25½ millim.).

L. pulchellus, A. M.-Edwards*, from the Cape-Verd Islands, has the front in the figure represented as truncated, concave on each side in front of the orbits, and may be distinct from any of the foregoing.

Lambrus (*Parthenopoides*) *bicarinatus*, sp. n.

In this, which I must regard as a distinct species, because I have observed no examples connecting it with any of the

* Nouv. Arch. Mus. Hist. Nat. iv. p. 53, pl. xvi. figs. 7–9 (1868).

varieties above enumerated of *L. massena*, the carapace is more depressed than in that species, and the front elongated triangulate acute or subacute, and scarcely at all deflexed. There are a few small granules on the summit of the gastric, cardiac, and branchial regions, and in the interspaces between the two last mentioned, and on the posterior margin; but the anterior part of the carapace, rostrum, and the sides of the branchial regions are smooth; the branchial regions are obliquely carinated, the carina reaching to and most distinctly defined near the postero-lateral margins. The chelipedes have the arms distinctly tuberculated; palms smooth on the upper surface. Colour (in spirit) yellowish brown or pinkish. Length and breadth of the largest example about 6 lines (12½ millim.).

Four specimens (males and females) are in the collection from Goree. There is also in the British Museum a male from the Canaries.

This well-marked form may be distinguished from *P. expansus*, Miers, by not having the carapace nearly so much produced over the bases of the ambulatory legs, the acute rostrum, and other points.

It bears some resemblance to the variety figured by Costa * of the form he designates *Parthenope contracta*; the carapace, however, is broader, not indented on the sides of the hepatic regions, and there is no prominent spine on the cardiac region. The typical *P. contracta* is regarded by Heller and others as synonymous with *P. massena*.

Heterocrypta Maltzami, sp. n.
(Pl. XIII. fig. 1.)

In this species, of which I have seen a large number of specimens of both sexes from Goree, the carapace is pentagonal rather than triangulate, the lateral margins at first widely divergent, and afterwards nearly parallel; the gastric, cardiac, and branchial regions convex; the gastric region is posteriorly steeply inclined; anteriorly it slopes gently downward to the front, which is very prominent, nearly horizontal, smooth, and flat above, with the sides slightly arcuated and the apex subacute; the sides of the anterior face of the gastric prominence are sharply defined and usually somewhat granulated; the cardiac prominence has the form of a large, very distinctly defined granulated tubercle; on the branchial regions is a sharply defined oblique granulated ridge that extends from the postero-lateral angles of the carapace nearly

* Crustacea in Fauna del Regno Napoli, pl. vi. fig. 3 (1838).

to the base of the gastric prominence; the intervening parts of the carapace are nearly smooth; the antero-lateral, lateral, and posterior margins of the carapace are thin, sharp-edged, and somewhat obscurely crenulated. As in *Heterocrypta granulata*, there is a distinct more or less granulated ridge on the pterygostomian regions; the postabdomen in both sexes has six joints distinct. The short thick eyes fit closely into the orbits, which have a scarcely distinguishable closed fissure in their upper margins; the longitudinally-folded antennules are widely separated from the antennæ, whose basal joint occupies the inner orbital hiatus and whose short flagellum is scarcely visible from above in a dorsal view; the ischium joint of the outer maxillipedes is broad, nearly oblong, excavated at its distal end to receive the merus, which is nearly quadrate, not notched at its antero-internal angle, where it is articulated with the next joint; the exognath is narrow, and about reaches to the distal end of the merus. Chelipedes slender and somewhat elongated; merus or arm trigonous, with the three faces smooth, the margins with little-prominent crenulations or teeth, which are themselves minutely denticulated; wrist with three crenulated and minutely denticulated ridges; palm longer than the arm, trigonous, its upper surface smooth, the margins dentated, the teeth themselves granulated or denticulated and very small, except on the inner margin, where they average about ten in number; fingers small, acute at apices, and distinctly toothed on their inner margins. Ambulatory legs slender, smooth, with the joints compressed and usually unarmed; the merus joints of the first ambulatory legs, however, are sometimes minutely denticulated.

Colour (in spirit) yellowish white, pinkish, or slaty. Length of the largest male 5 lines (nearly 11 millim.); breadth nearly 6 lines (12 millim.); length of chelipede when extended as far as its conformation will allow 10½ lines (22 millim.).

The description is taken from an adult male. Most of the females bear ova.

It is at once distinguished from its congeners, *Heterocrypta granulata*, Stimpson, and *H. macrobrachia*, Stimpson *, from the American seas, by the different form of the carapace, which in outline more nearly resembles that of certain species of *Cryptopodia* (e. g. *C. concava*).

It is certainly one of the most interesting species in the collection; and I have much pleasure in dedicating it to Baron Hermann-Maltzam, its discoverer.

* Ann. Lyc. Nat. Hist. New York, x. p. 105 (1871).

Lophozozymus (*Lophoxanthus*) *sexdentatus*, sp. n.
(Pl. XIII. fig. 2.)

In this pretty little species the carapace is less than one and a half times as broad as long; its dorsal surface is less convex than usual, and rather strongly lobulated on the postfrontal, gastric, and hepatic regions, and on the sides of the carapace behind the antero-lateral marginal teeth; the cervical suture and the depressions between the lobules are very distinct; the surface of the carapace (viewed under a lens) appears punctulated; the frontal margin projects somewhat more than is usual in the genus, and is straight and entire. The first (or outer orbital) tooth and the second tooth of the antero-lateral margins are not developed, the three posterior antero-lateral marginal teeth are prominent, triangulate, and acute, the front part of the antero-lateral margins and the subhepatic and pterygostomian regions, and the narrow epistome are more or less pitted and eroded. The segments of the post-abdomen are all separate and distinct in both sexes. The basal antennal joint reaches to the infero-lateral angles of the front. The outer maxillipedes are punctulated on their outer surface, the transverse merus joint being marked with two somewhat larger and deeper depressions. The chelipedes in the male are short, robust, and (in the specimens I have examined) of unequal size; arm or merus joint very short; carpus somewhat pitted above and on its outer surface, and with a spine on its inner surface; palm slightly convex on its upper and inner surface, and more or less pitted above and on its outer surface; fingers short, compressed, and nearly meeting along their inner edges when closed; the dactylus or mobile finger carinated above.

Ambulatory legs of moderate length, compressed, and carinated above; dactyli not carinated and closely pubescent. Coloration yellowish or slaty; chelipedes and ambulatory legs sometimes reddish, fingers brownish. Length of the largest example rather over $5\frac{1}{2}$ lines (11 millim.); breadth about $7\frac{1}{2}$ lines (16 millim.); the largest male is a trifle smaller.

All the specimens are males, except the largest, which differs in coloration, having the carapace marked with reddish blotches on a paler ground. In this example one chelipede only remains; in this the palm is more strongly pitted on its outer surface, and the fingers are pinkish.

M. Alph. Milne-Edwards has recently * established the genus *Lophoxanthus* for two species which apparently scarcely differ from *Lophozozymus*, except in the more depressed cara-

* Crust. in Mission Scientifique du Mexique, p. 256 (1873-80).

pace and the obsolescence of the first and second antero-lateral marginal teeth. To this genus (or subgenus, as I prefer to regard it) *L. sexdentatus* is to be referred. It differs from both the West-American species, *L. lamellipes*, Stim., and *L. bellus*, Stim., in the much more prominent front and teeth of the antero-lateral margins.

Prof. A. Milne-Edwards* has united with the *Lophozozymus* (*Xantho*) *radiatus* of M.-Edwards both the *Xantho lamelligera* and *Atergatis lateralis* of White. Yet more recently Dr. F. Hilgendorf † has referred all these species to the *Cancer dodone* of Herbst. It appears to me very doubtful, however, whether these identifications can be sustained. In White's specimens of *A. lateralis* in the British-Museum collection the chelipedes have the hands pitted and the wrist with a short keel or lobe (not two tubercles) on its inner surface, as in *L. dodone*, but there are no hairs on the antero-lateral marginal teeth, as described by Hilgendorf in that species. In *Lophozozymus lamelliger*, White, the carapace, as well as the chelipedes, is very distinctly granulated and pitted, the frontal lobes are sinuated, and the lobes of the antero-lateral margins granulated and very obscurely defined. The carpus of the chelipedes is rather bluntly cristate on its inner margin.

Xanthodes melanodactylus.

Xanthodes melanodactylus, A. M.-Edwards, Nouv. Arch. Mus. Hist. Nat. iv. p. 60, pl. xvii. figs. 1–3 (1868).

A large series is in the collection, all the specimens being of small size, the largest scarcely more than 3 lines (6·5 millim.) in length and 5 lines (11 millim.) in breadth; the anterior legs are unequally developed, ordinarily the right, but more rarely the left, being the larger; in the smaller chelipede the palm is slenderer and the fingers bent downwards, so that the lower margin of the smaller finger is not in a straight line with the inferior margin of the palm. The colour (of specimens preserved in spirit) is variable: sometimes the minute red punctulations on the carapace mentioned by M. A. Milne-Edwards are discernible, but in other examples they are quite obliterated; ordinarily the chelipedes are reddish and the fingers black or dark-coloured, with paler tips; but in others these limbs are pale-coloured, and in some the fingers are purplish. These variations seem to afford evidence that the coloration is of little value in this genus as a specific distinction.

* Nouv. Arch. Mus. Hist. Nat. ix. p. 206 (1873).

† Monatsb. der Akad. Wiss. Berlin, p. 789 (1878).

There is in the British-Museum collection a small specimen of this species from the Island of Ascension (*R. Trimen, Esq.*) in which carapace and legs are alike of a pale rose colour, and the fingers brownish, also specimens from Madeira (*Rev. R. Boog Watson*) in which the coloration is obliterated.

It may be of interest to add that there is in the series obtained by Baron Maltzam a female bearing ova whose length does not reach 2 lines (4 millim.).

X. rufopunctatus, A. M.-Edwards*, from Cape St. Vincent and Maio, is very briefly described, and I should be inclined to doubt its distinctness from *X. melanodactylus*; but not having examined the type, I do not venture to quote it as synonymous with the latter species.

X. eriphioides, A. M.-Edwards†, also obtained from Cape St. Vincent, is at once distinguished by the strong spiniform tubercles of the carapace, chelipedes, and legs. This species is still a desideratum in the collection of the British Museum.

Xantho pilipes ?

? *Xantho pilipes*, A. M.-Edwards, Ann. Soc. Entom. France, vii. p. 268 (1867).

There are in the collection numerous specimens of a species of *Xantho*, which I refer here with some hesitation, as Milne-Edwards's diagnosis is in few words. According to the distinguished French naturalist *X. pilipes* is nearly allied to *X. rivulosus*, but is distinguished by its narrower and less convex carapace, the much deeper depressions separating the branchial from the hepatic regions, the well-defined triangular antero-lateral marginal teeth, which are four in number, the slight prominence of the external orbital angle, and in the inferior and lateral regions of the carapace being covered with hairs. Breadth of carapace 40 millim., length 34 millim. In all these particulars the specimens before me agree with *X. pilipes*.

The front in these specimens, as in most species of the genus, is divided by a median notch into two broad and truncated lobes. On the postfrontal region and on the front of the gastric region are slightly marked transverse elevations. The male postabdomen is five-jointed; the third to fifth segments coalescent; the anterior legs (in the adult male) are very robust; merus or arm short, smooth; carpus or wrist with a small tooth on its inner margin; palm short, robust, smooth on its outer and inner surfaces, in all except the largest examples obscurely ridged on its upper margin;

* Rev. et Mag. Zool. (ser. 2), xxi. p. 409 (1869).

† Arch. Mus. H. N. iv. p. 58, pl. xvi. figs. 10–14 (1868).

fingers black or pale brown, with lighter tips. Ambulatory legs short, compressed, the hairs most dense on the merus joints. In spirit-specimens the chelipedes are often orange or reddish, and the carapace with more or less trace of reddish coloration upon a paler ground. None of the specimens before me are so large as Milne-Edwards's type, the largest not 7 lines (14 millim.) in length, and a little under 10 lines (20 millim.) in breadth.

X. pilipes has been hitherto a desideratum in the collection of the British Museum.

X. parvulus (Fabr.), Milne-Edwards* (a species found in the West Indies and on the coast of Brazil, and which, according to Dana, occurs at the Cape-Verds), has an extremely strong tooth at the base of the mobile finger, which does not exist in the specimens I refer to *X. pilipes.*

In *X. minor*, Dana†, from Madeira and the Cape-Verds, the upper margin of the hand is deeply sulcated; and in specimens I refer with some hesitation to this species in the Museum collection from Madeira (*Rev. R. B. Watson*), the chelipedes are much slenderer, hand and carpus more rugose and tuberculated.

Leptodius punctatus, sp. n. (Pl. XIII. fig. 3.)

Carapace moderately convex, about one and a half times as broad as long, the convexities on the anterior part of its upper surface prominent and separated by strongly-marked and rather wide depressions; these elevations are pitted with scattered punctuations; but the intervening depressions and the flat posterior and postero-lateral regions of the carapace are smooth. Front bisinuated and with a median incision, thus divided into four rounded and not prominent lobes, the frontal margin and the upper orbital margins somewhat thickened. Antero-lateral margins of the carapace with the four posterior teeth distinct and somewhat tuberculiform; the tooth at the exterior orbital angle obsolete. Postabdomen of the male narrow, composed of only five distinct segments; terminal segment triangulate. Outer maxillipedes having the merus joint transverse and marked with a circular pit on its outer surface. Anterior legs or chelipedes (in the two specimens examined) robust; merus or arm short; carpus or wrist pitted on its upper and outer surfaces, smooth on its inner surface, with a blunt tooth at its antero-internal angle; palm pitted above and on the upper part of its outer surface, smooth

* Hist. Nat. Crust. i. p. 395 (1834).

† Cr. U.S. Expl. Exp. xiii. p. 169, pl. viii. fig. 7 (1852).

below and on its inner surface; fingers rather obscurely toothed on their inner margins, of a deep black colour, the coloration not extending along the inner and outer surfaces of the palm; the mobile finger is longitudinally channelled above, but without spinules or tubercles near its base. Ambulatory legs short, compressed, with only a few hairs on the upper margins of the merus joints; terminal joints clothed with a short dense pubescence. Colour in the typical example coppery red, paler below. Length of carapace about 7 lines (15 millim.), greatest breadth nearly 11 lines (23 millim.).

The single specimen in the collection is an adult male. In the pitted carapace and chelipedes, and in the strongly defined inequalities of the carapace, this species more nearly resembles *Xanthodius* than *Leptodius*; but it presents no traces of the palatal ridges which are characteristic of the former genus and, indeed, constitute its sole claim to generic distinctness. As these ridges in *Xanthodius* are sometimes imperfectly defined, it may be necessary to unite the two genera, as has been done by Prof. A. Milne-Edwards. As compared with the West-Indian *Xanthodius americanus*, Saussure, *Leptodius punctatus* has the carapace somewhat less convex toward the frontal and antero-lateral margins, the lobulations of the carapace less prominent and separated by wider depressions. In both specimens of *Leptodius punctatus* examined the right chelipede is but little larger than the left.

The differences, however, between the West-Indian and African forms are so slight that, but for the single character of the absence of the palatal ridges, I should have considered *L. punctatus* a mere variety of *X. americanus*. *L. punctatus* further resembles *Xanthodius*, and differs from most species of *Leptodius*, in that the black coloration of the fingers does not extend along the inner or outer surface of the hands. There is in the British-Museum collection a male, preserved dry, from the west coast of Africa, in which the frontal lobes are obsolete*.

* *Leptodius Macandreæ*, sp. n. (Pl. XIII. fig. 4.)

There is in the collection of the British Museum a single specimen of a species of *Leptodius* from the Canaries, which is very distinct from the preceding and from all others that I have examined. It may be briefly diagnosed as follows:—Carapace flat above, with scarcely any traces of surface prominences or depressions; slight sulci, however, are observable, which originate at the bases of the third and fourth antero-lateral marginal teeth. Frontal margin divided by a median notch into two broad truncated lobes, from which the little prominent internal orbital angles are separated by a notch; the teeth at the exterior orbital angles and the first pair of antero-lateral-marginal teeth are obsolete, the three posterior teeth of the antero-lateral margins distinct. Chelipedes robust; carpus

Pilumnus verrucosipes. (Pl. XIII. fig. 5.)

Pilumnus verrucosipes, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 38 (1858).

Four specimens in the collection agree in all particulars with Simpson's diagnosis, to which the following may be added:—The front is rather prominent, its median notch very small; the first or exterior orbital tooth is small; the verrucosities of the chelipedes and ambulatory legs are prominent and tuberculiform; the outer surface of the larger chelipede (which may be either the right or the left) is nearly naked, and the granulations with which it is covered become obsolete toward the inferior margin. The oblique ridges on the inner surface of the palate do not quite reach to the anterior margin of the buccal area. Orbital margin with a wide inner hiatus and a very narrow fissure near the outer orbital tooth, near to which, on the upper orbital margin, is sometimes a second very small tooth. Colour yellowish or olive-brown. Length of the largest example 3 lines (nearly 6 millim.), breadth a little over 4 lines (9 millim.).

This species was hitherto unrepresented in the British-Museum collection; and its acquisition is of interest, since the type was obtained by the United-States expedition at Simon's Bay, Cape of Good Hope.

A *Pilumnus* (*P. africanus*) has been described by Prof. A. Milne-Edwards* from Goree and Angola, which is in all respects very distinct from *P. verrucosipes*, and is allied in many of its characters to *P. hirtellus.* To it I refer specimens without locality in the Museum collection.

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with two obscure teeth on its inner surface; palm obscurely ridged and sulcated along the upper margin; fingers somewhat compressed, distinctly toothed near the base, and ridged above; pale coloured, the lower fingers only being excavated at tips; those of the larger chelipede widely gaping; ambulatory legs compressed.

The specimen, which is preserved dry, has faint reddish markings on a pale ground. Length of carapace little more than 6 lines (11 millim.), breadth about 8 lines (17 millim.). The smooth carapace, together with the obsolescence of the exterior orbital and first antero-lateral-marginal teeth, seems to distinguish this species, which was presented to the British Museum by the late R. MacAndrew, Esq.

It bears a curious resemblance to *Lophozozymus* 6-*dentatus,* from which not only the excavated finger-tips but the much broader, smoother carapace, with less prominent front and smaller antero-lateral teeth, at once distinguish it. It is very nearly allied to *Leptodius dispar,* Stimpson, a Cuban species, in all particulars except that in *L. dispar* no trace exists of the third antero-lateral tooth, and the chelipedes are described as "naked, smooth, and polished; fingers a little more than one half as long as the palm, scarcely gaping, and but little excavated at the tips."

* Ann. Soc. Entom. France (ser. 4), vii. p. 280 (1867).

Neptunus (*Amphitrite*) *inæqualis*, sp. n.
(Pl. XIII. fig. 6.)

Carapace rather convex, closely pubescent and granulated; the granules disposed in series upon the more elevated parts of the gastric, cardiac, and branchial regions; on the gastric region the granulated prominences are disposed in a cruciform figure, behind which are two closely approximated tubercules in the median line; two similar submedian prominences exist on the cardiac region, and three oblique granulated elevations on each branchial region; from the long lateral epibranchial spines a line of granulations extends on each side to the hepatic region, where it is bifurcated. Front with six lobes, of which the two median are small, the next on each side prominent and triangulate, and the outer (or inner orbital lobe) broadly rounded. The antero-lateral marginal teeth are spiniform and acute; the ninth (or lateral epibranchial) tooth very long, in the largest individual about one third as long as the greatest width of the carapace. No spines at the postero-lateral angles of the carapace. Postabdomen (in the male) subtriangulate, not T-shaped, as in *Callinectes*. Anterior legs slender and somewhat elongated; arm or merus with four or five spines on its anterior margin, and one at the distal extremity of its posterior margin; wrist or carpus with a strong spine on its inner and outer surfaces; palm slender and elongated, with two spines on its upper margin (one just above the articulation of the dactylus, and the other a short distance behind it), and with a third spine just above the articulation with the wrist. Ambulatory legs slender; fifth pair having the merus joint unarmed, and the terminal joint ovate, ciliated, and rounded at the distal end. Colour (of spirit-specimens) light yellowish, inclining to pink; fingers variegated with reddish or purplish. Length of largest individual (a female with ova) about 7 lines (15 millim.), breadth to base of lateral epibranchial spines 11½ lines (24 millim.). Length of chelipede, when extended, 1 inch 6½ lines (39 millim.).

The description is taken from the largest example; three other smaller specimens are in the collection, two of which are males. In the smaller specimens the elevations of the carapace are less distinctly marked, the two anterior gastric prominences being indeed obsolete: the teeth of the antero-lateral margins are less spiniform; but the full number are developed even in the smallest example, which measures scarcely 3 lines (6 millim.) in length.

In many particulars this species is nearly allied to the West-Indian *Neptunus Gibbesii*, Stimpson, but may be distinguished by the greater prominence of the submedian frontal teeth, more convex and tuberculated carapace, with longer lateral epibranchial spines, &c. From *Neptunus marginatus*, A. M.-Edwards, which inhabits the Gaboon coast, it is at once distinguished by the tuberculated carapace and the existence of an additional spine on the upper margin of the palm; and from *N. vocans*, A. M.-Edwards, from the Cape-Verd Islands, by the form of the frontal teeth and the absence of a spine at the postero-lateral angles of the carapace.

N. anceps, Saussure*, of which there is a specimen from Martinique in the Museum, has the carapace much less tuberculated and differently shaped antero-lateral marginal teeth, &c.

Thalamita integra, var. *africana*, n.

This designation is proposed for several *Thalamitæ* in the collection, which scarcely differ from typical specimens of *Thalamita integra*, except in having the lateral lobes of the front shorter than the median lobes. As is usual in *T. integra*, the fourth lateral marginal spine is rudimentary, the basal antennal joint is armed with a smooth and entire crest, and the penultimate joint of the fifth leg bears traces of very minute denticulations. The carapace is somewhat pubescent; the armature of the chelipedes closely resembles that of the typical *T. integra*. The fact of *Thalamita integra* being an Oriental species and not occurring (as far as is known) on the west African coasts, renders it possible that the specimens from Goree Island may belong to a distinct species; but a larger series is required to determine the point with certainty.

There are in the British Museum two small specimens from the Canaries (*R. MacAndrew, Esq.*) which belong to the new variety.

Goniosoma Millerii.

Goniosoma Millerii, A. M.-Edwards, Nouv. Arch. Mus. Hist. Nat. iv. p. 54, pl. xviii. figs. 1–3 (1869).

Here are referred two small examples, males; the larger measures little more than 5 lines (11 millim.) in length, and about 7 lines (15 millim.) in breadth. The small denticles between the larger antero-lateral teeth are perfectly distinguishable, although very small; the frontal teeth, although broad and obtuse, are scarcely as much truncated as in the figure above cited. In the smaller example, length only $3\frac{1}{2}$ lines (little over 7 millim.), the denticles of the antero-

* Mém. Soc. Phys. et Hist. Nat. Genève, xiv, p. 434, pl. ii. fig. 11 (1858).

lateral margins are on one side obsolete and on the other discernible only by a lens of considerable power; the frontal teeth are less regular, and separated by somewhat shallower incisions; so that, had the larger specimen not been available for comparison, the identity of the smaller with Milne-Edwards's species might well have been questioned.

This is a very interesting acquisition, the species having been hitherto a desideratum in the Museum collection.

Its near affinity with the Oriental *G. erythrodactylum*, noted by Milne-Edwards, is unquestionable; but in adult individuals of that species there are only two rudimentary denticles in the interspaces between the three anterior teeth of the antero-lateral margins; moreover, in the specimens I have seen of *G. erythrodactylum*, the carapace is smooth and naked, whereas in *G. Millerii* it is clothed by a short pubescence.

Since the above was written a larger female has been received from Baron Hermann-Maltzam, from Goree Bay. Length nearly 10 lines (21 millim.), breadth about 1 inch 2 lines (30 millim.).

Portunus corrugatus (Pennant).

Here are referred several specimens in the collection; they are of the typical form, with distinctly defined frontal lobes. The wide Oriental range of this common European species I have already noted*; and the fact of its occurrence in the Atlantic region, as far southward on the west coast of Africa as Senegambia, is not without interest.

Portunus pusillus, Leach.

Three examples, a male and two females, are in the collection, which agree in all particulars with Mediterranean specimens.

There are in the British Museum examples from the Canaries (*R. MacAndrew, Esq.*).

Portunus pusillus has much affinity with *Portumnus africanus* (A. M.-Edw.) and *P. nasutus* (Latreille), and it is indeed difficult to cite any certain differences by which these species may be distinguished from *Portunus*.

P. pusillus has evidently a wide geographical range, being found on the British coasts as far north as the Shetlands, from which locality there are specimens in the British-Museum collection.

It is one of the British species recently mentioned by Mr.

* "On a Collection of Crustacea from the Corean and Japanese Seas," Proc. Zool. Soc. 1879, p. 33.

Kirk as occurring in the New-Zealand seas; but I am inclined to think the New-Zealand species distinct, since Mr. Kirk mentions the existence of a "prominent spine" on the anterior margin of the hand in his specimens: this I have never observed in the true *P. pusillus*, which has the distal end of the anterior margin acute or armed with a very small spinule.

Atelecyclus rotundatus, Olivi.

Several specimens of this common Mediterranean species are in the collection. Length of the largest 11 lines (23 millim.), breadth a little over 1 inch 1 line (28 millim.); the others are all much smaller.

[To be continued.]

XXII.—*Remarks upon Mr. Wood-Mason's Paper "On the Discrimination of the Sexes in the Genus* Paludina." By Edgar A. Smith.

Mr. Wood-Mason's object is to show that the sexes of *Paludina* are distinguishable by differences both in the shells and animals. This fact, I need scarcely remind the readers of this journal, has been known for nearly two hundred years. Lister, in 1695 *, gave a very fair anatomical description of the animal, demonstrating (p. 46) the bisexuality of the genus and the characters of both male and female.

He says, in reference to the distinguishing external features, "si tamen nota aliqua *externa*, qua mas a fœmina primo intuitu discerni possit, desideretur, scire licet mares fere *minores* esse, deinde, in maribus *dextrum cornu* (tab. 2. fig. 1, *f*) sinistro duplo latius esse, apiceq. obtuso desinere." On turning to the above-quoted figure we find it thus described:—"Dextrum maris cornu obtusum, in quo penis exitus est."

The latter discovery has since received confirmation from Cuvier †, Moquin-Tandon ‡, and others.

Supposing a marked difference in the size of the adult shells generally prevails in the sexes of *Paludina*, I fail to perceive how a conchologist, judging from the shells alone, can know which, in any series he may have before him, have contained males and which females. In any large number of a species

* 'Exercitatio anatomica altera, in qua maxime agitur de Buccinis fluviatilibus et marinis' (12mo, London, 1695).

† Ann. du Mus. 1808, p. 170; also Mémoires pour serv. à l'Hist. des Mollusques, 1817.

‡ Mollusques terr. et fluv. de France, 1855, vol. ii. pp. 530–537.

we invariably meet with intermediate sizes, which *with certainty* can neither be considered small females nor yet large males. Then, again, as in other classes of the animal kingdom, individuals of the same species of both sexes vary much in their dimensions; consequently that which we might deem an ordinary-sized female would possibly prove to be an overgrown male were the inhabitant known, and *vice versâ*.

Mr. Wood-Mason says, in reference to the difference in the size of the shell, "It is far from probable that any other Gasteropodous genera will be found to present similar sexual differences." But this feature has *already* been noticed in the whelk tribe (*Buccinum*); for Messrs. H. and A. Adams (Genera Recent Moll. vol. i. p. 108) observe, "The shells of the males are generally smaller than those of the females," a result due probably to the same cause as in *Paludina*, namely the greater space requisite to contain a distended ovarium.

In the quotation from Professor Owen's work ('Lectures on the Comparative Anatomy and Physiology of the Invertebrate Animals,' 1855, p. 564) there occurs an important mistake. Mr. Wood-Mason observes that in *Paludina vivipara* the penis "is closely connected with the right tentacle" (*Owen*). From this it might seem to some that the great anatomist was somewhat indefinite in his demonstration. However, if the line had been correctly quoted, and the words "*united to*" substituted for *connected with*, the sense and clearness of the description become apparent. Moreover, can it for a moment be conjectured that the writings of Lister and Cuvier upon this subject were unknown to the distinguished author. Mr. Wood-Mason goes on to say, "but in the Indian species the penis is altogether aborted, and its function has been transferred to the contiguous right tentacle, which has consequently become converted into a hooked copulatory organ."

From this it would appear that he imagines that in *P. vivipara* the penis arises from a spot somewhere near the right tentacle, whereas it is contained within it, as in his Indian species, and although contained by it, does not, I conjecture, transfer its *function* at the same time, the tentacle being but as a sheath to the penis, which, at the time of copulation, protrudes through the end of it.

Beyond the fact of the tentacle in question being curved or hooked in *P. crassa* and *P. bengalensis*, we gain little further knowledge of this genus from Mr. Wood-Mason's paper; and it is advisable that inquiry should be made concerning what has already been done upon any subject before trespassing upon the valuable space of such a journal as the 'Annals and Magazine of Natural History.'

XXIII.—*On* Spongiophaga *in* Spongilla. By H. J. Carter, F.R.S. &c.

Through the kindness of Mr. Edward Potts of Philadelphia, United States, I have received a present of twenty-four slides of different kinds of *Spongilla* for examination; and among them are at least four (I think six; but there are certainly four) that contain unmistakable evidence of the presence of a new species of *Spongiophaga*, which I desire to name after Mr. Potts, who brought it to my notice, "*Spongiophaga Pottsi.*" The spongiophagous filament in this instance rises by one (the broad) end from a prolongation of the chitinous coat through the hilous opening of the seed-like body or statoblast of *Spongilla*, and, after twisting about for some time, gradually becomes diminished in thickness to an almost immeasurable point or irregular termination—thus *not* ending in a bulb at each end, like the marine species *Spongiophaga communis* ('Annals,' 1878, vol. ii. p. 168), but in other respects identical with it. Apparently from two to four filaments are extended from the prolongation mentioned, webbed together at their origin, like the arms of a Cephalopod; and, besides being found in a *new* species of *Spongilla* from a small stream in the Centennial Grounds of Philadelphia, it also occurs in the same species from Bethlehem, about fifty miles distant; while two other slides, each bearing specimens of *Meyenia* (*Spongilla*) *Baileyi*, Bk., from Buffalo, Lake Erie, appear to be equally affected by the same (if not still another) species. The existence of *Spongiophaga* in the fresh- as well as in the salt-water sponges is thus substantiated. Whether it belongs to the animal or vegetable kingdom, no one yet has been able to find out, although it is perfectly evident that the marine species destroys the sponge which is infested by it. It is to be hoped that Mr. Potts, who, like Lieberkühn with the marine species, is under the impression that it is part of the sponge itself (*op. et loc. cit.*), will, under the advantage of a medium which is much more manageable than sea-water, be able to trace its development, and thereby tell us something more about it, if not what it really is. Meanwhile I hope before long to state more in detail, with illustrations, that which I can make out of this enigmatical organism from the slides.

XXIV.—*On some Mammals from Kandahar.* By J. Scully.

Lieut.-Col. C. Swinhoe lately intrusted to me for examination a small collection of mammals which he made in the neighbourhood of Kandahar, in Southern Afghanistan. As nothing has to my knowledge been published about the mammals of that country since Captain Hutton's "Rough Notes on the Zoology of Candahar," in the 'Journal of the Asiatic Society of Bengal' for 1845, I have thought it would be of interest to give a notice of the species which Colonel Swinhoe has obtained, and which he has presented to the British Museum. There has been so much discussion about Kandahar lately, that the position of the place will doubtless be well known to whoever may read these notes; the elevation of the city is about 3500 feet above sea-level.

Vesperugo Kuhlii (Natt.).

Pipistrellus lepidus, Blyth, J. A. S. B. xiv. p. 340 (1845).
Pipistrellus leucotis, Dobson, J. A. S. B. xli. pt. 2, p. 222 (1872).

Male, city of Kandahar, March.

Head and body 1·75 inch, tail 1·43, head 0·6, ear 0·54, tragus 0·24, forearm 1·35, thumb 0·24, third finger 2·3, fifth finger 1·7, tibia 0·5, foot and claws 0·27, calcaneum 0·53.

Upper inner incisors long and pointed, the outer incisor less than a fourth of the length of the inner ones; lower incisors with trifid crowns; postcalcaneal lobe large.

This specimen agrees well with Blyth's description of *P. lepidus* and Dobson's account of *V. leucotis*. I follow the latter author in considering this pale desert form only a variety of *V. Kuhlii*; but I would mention that, if it is to be separated from *V. Kuhlii* of Southern Europe, it must bear Blyth's title of *lepidus*, which has precedence by twenty-seven years over the term *leucotis*.

The following is Captain Hutton's account of the habits of this bat in Kandahar:—"This species is very common, and may be seen from February till towards the end of October, flitting about in crowds in the twilight hours of evening; they shelter during the day in holes of houses, walls, and rocks."

Erinaceus megalotis, Blyth.

A hedgehog obtained at Kandahar in April agrees well with Blyth's and Hutton's description of the typical examples originally sent by Captain Hutton from that country. In the specimen before me, which is fully adult, there is no nude space on the vertex; the spines have three isabelline bands, situated at the base, middle, and tip, and two black bands, one above the basal pale band and one subterminal. The upper canine has two roots, the first premolar only one; and the second premolar has two, one external and one internal. I mention this, as Dr. Anderson notes (J. A. S. B. ii. 1878,

p. 196) that *E. megalotis* has three roots to the second upper premolar.

The following are measurements of the skull of this specimen :—

	millim.
Total length	58
Zygomatic breadth	34
Length of palate	32
Length of nasal bones	20·5
Breadth of postorbital constriction	13
Length of mandible	44

Erinaceus macracanthus, Blanford.

A specimen obtained at Kandahar in April is obviously distinct from the preceding species, and is clearly referable to the hedgehog described by Mr. Blanford in his 'Zoology of Persia' (1876, p. 27). This example, which agrees perfectly with the original description and figure of the adult animal, has a distinct nude space on the vertex, running back to the nape; the spines are much longer and coarser than in *E. megalotis*, and are differently coloured. There are two pale bands, one at the base of the spine and one subterminal, and two black ones, situated one above the basal isabelline band and one occupying the tip of the spine. The general effect produced by the different distribution of colours on the spines of *E. megalotis* and *E. macracanthus* is this, that, viewed from above, the former is of a pale clay-colour, while the latter is black. In the present specimen the upper canine has two roots, the first upper premolar has also two, and the second upper premolar has three roots.

The following are the measurements of the skull of *E. macracanthus*, which differs considerably in shape from that of *E. megalotis.*

	millim.
Total length	51·5
Zygomatic breadth	30
Length of palate	27
Length of nasal bones	16·5
Breadth of postorbital constriction	11·5
Length of mandible	38

This species has not previously been recorded from Kandahar.

Canis lupus, Linn.

According to Hutton, wolves are common about Kandahar. He gives the dimensions of a specimen he measured there as— total length, including the tail, 56 inches, and height at shoulder 27. Colonel Swinhoe has brought two skulls of wolves, killed at Kandahar in December, of which the measurements in millimetres are appended; the parts measured are as defined by Prof. Huxley in his paper on the "Cranial and Dental Characters of the Canidæ" (Proc. Zool. Soc. 1880, p. 243) :—

	a. millim.	*b.* millim.
Total length	230	204
Zygomatic breadth	117	105
Length of palate	111	104
Breadth of palate	69	64
Length of $\frac{pm.\,4}{}$	24	23·5
Length of $\frac{m.\,1}{}$	16	14
Breadth of $\frac{m.\,1}{}$	20	19
Length of $\frac{m.\,2}{}$	8	8
Breadth of $\frac{m.\,2}{}$	13	13
Length of mandible	174	152·5
Length of $\frac{}{m.\,1}$	27	26
Length of $\frac{}{m.\,2}$	12	10
Length of $\frac{}{m.\,3}$	6	6

The difference in size between these two specimens is due to age, the smaller example (*b*) being the skull of a young animal. It will be observed that in these examples the upper sectorial tooth is equal in length to, or longer than, the two upper molars together; in *C. pallipes* from India, as far as is known, the upper sectorial is always shorter than the two upper molars taken together. But it appears that this difference cannot alone always be relied upon for the separation of the skulls of the two supposed species; for Prof. Huxley gives in the paper above mentioned, at page 279, the measurements of the cheek-teeth in two specimens of *C. lupus* from Belgium and Russia, showing that in these skulls the upper sectorial and the two upper molars have the same relative proportions as in *C. pallipes*. However, if *C. pallipes* is to be ranked as a species distinct from *C. lupus*, the Kandahar wolf is evidently to be referred to the latter and not to the former.

Vulpes montana, Pearson.

It was long ago asserted by Griffith that there were two species of foxes in Afghanistan, distinguished principally by size—a large form found near Quetta, and apparently identical with the Himalayan fox (*V. montana*), and a smaller animal, resembling the fox of the plains of North-west India. Blyth subsequently named the small fox of Afghanistan

V. Griffithi, the type being a specimen obtained at Kandahar by Capt. Hutton. Col. Swinhoe has brought home two skulls of foxes killed near Kandahar in December; and these certainly tend to confirm the view above mentioned, that there are two separable forms of foxes in that country.

The larger skull, which I have now to notice, exactly resembles several skulls of the true *V. montana* from Gilgit; and I cannot doubt that it is referable to that species. Compared with examples of *V. vulgaris*, the whole skull is smaller in all its dimensions; but the teeth are decidedly larger.

The following are the cranial and dental measurements of this specimen:—

	millim.
Total length	139
Zygomatic breadth	70
Length of palate	69
Breadth of palate	38
Length of $\frac{pm.\,4}{}$	14
Length of $\frac{m.\,1}{}$	11
Breadth of $\frac{m.\,1}{}$	14
Length of $\frac{m.\,2}{}$	6
Breadth of $\frac{m.\,2}{}$	9
Length of mandible	100
Length of $\frac{}{m.\,1}$	16
Length of $\frac{}{m.\,2}$	7·4
Length of $\frac{}{m.\,3}$	3·5

Vulpes Griffithi, Blyth.

Vulpes Griffithi, Blyth, J. A. S. B. xxiii. p. 730 (1854), and xiv. p. 344 (1845).

Capt. Hutton notes that this species is numerous in the valleys around Kandahar, hiding in burrows and holes in rocks. Of two specimens which he measured he gives:— Length of head and body 24 inches, tail 17 and 17·5; height at shoulder 14 and 15. Blyth says that *V. Griffithi* is of about the size of *V. pusillus*, and larger than *V. bengalensis* and *V. leucopus*, with longer fur than in the last-mentioned species, "and the pale parts tinged with yellowish fulvescent." The following is his detailed description of the pelage of *V. Griffithi*:—"The winter fur is long and soft, and is of two sorts—a shorter and delicate underfur, which on the back is darkish, passing to white on the sides and underparts, and pure white on the sides of the neck and shoulders in some, in others but partially so, and longer straight hairs, black-tipped, and yellowish white along the back, whiter on the sides; the breast and underparts, with the exterior of the limbs above the mid joint, dusky; ears brown-black to near their base; face fulvescent, with dark patch before each eye; and the tail very bushy, a little fulvescent, and white-tipped. In summer dress the long hairs have more or less disappeared; and in a male before me the inner fur is considerably deeper-coloured than in Capt. Hutton's female."

The following are measurements of the skull of this species, collected by Col. Swinhoe at Kandahar:—

	millim.
Total length	119
Zygomatic breadth	63·5
Length of palate	59
Breadth of palate	33
Length of $\frac{pm.\,4}{}$	12
Length of $\frac{m.\,1}{}$	9·5
Breadth of $\frac{m.\,1}{}$	12
Length of $\frac{m.\,2}{}$	5·5
Breadth of $\frac{m.\,2}{}$	9
Length of mandible	86
Length of $\frac{}{m.\,1}$	14
Length of $\frac{}{m.\,2}$	7
Length of $\frac{}{m.\,3}$	3

A comparison of the above measurements with those given under *V. montana* will show that the two skulls differ considerably. I have compared this skull with those of *V. leucopus* and *V. bengalensis*, and find that it is larger than in either of these species; in general shape of skull *V. leucopus* more nearly resembles *V. Griffithi* than does *V. bengalensis.*

Mustela sarmatica, Pallas.

This brightly-coloured species is said by Capt. Hutton to be plentiful about Kandahar. The following are dimensions of the skull of an example obtained in the neighbourhood of that city in April:—

	millim.
Total length	52
Length of bony palate	23·5
Width of palate at junction of outer faces of $\frac{pm.\,3}{}$ and $\frac{m.\,1}{}$	18
Zygomatic breadth	30
Breadth of muzzle	13

	millim.
Greatest breadth of brain-case	24
Length of $\frac{pm.\,3}{}$	6·5
Breadth of $\frac{m.\,1}{}$	5·5
Length of mandible from condyle to symphysis	32
Height to coronoid process (straight)	15
Length of $\frac{}{m.\,1}$	6·5
Length of $\frac{}{m.\,2}$	2·3

Mus bactrianus, Blyth.

Of this species (the common house-mouse of Kandahar) there are three fine specimens in the collection, preserved in alcohol; they were captured in a house in the city of Kandahar in February. The following are the measurements in inches:—

	♂. millim.	♀. millim.	♀. millim.
Head and body	3·4	3·37	3·1
Tail	3·3	3·5	3·3
Nose to ear-orifice	0·83	0·8	0·8
Length of ear from orifice	0·5	0·49	0·53
Breadth of ear	0·45	0·45	0·46
Forearm and hand	0·93	0·9	0·9
Hind foot (without claws)	0·75	0·74	0·7

Gerbillus Swinhoei, sp. nov.

The following is a description of a male *Gerbillus* captured in April at Gatai, a place on the edge of the desert, about halfway between Kandahar and the Khojak Pass, at an elevation of about 4000 feet above sea-level:—

Head and body 3·4 inches, head 1·3, tail 3·1, hairs at end of tail 0·4, nose to car-orifice 0·95, length of ear 0·44, breadth of ear 0·38, forearm and hand 1·1, hind foot without claws 0·93, longest whiskers 1·75.

The colour of the fur above is rich brownish rufous, creamy white below, the colours sharply separated along the sides; the hairs of the upper parts have the basal three fourths slaty grey. On the middle of the back some long black hairs are intermixed; and these increase in number towards the insertion of the tail. The hairs of the lower surface and limbs are uniform creamy white throughout their length. A broad band from the nose, on each side of the muzzle, over the eye to the ear, pale isabelline. Ears small and oval, inside naked, except towards the margins, where they are scantily lined with fine greyish hairs; externally sparsely covered with isabelline hairs, which become long and close on the basal parts of the outer and inner margins; along the margin at the tip of the ear there is a fringe of short whitish hairs. Whiskers mostly white, the upper series black, with grey tips. The hands and feet are well clad above with whitish hairs; below the palms are bare, and the soles are covered with fine white hairs. The tail is short and cylindrical, only diminishing slightly in calibre towards the tip; it is uniform in colour above and below, and is very scantily clad with pale isabelline hairs; at the tip of the tail is a pencil of long pure black hairs.

The upper incisors are grooved as usual; the first and second upper molars have the transverse ridges forming the crowns of the teeth united in the middle, as in *G. hurrianæ*, *G. psammophilus*, *G. nanus*, &c. (*Rhombomys* of Wagner), and the third upper molar has no second posterior ridge or talon, as in *G. indicus* and *G. erythrurus*.

The animal, though not very old, appears to be quite full-grown.

I have failed to identify this specimen with any described species of *Gerbillus*, and have therefore ventured to name it after Lieut.-Col. C. Swinhoe, who collected it.

PROCEEDINGS OF LEARNED SOCIETIES.

DUBLIN MICROSCOPICAL CLUB.

January 20, 1881.

A Black Soot-like Fungus, resembling Torula pinophila, occurring on the Stoppers of Glycerine Bottles.—Prof. M'Nab exhibited a fungus found in the Botanical Laboratory at Glasnevin, upon the stoppers of bottles containing glycerine. The extremely dilute glycerine which moistens the stoppers catches and retains a black soot-like fungus, which seems to have some affinity with *Torula pinophila*, the soot-like fungus of spruce-firs. The subject is one which requires more investigation.

Pitchstone from Dyke near Newry.—Prof. Hull exhibited a thin section of pitchstone from the well-known dyke of that rock near Newry, which is marked on Griffith's geological map of Ireland (1855), and which (according to Dr. Frazer, who possesses specimens of the rock) was first discovered by the late General Portlock. The rock is of a dark bluish-grey colour, compact and vitreous, containing numerous crystalline grains or blebs of quartz, a few crystals of orthoclase (sanidine) sometimes in twins, and a few little black specks of magnetite. It is traversed by numerous parallel joint-planes dividing the whole rock into plates about $\frac{1}{8}$ inch across. These planes are so fully developed that the rock is exceedingly friable in consequence.

With a two-inch objective and the aid of the polariscope the paste is seen to be truly vitreous, as it becomes dark when the Nicol prisms are crossed. At the same time the quartz and felspar crystals polarize vividly.

With a magnifying-power of 400–500 diameters numerous microliths appear. A few with parallel sides suggest the forms of apatite prisms, others are probably of pyroxenic origin; there are also cellular spaces of amorphous matter. But the most noticeable appearances are those of stellate forms, generally originating in a centre and shooting out sharp-pointed needles in various directions. Somewhat similar forms are described by Rosenbusch from the obsidian of Greenland*, and by Allport from the pitchstone of Arran in Scotland†. These latter differ from those observed by the author in the fact that they polarize distinctly, and are considered by Mr. Allport to be forms of pyroxene. Those in Prof. Hull's section, however, do not polarize‡, but with crossed Nicols entirely disappear from view along with the vitreous paste of the section. These forms, together with the absence of polarization, suggested that in the present instance they are those of shrinkage fissures originating in various centres during the cooling process, not those of crystalline bodies.

A new Sarcodine, possibly to be referred to the Genus Microgromia. —Mr. Archer showed examples of a very minute monothalamous freshwater Rhizopod, not very uncommon in moor-pools, but yet not hitherto recorded. Owing, however, to the fact that never yet was he able to alight on even a single example exhibiting pseudopodia, he was actually unable to refer this form definitely to a particular genus out of, say, three, to some one of which it might *à priori* belong. These were *Nebela*, *Hyalosphenia*, or *Microgromia*; Mr. Archer, however, for the present at least, felt inclined to suppose that in the last it would most probably find its most fitting location. The test in this form is very minute, membranous, as it were, somewhat crumpled, balloon-shaped or pyriform, with a comparatively thick neck, its circular opening with a distinctly marked, slightly thickened rim; the test, when young, colourless, but brownish eventually; the body-mass granular and faintly bluish in tint, though it might be called "colourless," and with a posterior nucleus. Were such a form as this to be seen to project even a single, ever so short, sharply bounded, pellucid, "finger-like" pseudopodium, it would doubtless fall under *Nebela* (*Difflugia* in part); but if so, it would be by far the most minute form known referable thereto; or its hyaline test might suggest *Hyalosphenia*. Its very small size alone would suggest *Microgromia*; but still the larger examples are, by comparison, a good deal larger, and with a

* Mikrosk. Phys. Band i. † Geol. Mag. vol. ix.

‡ This fact was witnessed by several members of the Club present. In one instance the light appeared through the sides of the needle.

considerably longer "neck" than *Microgromia socialis* (Archer), Hertwig, and still more so than *Microgromia mucicola*, Archer, the little form found nidulating in the enveloping mucous of the alga *Dimorphococcus lunatus*, or more especially in the alga of similar habit formerly referred by Mr. Archer to *Dictyosphærium* (but erroneously) and called *D. constrictum*. If, then, this Sarcodine had been seen projecting even ever so short pseudopodia of "reticulose" character, its genus would be decided; but, as mentioned, it has never been seen to emit any. All in this way that it ever has shown is but a slight "overflow" of the sarcode from the frontal aperture, this projecting quantity of sarcode with a "fuzzy" or somewhat torn-like margin. Now this sort of margin presents more of the "Gromian" aspect, or that which is seen in such forms before pseudopodia begin to be given off at length or in quantity—Difflugian Rhizopods presenting, on the other hand, a smooth, sharp outline before and during the emission of their pseudopodia. Add to this the fact that when this sarcodine presents itself in a gathering, it is mostly in some numbers, showing thus a good deal of a gregarious tendency, though it need not be said they do not occur combined "socially," like *Microgromia socialis*, by means of inosculating pseudopodia, and the idea that this form may prove to belong to *Microgromia* becomes slightly strengthened. "Conjugated" examples, however, are not infrequent, the mouths of the tests in close approximation. Such an example Mr. Archer was able to place under the microscope, and this too showed the by no means infrequent circumstance that the whole combined sarcode-mass of the two so joined examples had become balled together into a single globular "spore-like" encysted body occupying the globose base of one of the tests, this possibly destined to give origin another day to "zoospores." Were this form to have been seen issue linear (that is to say "Euglyphan") pseudopodia, it would fit into Schulze's genus *Platoum*; but having *waited* on it from time to time so long, Mr. Archer regarded this as most unlikely. For the reasons indicated, therefore, he felt most inclined to relegate this puzzling little form to *Microgromia*, at least *ad interim*, it possibly remaining as *Microgromia ambigua*; if it should stay there, the genus would consist of three species, all of which Mr. Archer had been the first to detect.

Stichococcus minor, Nägeli?—Dr. E. Perceval Wright exhibited examples of a chlorophyllaceous unicellular alga, identified by Dr. Wittrock as *Stichococcus minor*. He also showed examples of an alga forming a green coating on drowned flies, which appeared to be quite the same form as the foregoing; but, owing to the complete rotundate, in no way elongate figure, of the cells in both instances, it appeared very doubtful that either should be relegated to the genus *Stichococcus*, Nägeli, at all.

February 17, 1881.

Alcyonaria.—Dr. E. Perceval Wright exhibited the spicules of two very beautiful new species of *Alcyonaria* from the collection made by the 'Challenger' expedition, belonging to the group of the Primnoadæ. These spicules were feebly calcareous, longer than broad, and smooth on their edges.

Cerebellar Cortex, Cerebral Cortex, and Gastric Mucous Membrane stained with Klein's Cochineal Fluid, and its Formula.—Dr. R. J. Harvey showed specimens of cerebellar cortex, cerebral cortex, and gastric mucous membrane stained with Klein's cochineal fluid. The preparation of and *modus operandi* with this fluid are exceedingly simple. One per cent. of alum and cochineal in distilled water are boiled to four sevenths of the original volume; when cool, a few drops of carbolic acid are added and the liquid filtered. Sections will stain well in three or four hours, but will not be injured if left twenty-four hours. They require nothing but washing in distilled water. The branching processes of Purkinje's cells in the cerebellum, the connexion of the kite-shaped cells of the cerebral cortex, and the "chief" and "investing" cells of the gastric mucous membrane were rendered especially evident by this method.

Conceptacles of Xylaria polymorpha, the spores with two nuclei, one, or no nucleus.—Mr. Greenwood Pim exhibited sections of the conceptacles of *Xylaria polymorpha* showing the asci and spores. He drew attention to the fact that some of the spores presented two nuclei, some a single nucleus, and some were even destitute of any nucleus, and observed that this character, of considerable value amongst Pezizas, failed in the Xylarias.

Staurastrum, nov. spec.—Mr. Archer showed examples of an undescribed *Staurastrum*, which, so far as he was aware, had not been found out of Connemara, and there it was rare. It somewhat resembles *St. maamense* plus horns, these slender, sometimes furcate, and more or less dissimilar, the crenatures on the margins of the semicells smaller and less pronounced. Of this distinct form Mr. Archer would defer a description. This had so long stood as the "Horned" Staurastrum, it might probably remain as *Staurastrum cornutum.*

Testis of Hirudo.—Prof. Mackintosh exhibited cross sections of the testis of *Hirudo medicinalis*, showing the axis from which budded off the mother cells of the spermatozoa, which were seen in various stages of development.

March 23, 1881.

Capnodium Footii.—Mr. Greenwood Pim showed specimens of *Capnodium Footii* from Stephanotis-leaves, and of *C. citri* from orange-leaves. The chief interest in these somewhat obscure leaf-parasites turned on the fact that an action had recently been brought in Scotland against the Shotts Iron Co. to restrain them from smelting iron within a certain distance of the extensive and valuable plantations belonging to the Lord President of the Court of Session. The defence tried to show that the black deposit on the leaves was due to some form of *Capnodium* or *Fumago*, but failed to prove their case.

Torula pinophila.—Dr. M'Nab exhibited specimens of *Torula pinophila*, Chev. (*Antennaria pinophila*; Nees ab Es.), obtained abundantly on healthy spruce-firs growing in Glasnevin Botanic Garden. The fungus seems to live on the bud-scales, and only extends to the stems and leaves under exceptional circumstances. It was met with both in the conidial (*Torula*) stage and in the Coniothecium condition. The fungus was identical in all its characters with that observed at Glencorse, near Edinburgh.

Chlorochytrium Cohnii.—Dr. E. Perceval Wright showed living specimens of this green unicellular Alga, exhibiting the various stages of the division of the protoplasmic cell-contents, fuller details of which he hoped to publish shortly.

Conjugated State of a Compressed or Two-angled Form of Staurastrum pterosporum, Lundell.—Mr. Archer showed the zygospore of *Staurastrum pterosporum*, Lundell, especially remarkable inasmuch as nearly all the examples which occurred in the gathering were compressed (that is, two-angled), not three-angled, in the end-view; that is to say, they conformed to the character ascribed to the genus *Arthrodesmus*. And, indeed, in the eyes of some observers, these would doubtless be regarded as *Arthrodesmus incus*, "forma;" but how erroneously, the present conjugated examples demonstrated. There could be little doubt but several really distinct species are confused together under the designation *Arthrodesmus incus*; but perhaps only a couple have shown their zygospores, and no doubt these agree in the main, being simply orbicular and beset by not very numerous, but comparatively long, subulate, acute spines. However like the present parent form might be to *A. incus*, yet Mr. Archer must say he would have hesitated to so designate them, and so by some might possibly be regarded as running away with a pet idea. But let us, looking down the microscope, discuss the matter as we like, and come to varied conclusions, the little desmid knows better, and, our disputations notwithstanding, just runs its own specific course. Forget to develop a third angle during vegetative growth it may; but forget that it is all the time in reality not *A. incus*, or any form of it at all, when it comes to produce its zygospore, it would seem it cannot; it accordingly fashions its zygospore into a compressed cushion-like figure, oblong, the angles somewhat dilated into a wing-like appendage, this remaining still within the parent half-cells, and retaining them at the angles; for in truth *it is* just *Staurastrum pterosporum* all the time, a species very aptly named by Lundell. The first to exhibit the triangular (Lundell's) form conjugated in this country was our member Mr. Crowe, the examples, so far as Mr. Archer remembered, being from the Rocky Valley, near Bray. Just as there is, then, an *Arthrodesmus*-like (that is, a compressed) form of *St. pterosporum*, so there is a similar form of the closely resembling *Staurastrum O'Mearii.* Such cases tend to confirm the conclusion that *Arthrodesmus*, as a genus, cannot stand; still the species relegated to *Arthrodesmus* stand, *per se*, very good indeed. They show that there is as little reason for a separate genus for two-angled *Staurastra* as for the three- or four- or five-angled, as distinguished from one another.

Sections of Fœtal Vertebræ.—Dr. Harvey showed a section of fœtal vertebræ stained with purpurine. All the effects for which double staining had been so much recommended of late, in studying the process of ossification in cartilage, are brought out by this dye. The cartilage matrix remains unstained, the new territories of bone-substance assume a distinct though somewhat pale hue, while all the cells (cartilage-cells, bone-cells, osteoblasts, and marrow-cells) become brilliantly stained.—Mr. E. G. Hull subsequently showed a transverse section through the medulla of a human fœtus at full term, at the level of the apex of the calamus scriptorius (lower apex of fourth ventricle), showing the nuclei of the vagus and hypoglossal nerves (respiratory centre).

Tetraploa aristata exhibited.—Mr. Pim showed examples of *Tetraploa aristata* from dead Pampas-grass stems in his garden. This is a very rare Torulaceous fungus. It appears to consist of about eight cells, superposed two and two; from each of the upper four arises a long bristle or awn, the whole forming a pretty and singular object.

Structure of Micaceous Dolerite from Slieve Gullion.—Prof. Hull, F.R.S., exhibited a thin section of micaceous dolerite from Slieve Gullion, a mountain on the borders of Armagh and Louth rising 1893 feet above the sea. The rock occurs in association with quartziferous porphyry, and is probably of volcanic origin, belonging to a period more ancient than the Miocene lavas of co. Antrim. It is represented on the map of the Geological Survey, sheet 59. It is a rock of rare occurrence, as it is seldom that mica and augite are associated as essentials together in the same rock. It is largely crystalline-granular, and of a dark colour.

With a low magnifying-power and the aid of the polariscope the slice presents a very beautiful appearance, as all the minerals polarize more or less vividly. The following were observed:—

1. *Orthoclase*, in large crystals, rare.

2. *Plagioclase*, probably Labradorite, in long plates and prisms, perfectly crystallized, and indenting the augite. Some small crystals are seen enclosed in the latter mineral, which was consequently later in consolidating.

3. *Augite*, in large coloured patches without crystalline form, indented by the crystals of felspar.

4. *Mica*, easily recognizable in hand-specimens, and equally abundant with augite, from which it may be distinguished in the thin section by its parallel cleavage-planes.

5. *Olivine*, in small grains and crystals, occurring generally in groups imbedded in those of felspar. They are easy to distinguish by their form and polarization; and, though fresh and unaltered in the interior, they are bounded by a thick band of brown ochreous matter, due to decomposition.

6. *Magnetite*, in minute grains and small quantity, visible with a 1-inch objective.

The order of crystallization appears to have been:—first, magnetite and olivine; second, the felspars; third, mica; and last, augite. It was remarkable that in a rock of probably Mesozoic age the minerals should be so slightly (in most cases not at all) altered.

MISCELLANEOUS.

Observations on Siredon lichenoides. By William E. Carlin.

Como Lake, U. S., is a body of water about two miles and a half in circumference. It has no known outlet, but is fed by a stream of pure spring-water about two feet wide and a foot deep, which, continually running, prevents the lake's absorption by evaporation. The lake is quite shallow, and can be easily waded at almost any part, being not more than 10 feet deep in the deepest place that I have been able to find. The bottom of the lake is soft, and is covered in most places with grass and weeds. The water is strongly impregnated with alkali; and a large number of cattle are said to have died a number of years ago from drinking it. It is very disagreeable to the taste. The amount of water varies about 14 inches during the year, being highest in the spring, from the melting snow, and lowest in the autumn. This is the home of the *Siredon lichenoides* (Baird). They never enter the stream of fresh water, preferring the alkali water of the lake. They seem to suffer no inconvenience, however, if placed in fresh water. I have caught as many as a hundred and fifty, and placed them in a cauf, and have never had one die from the change. The change to fresh water undoubtedly hastens the metamorphosis into the *Amblystoma* form, as I have noticed quite a change in the course of twenty-four hours in individuals placed in the cauf, while an equal number kept in the alkali water in the boat have shown no change in any of them in several days. I have kept six at different times in jars of fresh water until they have completed their metamorphosis. I made no systematic note of appearance from day to day; but my observation was careful and regular. In two cases the change in external appearance was so abrupt that I should have been almost certain that another salamander had been substituted for the one in the jar, had I not had him so completely under observation that it was impossible. The gills had assumed a stubby form about half the length that they were the night before; and the gill on the back of the body was nearly half gone. It took air quite often; and I removed it from the jar and placed it in a box with some lake-grass around it to keep it moist. It completed the metamorphosis in a few days. I did not feed it during this time. While it was in the jar it was well fed with flies. The jar was placed upon a table in the telegraph-office. The flies at first had to be pushed in front of it with a pencil. It finally got to know that tapping the jar with a pencil meant a fly, and would rise to the surface immediately and snap at whichever it saw first, pencil or fly. It furnished train-men continual amusement while here; and they kept it constantly gorged. Those that I kept well fed in jars and seldom changed the water, say once in three days, usually began to show a slight change in from two to three weeks, and all of them completed the change into the *Amblystoma* inside of six weeks, while I have had but three changes of those kept in the cauf (sixty of them) in three months. During that time they have not been fed at all. The *Siredon mexicanus* is said to never undergo the transformation in its home; and Professor Marsh doubts that it ever makes it here. This doubt I can put at rest. They do make the change here, and in large numbers. During the latter part of the month of July and the entire month of August, if the day is rainy or misty, they come from the lake on to the shore in large numbers, and secrete themselves under some piece of wood or rock where they can keep moist. Sometimes they venture out in a shower, and the sun catches them before they can obtain shelter either in the lake or under cover, and in a few minutes kills them. They can be found dried hard anywhere about the lake, on the shore, or in the grass. While catching *Siredon* I have seen and caught a number of *Amblystoma* in the lake with the metamorphosis, as far as I could see, as complete as those we find half a mile from the lake. They cover the ground by thousands during a warm summer rain, coming from every conceivable place where they could have found shelter—from under rocks, boards, old ties, and out of gopher-holes. I have a cat that eats them greedily. She has fished several out of jars on the table, and devoured them during the night when there was no one to watch her; and I am told by a resident that the numerous skunks that live around the lake live principally on them. They are of two colours, a blackish-green and a yellowish-green colour. I have had two of the blackish-green complete the change in sequence while one of the yellowish-green was completing it under the same circumstances of change of water and food. I think this will be found to be the result in all similar cases. I have caught them in all stages of growth, and in all stages of their changes into the *Amblystoma* state. During the months of July and August they lie close to the shore of the lake, where it is shallow; but after the first frost they disappear completely; or, at least, I have never been able to find them. I think they must bury themselves in the mud at the bottom of the lake, as I have stirred up the grass often and have not seen them issue from it.—*Proceedings of United States' National Museum*, June 1881, p. 120.

On the Nature of Dictyophyton. By R. P. Whitfield.

Since writing the article on *Dictyophyton* published in the last number of this journal I have obtained additional evidence of their spongoid character. About the middle of May, while discussing their nature with Principal Dawson, of Montreal, we examined some allied forms from the Keokuk beds at Crawfordsville, Indiana, which lately came into the possession of the American Museum of Natural History, and found one which retained the substance of the organism. Under a hand-glass of moderate power it is seen to have been composed of cylindrical threads of various sizes, now replaced by pyrite. With the means then at our command it was impossible to fully determine whether they had been bundles of vegetable fibres or sponge-like spicules; but Dr. Dawson kindly offered to examine them more critically if I would forward a specimen to him at Montreal. This was done; and his note on their nature is appended below. The specimen used probably belongs to the genus *Uphantænia*, Vanuxem, and is a fragment about $2\frac{1}{2}$ by 3 inches across, and seems to have been a part of a circular or discoid frond of 8 or 10 inches diameter. It differs from *Uphantænia chemungensis* of New York in many features. The broad radiating bands are more distant, with a narrow thread-like band between; while all the circular bands have been narrow or thread-like. The spaces between the bands and threads are rectangular and covered by a thin film, which is alternately elevated or depressed in the adjoining spaces, as if the bands had been elastic, like rubber, and had contracted, wrinkling up the intermediate spaces. A further description and illustration of the form I shall defer to a future occasion, but shall here designate the species as *Uphantænia Dawsoni*. The broad bands are composed of very fine thread-like spicules, and the narrow ones of much stronger ones, while the thin film occupying the intermediate spaces is composed of still smaller spicules, apparently arranged in a radiating manner. The character and nature of these threads and spicules are well set forth in Dr. Dawson's note below, and the spongoid features and relations to *Euplectella* indicated.—*Amer. Journ. Sci.*, Aug. 1881.

Note by Dr. J. W. Dawson *on the Structure of a Specimen of* Uphantænia *from the Collection of the American Museum of Natural History, New York City.*

To the naked eye the fossil presents rectangular meshes of dark matter on a grey, finely arenaceous matrix. The spaces of the network are of an average size of 6 millim. in length and 4 or 5 in breadth. The longitudinal bands are about 3 millim. broad, the transverse bands much narrower. Some of the rectangular interspaces are of the colour of the matrix, others wholly or partially stained with dark matter. The meshes are nearly black, but in a bright light show a fibrous texture and metallic lustre, due to pyrite.

Viewed as opaque objects under the microscope, the reticulating bands are seen to be fascicles of slender cylindrical rods or spicules varying much in diameter, some of the largest being in the narrow transverse bands. The spicules may in a few cases be seen to be tapering very gently to a point, but usually seem quite cylindrical and smooth. In their present state they appear as solid shining rods of pyrite. The largest spicules are about $\frac{1}{500}$ of an inch in diameter, the smaller scarcely one fourth of that size. The spicules of the transverse bands cross those of the longitudinal ones without any organic connexion. Among the long spicules of the bands can be seen multitudes of very minute and apparently short spicules confusedly disposed; and these abound also in the dark-coloured areoles.

On the whole the structures are not identical with those of any plant known to me, and rather resemble those of siliceous sponges of the genus *Euplectella*.

The most puzzling fact in connexion with this view is the mineral condition of the spicules, now wholly replaced by pyrite. Carbonaceous structures are often replaced in this way; and so are also calcareous shells, especially when they contain much corneous matter; but such changes are not usual with siliceous organisms. If the spicules were originally siliceous, either they must have had large internal cavities which have been filled with pyrite, or the original material must have been wholly dissolved out and its place occupied with pyrite. It is to be observed, however, that in fossil sponges the siliceous matter has not unfrequently been dissolved out, and its space left vacant or filled with other matters. I have specimens of *Atylospongia* from the Niagara formation which have thus been replaced by matter of a ferruginous colour; and in a bundle of fibres, probably of a sponge allied to *Hyalonema*, from the Upper Llandeilo of Scotland, I find the substance of the spicules entirely gone, and the spaces formerly occupied by them empty. It should be added that joints of crinoid stems and fronds of *Fenestella* occurring in the same specimen with the *Uphantœnia* are apparently in their natural calcareous state.

Though I have hitherto regarded this curious organism as a fucoid, I confess that the study of the specimen above referred to inclines me to regard it as more probably a sponge.

I owe the opportunity of examining this very interesting specimen to the kindness of Professor Whitfield.—*Amer. Journ. Sci.*, Aug. 1881, p. 132.

Mortality of Fish in the Gulf of Mexico.

From notices appearing in the 'Proceedings of the United States' National Museum' it appears that for the last two years there has been a very serious mortality among the fish in the Gulf of Mexico near Florida, arising apparently from some peculiar condition of a belt of water at some small distance from the shore. Mr. M. A. Moore, writing on 30th November last, from Braidentown, Manatee County, Florida, to Prof. S. F. Baird, gives the following account of the facts as brought under his observation. He says:—

"You are doubtless aware that we have employed here a number of vessels as fishing-smacks, ranging from 30 to 50 tons, whose vocation it is to carry live fish to the Cuban markets. This industry provides occupation and subsistence for a large portion of our population in South Florida.

"About two years ago certain portions of our Gulf-waters became poisoned in some way that caused the death of all the fish that came in contact with it. Whenever a smack with a full fare, *i. e.* a full cargo, of fine healthy fish in her well sailed into this poisoned water, every fish would die, and they would have to be thrown away. This compelled the vessel to return to fishing at the loss of a month's hard work.

"This state of affairs has occurred again, the waters of some portions of the Gulf becoming so noxious as to kill the fish. The poison seems to be confined to certain localities and currents for the time being, as sometimes this state of affairs is observed more marked at one place and sometimes at another. However, there seems to be more of it about the mouth of Charlotte Harbour and off Punta Russa than elsewhere.

"Where this condition of water prevails the surface of the water is covered with dead fish, and the beach is covered with them in such numbers that sometimes the stench is intolerable.

"I live immediately on the beach of Palma Sola Bay; and some two weeks ago the beach was covered with dead fish. The only thing that seems to be inexplicable is, that this water seems to affect what are termed here bottom-fish more than any others. The principal game of the fishing-smack are the grouper (*Serranus nigritis*) and the snapper (*Serranus erythrogaster*). These, with the perch, kingfish, trout, and all those fish which take the hooks, seem to be much more affected than the mullet (*Mugil lineatus*) or the pompano (*Bothrolæmus pampanus*). . . . . Numbers of sharks and rays, eels and catfish are thrown up dead on the beach. . . . . My own opinion is, that the state and condition of the water are caused by some volcanic action at the bottom."

These facts of the death of the fish in the wells of the smacks "on reaching a certain kind of water distinguishable by its colour," and of the mortality among the fish in the Gulf, are confirmed by other writers. The noxious water is said to be of a brick-red colour, and to occur over a space of 200 miles.

Various hypotheses have been put forward by local writers to account for the phenomenon. Mr. Moore, in the above letter, suggests volcanic action at the sea-bottom; and this opinion seems to be held by others. Sometimes it is put definitely, namely an escape of noxious gases, or of mineral substances held in solution; and the editor of the newspaper 'Forest and Stream' refers particularly to a boiling spring which is said to exist off the coast. Others suggest the action of parasitic plants; and this appears to be the opinion of Dr. F. M. Endlich, who has made an analysis of the noxious water, and reports upon it as follows:—

"Having completed the examination of sea-waters from the Gulf of Mexico, so far as the scant supply would permit, I have the honour to offer the following report thereupon, the water in which the fish die being designated as A, the good water as B:—

	A.	B.
Specific gravity	1·024	1·022
Solid constituents (total), per cent...	4·0780	4·1095
Ferric compounds, per cent.	0·1106	0·0724
Injurious organic matter	ratio=3	ratio=2

"I find that the water A contains a large quantity of Algæ and Infusoria. It is eminently probable that the former may have had an injurious effect upon the fish. Specimens of the Algæ have been submitted to Professor Goode, who will send them to some expert in order that their specific character may be determined.

"The 'dead fish' in the possession of the United States' National Museum are such that any examination of the organs of respiration will be of no avail.

"I cannot find, even by spectroscopic analysis, any mineral constituents in the water A which could noxiously affect the fish.

"In my estimation the death of fish was caused by the more or less parasitic Algæ, which are found in large quantities in water A, but do not occur at all in water B.

"In case the same phenomenon should recur, the presence of an expert in the questions involved, more particularly chemistry and botany, would most likely lead to definite results."

Rhizopods the Food of some young Fishes.

Dr. Leidy reports that the young of some of the Suckers (Catostomidæ), *Hypentelium*, *Myxostoma*, &c., have been found by Mr. S. A. Forbes, of Illinois, to have the intestines packed with tests of *Difflugia* and *Arcella*, indicating that they feed on Rhizopods. In a slide containing material from the intestines of the young mullet (*Myxostoma macrolepidotum*) from Mackinaw Creek, prepared by Mr. Forbes, Dr. Leidy distinguished *Difflugia globulosa* and *D. acuminata*; and in another of the food of *Eremyzon succetta* he found *Difflugia globulosa*, *D. lobostoma*, *D. pyriformis*, *Arcella vulgaris*, and *A. discoides*, besides another peculiar undescribed form.—*Amer. Journ. Science*, July 1881.

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INCLUDING
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No. XLVI.

OCT. 1881.

CONDUCTED BY

ALBERT C. L. G. GÜNTHER, M.A., M.D., PH.D., F.R.S.,
WILLIAM S. DALLAS, F.L.S.,
WILLIAM CARRUTHERS, F.R.S., F.L.S., F.G.S.,
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WILLIAM FRANCIS, PH.D., F.L.S.

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

WITH TWO PLATES.

Illustrative of Mr. E. J. Miers's Paper on Crustacea from Goree Island, Senegambia.

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THE ANNALS

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[FIFTH SERIES.]

No. 46. OCTOBER 1881.

XXV.—*Contributions to our Knowledge of the* Spongida.—*Order* I. Carnosa. By H. J. Carter, F.R.S. &c.

In the first part of this contribution I propose to enumerate with short commentary all the species of the order Carnosa that have been made known, tabulating them afterwards as they might be arranged with reference to my Classification (No. 23 *); and in the second part I propose giving a descrip-

* Publications to which reference is made in the following communication:—

1.—1838. Dujardin, F. "Observations sur les Éponges et en particulier sur la Spongille ou Éponge d'eau douce," Ann. d. Sc. Nat. Zool. sér. 2, tome x.
2.—1842. Johnston, G. A History of British Sponges and Lithophytes.
3.—1847. Nardo, D. "Osservazioni anatomiche sopra l'animale marino detto volgarmente Rognone di mare," Atti dell' Instituto Veneto, vol. vi.
4.—1862. Schmidt, O. Die Spongien des adriatischen Meeres.
5.—1864. Schmidt, O. Die Spongien &c. Erstes Supplement.
6.—1866. Bowerbank, J. S. A Monograph of the British Spongiadæ, vols. i. and ii.
7.—1866. Schmidt, O. Die Spongien des adriatischen Meeres. Zweites Supplement.
8.—1867. Selenka, E. "Ueber einige neue Schwämme aus der Südsee," Zeitschrift f. wiss. Zoologie, Bd. xvii.

tion of the elastic tissue of the Spongida, which, although principally developed in the Carnosa, is so widely distributed throughout the class, that it may be considered one of the constituent elements of the Spongida, and therefore deserving of that special attention which hitherto it has not had. Finally, I propose adding some observations on other sponges which seem to claim admission into the Carnosa, ending with a notice of Dr. Oscar Schmidt's genus *Cellulophana*.

Since the Ray Society published the late Dr. Bowerbank's work on the British sponges, entitled 'A Monograph of the British Spongiadæ' (Nos. 6 and 21 respectively), which is chiefly confined to the species growing on the shores and comparatively shallow depths of the submarine bank immediately round the British Isles, not only more species from this locality have been discovered, but the "dredgings" of H.M.S. 'Porcupine,' having extended a little beyond the border of the bank into the "deep sea" of the Atlantic

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9.—1868. Schmidt, O. Die Spongien der Küste von Algier. Mit Nachträgen zu den Spongien des adriatischen Meeres. (Drittes Supplement.)

10.—1869. Carter, H. J. "A Descriptive Account of Four Subspherous Sponges, Arabian and British, with General Observations," Ann. & Mag. Nat. Hist. ser. 4, vol. iv.

11.—1869. Carter, H. J. "On *Grayella cyathophora*, a new Genus and Species of Sponges," ibid. vol. iv.

12.—1870. Carter, H. J. "Note on the Sponges *Grayella, Osculina*, and *Cliona*," ibid. vol. v.

13.—1870. Schmidt, O. Grundzüge einer Spongienfauna des atlantischen Gebietes.

14.—1871. Carter, H. J. "A Descriptive Account of three Pachytragous Sponges growing on the Rocks of the South Coast of Devon," Ann. & Mag. Nat. Hist. ser. 4, vol. vii.

15.—1872. Häckel, E. Die Kalkschwämme, ein Monographie in zwei Bänden Text und Atlas, mit 60 Tafeln Abbildungen.

16.—1872. Giard, A. "Recherches sur les Ascidies Composées ou Synascidies," Archives de Zoologie expérimentale et générale, H. de Lacaze-Duthiers, tome i.

17.—1873. Carter, H. J. "On two new Species of Gummineæ, &c.," Ann. & Mag. Nat. Hist. ser. 4, vol. xii.

18.—1873. Giard, A. "Contribution à l'Histoire Naturelle des Synascidies," Archives de Zoologie expérimentale et générale, H. de Lacaze-Duthiers, tome ii.

19.—1874. Carter, H. J. "On the Spongozoa of *Halisarca Dujardinii*," Ann. & Mag. Nat. Hist. ser. 4, vol. xiii.

20.—1874. Carter, H. J. "On *Halisarca lobularis*," ibid.

21.—1874. Bowerbank, J. S. A Monograph of the British Spongiadæ, vol. iii.

22.—1874. Carter, H. J. "Descriptions and Figures of Deep-sea Sponges and their Spicules from the Atlantic Ocean, dredged up on board H.M.S. 'Porcupine,' with Figures and Descriptions of

Ocean, have brought to light a still greater number (Nos. 17, 22, and 25, pp. 17, 207, and 226 respectively), most of which must be considered as much British as those which, growing a little further in towards the shore, are more accessible. Hence all these will also have to be added to the "British Sponges."

Among them are a few belonging to my order Carnosa, of which nothing is stated in the 'British Spongiadæ,' except *Hymeniacidon Dujardinii*, Bk. (No. 6, vol. ii. p. 224), which the author has endeavoured to identify with *Halisarca Dujardinii*, Johnston (No. 2, pp. 192 and 251), in a way that almost amounts to "burlesque," inasmuch as his statement is made upon the assumption that Dujardin (who first described *Halisarca*, No. 1, p. 6, and No. 2, *l. c.*) and Johnston (who designated it *Halisarca Dujardinii*, and made a genus of it under the following characters:—"Spongia gelatinosa diffuse repens cute tenui et lævi vestita spiculis et cellulis fibratis carens. Genus litorosum, rupes et fucorum radices ornans." No. 2, p. 251) had made a mistake!

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some remarkable Spicules from the Agulhas Shoal and Colon, Panama, respectively," Ann. & Mag. Nat. Hist. ser. 4, vol. xiv.

23.—1875. Carter, H. J. "Notes Introductory to the Study and Classification of the Spongida," ibid. vol. xvi.

24.—1876. Barrois, Ch. Thèse pour le Grade de Docteur ès Sciences Naturelles. (Also printed in Ann. d. Sc. Naturelles, Zool. sér. 6, tome iii.)

25.—1876. Carter, H. J. "Descriptions and Figures of Deep-sea Sponges," Ann. & Mag. Nat. Hist. ser. 4, vol. xviii.

26.—1877. Schulze, F. E. "Untersuchungen über den Bau und die Entwicklung der Spongien. Die Gattung *Halisarca*," Zeitschrift f. wiss. Zoologie, Bd. xxviii.

27.—1879. Schulze, F. E. "Untersuchungen über den Bau und die Entwicklung der Spongien. Die Familie der Chondrosidæ," ibid. Bd. xxix.

28.—1879. Carter, H. J. "Contributions to our Knowledge of the Spongida," Ann. & Mag. Nat. Hist. ser. 5, vol. iii.

29.—1879. Carter, H. J. "On a new Species of Excavating Sponge (*Alectona Millari*), &c.," Journ. Roy. Microscop. Soc. vol. ii.

30.—1880. Carter, H. J. "Report on Specimens dredged up from the Gulf of Manaar, and presented to the Liverpool Free Museum by Captain W. H. Cawne Warren," Ann. & Mag. Nat. Hist. ser. 5, vol. vi.

31.—1880. Schmidt, O. Spongien des Meerbusen von Mexico (und des Caraibischen Meeres). Zweites (Schluss-) Heft.

32.—1881. Carter, H. J. "Supplementary Report on Specimens dredged up from the Gulf of Manaar, together with others from the Sea in the Vicinity of the Basse Rocks and from Bass's Straits respectively, presented to the Liverpool Free Museum by Capt. W. H. Cawne Warren," Ann. & Mag. Nat. Hist. ser. 5, vol. vii.

33.—1881. Schulze, F. E. "Untersuchungen über den Bau und die Entwicklung der Spongien. Zehnte Mittheilung. *Corticium candelabrum*, O. Schmidt," Zeitschrift f. wiss. Zoologie, Bd. xxxv. S. 410.

The fact is that *Hymeniacidon Dujardinii*, Bk., although well described (No. 6, *l. c.*) and illustrated (No. 21, pl. xxxviii. figs. 1–4), is no *Hymeniacidon* at all, but a *Hymedesmia* according to Dr. Bowerbank's classificatory diagnoses (No. 6, vol. i. p. 153 &c.); for the thin gelatinous film of which it is composed supports a bed of spicules ("tibiella" with inflated ends, not simply cylindrical and obtuse, as figured by Dr. Bowerbank, No. 21, *l. c.*) confusedly arranged; from the surface of which project shorter, clavate, spined spicules with an inflated end respectively, in an echinating manner (that is, with their points outwards), while the whole *when dry* is brittle and not tenacious like the gummy consistence of the Carnosa. Thus the character of *Hymeniacidon Dujardinii* more resembles that of the lamina of "*Microciona* and *Hymerhaphia*" (No. 6, vol. i. p. 190), to which Dr. Bowerbank himself has especially likened *Hymedesmia*, than the massive forms with crumb-of-bread-like structure in *Hymeniacidon*. Similar remarks might be made on his *Hymeniacidon paupertas*, whose description just precedes that of *H. Dujardinii*; but this is not the place for them. It is therefore Dr. Bowerbank's and not Dujardin's "misapprehension" of the "structure of the genus *Halisarca*" (No. 6, vol. ii. p. 225) that alone concerns us for the present as it has done. Let us now turn our attention to the enumeration and classification of the Carnosa as proposed in my "Notes" (No. 23, p. 43).

Class SPONGIDA.

Order I. CARNOSA.

Char. Without evident skeleton *.

Family 1. Halisarcida.

Char. Possessing no spicules.

In 1838 Dujardin discovered on the coast of Normandy (Calvados, No. 1, *l. c.*), and described, the sponge-substance to which he gave the name of "*Halisarca*;" and in 1842 Johnston described the same kind of sponge as a British species from Berwick Bay &c. under the designation of *Halisarca Dujardinii* (No. 2, *l. c.*). To this Schmidt, in 1862, added another species, viz. *Halisarca lobularis* (No. 4, p. 80), which, in 1874, I first found, together with *H. Dujardinii*, growing plentifully on this coast, viz. Budleigh-

* Emended *posteà*, p. 255.

Salterton, South Devon, *where I reside* (Nos. 19 and 20, pp. 315 and 433 respectively).

As regards *H. Dujardinii*, nothing can be better than Johnston's description and generic diagnosis, excepting that he did not see any ova. They are abundantly present, however (though not far advanced), in the specimens which I have just now (28th June) taken off the rocks, while the more minute histology of the species was described in 1874 (*loc. cit.*).

When fresh and *in situ* the yellow transparent colour and oily appearance of *Hymeniacidon Dujardinii* and *Halisarca Dujardinii* are so much alike that it is almost impossible to distinguish them from one another without microscopic examination, when the presence of the spicules in the former, without any thing else, is quite sufficient. It is therefore not extraordinary that Dr. Bowerbank so far, should *himself* have made the mistake to which I have alluded.

Halisarca Dujardinii not only differs from *H. lobularis* when observed *in situ* by shape and colour, the former presenting an even surface with a yellowish transparent colour like oil or albumen ("white of egg" uncooked), and the latter a lobulated surface with a bluish carmine colour, especially over the more prominent parts, but, when examined under the microscope, *H. Dujardinii* is found to consist of a massive structure permeated by an excretory canal-system that has generally only one (but may have more) short tubular vents projecting from the surface, which is otherwise *entirely* covered by a smooth epidermis or dermal layer of sarcode (*cuticula*). On the other hand, *H. lobularis* is made up of contorted anastomosing knotted tubulation, with intervals (*lacunæ*) between the convolutions like those of *Grantia clathrus*, Sdt., = *Clathrina*, Gray, = *Ascetta clathrus*, Häckel (No. 15, vol. ii. p. 30, Taf. 4), opening here and there, by the union of two or more convolutions, in common vents (No. 26, Taf. 1. figs. 6 and 7); so that there is an excretory canal-system, as usual, together with the spongozoa in groups (ampullaceous sacs), and other sponge-elements *inside* the tubulation, and an external one, apparently produced by cilia, on the *outside*, which may thus keep up a circulation of water throughout its lacunose or reticulated mass. The latter has been called by Häckel the "intercanal system" (No. 15, vol. i. p. 275); but I have not been able to observe, under the most favourable circumstances, any cilia on the surface of the tubulation in *Clathrina* (which is abundant here); while, from the dermal layer of cells in preserved-in-spirit specimens of *H. Dujardinii* being so like that of *H. lobularis*, I think the former, if examined in the living state, might also be found to be so ciliated. Lastly, in *H. Dujardinii* under the microscope, it may be observed that the spongozoa &c. are but scantily accompanied by filaments of elastic tissue, like that so abundant in the next genus, viz. *Chondrosia*; while in *H. lobularis* there seems to be none at all; so that in this respect *H. lobularis* would appear to be the most simply formed of the two, yielding, from the absence of the elastic element, *permanently* not only to the pressure of objects with which it may come into contact in the "preserving-jar," but, although much thicker than *H. Dujardinii* when freshly laid upon the glass slide, also on this account subsiding on being *dried* into a much thinner stratum. When a fragment of *H. Dujardinii* is placed on a glass slide in water for examination, it slips away to the border of the cover, from its slimy elastic nature, while that of *H. lobularis* under the same circumstances remains stationary like a bit of soft dough. Hence I cannot understand how specimens of the latter found by Dr. Ch. Barrois on the north coast of France, nearly opposite this place, should be termed "semi-cartilagineuse" (No. 24, p. 42).

Could the calcareous sponges have originated in *H. lobularis*, which, together with the spicules, would be very like *Ascetta* (*Clathrina*), from the tubular, tortuous, anastomosing structure in both being almost identical? At all events, it is remarkable that the earliest forms, according to Häckel, of the calcisponges, viz. *Ascetta*, should afford the only analogous structure among the Spongida, so far as I know, to *Halisarca lobularis* (No. 15, vol. ii. and Atlas).

Thus, when carefully examined, there are such strong differences between *Halisarca Dujardinii* and *H. lobularis*, that it almost becomes questionable whether they should be in the same genus.

Halisarca guttula, Sdt. (no. 5, p. 41, and Taf. v. fig. 2, No. 9), is thought by Schulze to be the same as his (Schulze's) *H. lobularis purpurea* (No. 26, Taf. i. fig. 5).

Giard's *Halisarca mimosa* (mimic) from Boulogne, which, according to his description, consists of a thin lamina with plane surface, of a brick-red colour varied with orange-yellow, having its oscules bordered with deeper red slightly carmine, from which radiate orange-coloured lines, like "ascidian animalcules" (no. 18, p. 488), requires confirmation. And the other species, which was found at Roscoff, although so like *H. lobularis* that Schulze conjectured it to be the same as his variety, viz. *H. lobularis purpurea* (No. 26, p. 45, Separat-Abdruck), differs from *H. lobularis* in being "semi-cartilagineuse" in consistence, and the specimens possess "une grande élasticité et repoussent vivement le verre qui les comprime quand on veut en examiner une parcelle au microscope," as my above description of *H. lobularis* will show.

Halisarca cruenta, n. sp., 1876.

Smooth, more or less puckered, extending among the detritus of sea-bottom, and agglomerating the whole on its way, so as to give it a dark crimson-red colour, most intense where it is most exposed. Consistence firm, tolerably resilient. Surface, here and there where uninterrupted by the irregularities of the detrital bodies, of glassy smoothness, puckered towards the projecting points of the latter, and presenting vents irregularly scattered on a level with the dermal layer or cuticula. Internal structure more or less permeated by the branches of the excretory canal-system; tolerably resilient; crimson colour of the surface, which is seated in an extremely thin cuticula, fading off into grey internally; tissue, when examined under the microscope, presenting elongated granuliferous cells, rather than the fusiform transparent filaments so characteristic of the Chondrosidæ and upon which the amount of resistance or elasticity in the latter seems to depend, scattered among the spongozoa and other cells &c. of which the body-mass is composed. Ova not seen. Size indefinite, according to the extent of the spreading agglomeration, many portions of which are free from foreign objects to the extent of a quarter of an inch square and deep, which, when cut out, do best for examination.

Hab. Marine. Spreading among the detrital objects of sea-bottom and enveloping every particle in its course.

Loc. Gulf of Suez.

Obs. This forms part of the contents of a small jar of organisms of a like nature, among which is *Chondrilla nucula* growing over a piece of stony coral, collected by J. K. Lord, Esq., in the Gulf of Suez, and presented to the British Museum. It seems to be the same species as that previously noticed by myself under the above name, in my account of the sponges dredged on board H.M.S. 'Porcupine,' in the deep sea of the Atlantic Ocean, near Cape St. Vincent (No. 25, p. 228), of which the supply was too small for any thing but a provisional description; hence the above emended one. In appearance and firmness it is more like *Chondrosia* than *Halisarca Dujardinii* or *H. lobularis*; but in composition, from the comparative absence of the elastic filamentous element and consequent diminution of tenacity, more like the latter.

For an account of the specimens from Bass's Straits provisionally named *Halisarca bassangustiarum*, I must refer the reader to my second Manaar report (No. 32, p. 373), and for that of *H. rubitingens*, also provisionally named (*ib.* p. 366). The latter will be more particularly considered hereafter in connection with *Cellulophana*, Sdt. (No. 4, p. 41, &c.).

Chondrosia reniformis, Sdt. This name is taken from Nardo's description (No. 3), translated *in extenso* by Schmidt (No. 4, pp. 40, 41); so that it has been known for many years and, curious enough, to the Adriatic fishermen, under the name of "Carume di mar," which, in Greek, becomes "Halisarca," the name that, just ten years previously, had been given by Dujardin to *Halisarca Dujardinii*, which, as before stated, was found on the coast of Normandy. Since this sponge has been studied by Dr. F. E. Schulze, of Gratz, as well as the preceding genus *Halisarca*, in two separate communications, and the result of his careful investigations thus recorded (Nos. 26 and 27), I cannot do better than refer the reader to these as being a *sine quâ non* to a right understanding of both *Chondrosia* and *Halisarca*, merely adding here that, as the filaments of which the elastic felt-like trama of *Chondrosia reniformis* is characteristically composed form an element in many of the Spongida quite apart from the dendriform skeletal fibre, they demand a distinct consideration, which, not having been accorded to them before, I propose, as before stated, to give hereafter.

Gummina gliricauda and *G. ecaudata* are two other species described and figured by Schmidt (No. 4, Taf. iii. figs. 20 and 21 respectively). They appear only to differ in form from *Chondrosia reniformis*; and all, judging of specimens from Madeira which I possess, seem to take in foreign bodies during their growth, although Schmidt does not mention them in *G. gliricauda* and *G. ecaudata* from the Adriatic; but they produce no spicules of their own. It might be questionable how far the "foreign bodies" are a substitute for proper spicules, and thus analogous to the foreign bodies taken in by the Psammonemata for the core of their fibre.

Chondrosia plebeja, Sdt., from Algiers (No. 9, p. 1), appears to do the same (that is, to take in foreign bodies); but *Chondrosia tuberculata*, Sdt., from the Adriatic (*ib.* p. 24, Taf. v. fig. 4), contains neither foreign bodies nor spicules, and according to Schmidt is, in the section, very much like *Halisarca lobularis*; wherefore Schulze thinks it to be the same (No. 27,

p. 31, Separat-Abdruck); but if so, why should Schmidt call it "*Chondrosia*," likening its "firmness" especially to *Chondrilla*? If it be *Halisarca lobularis*, then the "semi-cartilagineuse" consistence of the specimen found by Dr. Ch. Barrois at Saint-Vaast, near Cherbourg, can be understood (*loc. cit.*).

Family 2. **Gumminida.**

Char. Possessing spicules.

Chondrilla nucula, Sdt. In 1862 Schmidt established this genus (No. 4, p. 38, Taf. iii. figs. 22, 22*a*), together with *C. embolopora*, both possessing spicules and both found in the Adriatic Sea. The former appears to be a "world-wide" species; for during the last five years I have had specimens of it from the Red Sea, the Gulf of Manaar, the Mauritius, Molucca Islands, and the West Indies. Schulze has added *Chondrilla mixta*, from the Red Sea, and *C. distincta*, from Ponapé (No. 27, p. 32, Sep.-Abd.).

In 1870 Schmidt described an incrusting species, about "1–2 millim." thick, charged with a pin-like skeleton-spicule and a spinispirular flesh-spicule from the Antilles, to which he gave the name of *Chondrilla phyllodes* (No. 13, p. 26, Taf. vi. fig. 1); and in 1873, I added *Chondrilla australiensis* from Port Jackson (No. 17, p. 23, pl. i. figs. 10–16).

If the species *Lacinia stellifica* from Bass's Straits (No. 8, p. 568, Taf. xxxv. fig. 8), described and illustrated by Selenka in 1867, possesses, as stated, a spicule "ganz ähnlich," exactly like his fig. 13, then it seems to me that he has made a mistake in calling it *calcareous* (Kalksternchen); or the organism is a *Leptoclinum*, M.-Edw., = Tribus 11. Didemniæ, Giard, "Tunique commune remplie de spicules calcaires" (No. 16, p. 644, pl. xxii.). Were the spicule siliceous, then the species would be like Schmidt's *Chondrilla nucula*; but if calcareous, then, as I only know of the existence of similar stellates in the compound Ascidians and never in the Calcispongiæ, I think that Selenka's discovery also requires confirmation. If substantiated it would indeed far exceed M. Giard's *Halisarca mimosa* in point of *mimicry*!

Corticium candelabrum. Of this sponge Schmidt, who found it in the Adriatic Sea in 1862, made a new genus, observing in his characters, "Spongia incertæ hucusque familiæ," describing and figuring its spicules (No. 4, p. 42, Taf. iii. fig. 25, *a–g*). There is no doubt, however, of its family now; for it evidently belongs to our order Carnosa, and, possessing spicules, to our family Gumminida; but very little of the filamentous element, as may be learnt from Schmidt's and Kölliker's observations, appears to exist in it; indeed, Schulze could not see any at all (No. 33, p. 422). It is present, however, in *Corticium abyssi*, but here very scanty, especially in the body-substance; hence the want of tenacity displayed in tearing a portion of the latter to pieces with needles, compared with *Chondrosia* and *Chondrilla*, in both of which this elastic filamentous trama abounds.

In 1868, Schmidt added another species from the Adriatic Sea (No. 9, p. 25, Taf. iii. fig. 6), which he named *C. stelligerum*; and in the same publication (p. 2, Taf. iii. fig. 11), another from the coast of Africa, which he named *Corticium plicatum*, in which the spicules are allied, in their tetractinellid form, to those of *Corticium abyssi*. The latter I described and figured from a specimen found in the "deep sea" at the entrance of the English Channel (No. 17, p. 18, pl. i. figs. 1–9). I have just stated that the filamentous element is very scanty in *Corticium abyssi*, which probably accounts for its amount of tenacity being far less than that of *Chondrosia* and *Chondrilla*, approaching therefore nearer to that of *Halisarca lobularis*. But it is not identical (identisch) with *Samus anonyma*, Gray, as supposed by Schmidt (No. 31, p. 69), which may be seen by my descriptions and figures of these sponges respectively (No. 28, p. 350, pl. xxix. figs. 1–4, and No. 30, p. 59).

My species (named *pro temp.*) *Corticium Kittonii* is only conjectural, being provisionally inferred from the tetractinellid form of some spicules hitherto only found among the detritus of sea-bottom at Colon, Panama (No. 22, p. 24, pl. xv. figs. 48, *a–e*); while *C. parasiticum* from the "deep-sea" was not sufficient in quantity for much more (No. 25, p. 229, pl. xvi. fig. 52).

Corticium versatile, from St. Vincent (West Indies), is another species lately (1880) adverted to by Schmidt, who has unfortunately devoted much more to the possible "combinations" of its tetractinellid form of spicules than to a description of the sponge itself (No. 31, p. 69, Taf. ix. fig. 5). All that is stated of it is that it is a "Crustenschwamm," to which are added figures of the spicule in the plate (*l. c.*), but nothing else. From the form of the flesh-spicule not having been given, if, indeed, there was any, I cannot speak with certainty; but the skeleton-spicules are very like those of *Samus simplex* (No. 30, p. 60, pl. v. figs. 26 *a–c*), which, of course, are liable, like those of *C. versatile* and all other tetractinellids, to irregularity in the division of the arms; but when accompanied by a particular form of flesh-spicule in great abundance, as in *Samus anonymus* and *Samus* (olim *Pachastrella*) *parasiticus* (No. 25, p. 410, pl. xv. fig. 41, *a*, *b*, and No. 30, p. 60), I think that, however great the variety in the skeleton-spicule may be, the form of the flesh-spicule *here* should decide the species question, as the branches in the skeleton-spicule are as inconstant as they are accidental. Schmidt's second part of his descriptions of the sponges from the Gulf of Mexico, which were sent to him from America for this purpose (No. 31), reached me on the 2nd July 1880, just two months after my Report on the Manaar specimens (No. 30) had been written and illustrated; or I should have referred therein to his observations in connection with *Corticium versatile* and its relationship with *Pachastrella*, to which now I can only commend the student for instruction.

Sarcomella medusa, as its substance proclaims, is an Algerine specimen, shortly described by Schmidt as an irregularly convex body, medusa-like in consistence, and charged with one form of spicule only, viz. acerate, like a *Reniera* (No. 9, p. 1).

Osculina polystomella, Sdt. Of this sponge, which came from La Calle, on the Algerine coast, and was forwarded in spirit to Schmidt by Lacaze-Duthiers, the former states in his description of it (No. 9, p. 3, Taf. 1) that its consistence is the same as that of *Chondrilla*, which, together with its being spiculiferous, is sufficient for our classification. It would have been more satisfactory if the thickness of the cortex had been mentioned in the text instead of having only been represented in the illustration with the indefinite term a little (geringe), when it may fairly be inferred to be *very much*, magnified. In 1870 I compared *Osculina polystomella* with *Grayella cyathophora* (No. 12, p. 73) from the Gulf of Suez, which in many particulars are very much alike—so much so indeed that I feel compelled now to add *Grayella* provisionally to the Gumminida as follows :—

Grayella cyathophora was described and illustrated by myself in 1869; and I still possess the little specimen in spirit as it came to me from the late Dr. J. E. Gray (No. 11, p. 189, pl. vii.). Since then a much larger but dry specimen has been added by purchase to the British Museum, which was stated by the dealer to have come from Port Elizabeth, Cape of Good Hope. It is 4 × 4 inches superficially, and half an inch thick, bearing the register no. 71. 6. 5. 1 and my running no. 15. On reexamining the wet specimen, to which I have alluded, I find that the dermal layer or cortex is only 1-277th inch in vertical diameter, but sufficiently thick to present a slippery, homogeneous, glutinous consistence, which, by its opacity, prevents the subjacent structure from being seen; so that, with its stelliferous character, *Grayella cyathophora* also comes within our specification of the Gumminida; but whether all such sponges should be here introduced which conform to *this* "specification" alone, is questionable; hence I shall return to this point hereafter under the head of "Observations."

Columnitis squamata, from the Antilles, is another sponge which Schmidt has added to his Gumminieæ (No. 13, p. 25, Taf. v. figs. 3, 4), and therefore is inserted here; but as a similar incrustation occurs on this coast which I have always regarded as closely allied to, if not the same as, *Donatia* (*Tethya*) *lyncurium*, and *Donatia* itself may justly claim a place among the Carnosa from its semicartilaginous consistence &c., I shall also return to this subject again.

Finally, in 1879 I figured and described a sponge under the name of *Latrunculia corticata*, said to have come from the Red Sea (No. 28, p. 298, pl. xxvii. figs. 1–4), covered with a homogeneous, semicartilaginous, thin dermis surrounding a reticulated structure internally charged with acerate skeleton- and spinispirular flesh-spicules, but the latter varying in form from a "spinispirula" to "sceptrella." When softened by soaking in water the dermal layer is found, under the microscope, to be almost entirely composed of the filamentous feltiform tissue, while the interior is also very tenacious and glue-like; so that, with its spicules, this species also must be classed with our Gumminida.

Hence, when tabulated, the whole will stand thus:—

Order 1. Carnosa.

Char. Without evident skeleton.

Family 1. **Halisarcida.**

Char. Possessing no spicules.

Halisarca Dujardinii, Johnston. Great Britain.
—— *lobularis*, Schmidt. Adriatic.
—— *guttula*, Sdt. Adriatic.

Halisarca mimosa, Giard. English Channel.
—— *cruenta*, Carter. Atlantic Ocean, Cape St. Vincent.
Gummina gliricauda, Sdt. Adriatic.
—— *ecaudata*, Sdt. Adriatic.
Chondrosia reniformis, Nardo *ap*. Sdt. Adriatic.
—— *plebeja*, Sdt. Algiers.
—— *tuberculata*, Sdt. Adriatic.

Family 2. **Gumminida.**

Char. Possessing spicules.

Chondrilla nucula, Sdt. Adriatic.
—— *embolopora*, Sdt. Antilles.
—— *australiensis*, Carter. Port Jackson, Australia.
—— *sacciformis*, Carter. Mauritius.
Corticium candelabrum, Sdt. Adriatic.
—— *plicatum*, Sdt. Algiers.
—— *stelligerum*, Sdt. Algiers.
—— *abyssi*, Carter. Entrance to English Channel.
—— *Kittonii*, Carter, prov. Colon, Panama.
—— *versatile*, Sdt. St. Vincent, West Indies.
Sarcomella medusa, Sdt. Algiers.
Osculina polystomella, Sdt. Algiers.
Grayella cyathophora, Carter. Red Sea.
Columnitis squamata, Sdt. Antilles.
Latrunculia corticata, Carter. ? Red Sea.

Observations.

In noticing the filamentous feltiform trama of *Chondrosia reniformis* I have stated that this structure demands "distinct consideration;" for the element of which it is composed is so generally developed among the Spongida that it may be said to form one of their constituent parts; hence it not only deserves a distinct notice, but also a distinct appellation, and therefore will be described under the following name:—

Elastic Tissue.

I first alluded to this woof or texture in 1873, in these words, viz.:—

"Thus, although in the Gummineæ there is no 'sponge-skeleton-fibre,' so to speak, the cuticula and a great part of the body is made up of fine intercrossing filaments, which are so soft that, on drying, they all sink their form into a common homogeneous mass like hard glue" (No. 17, p. 20).

This tissue, when examined in water microscopically, is found to consist of short, soft, flaccid, apparently fusiform, opaque or translucent, whitish-yellow filaments of variable length, being in *Chondrilla sacciformis* (from the Mauritius) about 1-150th inch long and about 1-6000th inch thick in the middle : at least this is what may be inferred from the parts which project from a fringed-out edge of a fragment of the sponge just mentioned, when torn to pieces with needles, in water, and placed under a microscopic power of 300–400 diameters; for it is not easy, as Schulze says, to isolate an *entire* filament. In the condition thus mentioned it may be observed to be translucent, and when unstranded to be made up of a number of almost immeasurable fibrils, like the finest hairs, which, although bound together in the pointed end of the filament that may project from the border of the fragment into the water, sinks down on drying upon the glass slide into an expanded lash of fibrils that become elementarily undistinguishable in the gum-like homogeneous consistence which they altogether then assume. How far the filaments may be interunited like the elastic tissue of the warm-blooded animals, *ex. gr.* the human subject, I am unable to say; but of course such an arrangement would enhance the elastic power of the tissue; and this interunion actually seems to be the case in a *dyed* and dried microscopic piece of *Halisarca Dujardinii* which I have mounted in balsam. At the same time, although generally distributed among the Spongida, the filaments of which this tissue is composed may not always present the same arrangement; and, again, although often alluded to as being "semicartilaginous," it should be remembered that this refers to the consistence and not the structure, which is not that of cartilage. When exposed for some time to the dyeing influence of aniline (magenta-red ink) it only becomes faintly coloured, compared with the sponge-cells and other sarcodic particles with which it is intermixed; while after having been dried and mounted in balsam in this state, no more of it can then be seen than has been above mentioned. As it is most abundant in those species of Carnosa which are most elastic and resilient, *ex. gr. Chondrosia* and *Chondrilla*, so it is least where the species is more easily torn to pieces, as in *Halisarca Dujardinii*, and apparently does not occur at all in *H. lobularis*, wherein, as before stated, I have not been able to discover any trace of it. How it originates I am unable to say; but it seems to me not impossible that its filament may have been an elongated fusiform cell whose contents generally have become developed into a bundle of fibrils such as that above described; nor am I able to say if it has any contractile power independently of its elasticity; while of its composition Schulze states:—"Die Prüfung auf *Cellulose* mit Kupferoxydammoniak sowie mit Schwefelsäure und Jod ergab ein *negatives* Resultat" (No. 27, p. 19, Sep.-Abd.).

It is not confined to the Carnosa, although most abundant there; for it may be found more or less present in most sponges with and without the genuine dendriform fibre-skeleton; although, where the latter is absent, this elastic tissue seems to supply its place. Perhaps the effect of its entire absence is best seen in the Calcispongiæ, where, in consequence of this absence, the fragility after drying is so great that the more tender forms, *ex. gr. Clathrina*, will hardly bear handling without breakage.

How far, then, the presence or absence of the Elastic Tissue should influence our classification is the next point to be determined.

It may be remembered that my diagnosis of the order Carnosa is simply "without evident skeleton;" but to what extent this will suffice may be inferred from the facts that *Chondrosia reniformis* and *Halichondria suberea*, Johnston (No. 2, pp. 140, 197), = *Suberites domuncula*, Sdt., both come under this definition; for neither have an evident skeleton (that is, genuine dendriform anastomosing fibre), while *Chondrosia reniformis* presents the consistence of india-rubber, and *Halichondria suberea* that of crumb of bread. Hence the former has been placed in the order Carnosa, and the latter in that of the Holorhaphidota.

Now, as it is plain that *Chondrosia reniformis* possesses an abundance of the "elastic tissue," and *Halichondria suberea* scarcely any (if any), while both are equally "without evident skeleton," which is our present definition of the order Carnosa, it is evident that this definition alone is not sufficient.

Again, when the "elastic tissue" is ever so scantily developed in the dermal layer, the latter, however thin, as in *Grayella cyathophora* (No. 11), presents a gelatinous consistence, with slimy, slippery surface, rendered opaque by spirit of wine—which, while preeminently characteristic of the Carnosa, is, on the contrary, very different from the thin delicate transparent sarcodic film which characterizes the other orders. Hence it becomes necessary to add these points to our present definition of the Carnosa, which would then stand thus:—"Surface slimy, glutinous, without evident skeleton, more or less composed of elastic tissue."

Still there remains a little difficulty, as with all border-questions, in adjustment; for in *Donatia* (*Tethya*) *lyncurium*, after which I have proposed a group, viz. Donatina, in the family Suberitida of the order Holorhaphidota (No. 23, pp. 182 and 184), there is a thick cortex composed of elastic tissue (charged, of course, with the spicules of the species), so densely developed that in consistence it is almost semi-cartilaginous, with no "evident skeleton;" while the same sponge, as before stated, grows *here* over shells in the form of an incrustation in which hardly more than the cortical layer is developed, thus simulating Schmidt's *Columnitis squamata* so closely that I cannot help thinking that one and all must be the same, and that therefore, if *Columnitis squamata* is, according to Schmidt, to be placed among his Gummineæ, *Donatia lyncurium* also ought to come under our Gumminida. That *Donatia* (originally called "*Tethya*" by Lamarck) has no specific alliance whatever with *Tethya cranium*, Johnston, which is the type of my group "Tethyina," may be easily seen by an examination of both species. Hence there seems no reason whatever why *Donatia* should not join *Columnitis squamata* among the Gumminida; so it may fairly be inserted in my tabulated enumeration of the Carnosa, p. 252, *anteà*.

It would have been satisfactory to have had a description of the form of the skeleton-spicule of *Columnitis squamata* in the text as well as in the illustration, in which the anteterminal inflation makes it differ from that of *Donatia lyncurium*; but in the Polymastina, which, not only in the tender but in the compact and hard forms, are in spiculation closely allied to *Donatia* (No. 25, p. 392), the head of the spicule constantly varies, even in the same species, between a simple fusiform acuate and an anteterminally-inflated shaft.

Lastly, in *Axos spinipoculum* (No. 28, p. 286, pl. xxv. figs. 1–9) there is an unusual development of the elastic tissue in the cortex as well as about the excretory canal-system (*l. c.* figs. 6–8); so that, but for the presence of an "evident skeleton," dendriform and spiculo-fibrous, it also, would be placed among the Carnosa instead of the Holorhaphidota, where, perhaps, after all it should form a distinct genus in the group Axona (No. 32, p. 381). I mention this instance chiefly to show that the elastic tissue may be developed to a great extent in sponges which, possessing in addition an "evident skeleton," cannot therefore be admitted into the order Carnosa.

The soft, slippery, velvet-like dermis of the common black sponge of this coast, named *Dercitus niger* by Dr. Gray, and described by myself (No. 14, p. 3, pl. iv. figs. 1 &c.), = *Hymeniacidon Bucklandi*, Bk., of 1866 (No. 6), = *Battersbya Bucklandi*, Bk., of 1874 (No. 21), = *Pachastrella*, Sdt., of 1868 (No. 9), aptly compared by Dr. Bowerbank to "bullock's liver" when fresh, in which the elastic tissue is powerfully developed, especially towards the surface, with no dendriform fibre-skeleton, but with an abundance of spicules, might also claim a place among the Carnosa—although I cannot speak with such certainty of the other species of *Pachastrella* that have come before me, which, as Schmidt has stated, are very ill-supplied in this way ("sehr arm an Weichtheilen," No. 31, p. 69), while the habit of *Dercitus niger* of extending itself into the cracks and crevices, however minute, of the rock on which it may be growing, inclines me to the view that it would do this with other objects, such as shells and corals, under similar circumstances, if growing upon them: hence, on one occasion, I found its spicules, together with those of *Cliona mucronata*, Sollas, in the excavated multilocular cavities of a branch of stony coral from the island of Cuba.

And this opens another question, viz. how many of the Eccœlonida (No. 29, p. 496) or excavating sponges may belong to the Carnosa; for, on the one hand, the tetractinellid spiculation of *Samus* is in form very evidently allied to that of *Pachastrella*, ex. gr. *Dercitus niger* &c., and on the other to that of *Corticium plicatum*, Sdt., *C. abyssi*, Carter, and *C. versatile*.

So far as *Cliona alata*, when growing within its excavated multilocular cavities in shells or rocks (calcareous), and when free in the form of *Rhaphyrus Griffithsii*, Bk., and *Cliona corallinoides* ('Annals,' 1871, vol. viii. p. 14, pl. ii. figs. 33–36) go, there is nothing but the absence of an "evident skeleton," as in *Halichondria suberea*, that would induce me to place them among the Carnosa; and of the rest I can state nothing in this respect; but as regards the genera *Samus* (No. 30, p. 59), *Alectona* (olim *Gummina*) *Wallichii* and *Millari* (No. 29, p. 494), if not of *Thoosa socialis*, *Dotona pulchella*, and *Alectona Higgini* (No. 30, pp. 56–58), whose almost microscopic dimensions render this evidence respecting them presumptive only, the gum-like consistence of the sarcode, together with the presence of the elastic-tissue filaments and the absence of a fibre-skeleton, seems to claim for them all a place among the Gumminida; indeed Schmidt's *Corticium versatile* appears to be my *Samus simplex* (No. 30, p. 60, pl. v. figs. 26 *a–c*).

All these are "border-questions," as I have said before, in which the transition of one kind of structure into another, as exemplified in different species of sponges, becomes perplexing to the classifier, who, after all, can only divide them at the confines of his grouping by an empiric distinction, chiefly based upon "degree," which arrangements, under the best of circumstances, must be conventional, as there is no line of demarcation in nature. But until all such facts as I have mentioned are known and duly considered, the classification of the Spongida will not become satisfactorily useful, although much may and must be done in this way previous to arriving even at this point; while at last, the nearest approach to the imaginary line of demarcation can only be attained by the most masterly mind on the subject.

CELLULOPHANA, Sdt., 1862.

Before concluding, it is desirable to turn our attention for a few moments to the nature of *Cellulophana pileata*, first named, described, and figured by Schmidt, who placed it among his Gummineæ or Kautschukschwämme (caoutchouc sponges), equal to our Carnosa (No. 4, p. 41, Taf. iii. figs. 24 and 24 *a*), but was so uncertain about its sponge-nature, that he proposed to refer the question to the botanists. He recurs to the subject again in his 2nd Supplement (No. 7, p. 22), but with little advancement, and finally ends with the description of another species from the coast of Florida, which is named *C. collectrix*, but, after all, adds in a "footnote" that the subject requires further observation (No. 13, p. 25).

His illustration of *Cellulophana pileata* (*l. c.*) represents a vertical section of the entire body, which had a roundish form, elongated and enlarged upwards, about $\frac{3}{4}$ inch high and $\frac{6}{12}$ inch thick, said to be "etwas vergrössert," whatever that may amount to, and to have been surrounded by a cortex enclosing a parenchyma, the former brown and thick, according to the illustration, and the latter carmine, passing into grey inwards. In fig. 24 *a* the epidermis is shown to consist of a thin fibrous layer with polygonal plant-like cell-structure underneath; while the second species, viz. *C. collectrix*, contained foreign bodies.

Now the chief objections to the sponge-nature of this organism are that no pores or oscula have been discovered in the epidermis, nor is there any excretory canal-system, while the presence of the polygonal cell-structure to which I have alluded (*l. c.* fig. 24 *a*) is also totally opposed, so far as my experience goes, to ordinary sponge-character, where all the cell-structure, if not polymorphic, is too gelatinous to present a defined cell-wall like that of plants. But I must refer the reader to the whole of Schmidt's observations, as *they* tend towards establishing the sponge-nature of this organism; meanwhile I would mention that I myself labour under similar difficulties with the organism from the Gulf of Manaar that I have provisionally named *Halisarca rubitingens*

ERRATUM.

By an unfortunate oversight on my part, which I regret extremely, Baron Maltzan's name has been mispelled in the earlier parts of this paper. Instead of "Maltzam" *read* "Maltzan," and instead of "*Heterocrypta Maltzami*" read "*Heterocrypta Maltzani.*"—E. J. M.

(No. 32, p. 365), which, presenting a membranous form when stretched across the irregularities of the detritus of the sea-bottom in which it may be growing, can be satisfactorily examined with the microscope, when it is found to be composed of an extremely thin transparent layer or epidermis on each side, enclosing one of polygonal cells of different sizes, indistinctly defined, but filled with granules, and apparently each containing a nucleus. In this membrane may be observed minute foreign bodies, such as fragments of sponge-spicules &c.; but their presence is only a part of what is taking place generally with the detritus under the spreading growth and agglomerating influence of this ruby-coloured organism, whose "granules" appear to bear the colouring-material. This is all that I could make out of *Halisarca rubitingens* in the dry state; and therefore, like Schmidt, I have stated that further observations in the wet state or while living are necessary for its elucidation.

XXVI.—*On a Collection of Crustacea made by Baron Hermann-Maltzam at Goree Island, Senegambia.* By EDWARD J. MIERS, F.L.S., F.Z.S.

[Continued from p. 220.]

Pilumnoplax sulcatifrons, var. *atlantica,* n.

Pilumnoplax sulcatifrons, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 93 (1858).

I thus designate, with much hesitation, a small female crustacean which agrees in nearly all its characters with specimens from the "Eastern seas" in the Museum collection that are referred to Stimpson's species, of which, however, I have seen no typical specimens. The Oriental examples have lost their ambulatory legs, but agree in the form of the carapace and the antero-lateral marginal teeth, the notched and sulcated frontal margin, and the structure of the antennæ with the West-African specimen. This latter has somewhat slenderer chelipedes—a character that cannot be depended upon, in the absence of males from the same locality for comparison. Length $3\frac{1}{2}$ lines (nearly 8 millim.), breadth about $4\frac{1}{2}$ lines (10 millim.).

I may add, as further points of distinction, that there are a few granules near the base of the second antero-lateral tooth, and the sulcus reaching from the fourth tooth to the cardiac region is obsolete in the West-African specimen.

Typhlocarcinus integrifrons, sp. n.
(Pl. XIV. fig. 1.)

The carapace is transverse, granulated, convex longitudinally, with a short scanty pubescence on its upper surface, and clothed with longer hairs on the lateral margins and on the margins of the legs; the cervical and branchio-cardiac sutures are very distinct. Front somewhat deflexed, with its anterior margin entire, straight, and clothed with long hairs, and rounded off on the sides towards the inner orbital angles. Antero-lateral margins arcuated, when viewed under a high magnifying-power appearing granulated, with obscure indications of division into two or three granulated lobes. Epistome very short. Postabdomen (of male) not as wide in its widest part as the sternum, with all the segments distinct, terminal segment subtriangulate. The ocular peduncles lie closely within the orbits, which are widest internally, with granulated margins; a wide hiatus exists between the inner suborbital angle and the front, which is filled by the broad quadrate basal (or second) joint of the antennæ, which reaches to the front; the exposed joints of the antennal peduncle are slender and clothed with long hairs; the flagellum rather long and multiarticulate, the joints clothed with very short setæ; the outer maxillipedes are smooth externally, with scarcely any intervening hiatus when closed; ischium rather broad, merus about as broad as long, not notched at its antero-internal angle, where it is articulated with the next joint. Chelipedes (in the male) rather robust, pubescent; arm short, carpus without a tooth on its inner surface; palm short and broad, and rather convex, broader transversely than the carpus; fingers slightly arcuated, minutely toothed on their inner margins, which are hairy at base, and having a rather wide interspace between them when closed. Ambulatory legs compressed, with hairy margins and rather long and slender terminal joints. The male verges lie in channels of the sternum, but are visible from above. Colour light fulvous-brown. Length of the largest example (a male) somewhat over 3 lines (7 millim.), breadth 4 lines (nearly 9 millim.).

A second specimen (female) is of rather smaller size, with slender chelipedes, the fingers of which meet when closed.

It is with some hesitation that I assign this species to the genus *Typhlocarcinus* of Stimpson's family Rhizopidæ, as but few of the types to which it is apparently most nearly allied are represented in the Museum collection. The different genera of this family described by Stimpson are apparently separated by characters of small importance. The species now described is apparently most nearly allied to *Ceratoplax* in the characters of the orbits, antennæ, and ambulatory legs, but differs in the form of the carapace, the small epistome, and the form of the merus of the maxillipedes. From *Typhlocarcinus nudus* and *T. villosus* it is distinguished by the form of the front, &c.

THAUMASTOPLAX, gen. nov.

I propose this generic name for a species in the collection that is closely allied in all its characters, and particularly in wanting the fifth pair of thoracic legs, to the genera *Hexapus*, De Haan, and *Amorphopus*, Bell, but is distinguished from the former by the much greater development of the second ambulatory legs and the structure of the outer maxillipedes, whose merus joint is elongated and narrowed at its summit, where it is articulated with the next joint; and from the latter by the well-formed orbits and the entire absence of rudimentary fifth legs.

Thaumastoplax anomalipes, g. et sp. n. (Pl. XIV. fig. 2.)

The carapace is transverse, about one and a half times as broad as long, longitudinally rather convex, polished, naked, and rather coarsely punctulated above; the regions not defined; the sides sharp-edged; the antero-lateral margins arcuated, the margins of the branchial regions straight and parallel. The front is nearly a quarter the breadth of the carapace, and has its anterior margin nearly straight. The orbits are very small, without marginal fissures, with a wide hiatus at the infero-internal angle, which is filled by the basal part of the antennæ. The buccal cavity is without distinct longitudinal ridges on the palate; epistome obsolete; abdomen in the male narrow, five-jointed, the third and fourth joints coalescent, and also the fifth and sixth, although in one specimen traces of the suture dividing the two last-mentioned joints are discernible under the microscope; the sternal surface (in the specimens examined) is nearly naked. The eyes are closely encased in the orbits, which have a distinct inferior margin; the large antennules are transversely folded; antennæ with the basal portion very small and occupying the infero-internal orbital hiatus; antennal flagellum rather long and about ten-jointed. The outer maxillipedes are slender and clothed with long dense hairs on their inner margins; ischium and merus each longer than broad, narrowing at each end, and with the inner margin arcuated; the penultimate joint dilated distally. Chelipedes (in the specimens examined) subequal, of moderate length; arm very short, little exceeding its vertical depth in length; carpus small; hands compressed, with short hairs and with subseriately-arranged tubercles on their outer surface; fingers thin, sharp-edged, denticulated, and nearly meeting along their inner margins; second legs small, third and fourth legs thick, with the third to fifth joints very robust, and the claws small; fifth legs entirely wanting. Colour (in spirit) light yellowish brown; legs more or less densely clothed with a short pubescence. Length of the largest example (a male) nearly 4 lines (8 millim.), breadth a little over 6 lines (13 millim.).

Two smaller examples are in the collection—one a male, the other apparently an immature female.

This form is apparently so nearly allied to *Amorphopus* of Bell* that I am not sure whether it ought to be generically separated from it. In *Amorphopus*, however, the carapace is described as cylindrical, the inferior orbital margin is wholly wanting; the chelipedes are unequal, the fingers in the larger hand meeting only at the tips, and the fifth legs are represented by a minute tubercle inserted in a little notch at the base of the first joint of the fourth pair. Of this I find no trace in *T. anomalipes*.

The locality of Bell's type, *Amorphopus cylindraceus*, is not stated.

Hexapus sexpes (Fabr.), as described and illustrated by De Haan, in v. Siebold †, resembles this species in general shape and in having only three pairs of ambulatory legs, without a rudiment of a fourth; the species, however, is of minute size, the carapace somewhat broader behind, the outer maxillipedes with the ischium or second joint broad and transverse, merus quadrate (as shown in the figure), truncated at its distal end, with the next joint articulated with it at its antero-internal angle; the second legs are shorter, whereas in *T. anomalipes* they are longer and more robust than the rest.

Gelasimus tangieri (yg.).

Gelasimus tangieri, Eydoux, Magas. de Zoologie, vii. pl. xvii. (1835); M.-Edw. Ann. Sci. Nat. (ser. 3) Zool. xviii. p. 151, pl. iv. fig. 21 (1852); Heller, Crust. des südl. Europa's, p. 101 (1863); Kingsley, Proc. Acad. Nat. Sci. Philad. p. 153 (1880).

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* Journ. Linn. Soc., Zool. iii. p. 27 (1859).

† Fauna Japonica, Crust. pp. 35, 63, pl. xi. fig. 5, and pl. D. fig. (1849).

Gelasimus perlatus, Herklots, Addit. Faun. Carcin. Afric. Occid. p. 6, pl. i. fig. 3 (1851); M.-Edwards, Ann. Sci. Nat. *t. c.* p. 151 (1852); Hilgendorf, Monatsber. der Akad. Wissensch. Berlin, p. 806 (1878); Kingsley, *t. c.* p. 153 (1880).

Here are referred three very small specimens in the collection, which I was at first disposed to regard as a distinct species; the largest only measures about 3 lines (7 millim.) in length and 4 lines ($8\frac{1}{2}$ millim.) in breadth. Not only do they differ from all the specimens of *G. tangieri* I have seen in their much smaller size, but also in the small number of the granules of the carapace, of which there are scarcely any on the median portions, and in the relatively much shorter fingers of the larger chelipede, which are no longer than the palm. The hand, when the fingers are closed, is nearly ovate; and there are scarcely any granules on its inner surface. An approach to these specimens is exhibited, however, in an example from Sierra Leone of rather small size; length of carapace $5\frac{1}{2}$ lines (12 millim.).

This species occurs at various localities on the northern and western coasts of Africa, as noted by Mr. Kingsley in his monographic list of the species of the genus above cited; and I may add, as a fact of much interest, that there are specimens from the West Indies (*Frazer*) in the British-Museum collection which are not to be distinguished specifically from the African examples.

Philyra cristata, sp. n. (Pl. XV. fig. 1.)

In this species the body is depressed, suborbiculate; carapace minutely punctulated above, produced at the margins into a thin continuous crest that surrounds the body; the regions are not distinguishable; the intestinal region, behind the posterior marginal crest, is also strongly cristate. The front has its anterior margin straight, and does not project anteriorly so much as the front of the buccal cavity. Orbits small; the fissures of the upper margin are very indistinct, and have a wide hiatus at their exterior and interior angles, and no lower margin other than that formed by the projecting rim of the buccal cavity. Postabdomen with all the joints except the first and last coalescent, of the male nearly half as broad as the sternum, concave on the sides in the middle, with a small tubercle on the penultimate joint, terminal joint much smaller than the preceding. Eyes small, black. Antennules lodged in horizontal fossettes. Antennæ scarcely distinguishable. Inferior surface of the body smooth and minutely punctulated. Outer maxillipedes with the triangular merus as long as the ischium; exognath very broad, with its exterior margin arcuated, broader at its distal end than the endognath. Anterior legs or chelipedes rather slender; merus trigonous with the margins granulated; carpus very small; palm slightly compressed, with the upper and lower margins carinated but not granulated; fingers slightly incurved at their acute apices, and slightly hairy on their inner margins. Ambulatory legs slender and short, with the joints (except the dactylus) slightly compressed and carinated but not granulated; dactylus slender. Colour (in spirit) light yellowish or greyish, sometimes with faint dusky lines on the carapace. Length of the largest specimen nearly 3 lines (6 millim.), breadth very little more; length of chelipede, when extended, about 4 lines ($8\frac{1}{2}$ millim.).

I refer this species to the genus *Philyra*; but it may not improbably be found to constitute the type of a distinct genus intermediate between *Philyra* and *Onychomorpha*. It differs from all other species of the genus except *P. marginata*, A. M.-Edwards*, from Upolu, in the marginal crest or rim of the carapace, and in the form of the male postabdomen. From *Onychomorpha lamelligera*, Stimpson†, it differs not only in the form of the carapace, but also in the transverse antennulary fossettes, form of the postabdomen in the male, and longer fingers of the chelipedes. *O. lamelligera* was obtained at Hong-Kong.

Philyra marginata is very briefly described, but is apparently distinguishable by the finely granulated upper and lower margins of the chelipedes.

Philyra lævidorsalis, sp. n. (Pl. XV. fig. 2.)

Carapace moderately convex, smooth and shining, its upper surface minutely punctulated, slightly concave behind the front, but without any marked depressions or sutures, and destitute of granulations and tubercles; the lateral margins, however, are defined by a granulated line, which extends from the front to within a short distance of the posterior margin, which is straight and marked with a granulated ridge. The frontal margin projects less than the anterior margin of the buccal cavity, and has a very obscure median prominence. The inferior surface of the body is naked, shining, but minutely punctulated. The postabdomen of both sexes has all the joints except the first and last coalescent, without tubercles; the terminal joint in the male is very small, much narrower than the preceding, whose posterior limit is indicated by cre-

* Journ. Mus. Godeffroy, iv. p. 85 (1873).
† Proc. Ac. Nat. Sci. Phil. p. 162 (1858).

nations in the lateral margins. The eyes are contained in small circular orbits, whose upper margins are marked by a fissure. Antennules transverse ; the minute antennæ are also placed almost transversely, and occupy the narrow inner orbital hiatus. Maxillipedes with large ischium and elongate triangulate merus joint; exognath stout, with its exterior margin curved, and apex (which does not reach quite to the distal end of the merus) rounded. Chelipedes robust, of moderate length; merus or arm with numerous small granules at its proximal end on its upper and under surfaces, the margins also granulated; carpus smooth, convex; palm little longer than broad, convex on its inner and outer surfaces, its upper margin acute, its inferior margin rounded; fingers but little shorter than the palm, curved at the apices and denticulated on the inner margins. Ambulatory legs slender, short; dactyli longer than the penultimate joint. Colour (in spirit) more or less slaty or pinkish. Length of the largest example (a male) little over 7 lines (15 millim.), breadth about 6½ lines (nearly 14 millim.); length of chelipede (when extended) nearly 1 inch (25 millim.). In the smallest example (a female) the length of the carapace is about 4 lines (9 millim.).

Five males and females are retained from Baron Hermann-Maltzam's collection.

From the preceding species *P. lævidorsalis* is distinguished by the absence of the lateral marginal crest, not to speak of other characters. It is distinguished from most of the other species of *Philyra* by its smooth and somewhat polished carapace and shorter robust chelipedes—from the Australian *P. orbicularis*, Bell, by the lateral marginal line of granules not being continued over the posterior margin, by the absence of a tubercle on the male postabdomen, smaller granules of the arms, and other characters.

Ilia spinosa, sp. n. (Pl. XV. fig. 3.)

This very interesting species has the subglobose body covered with small granules, which, however, are less numerous and crowded than in *I. nucleus*. There is a short spine on the pterygostomian region, and two long somewhat curved spines on the postero-lateral margins of the carapace, in place of the short postero-lateral spines of *I. nucleus*; also two shorter somewhat triangulate and compressed spines on the posterior margin, occupying the position of the rounded prominences of *I. nucleus*. In the form of the rostrum, postabdomen, and the thoracic limbs this species very nearly resembles *I. nucleus.* Colour (in spirit) light purplish or yellowish; the smallest example has reddish markings. Length and breadth of the largest example (a female) about $8\frac{1}{2}$ lines (18 millim.); length of chelipede, when extended, 1 inch 7 lines (40 millim.).

Five specimens have been retained for the British Museum from Goree Bay. The largest male, which is but little smaller than the female above mentioned, has the carapace rather more strongly and closely granulated than the other specimens. In the adult females the postabdomen completely conceals the sternal surface; in a smaller example which appears to be of this sex, length and breadth nearly 5 lines (10 millim.), the postabdomen occupies little more than one third the breadth of the sternum.

The length of the posterior and postero-lateral spines of the carapace is so much greater than in *I. nucleus* that I cannot regard the distinction as of less than specific value when taken in connexion with the other characters I have mentioned. In the young examples, however, the spines are less developed. There is in the collection of the British Museum a young specimen from the Canaries (*R. MacAndrew, Esq.*) which I refer to this species.

Ebalia.

The specimens of this genus, and of the allied *Phlyxia* (which, I am inclined to think, cannot be retained as generically distinct), present such great individual variations of sex and age that their determination is extremely difficult, and is moreover complicated by the insufficiency of the figures and descriptions of several of the species. It is therefore not without much hesitation that I have described the following as new; and it is possible that a comparative examination of the types would have enabled me to identify one or more of them with previously described forms, or that a larger series would have shown that the distinctions are not in all cases of specific value.

Ebalia tuberculata, sp. n. (Pl. XIV. fig. 3.)

In this handsome species the carapace is subrhomboidal, rather convex, and covered with numerous small but prominent granulations, which are numerous and crowded on the prominent parts of the carapace, but absent upon some of the depressions—as, for instance, on the deep concavities behind the antero-lateral margins. The front is obtusely truncated or obscurely emarginated; a longitudinal narrow ridge passes from it to the gastric region; the carapace is crossed in its widest part by a transverse series of six granulated elevations or tubercles, of which the two median are situated on the gastric region; posterior to these is another granulated prominence. The cardiac region is obtusely rounded and very convex; there are usually two slight prominences on the antero-lateral margins of the carapace, one on the postero-lateral margins, and two rounded lobes, which are sometimes confluent, on the posterior margin. The fissures of the upper orbital margin are indistinct or sometimes quite obliterated. The male postabdomen has its third to sixth joints coalescent. The antennulary fossæ communicate with the orbits by the cavity at the inner suborbital angle, which is also partly occupied by the basal antennal joints. The outer maxillipedes, legs, and the inferior surface of the carapace are granulated; the exognath of the maxillipedes is robust, with a nearly straight outer margin, and does not reach to the extremity of the triangulate merus joint of the endognath. The chelipedes (in the adult male) are closely granulated, the granules often acute; the arm or merus is slender and, like the carpus, destitute of prominent spines or tubercles; the palm has two slight prominences on its upper margin, and is rather convex on its inner surface; fingers compressed, acute at apex. Ambulatory legs short, slender, the joints (except the last) somewhat compressed, margins with acute granulations; terminal joints slender, pubescent. Colour (in spirit) yellowish or grey, often tinged with pink, sometimes with irregularly-disposed punctulations of a more intense purplish pink. Length of largest male a little over 5 lines (11 millim.), breadth about 6 lines (nearly 13 millim.); length of chelipede a little over 7 lines (15 millim.).

A good series of both sexes is in the Museum collection. The tuberculations of the carapace are more distinct in some specimens (from which the description is taken) than in others, where they are rather to be described as rounded prominences. In the females they are sometimes nearly obsolete. The margins of the postabdomen are usually marked with red spots. I very much doubt the generic distinctness of *Phlyxia* from *Ebalia*: the presence or absence of supraocular fissures is not a character of much importance; and the antennulary fossettes certainly communicate with the orbits in some species of *Ebalia* (*e.g.* in adult *E. tuberosa*).

There is a specimen from the Canaries, and another from Madeira, in the collection of the British Museum which have the carapace everywhere evenly and distinctly granulated, and scarcely any trace of the transverse series of prominences.

These may be designated *E. fragifera*; they may be no more than a marked variety of the preceding.

In *Ebalia maderensis*, Stimpson, from Funchal Bay*, no mention is made of the tubercles on the gastric region, and that on the cardiac region is described as "acutely prominent." Specimens are in the British-Museum collection from Madeira (*Rev. R. B. Watson*) which I refer to this species, which is perhaps identical with *E. tumefacta*.

Ebalia insignis, Lucas†, appears to be allied to *E. tuberculata*; but the tubercles of the carapace are differently disposed.

E. granulosa, M.-Edwards‡, has the posterior margin of the arm or merus joint cristate.

E. aspera, Costa§, somewhat resembles *E. fragifera* in the even granulation of the carapace, which, however, is very much more convex in *E. aspera* than in *E. fragifera*.

Ebalia affinis, sp. n. (Pl. XIV. fig. 4.)

The carapace is depressed, finely and closely granulated on the posterior half, but nearly smooth in its anterior half, with three small tubercles disposed in a triangle on the gastric region, a rounded prominence on the cardiac region, one on the hepatic and pterygostomian regions, a small tubercle, which is sometimes obsolete, on each branchial region, and two prominent rounded lobes on the posterior margin. Front slightly concave. Fissures of the upper orbital margin nearly obsolete. Inferior surface of the carapace, maxillipedes, and the merus joints of the chelipedes strongly granulated. Male postabdomen narrow, with the third to sixth joints coalescent. The exognath of the maxillipedes is broad and reaches to the distal end of the merus joint. Anterior legs or chelipedes slender and elongated, with the arms everywhere closely granulated, but not cristate or tuberculate; wrist and palm more finely granulated; palm somewhat convex on its inner surface and slightly cristate above; fingers straight, acute at their apices, and somewhat hairy on the inner margins at base. Ambulatory legs slender, with the joints not dilated and compressed, very finely granulated; tarsi pubescent. Colour (in spirit) yellowish or slate, tinged with pink. Length and breadth of an adult male about $4\frac{1}{2}$ lines (10 millim.);

* Proc. Ac. Nat. Sci. Phil. p. 160 (1858).
† Crust. in Explor. Sci. Algérie, p. 24, pl. ii. fig. 8 (1849).
‡ Hist. Nat. Crust. ii. p. 130 (1837).
§ Crost. in Fauna del Regno Napoli (Addizioni), p. 6, pl. v. fig. 5 (1838).

length of chelipede, when extended, about 7 lines (nearly 15 millim.).

In the females the lobes of the posterior margin of the carapace are not distinct one from another, so that the posterior margin appears nearly straight.

This species is evidently very nearly allied to *E. Cranchii*, but is more coarsely granulated, the two anterior of the tubercles of the gastric region are much less distinct, the palm of the chelipedes in the male slenderer and more elongated. Moreover, in *E. Cranchii* the exognath of the maxillipedes does not nearly reach to the distal end of the merus joint.

Dorippe armata. (Pl. XV. fig. 4.)

Dorippe armata, White, List Cr. Brit. Mus. p. 54 (1847), descript. nullâ.

Several small examples are in the collection (males and females); length of the largest nearly 6 lines (12 millim.), breadth about 7½ lines (16 millim.).

The description that follows, as also the figure, is taken from White's typical example, which is a male of much larger size, length of carapace about 10 lines (21 millim.), greatest breadth about 1 inch 1 line (28 millim.), and was obtained during the Congo expedition (*J. Cranch*). It is without precise indication of locality.

Carapace moderately convex, with the cervical and branchio-cardiacal sutures strongly defined. The branchial and cardiac regions are convex above and distinctly granulated. The front between the orbits is concave; the inner orbital angle is prominent, but scarcely spiniform; there is a spine at the outer orbital angle, and a very strong spine on the sides of the branchial regions at the widest part of the carapace. The inferior surface of the body is more or less hairy; postabdomen 7-jointed in both sexes; the third joint in the male with a transverse prominence; terminal joint small, received into an excavation in the anterior margin of the penultimate joint, its distal half triangulate. Chelipedes (in the male) unequal; the larger (which is the right in the specimen described) has the arm granulated on its outer surface, without spines or tubercles; wrist granulated in its outer and proximal portion, without spines; hand about as long as vertically deep; palm posteriorly rounded, smooth on its outer and inner surfaces; fingers nearly straight, with acute apices, and only very obscurely denticulated on their inner margins. Smaller chelipede slender, with the fingers relatively longer and more distinctly denticulated. Second and third legs more than twice as long as the carapace; fourth to sixth joints not much dilated, nor armed with spines, but longitudinally granulated above; terminal joint not quite as long as the preceding, compressed, and somewhat twisted. Fourth and fifth legs slender, short, and subdorsally elevated as in other species of the genus. Colour pale yellowish or greyish. The body and legs are more or less pubescent.

From the Mediterranean *D. lanata*, to which this species seems to be most nearly allied, *D. armata* differs not only in the much stronger lateral branchial spines, but in the non-tuberculated carapace, the non-spinulose merus joints of the second and third legs, &c. In the small West-African examples the chelipedes are feeble, subequal, and the outer orbital and lateral branchial spines much smaller.

Ethusa mascarone (Roux).

Several specimens (among them males and females) are in the collection from Goree Bay, which cannot be regarded as specifically distinct from Mediterranean examples, although the larger chelipede in the male has the palm deeper and externally somewhat more convex than the male from the Mediterranean in the Museum collection. Colour (in spirits) pale yellowish or purplish; chelipedes (of male) pale, with purplish tips. Besides the Mediterranean examples there are specimens in the British Museum from the Canaries.

Prof. A. Milne-Edwards has recently described a species, *Ethusa americana*, from West Florida*, which is only distinguished from *E. mascarone* by the more acute and divergent rostral spines, more deeply notched orbital margin, and more prominent postorbital spine. In these particulars I can see no difference between the Mediterranean and African specimens of *E. mascarone*.

The *Ethusa microphthalma* is another American species of this genus, quite recently described by Prof. S. I. Smith, from the coast of New England†. It is apparently well distinguished by the diagnostic characters mentioned by its author, *i. e.* the very small eyes and form of the carapace.

Anomura.

Dromia fulvo-hispida, sp. n. (Pl. XVI. fig. 1.)

In this species the carapace is a little broader than long, moderately convex, and covered with a short close fulvous

* Bull. Mus. Comp. Zool. viii. p. 30 (1880).
† Proc. U.S. Nat. Mus. iii. p. 418 (1881).

pubescence, which is absent (perhaps from abrasion) on the median and most elevated portion of the body. The antero-lateral margins are entire and apparently somewhat flattened on the hepatic regions. The front is triangulate and deflexed, with a small tuberculiform tooth above the inner orbital hiatus. Epistome triangulate. The buccal cavity has apparently no longitudinal palatal ridges, and has three fissures in its anterior margin. The male postabdomen is narrow-triangulate, with all the joints apparently distinct, and is covered, as is all the inferior surface of the body, with a dense fulvous hairy coat. Eyes well nigh concealed in the deep orbital cavities, which are very incomplete below. Basal joint of the antennules much enlarged. Basal antennal joint occupying the large hiatus beneath the ocular peduncles. Outer maxillipedes with the merus joint as long as the ischium, and truncated at its distal end, articulated at its antero-internal angle with the next joint; exognath narrow. Anterior legs or chelipedes of moderate length, densely hairy, but apparently without spines or tubercles; fingers naked, excavated, and strongly dentated at their apices. Ambulatory legs of the first two pairs somewhat flattened above, clothed with longish fulvous hairs; terminal joints slender. In the fourth and fifth pairs of legs the spiniform terminal joint is reflexible against a spiniform process of the penultimate joint. Colour of the single specimen (a male in spirit) light yellowish or fulvous brown; tips of fingers white. Length nearly 4 lines (8 millim.), breadth 5 lines (nearly 11 millim.). The specimen has been somewhat crushed and its natural outline thereby altered.

Dromia spinirostris, sp. n. (Pl. XVI. fig. 2.)

In this species the carapace is rather convex, a little broader than long, and clothed with a short close pubescence, which is absent in certain places; the surface is rather uneven, there being an obscure rounded prominence on each branchial region near the branchio-cardiacal suture, which, however, is very faintly defined; nor are the other sutures of the carapace indicated. The rostrum is composed of two rather prominent conical and slightly divergent spines; there is a short spine at the inner angle of the orbit, and another on its lower margin; four small dentiform spines on the lateral margins of the carapace, one on the subhepatic region, and one at the antero-lateral angles of the buccal cavity. The inferior surface of the body is clothed with a dense pubescence; the buccal cavity has no longitudinal ridges on the palate; the sternal *sulci* in the female are not approximated, and terminate in a tubercle between the bases of the second pair of legs. The postabdomen in both sexes is seven-jointed; the terminal segment in the male is small, rounded at its distal end, and armed with a short rounded lobe or spine at its proximal and lateral angles. As is usual in the group, no *septa* separate the antennules from the antennæ and the antennæ from the eyes. The first antennal joint is short, the second robust. The outer maxillipedes have the merus as large as the ischium, with the next joint inserted at its antero-internal angle; exognath stout, and reaching nearly to the extremity of the merus. The chelipedes (in the two specimens examined) are subequal, moderately robust, and densely pubescent, except at the finger-tips; arm trigonous, carpus with two small tubercles on its upper and outer surface near the articulation with the merus; palm nearly twice as long as broad, in the male clothed with longer hair on the inner and under surface; fingers somewhat obliquely deflexed, dentated, and closely meeting along their inner edges, excavated, naked, and white at the apices. Second and third legs robust, not tuberculated, fourth and fifth legs subdorsally elevated; penultimate joint in both terminating in a spiniform process, against which the terminal claw closes; fifth legs much more slender and feeble than the fourth. Colour (in spirit) brownish. Length of the largest (a male) to tip of spines of rostrum about 1 inch 5 lines (nearly 36 millim.), breadth 1 inch 6 lines (38 millim.). The smaller example is a female with ova.

The form of the spines of the rostrum, together with the small dentiform teeth of the antero-lateral margins, appear to distinguish this species from its congeners.

Diogenes varians.

Pagurus varians, Costa, Fauna di Napoli, Cr. p. 9, pl. ii. fig. 2 (1838).
?*Pagurus arenarius*, Lucas, Anim. Artic. in Expl. Sci. Algérie, Crust. p. 33, pl. iii. fig. 7 (1849).
?*Diogenes arenarius*, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 233 (1858).
Diogenes varians, Czerniavsky, Materialia ad zoograph. ponticam comparatam, p. 127 (1868); Heller, Crust. südl. Europa, p. 170, pl. v. figs. 13, 14 (1863).

Here are referred with some doubt a series of specimens inhabiting sponge-incrusted shells of the genera *Oliva*, *Turritella*, and *Clavatula*. As M. Costa's description and figure leave several points undetermined, the following description is given of the specimens from Goree Island. I may add that *D. varians* may itself be identical with the *Pagurus pugilator* of

Roux *, a species very insufficiently characterized; but, to judge from the figure, the smaller chelipede differs from that of *D. arenarius.* Heller, however (*t. c.*), unites it with that species.

The carapace is smooth and naked, the cervical suture very distinct, the branchial regions but little dilated; the front between the eyes has a very slight rounded median prominence, but a strong lobe or tooth on the outer side of the eye-peduncles; the rostriform spine attached to the ophthalmic segment does not reach to the apices of the ophthalmic scales. The terminal postabdominal segment is somewhat transverse, and has its margins armed with numerous small spinules. The eye-peduncles are rather slender, and do not quite equal in length the width of the frontal margin; their basal scales are spinulose on their outer and distal margins, the distal spinules being the longest; the antennules have the terminal peduncular joint slender and longer than the preceding, the flagella very short; the second joint of the peduncle of the antennæ is armed with a spinulose tooth, which does not reach to the apex of the eye-peduncle; the terminal joint of the peduncle is slender and longer than the preceding; the joints of the rather short flagella are clothed on the underside with very long setæ. The chelipedes are very unequal, the right small and feeble, the left very considerably developed; in the right the arm, wrist, and hand are of about equal thickness, the wrist and hand armed with a series of small spinules on their upper margins, and more or less hairy; fingers acute at the apices, and distinctly toothed on the inner margins; in the left chelipede the arm is very short and thick, with a few spiniform granules at the distal end of its upper and lower margins; wrist granulated, with a large concavity extending somewhat obliquely across the upper surface, its margins towards the inner side with stronger, almost spinuliform granules; palm scarcely longer than broad, nearly flat, and very closely and evenly granulated on its outer surface, punctulated on the inner surface, its lower margin acute and strongly granulated; fingers rather shorter than the palm, acute at their apices, lower finger rather strongly toothed on the inner margin, upper robust, arcuate, with strong, almost spinuliform tubercles on its upper margin. Second and third legs moderately robust, somewhat hairy, with the dactyli faintly longitudinally channelled on their outer surface, curved, and longer than the penultimate joints; the fourth legs are thicker than the fifth, with very small dactyli that scarcely

* Crust. de la Méditerranée, pl. xiv. fig. 3 (1830).

project beyond the scabrous pad at the distal end of the penultimate joint. The fifth legs are more distinctly chelate, the dactylus closely applied to the projecting lobe at the distal end of the penultimate joint. The uropoda are nearly symmetrical, the left little larger than the right. Colour (in spirit) yellowish; eye-peduncles orange, the chelipedes pinkish; there are faint indications of longitudinal orange or brownish bands on the joints of the legs. Length of carapace about 4 lines (9 millim.); of the second leg on the left side about 9 lines (19 millim.); the larger chelipede is incapable of full extension, therefore its dimensions are not given.

In what I regard as the typical state of this species, because most nearly resembling Costa's figure, the palm of the left chelipede is more elongated, with the lower margin nearly straight, outer surface of lower finger concave at base; in another variety, which I will designate var. *ovata*, the palm is more ovate, lower margin convexly arcuated, the fingers somewhat shorter, the lower nearly flat on its outer surface. In both the concavity of the wrist is very distinct.

In a single specimen of small size the granules on the outer surface of the wrist and palm are smaller and less crowded, wrist without any concavity on its upper surface, hand more elongated and less flattened on its outer surface, dactylus as long as the palm and less strongly spinulose. This variety (or species) may be designated provisionally var. *gracilimana*.

M. Brito de Capello has recently described * two species (*Pagurus Bocagei* and *P. algarbiensis*) from the Portuguese coast which appear to belong to this genus, and must be designated *Diogenes Bocagei* and *D. algarbiensis*. They are distinguished by having the sides of the carapace armed with a spinose *crest*, and by the anterior legs being "covered with spines," &c.

Pagurus striatus (Latr.).

Several small specimens inhabiting shells of *Conus prometheus*, var. *siamensis*, Hwass., and *Mesalia brevialis*, Lamk., are referred to this species; their coloration, however, differs somewhat from that of *P. striatus* as described by Milne-Edwards and Roux, and as exhibited in dried specimens from the Mediterranean in the British-Museum collection. The coloration of the legs in the specimen preserved in spirits from Goree is a deep purplish red, variegated with pale blue and lighter red markings, and with numerous small whitish spots

* Jornal de Sciencias etc. de Lisboa, 1874, p. 123.

on the under and inner sides of the joints; the eye-peduncles are bluish, banded with red. Length of cephalothorax in the largest example (a male) about $7\frac{1}{2}$ lines (16 millim.), of the larger (left) chelipede, when extended as far as its conformation will allow, rather more than 1 inch (26 millim.). There are in the British Museum specimens of this species from Madeira (purchased) in which the coloration has to a considerable extent disappeared; also others apparently referable to the Mediterranean *P. calidus*, Roux. Of this latter species there are also specimens from Lanzarote Island (*Rev. R. T. Lowe*)*.

* There is in the collection of the Museum a remarkable Hermit-crab from St. Helena, which does not appear to have been described; it may be appropriately designated

Pagurus imperator, sp. n.

The carapace is indurated in its cervical portion, and considerably dilated on the sides of the branchial regions, with the cervical, postfrontal, and other sutures strongly defined; the lateral margins are hairy; the frontal margin is nearly straight, without any median rostriform prominence, but with an obtuse lobe or tooth on either side of the eye-peduncles. Four transverse calcareous plates protect the dorsal surface of the postabdomen; the penultimate and terminal segments are calcified, the penultimate segment with a T-shaped impression, the terminal segment furcate, with the lobes unequally developed and rounded at their distal ends, and with three or four denticles on their inner margins. Eye-peduncles robust and shorter than the front, with two or three tufts of hairs on their upper surface near the corneæ, and with their basal scales narrowing distally, and hairy and denticulated on their outer margins. Antennules short. Antennæ shorter than the body, with the terminal joint of the peduncle much longer than the preceding; the basal acicle short, spiniform, and not reaching far beyond the end of the penultimate peduncular joint; flagellum red, the joints clothed with very short setæ. Outer maxillipedes robust, short. Chelipedes robust, unequal; in both the merus is trigonous, with its inferior margin and the outer and distal margins armed with short spines; wrist and palm externally convex, wrist shorter than the palm; both wrist, palm, and fingers are armed on the outer surface with numerous conical acute spiniform tubercles, the surface between the tubercles in the larger (left) hand being closely pubescent, and in the smaller (right) chelipede clothed only with longer scattered hairs; the fingers are robust, dentated on their inner margins, and with black, corneous, excavated tips. The second and third legs are very robust, the last three joints armed above with strong spiniform tubercles and clothed with scattered hairs; tarsi externally longitudinally sulcated, except in the second leg on the left side, which has the last two joints dilated and nearly of the same form as in *P. pavimentatus*, Hilgendorf, *i. e.* with a strong longitudinal tuberculated ridge on their outer surface, above which the outer surface of each joint is deeply longitudinally concave; margins densely hairy, the concavity deepest in the terminal joint; the fourth pair of legs are imperfectly and the fifth perfectly chelate; the four postabdominal appendages (developed on the left side only, and articulated with the calcareous dorsal plates) are simple; the uropoda are asymmetrical, the left being larger

Pagurus granulimanus, sp. n.
(Pl. XVI. fig. 3.)

This designation is proposed for a species of *Pagurus* of which there are several specimens inhabiting shells of *Cassidulus morio*, Lamk., *Purpura hœmastoma*, Lam., and *Natica cruentata*, Lam., in the collection.

Carapace one and a half times as long as broad, with the cardiaco-branchial as well as the cervical sutures distinctly defined, punctulated in front of the cervical suture, with a few granulations near the antero-lateral angles; hepatic and branchial regions clothed with tufts of yellowish hairs; no distinct median rostriform projection; terminal postabdominal segment somewhat quadrate, with the angles rounded. Eye-peduncles slender and nearly or quite equalling in length the width of the frontal margin; ophthalmic scales narrow, nearly approximated in the median line, and with the apices denticulated. Antennules reaching little beyond the eye-peduncles; terminal joint of the peduncle slender and longer than the preceding; flagella very short. Antennæ shorter than the body, with thin basal acicles, rather narrow, acute at apices, reaching about halfway to the end of the eye-peduncles, and very hairy; the joints of the peduncle are very short, the penultimate joint has a short spine on the under surface near its distal end; flagella nearly naked. The last three joints of the outer maxillipedes have their under margins near the

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than the right. Length of the largest specimen about $5\frac{1}{4}$ inches (133 millim.), of the larger (left) chelipede about $3\frac{1}{2}$ inches (88 millim.).

The ground-colour of the specimen described (which was presented by H. E. Dresser, Esq., and at the time of its acquisition by the Trustees had been preserved for some time in spirit) is orange-yellow, the front of the carapace and eye-peduncles variegated with purple; the prevailing colour of the limbs is a deep blood-red. In a second smaller example from the same locality (*J. C. Melliss, Esq.*) the coloration is not so distinct. Both examples are males.

There are several species allied to *P. imperator* in the structure of the left leg of the third pair. In *P. setifer*, M.-Edwards, from Australia (of which there are specimens in the Museum collection), and in *P. sculptipes*, Stimpson, from Japan, the eye-peduncles are much longer and slenderer; in *P. pavimentatus*, Hilgendorf, the hand of the left chelipede is much shorter in proportion to its length; *P. hungarus*, Herbst, is very imperfectly known; but Hilgendorf, in his remarks upon the specimens in the Berlin Museum, does not mention any differences from *P. pavimentatus* in the form of the left chelipede. In *P. sinistripes*, Stimpson, from Panama, the outer surface of the left chelipede is described as granulate-squamose, and the last two joints of the left leg of the third pair are apparently but little excavated. A much larger series than the Museum at present possesses is needed to show whether these are truly distinct or may not be, some or all, varieties of one widely-distributed form.

distal ends fringed with long hairs; the penultimate and antepenultimate joints are somewhat dilated near the distal ends of their inferior margins; the terminal joints are slender.

The chelipedes are very unequal, the right being small and the left considerably enlarged; in the right the wrist is about as long as the palm, and both are externally granulated and hairy, the hairs being more dense on the hands; fingers a little longer than the palms, scarcely denticulated on their inner margins, and subexcavated towards the tips, which are corneous and black. The left chelipede has the arm very short, thick, trigonous, with a strong blunt tubercle on its under surface; wrist and hand naked, the wrist shorter than the palm, and externally closely granulated; palm shorter than its vertical depth, somewhat compressed, with the outer surface covered with large flattened granules. A longitudinal series of more prominent granules exists near the upper margin, and a longitudinal series of larger, transversely set, flattened tubercles parallel to the lower margin, which is sharp-edged and crenulated; fingers very short, granulated externally, acute at the apices; the mobile finger with the outer surface deeply concave. Second and third legs robust; the right legs of each pair have the joints nearly smooth; dactyli a little longer than the penultimate joints, with black corneous tips: the third leg on the left side has the upper and outer margins of the last two joints carinated, and the outer surface concave, the concavity being deepest on the last joint. In the fourth legs (which are shorter and more robust than the fifth) the small dactylus impinges against the produced scabrous portion of the preceding joint; the slender fifth legs are not chelate; the male postabdomen is armed with four filamentous appendages on the left side, besides the uropods, which are very unequally developed, the left being much the larger. Colour (in spirit) yellowish, inclining to orange on the front of the carapace, eye-peduncles, and legs; left chelipede of a slaty or purplish tinge. Length of the carapace of the largest specimen (a male) about 10 lines (21 millim.). The legs are not capable of complete extension.

The form and sculpture of the left chelipede apparently distinguishes this species from all its congeners.

Isocheles? gracilis, sp. n. (Pl. XVI. fig. 4.)

In this species the carapace is membranaceous, widest posteriorly (at the back of the branchial regions), with the sides nearly straight and convergent thence to the front, which is sinuated, but without any rostriform projection; so that the ophthalmic segment is just visible between the bases of the eye-peduncles. The postabdomen is clothed with scattered hairs, and has the dorsal surface of the antepenultimate and penultimate segments protected by imperfectly calcified plates; the terminal segment is somewhat transverse, and with a shallow emargination at its distal end. Eye-peduncles slender and longer than the width of the front; their basal scales small, with acute apices. Antennules small. Antennæ about as long as the animal, with a very small basal acicle; penultimate joint of the peduncle shorter than the terminal joint; joints of the flagellum with very short setæ. Outer maxillipedes very hairy. Right chelipede very little larger than the left; both are rather thinly clothed with longish hairs; with the merus unarmed; carpus with four or five short spines on their inner and upper margins; hands rather narrow-ovate (the left narrower than the right), with short spinules along the upper margins; fingers in the right about as long as, and in the left a little longer than, the palm, with acute apices, and rather strongly dentated along their inner edges. Second and third legs slender and hairy, with the penultimate longer than the antepenultimate joint, and the dactyli long, curved, and slightly twisted. Fourth and fifth legs slender, feeble, and hairy; in the fourth leg the small curved dactylus closes against the produced infero-distal scabrous lobe of the preceding joint; the fifth legs terminate in a very small but perfect chela; the left uropoda are much larger than the right, and hairy. Colour (in spirit) yellowish white; legs pinkish. Length of cephalothorax 5 lines (nearly 11 millim.), of right chelipede, when extended as far as its conformation will allow, $9\frac{1}{2}$ lines (20 millim.).

The single specimen examined is a male.

In most of its characters (*e. g.* the form of the carapace, hairy postabdomen, elongated eye-peduncles, which are approximated at base, short antennal flagella, and subequal horizontal chelæ, whose fingers are acute at the tips) this species belongs to *Isocheles*; but the antennal flagella are clothed with very short setæ, and the dactyli of the ambulatory legs are very slightly contorted.

Spiropagurus elegans, sp. n. (Pl. XVI. fig. 5.)

This is a very interesting addition to a genus whose only representatives hitherto known are from the Japanese seas and the West Indies (Barbadoes).

In general appearance it very much resembles the well-known *Eupagurus Prideauxii*, having similarly-formed but more nearly equal chelipedes, and long twisted and longitudinally canaliculated joints to the second and third ambulatory legs.

The cephalothorax and legs are slightly pubescent. The carapace is rather broad in proportion to its length, and is of a thin and almost membranaceous texture. There is no distinct median rostriform projection, the carapace between the eyes being rather broadly rounded, and leaving the ophthalmic segment at this part partially visible. The cervical suture is very distinct. The terminal postabdominal segment is divided by a narrow almost closed longitudinal median fissure; and the lobes are armed on their distal and outer margin with ten to eleven small spinules. The eye-peduncles are short and thick, the corneæ somewhat dilated; and the eyes do not reach beyond the apices of the acicles of the antennæ; the scales at base of the ophthalmic peduncles are broad, entire, subtruncated at the distal ends. The antennules are short, with two flagella; the last joint of the slender peduncle nearly as long as the eye-stalks, the upper flagellum fringed on its under surface with long hairs. Antennæ about as long as the animal, the last joint of the peduncle little longer than the preceding; the slender acicle scarcely reaching beyond the end of the penultimate joint; the outer maxillipedes reach (when thrown forward) considerably beyond the antennules; the joints are hairy on their under surface at their distal ends. The chelipedes are of about equal length; the right, however, is more robust than the left; merus short, with two small denticles near the distal end on its under surface; carpus about as long as the palm, with about half a dozen small spinules of unequal length near the distal end of its inner and upper margin; hand ovate, palm about as long as fingers, smooth on its outer surface, its upper margin without spinules, its lower subacute; fingers meeting along their inner edges when closed, acute at apices, and very indistinctly denticulated on their inner margins. The left chelipede is very similar to the right, but the joints are slenderer. Second and third legs robust, with the fourth to sixth joints thick, nearly smooth; fourth joint with transverse short impressed lines, fringed with short setæ on its outer surface; on the fifth joints these lines are longitudinal, and on the sixth oblique; dactyli slender, much longer than the penultimate joints, fringed above with long hairs, and deeply longitudinally channelled on their outer surfaces. The fourth legs are wanting in the single specimen examined; the fifth are slender, feeble, and are apparently not chelate, the last joint being densely hairy on its under surface and at its distal end; the spirally-coiled genital appendage of the left fifth leg is articulated with the posterior surface of the basal joint and is membranaceous, with the outer margin indurated and diminishing in thickness to the extremity, which is slightly hairy. The uropoda are unequally developed, the rami of the right being smaller than those of the left. Colour (in spirit) whitish. Length of the cephalothorax of the male a little over 6 lines (13 millim.), of right chelipede about 9 lines (19 millim.). The full extension of this limb, however, is not possible.

The single example (male) is in imperfect condition, not only the fourth pair of legs but also the second leg on the right side being deficient.

In *S. spiriger* (De Haan), from Japan, the ciliated striations of the limbs exist, it would appear, on the chelipedes as well as the following limbs. In *S. dispar*, Stimpson, from Barbadoes, the fingers of the right chelipede are short, not more than half the length of the palm, and are coarsely toothed within.

In *S. iris*, A. M.-Edwards *, also from the Barbadoes, there is a distinct rounded rostriform lobe, and the chelipedes are covered with small spines.

Eupagurus excavatus.

Cancer excavatus, Herbst, Nat. Krabben u. Krebse, ii. (Abth. 2) p. 31, pl. xxiii. fig. 8 (1796).

Pagurus angulatus, Risso, Crust. de Nice, p. 58, pl. i. fig. 8 (1816); Hist. Nat. Eur. Mérid. v. p. 39 (1826); Desmarest, Consid. sur les Crust. p. 178 (1825); Roux, Crust. de la Méditerranée, pl. xli. (1830); M.-Edw. Hist. Nat. Crust. ii. p. 217 (1837); Lucas, Cr. in Anim. Artic. de l'Algérie, p. 28 (1849); Heller, Cr. südl. Europa's, p. 166 (1863).

Pagurus meticulosus, Roux, Cr. de la Médit. pl. xlii. (1830), var.

Pagurus excavatus, White, List Cr. Brit. Mus. p. 59 (1847).

Eupagurus angulatus, Stimpson, Proc. Ac. Nat. Sci. Philad. p. 237 (1858).

Several small specimens, representing both sexes, are in the collection, which I refer here with little hesitation. They scarcely differ from the much larger specimens in the collection of the British Museum, except in the lesser granulation of the chelipedes, which yet are of the form so characteristic of *E. excavatus*. The spinules arming the upper margin of the penultimate and antepenultimate joints of the right leg of the second pair exist, but are with difficulty discernible among the hairs with which this limb is clothed. Colour (in spirit) light yellowish; limbs pinker. The length of the carapace of the largest specimen from Goree barely

* Bull. Mus. Comp. Zool. viii. p. 44 (1880).

exceeds 8 lines (17 millim.). One specimen inhabited a shell of a species of *Clavatula*.

I cannot regard the distinctions mentioned by Heller as characteristic of *E. meticulosus* as of specific importance.

The smallest specimen in the collection referred to this species—length of carapace not 3 lines (6 millim.)—has the outer surface of the palm in the larger chelipede much more evenly granulated and the median longitudinal ridge obsolete, and bears a great resemblance to *E. Forbesii*, Heller, of which there is an authentically named specimen from Falmouth (*W. P. Cocks, Esq.*) in the Museum collection, which may be nothing but the young state of this species. I hesitate, however, to unite the two without further comparison of a larger series of specimens. A much larger example from Sicily, in the Museum collection, designated *E. Forbesii*, has the outer surface of the larger chela armed with numerous spines, and without depressions or longitudinal ridges, and is probably referable to *E. Lucasi*, Heller (=*E. spinimanus*, Lucas).

Besides the Paguridæ enumerated above, there is in the collection a very small hermit-crab, apparently of the genus *Cibanarius*, inhabiting a shell of *Nassa miga*, Adanson, which it would be unadvisable to designate by a distinct specific name.

[To be continued.]

XXVII.—Dr. H. Adler's * *Researches on the Alternating Generation of the Gall-flies of the Oak.*

"A satisfactory explanation of the mode of reproduction of the Cynipidæ will only be obtained when their development is traced step by step, through all its stages, from the fertilized and unfertilized egg. Let us hope that amongst our entomologists an Œdipus will be found able to solve this enigma."

It was thus that Prof. von Siebold expressed himself in the last chapter of his work upon parthenogenesis, published ten years ago. The Œdipus has appeared, and has furnished us with one of the most curious chapters in the history of insects.

It has been known for a long time that in many species

* Translated by W. Francis, jun., from the 'Bibliothèque Universelle de Genève' for June 15, 1881.

of gall-flies the males are much less numerous than the females; among certain of these Hymenoptera they appeared even to be altogether absent. Several hypotheses had been put forward to account for these anomalies. It is useless to recall them here, as they have disappeared before the results of observation. It was eight years ago that the first true notion of the phenomena of the reproduction of these insects was introduced to science. In 1873 Mr. Bassett published in the 'Canadian Entomologist' some observations upon gall-flies, amongst which was one of great importance. He demonstrated that one species living on *Quercus bicolor* produced upon the peduncle of the leaf and upon its median nervure swellings whence emerged, in the month of June, insects among which the male sex and the female sex were represented in equal numbers. Galls of another form appeared at the end of summer upon the extremities of the young branches; the insects which were developed in their interior and hibernated there were all females, differing only from those of the preceding generation in being slightly larger. Mr. Bassett concluded from these facts that the two generations proceeded one from the other, and succeeded one another in the course of a year. Although based on a bare supposition and wanting in direct proofs, this theory has been verified by the observations of M. Adler of Schleswig, who, in 1875, began his numerous and persevering researches without being acquainted with the opinions of the Canadian entomologist.

The investigations of M. Adler extended to all the species of oak-gall-flies which he has been able to observe in his native country, North Germany. He took the greatest pains to follow the various phases of development of each species, and the successive forms in which it appears. The description of the methods employed in the rearing inspires absolute confidence in the results.

M. Adler divides the Cynipidæ of the oak into four groups, which include all the species observed by him, viz.:—

I. Group *Neuroterus*;

II. Group *Aphilotrix*;

III. Group *Dryophanta*;

IV. Group *Biorhiza*.

The insects belonging to the first of these groups may furnish us with an instance of the singular phenomena of reproduction discovered by M. Adler.

Neuroterus lenticularis produces, on the under surface of the leaves of the oak, galls which appear in July and fall to the ground in September or October. The larva is at this period very small; and the perfect insect does not come out till April or the beginning of May. Scarcely has it escaped from the gall in which it was developed, when it deposits its eggs upon the buds of the oak. Around these eggs are formed, upon the leaves and the peduncles of the male flowers, galls differing from those which had nourished the *Neuroterus*. The insect which emerges from them is no *Neuroterus* at all, but had been classed in another genus under the name of *Spathegaster baccarum*, L. This, in its turn, will deposit eggs which will produce *Neuroteri*.

The same alternation has been observed in three other species of *Neuroterus* corresponding to three distinct species of *Spathegaster*.

Not only do the two generations live in galls differing in form, size, colour, and situation, and the insects exhibit among themselves differences of size, proportions, and structure, but what renders the contrast more striking is, that *the* Neuroterus *generation is only represented by females, whilst the* Spathegaster *generation presents individuals of both sexes*. We have therefore here a new form of alternating generation*.

The genus *Aphilotrix* contains a great number of species of Cynipidæ, of which only the female individuals were known. M. Adler observed in nine of these an agamic and sexual alternation of generations; these last are represented by species belonging to the genus *Andricus*.

Three species of *Dryophanta* which were investigated by the same observer exist only in the female state; the succeeding generation is formed, as in the case of *Neuroterus*, of species belonging to the genus *Spathegaster*.

The fourth group, that of the *Biorhiza*, is the most interesting of all, on account of the differences of form and habits which the insects of the two consecutive generations exhibit.

Biorhiza aptera, which exists only in the female form, is a little wingless insect, from 4 to 7 millim. long, known to form upon the roots of the oak galls at first soft and of a reddish-white colour, which assume a brown colour on arriving at maturity, and become tolerably solid. M. Adler observed that the insect which comes out from them does not lay its eggs on the roots, but climbs the oak to attack the young shoots, and, above all, the big terminal buds. From the galls which are developed round the punctures an insect comes out,

* This case belongs to the category which Prof. Balfour, in his treatise on embryology, calls heterogamy.

which had received the name of *Teras terminalis*. This second form includes winged males, and females either wingless or furnished only with the rudiments of wings. In other respects the two generations do not differ much in the totality of their organization.

In another species of the same group, *Biorhiza renum*, the differences of structure between the two generations are far more striking. This insect (the agamic generation) is wingless, 1·5 millim. long; its abdomen is sessile. Its antennæ have thirteen joints, its labial palpi two, its maxillary palpi four. From its eggs, deposited on the adventitious buds of the trunk, branches, or twigs, emerge, at the end of May or middle of June, a Cynips known under the name of *Trigonaspis crustalis*, and which differs very much from the preceding. It is 4 millim. in length; the male and female are both provided with very long wings. The antennæ of the male have fifteen joints, those of the female fourteen; the labial palpi have three joints, the maxillary five. The colour and the sculpture of the body are very different from what is seen in *B. renum*. The ovipositor has also quite a different structure.

In the species of these four groups, the transformations of which we have just traced from the observations of M. Adler, there is a cycle formed of two generations more or less distinct one from the other—one of which is represented only by females laying by parthenogenesis, while the other exhibits both sexes. This alternation, although very much diffused amongst the Cynipidæ, is not the general rule. There are some *Aphilotrices* which reproduce in a continuous way without any males appearing. The four species in which M. Adler has observed this mode of reproduction emerge in April, and have only one generation, of which the period of development is a year.

The galls which furnish food and shelter to the Cynipidæ during the greater part of their existence, as is known, vary considerably in form, colour, size, and situation. They furnish good characters for distinguishing species which are otherwise difficult to separate.

It has been generally supposed that it is the puncture of the gall-flies, with the introduction into the wound of a secretion peculiar to the insect, which causes an irritation and, in consequence, an abnormal production of cellular tissue. On this hypothesis the differences between the galls are to be explained by the variety of the substances produced in the glands of the insect and deposited in the tissue of the plant. M. Thomas, of Ohrdruf, who has examined a great number of galls of insects and Acari, had already called in question this explanation. M. Adler, on the other hand, proves its falsity as regards the galls of the Cynipidæ of the oak. At the same time he admits that it holds good in the case of certain galls which owe their existence to other Hymenoptera. Thus, the wound made by the serrated ovipositor of *Nematus Vallisnierii* in the leaves of *Salix amygdalina* causes an abundant formation of cells; and the gall thus formed attains its full growth at the end of a few days, before the larva has escaped from the egg. In the *Cecidomyiæ*, on the contrary, the manner in which the eggs are laid shows clearly that it is the larva which causes the formation of the gall. The same is the case with the Cynipidæ. No effect is produced until the larva is hatched. *Trigonaspis crustalis* lays its eggs in May, and the larvæ do not hatch till September; and it is only in this last month that the gall begins to form. As soon as the larva has attacked some cells the increase is effected. M. Adler has even proved that whilst the young larva has the hind part of its body still enclosed in the membrane of the egg, a large proliferation of cells is formed in front of it round the slightly wounded tissue. M. Adler gives many particulars concerning the regions of the tree and the nature of the tissues in which the galls are developed, and concerning the causes which lead to anomalies or arrests of development of these galls. [Two coloured plates very well executed represent the galls mentioned in the memoir.] The author describes and figures with care the parts of the ovipositor, and discusses the manner in which the egg is probably introduced to the further end of the canal pierced by the insect.

The eggs of the gall-flies differ from the pedicellated eggs of other Hymenoptera in so far that in the latter the pedicel is placed at the anterior pole of the egg instead of at the posterior. Moreover this extension is not a simple solid appendage of the envelope of the egg of cuticular nature. It contains a cavity which is in direct communication with the vitelline cavity; and its extremity presents a club-like swelling. M. Adler is of opinion that this pedicel, which is exposed to the atmosphere, performs the part of a respiratory tube.

We have already pointed out above some of the essential characters which distinguish the two generations in certain Cynipidæ. The distinction is far from being always so striking as that which is observed in the group *Biorhiza*. The species of *Neuroterus* and *Spathegaster* do not exhibit externally much difference; but on examining them more closely it is seen that the *Neuroterus* form is thicker set and has the abdomen more strongly developed, the wings shorter and broader, and the antennæ longer than the *Spathegaster* form. The differences which are perceived in the abdomen are due to the structure and form of the ovipositor, which vary according to the duty it is called upon to perform and the part which it is destined to pierce.

The reproductive organs seem to have on the whole the same structure in the females of the two generations. In both the ovaries are formed of a great number of ovarian tubes, in each of which are found from six to twelve eggs. Generally the agamic generations have a greater number of ovarian tubes, and there are more eggs in each tube. One gland, which M. Adler regards as playing the part of a prostate, although more developed in the females of the sexual generation, exists also, however, in those of the agamic generation. What is still more remarkable is that *the seminal receptacle is found not only in the females of the agamic generations which alternate with the sexual generations, but also in those of the species which propagate only by parthenogenesis.* A certain degree of atrophy of this organ is found, however, among the agamic females in comparison with that among sexual females. The persistence of the seminal receptacle in these parthenogenetic insects plainly shows, as M. Adler remarks, that at a very remote period males must have existed. Other facts described by the author tell the same tale. There is found, moreover, among the Cynipidæ (*Rhodites rosæ* and *R. eglanteriæ*) living on other plants than the oak a manifestation of atavism, thus confirming the bonds which exist between the sexual and agamic states. Although reproduction among them has become entirely parthenogenetic, yet at times males appear, although probably no copulation has taken place for a long period.

Besides the differences existing between the perfect insects, the two alternating generations are distinguished also by the longer or shorter time necessary for the development of the egg and of the larva, and by the division of the phases of this development. The larvæ of *Neuroterus* and those of *Spathegaster* also exhibit differences in the form of their mandibles, these organs being adapted to the kind of life of each.

The researches of M. Adler have not been merely limited to the Cynipidæ of the oak. Other Hymenoptera, parasitic on animals and plants, have disclosed to him some interesting facts, which show to what a great extent parthenogenesis prevails among the insects of this order, and under what different conditions it shows itself in the various groups, and even in the species of the same genus.

Von Siebold proved that in *Nematus ventricosus* the males and females are in equal numbers, and that nevertheless parthenogenesis exists. M. Adler has observed the mode of reproduction of *N. Vallisnierii*, and discovered in this species the existence of two broods a year which are entirely parthenogenetic; so that parthenogenesis, which is only exceptional in the first species of this genus, has become constant in the second.

Pteromalus puparum, the larva of which lives as a parasite in the chrysalides of various species of diurnal Lepidoptera, also exhibits phenomena of parthenogenesis; but the consequences of this mode of reproduction are the inverse of those which are observed in *Nematus Vallisnierii*. Thus the virgin females chiefly give birth to males, a fact which brings these insects near to the bees as regards their reproduction. Of four chrysalides infested with larvæ of this *Pteromalus* produced by parthenogenesis, the first yielded 124 males, the second 62 males, the third 75 males and 5 females, the fourth 45 males and 4 females.

All these facts tend to prove that parthenogenesis among the Hymenoptera originates from sexual generation. It is, apart from that, difficult to establish any general law, because the results relative to the sex of the progeny are too changeable. Sometimes the virgin females give birth principally or exclusively to females, sometimes to males and females in apparently equal numbers, and, lastly, sometimes principally or exclusively to males. In the case where the male sex seems to have entirely disappeared in consequence of prolonged parthenogenesis, there still reappears from time to time a male among a great number of individuals.

M. Adler seeks to explain the origin of the alternation of the two different annual generations among the Cynipidæ. He assumes that at first there was probably only one generation a year, and subsequently two identical generations. The modifications produced later on in these two generations are to be attributed to the influence of external vital conditions. Among the first must be placed changes of climate; for we know, chiefly from the observations and experimental researches of M. Weismann, that the influences of different climates are able to give the first impulse to the changes which lead to the separation of two generations. As for the degree of the modifications, it arises from a factor whose importance we cannot well appreciate; the special organization of a species presents sometimes a great disposition to vary, sometimes a tendency to preserve its characters; so that there is sometimes scarcely any difference between the two alternate generations of the Cynipidæ in spite of the most varied external conditions (*aptera-terminalis*), whilst at other times there are striking differences (*renum-crustalis*).

Whilst admitting that the two generations may have been originally identical, one is led to ask, which of the two now existing corresponds to the original form, or at least resembles it most. M. Adler believes that it is the agamic generation that represents this original form; if it is not identical with it, it should at least be very near. This conclusion is deduced from the following facts:—

First, the parthenogenetic form exists alone in certain species.

Secondly, among the Cynipidæ there is no case known of a sexual form existing alone; all the sexual species are only known to us as a link in a cycle containing an agamic generation.

Without being absolutely convincing, the arguments of M. Adler have a certain value. To this we might add that, contrary to what we see in other Articulata in which parthenogenesis exists, the sexual generations are the summer broods, and the parthenogenetic generations producing females are those which hibernate. Now the analogies with other insects would lead us to suppose that the hibernating generation is the original, and that the summer generation is secondary*.

These provisional hypotheses will probably have to be much modified by later discoveries; but the researches of M. Adler will always be conspicuous as being a great advance in our knowledge of parthenogenesis, and be reckoned among the most patient and fruitful researches which have been undertaken on insects. A. H.

XXVIII.—*Note on* Wagnerella borealis, *a Protozoan*. By C. Mereschkowsky.

When I described in this Journal† the interesting organism that I discovered in the White Sea, and named *Wagnerella borealis*, in honour of my master Prof. Nicolas Wagner, I had before me only a few specimens; and these were preserved

* See A. Weismann's 'Studien zur Descendenz-Theorie: I. Ueber den Saison-Dimorphismus der Schmetterlinge,' Leipzig, 1875.

† C. Mereschkowsky, "On *Wagnerella borealis*, a new Genus of Sponge nearly allied to the Physemariæ," Ann. & Mag. Nat. Hist. 1878, ser. 5, vol. i.; and "Etudes sur les Eponges de la Mer Blanche," in Mém. de l'Acad. de St. Pétersb. vol. xxvi. no. 7.

in spirits. Now the individuals preserved in alcohol, even when afterwards placed in glycerine, become entirely opaque; one can see nothing of their contents or of their internal organization; and consequently it is only possible to form an idea of the nature of the animal from the characters presented by their exterior. But this exterior bears witness strongly in favour of the animal being nothing but a small sponge; the spicules of two different kinds produced by the animal itself, above all, suggest this opinion as to the nature of the animal.

Since then I have had the opportunity of seeing some hundreds of specimens of *Wagnerella borealis* in the Bay of Naples, as also the preparations made of it by M. Paul Mayer, who has had the kindness to show me these as well as his drawings. The preparations of these animals coloured with tincture of cochineal have especially served to convince me that I was entirely deceived in assigning them a place among the sponges. I am now convinced that it is an organism probably belonging to the group Heliozoa, in the class Protozoa; for there is no doubt that the protoplasmic mass is not formed of cells; it is in all only a single cell with a single nucleus, which divides only for the purpose of propagation into two, four, and eight nuclei, as described by M. Paul Mayer*.

It is therefore, in the first place, to correct this error that I write this note, and, further, to confirm the identity of the *Wagnerella borealis* of the White Sea with that which occurs in the Bay of Naples, and which has been recognized as a Protozoan by the researches of M. Paul Mayer.

In the second place, it is to rectify another error that I committed in describing the animal discovered by me in the White Sea, and an error of a much less pardonable nature than the former. I described the spicules that occurred in *Wagnerella borealis* as being of a calcareous nature. A more careful examination of the object has convinced me that in this I have committed a profound and gross error, the spicules being siliceous as in all the Heliozoa. It was in reading the fine work by M. Bütschli on the Protozoa† that I recognized the necessity of correcting this error, which I hope will be excused me, seeing that I committed it at the very outset of my zoological studies.

As to the question whether the spicules are produced by the animal itself, or elements foreign to the organism and selected by it from among the spicules of sponges, I think that M.

* Paul Mayer, "*Wagnerella borealis*," Zool. Anzeiger, Bd. ii. 1879, pp. 357, 358.

† Bütschli, Bronn's 'Klassen und Ordnungen,' Band i. Protozoa, 1881.

Bütschli has no reason for doubting that the former supposition is the only correct one. Among a great number of these animals I have not seen a single one in which there were not always the two kinds of spicules, and always arranged in the same manner—that is to say, the longer ones implanted only by one end at the surface of the head, and the smaller ones entirely immersed in the organic substance of the head and peduncle; further I have never observed any other spicules, small grains of sand, or other foreign substances. I believe, therefore, that we may, without hesitation, accept my opinion that these spicules are the product of the organism itself, as, indeed, we not unfrequently find siliceous spicules formed by the protoplasm of the Heliozoa.

As regards the classification of the animal, there is only a single point that makes me hesitate before placing it among the Heliozoa; and that is the absence of pseudopodia. I have never been able to observe pseudopodia issuing from any part of the body, just as I have also never seen them in *Haliphysema ramulosa*; and M. Paul Mayer has also told me that he never saw them in *Wagnerella*. With the exception of this difference there is a very great resemblance between *Wagnerella* and the Heliozoa, such as *Clathrulina*, for example—a resemblance much closer than with any Rhizopod or, in general, any other Protozoa. It must consequently form a distinct family in the group of the Heliozoa—a family which will be characterized by the presence of separate spicules forming the skeleton, and by the presence of a peduncle which attaches the animal to foreign objects. This family should undoubtedly be called WAGNERELLIDA, from the generic name of the single species known.

XXIX.—*Notes on Longicorn Coleoptera.—Revision of the* Ærénicides *and* Amphionychides *of Tropical America.* By H. W. BATES, F.R.S., F.L.S.

[Continued from p. 204.]

Isomerida fimbriata.

I. albicolli major et robustior, elytris postice paullo dilatato-explanatis. Niger, griseo subtiliter pubescens, thorace lateribus obtuse tumidis vittaque angusta indistincta grisea; elytris apice rotundatis et planatis, carina laterali paullo ante apicem desinente, dorso subcrebre punctulatis, lateribus vitta alba (spatium inter carinam et marginem occupante) longe ante apicem terminata; antennis (♂) corpore longioribus nigris, articulis secundo ad sextum infra sparsim ciliatis, cæteris pubescentibus; corpore subtus nigro, femoribus basi testaceis; trochanteribus posticis productis, acutis.

Long. 6–7 lin. ♂.

Rio Janeiro, Minas Geraes.

Resembles *Spathoptera gutticollis*, Thoms., but is smaller, and distinguished at once by the generic character of unarmed thorax. In *Spathoptera* the sides (behind the middle) are furnished with a long and robust spine (obtuse at the point); in the present species they are simply though rather strongly rounded.

Isomerida plumosa.

Angustior, elongata, nigra; antennis articulis secundo ad sextum supra, infra et intus densissime nigro-penicillatis; thorace breviter cylindrico, lateribus medio vix rotundatis, basi et apice paullulum sulcatis; linea laterali vix conspicua pallida; elytris apicem versus perpaullum dilatatis, apice singulatim rotundatis; dorso sublineatim punctulatis, carina laterali elevata, apicem fere attingente, epipleuris vitta indistincta cinerea; femoribus basi rufo-testaceis; trochanteribus posticis spiniformibus.

Long. $7\frac{1}{2}$ lin. ♂ ♀.

Rio Janeiro, ♀ Tucuman.

The brush-like ornamentation of the antennæ, at first sight, resembles that of *Isomerida crinicornis* (Germar); but in that species the pencils are on the *under* side of the joints only from the first to the seventh, though on each joint they form two diverging brushes. *I. crinicornis* has the elytral suture pale testaceous, and the posterior trochanters simple.

Isomerida picticollis.

Elongata, nigra, subtiliter griseo-pubescens, fronte maculis duabus, occipite vittis duabus thoraceque macula magna utrinque antico-laterali cano-tomentosis, elytris linea utrinque juxta carinam marginalem testacea; fronte convexa; thorace parvo, basi constricto; elytris elongatis, fere parallelis, apice singulatim rotundatis vix truncatis, supra crebre punctulatis: antennis ♂ corpore haud longioribus, articulis primo ad septimum infra subpenicillatis, tertio cæteris conspicue longiore.

Long. 6 lin. ♂.

Paraná, South Brazil.

Although the relatively greater length of the third antennal joint would bring this species within the definition of *Amphionycha*, the thick and somewhat tufted and long cilia of the underside of the joints, from the first to the seventh, is a decided character of the genus *Isomerida*. The whitish tomentose spots of the thorax are situated on the antero-lateral part on each side, reaching a little way down the flank, but not attaining the mesial dorsal line, where there is a very straight stripe of the black ground-colour.

Isomerida vittipennis.

I. lineatæ (Bates) simillima, at differt antennarum articulo tertio quam quartus vix longiore. Cylindrica, nigro-fusca, subtiliter griseo-pubescens, thorace vitta laterali, elytris linea elevata dorsali limboque laterali carneo-fulvis: capite inter antennas fortiter concavo; thorace antice angustato, medio vix latiore, disco subtuberculato, nitido, sparsim punctato; elytris lineatim punctulatis, apice breviter truncatis: antennis articulis basi flavo-testaceis, articulis omnibus (secundo excepto) subæqualibus, primo ad sextum infra penicillatis; femoribus ventrisque apice flavo-testaceis.
Long. 6–7 lin.

Rio Janeiro, Novo Friburgo.

In colour very similar to *I. lineata* ♀, but longer and more cylindrical, and the third antennal joint very little longer than the fourth, with thick tufts of hair beneath all the joints from the first to the sixth.

Isomerida longicornis.

Cylindrica, fulvescens pube tenui flavo-cinerea vestita, pedibus rufis, tibiis extus tarsisque nigris: antennis (♂) corpore multo longioribus, robustis, filiformibus, nigris, articulo tertio cæteris distincte longiore, secundo ad septimum infra paullo densius ciliatis; capite haud retractili, fronte convexa; thorace cylindrico, densius flavo-tomentoso; elytris fundo rufescentibus, apice truncatis, angulo externo dentato, dorso lineatim punctulatis interstitiis nonnullis subelevatis, carina laterali paullo ultra medium obsoleta, carinulaque exteriore paullo longiore.
Long. $6\frac{1}{4}$ lin. ♂.

Bahia, Brazil.

Of all the species hitherto described, this approaches *Amphionycha* nearest in the relative proportions and ciliation of the antennal joints. The third joint, however, is not relatively so long as it is in *Amphionycha*; and the hairs beneath the joints are longer than in that genus, and decidedly denser on joints 2–7. In facies and style of coloration and in the truncature of the elytra the species is quite conformable to the prevailing character of *Isomerida*.

Hemilophus infuscatus.

Fere cylindricus, fusco-niger, capite et thorace (hoc disco postice fusco excepto) fulvescenti-rufis, elytrorum sutura (anguste et indistincte) vittaque abbreviata laterali cinereis; antennis nigris, articulis nonnullis basi testaceis, femoribus fulvo-testaceis: antennis articulis secundo ad quartum subtus dense, cæteribus sparsim ciliatis; thorace sparsim grosse punctato, disco posteriore

valde convexo; elytris apice recte truncatis, angulo exteriore dentiformi, dorso sublineatim punctulatis, carina laterali acutissima.
Long. $4\frac{1}{2}$ lin. ♂ ♀.

Rio de Janeiro, Brazil.

This species, long known in collections under the inedited name which I have adopted, is closely allied to *H. dimidiaticornis* (Serv.), the type of the genus. It differs *inter alia* in the colour of the thorax, which in Serville's species is black with a large spot on each side pale reddish.

Hemilophus leucogramma.

H. dimidiaticorni valde affinis, at differt thorace nigro linea utrinque alba tomentosa. Niger, capite rufo; thorace supra nigro nitido, punctato, vitta laterali utrinque alba: elytris apice obtusissime truncatis, muticis, vitta lata marginali apicem longe haud attingente, albo-tomentosa; femoribus quatuor anticis flavo-testaceis, geniculis infuscatis; antennis articulis secundo ad quartum infra densissime nigro-penicillatis.
Long. 5 lin.

Province of Paraná, Brazil.

Hemilophus unicolor.

Fuligineo-niger, vitta laterali elytrorum rufescenti-cinerea, femoribus fulvo-testaceis fusco-signatis; elytris apice obtusissime truncatis, muticis; antennis articulis secundo ad quartum infra densissime nigro-penicillatis, omnibus basi testaceis.
Long. 5 lin.

Brazil.

Hemilophus Smithii.

H. fasciato et *spectabili* quoad colores similis; fere cylindricus, niger, elytris fascia postmediana fulvescenti-alba maculaque humerali fulva; capite fulvo, fusco-nebuloso vittulaque verticis nigra; thorace vitta laterali e tomento compacto flava, vel cretacea fulvo-marginata; corpore subtus medio plus minusve fulvo, abdominis segmentis tertio et quarto in ♀ albis (medio fuscis); pedibus nigris, femoribus basi fulvis: antennis articulis tertio et quarto valde elongatis fere æqualibus, quarto paullo grossiore et in ♀ infra densius ciliato; thorace medio utrinque paullulum angulato; elytris apice late rotundatis paullo truncatis, dorso confuse punctulatis, carina laterali fortissima.
Long. 6–$6\frac{1}{2}$ lin. ♂ ♀.

Lower Amazons (*Mr. Herbert Smith*).

Hemilophus cayennensis.

Subcylindricus, robustus, fusco-niger, antennarum articulis quinto ad septimum totis, quarto apice, secundo ad quartum octavoque basi flavis; capite linea verticis genisque cinereis; thorace vitta lata utrinque laterali cinereo-tomentosa: elytris apice late rotundatis et prope suturam breviter truncatis, carina laterali valde elevata flexuosa, dorso basin versus punctulatis, fascia postmediana (ad suturam late interrupta) alba fulvo-marginata, maculaque humerali fulva; femoribus pallide fulvis; abdomine (♀) segmentis secundo et tertio albo-tomentosis; antennis articulis tertio et quarto modice elongatis, infra dense ciliatis.

Long. $6\frac{1}{2}$ lin. ♀.

Cayenne.

Hemilophus duplicatus.

Subangustus, erecte pilosus, fusco-niger, fronte, thoracis lateribus, elytrisque vitta lata mediana, macula supra callum humeralem lineaque marginali versus humeros ochraceo-fulvis: capite angusto, retracto; antennis articulo tertio modice, quarto vix elongato, subtus dense hirsutis; thorace cylindrico; elytris parallelis, apice rotundatis, carinis lateralibus utrinque duabus, interiore abbreviata; femoribus basi fulvo-rufis.

Long. 5 lin. ♂?

New Granada.

Differs from all other species of the genus in its retractile head and double elytral carina, besides the much shorter fourth joint of the antennæ. In other respects it presents the characters of *Hemilophus*, and in colours resembles *H. fasciatus* and *H. spectabilis.*

Tyrinthia macilenta.

Angusta, elongata, postice sensim dilatata, supra fulva, thorace medio elytrisque utrinque vitta nigro-fuscis; capite antice fulvo, postice nigro fulvo-trivittato: vertice profunde impresso, fronte modice prominula; antennis gracilibus, nigris, articulo tertio infra (quartoque basi) longe ciliato; thorace angusto; elytris dense substriatim punctulatis, absque costulis; pedibus nigris, coxis femorumque dimidio basali flavo-testaceis.

Long. $3\frac{3}{4}$–5 lin.

Novo Friburgo, Rio Janeiro.

Tyrinthia longiscapus.

Gracilis, erecte breviter nigro-pilosa, supra fulva; capitis vertice et vittis tribus, thorace vitta dorsali alteraque laterali, elytris vitta abbreviata communi basali-suturali alteraque utrinque apicali (versus medium, interdum usque ad basin) attenuata nigris: antennis nigris, longe pilosis, scapo valde elongato, articulo tertio haud incrassato; elytris versus apicem paullo dilatatis, apice singulatim rotundatis, supra sublineatim punctatis; corpore subtus pedibusque nigris, femoribus plus minusve testaceis.

Long. $3\frac{1}{2}$–4 lin.

Rio Janeiro (*Rev. Hamlet Clark*).

The forehead is only moderately convex in the single example examined; but the vertex is deeply depressed, and the elytra are destitute of lateral keels. The antennal scape is relatively only a little longer than in *T. capillata*, but it is nearly equal in length to the third joint; the long hairs are not so dense beneath the joint as in other species.

Tyrinthia reversa.

Elongata, postice dilatata, nigro-pilosa, supra fulva, fascia frontali, thoracis lateribus, sutura vittaque utrinque elytrorum nigris: fronte conice porrecta; antennis dense et longe pilosis, scapo valido, modice elongato; elytris dense punctatis, subtiliter elevato-lineatis, apice singulatim rotundatis; corpore subtus pedibusque nigris, coxis et femoribus testaceis.

Long. $4\frac{1}{4}$ lin.

Rio Janeiro (*Rev. Hamlet Clark*).

Very similar to *T. longiscapus*; but the dorsal part of the occiput and thorax are fulvous instead of black, and the entire flanks of the latter are black. The forehead is produced and conical, with a slight notch in the apex of the protuberance.

Tyrinthia xanthotænia.

Sublinearis, postice deplanata, erecte pilosa, cinereo-nigra, capite (vertice excepto), thorace vitta angusta laterali, elytris vitta lata laterali, pedibus antennarumque articulis quarto quintoque et scapo (infra) melleo-flavis: capite inter antennas depresso, fronte convexa linea mediana profunde divisa; thorace parvo, medio paullulum angulato, antice angustato; elytris ante apicem paullo rotundatis, apice sinuatim truncatis, angulo exteriore dentato, dorso usque ad apicem declivi, lineatim crebre punctulato, carina laterali obtusa subrecta, epipleuris modice (postice perparum) elevatis; antennis articulo tertio undique longe, modice dense piloso.

Long. $3\frac{3}{4}$ lin. ♂?

Rio Janeiro, Brazil.

Tyrinthia obtusa.

Oblongo-linearis, elytris apice late rotundatis haud dilatatis, lateribus carina incrassata longe ante apicem terminata: rufo-fulva, erecte pubescens, capite postice supra nigro, fronte (♂ fortius) conica, vertice valde concavo; antennis nigris, articulo tertio longissimo, paullo incrassato, dense hirsuto, quarto ad undecimum elongatis (præcipue ♂) gracillimis; thorace valde transverso, dorso convexo, nigro nitido, linea laterali rufo-fulva; elytris subplanatis crebre punctatis, rufo-fulvis, apice nigris; corpore subtus pedibusque nigris; pectore medio, coxis femoribusque testaceis.

Long. 5 lin. ♂ ♀.

New Granada.

The species has a peculiar facies, owing to its parallel form, the length and slenderness of the joints 4–11 of the antennæ, and the coloration. The surface is slightly shining. The lateral carinæ of the elytra extend from the base to beyond the middle, and are thickened and raised posteriorly so as to give the elytral surface a plane appearance in the central portions.

Malacoscylus albens.

Angustulus, nigro-fuscus, passim erecte pilosus, antennis articulo quarto quintoque basi, pedibus (tarsis tibiisque apice exceptis) et vitta laterali elytrorum albo-testaceis; capite (occipite excepto) thoracisque lateribus rufo-testaceis: capite postice subtumido; thorace brevi, antice et postice constrictulo, sparsim grosse punctato; elytris apice breviter truncatis (angulo exteriore producto), subcrebre punctulatis; antennis articulo tertio valde elongato et piloso sed haud incrassato, quarto dimidio breviore.

Long. $4\frac{1}{4}$ lin.

South Brazil.

Agrees with *Malacoscylus* in the great length and pilosity of the third antennal joint, although the absence of thickening in the same joint gives the insect a different facies. The elytra have no elevated lines, and the lateral keel is much thickened; the white lateral vitta is broad from the shoulder to far beyond the middle, whence it narrows and terminates in a point before the apex.

Malacoscylus iodinus.

Elongatus, niger, elytris violaceis sericeo-nitentibus, fascia postmediana flava; capite thoraceque nigro-velutinis, fronte vix convexa; thorace linea utrinque laterali indistincte fulva; elytris apice late rotundatis, dorso convexis, utrinque costulis duabus tertiaque laterali præter carinam, lateribus post medium paullulum explanatis; pedibus antennisque nigris, coxis fulvis.

Long. $6\frac{1}{2}$ lin.

Ecuador (*Buckley*).

Malacoscylus auricomus.

Elongatus, angustus, niger, verticis et thoracis vitta utrinque laterali elytrisque fulvis aureo-sericeis, his vitta suturali usque ad medium ibique in maculam magnam dilatata alteraque marginali a basi usque ad medium nigris; antennis nigris, articulo quarto basi fulvo; capite antice, pectore medio coxisque flavis; elytris apice late rotundatis, angulis exterioribus breviter spinosis, dorso crebre sublineatim punctulatis.

Long. 5 lin. ♀.

Chanchamoyo, Peru (*Dr. Thamm*).

Apparently closely allied to *M. Klugii*, Thomson, from Colombia.

Malacoscylus cinctulus.

Hemilopho spectabili (Blanch.) similis, at minor. Gracilis, linearis, niger; vertice et thorace utrinque vitta laterali elytrisque macula triangulari humerali fasciaque lata postmediana ochraceis aureo-sericeis; fronte et genis flavis; antennis nigris, articulo quarto basi flavo; elytris apice subtruncatis, angulo exteriore spinoso, dorso lineatim punctulatis; pedibus basi testaceis.

Long. $4\frac{1}{4}$ lin. ♀.

Bolivia, Yungas, La Paz (*Buckley*).

Malacoscylus gratiosus.

Elongatus, niger, elytris (vittula subhumerali excepta) croceo-fulvis, capite antice fulvo, vertice thoraceque nigris, vitta utrinque laterali fulva; scutello nigro; elytris apice late subtruncatis, angulo exteriore breviter spinoso, dorso planatis crebre punctulatis, carina laterali acutissima; antennis nigris, articulis quarto, quinto et sexto basi fulvis.

Long. $6\frac{1}{2}$ lin. ♀.

Ecuador (*Buckley*).

Malacoscylus gonostigma.

M. cirrato (Germ.) proxime affinis, differt elytrorum macula nigra postica antice ad suturam acute angulata. Niger, vertice vittis duabus postice divergentibus et per thoracis latera continuatis fulvo-rufis; elytris (quarto apicali nigro excepto) fulvo-ochraceis, sutura et lateribus usque ad basin nigris; genis (♂) femorumque basi antennarumque articulis quarto et quinto flavo-testaceis.

♂. Caput inter antennas late concavum, fronte medio linea impressa; vittis flavis verticis et thoracis angustis.

♀. Caput crassum, inter antennas modice concavum; fronte genisque totis fulvis.

Long. 4 lin. ♂ ♀.

Rio Janeiro, Brazil (*Rev. Hamlet Clark*).

The head in the female is much broader behind, and the crown and occiput much more convex than in the same sex of the common Brazilian *Malacoscylus cirratus*. The species further differs in the crown having a single central black stripe, and not two separate vittæ. The colour of the fore part of the head varies, being sometimes wholly fulvous and sometimes more or less clouded with dusky or black.

Themistonoe exilis.

Elongata, gracilis, postice paullulum rotundato-ampliata, longe sparsim setosa, subtus nigra, supra fulvo-ochracea, vertice et thorace vittis tribus elytrisque margine apicali nigris: antennis articulo tertio valde elongato, incrassato, infra ciliato, lateribus utrinque dense hirsuto, articulis quarto ad undecimum modice tantum abbreviatis; elytris utrinque costulis dorsalibus duabus carinaque acuta laterali.

Long. 5 lin.

Yungas, La Paz, Bolivia (*Buckley*).

Intermediate in generic structure between *Themistonoe* and *Malacoscylus*, but nearer the former on account of its elongate shape and the distinct, though moderate, rounded expansion of the elytra towards their apices. The third antennal joint, viewed sideways, appears slender and fringed beneath only with fine and long hairs; but viewed from above it is thicker than the fourth and densely pilose on each side, as in the larger species of *Themistonoe*.

Lycidola expansa.

L. Beltii quoad formam similis, elytris mox pone humeros valde explanato-dilatatis. Nigra, thorace lateribus, elytris fascia basali alteraque mediana fulvis, his area apicali violacea; pedibus basi testaceo-flavis; elytris utrinque 4-costulatis, interstitiis punctulato-coriaceis.

Long. $6\frac{1}{2}$ lin. ♂.

New Granada.

Agrees with *L. Beltii* in the wide dilatation of the elytra, which is carried to a greater extent in these species than in *L. simulatrix* and *L. togata*. It differs, however, in colours, the elytra being violet-black (more violet in the apical part) and traversed by two tawny-ochreous belts of equal width, one basal and the other median. The sides of the thorax are also tawny ochreous, having a broad dorsal vitta (much narrowed behind) of the black ground-colour; the head is black, with a spot between the antennæ and one on the occiput on each side tawny.

List of the Ærénicides *and* Amphionychides *of Tropical America**.

Subfamily **Saperdinæ**.

Group Ærénicides.

Genus 1. Mecas, Lec. (*Dylobolus*, Thoms.).

1. *senescens*, Bates, Biol. Centr.-Amer., Col. v. p. 203. Mexico.
2. *rubripes*, Bates, ibid. p. 203. Mexico.
3. *ambigenus*, Bates, ibid. p. 203. Mexico.
4. *laminata*, Bates, ibid. p. 204. Mexico, Guatemala.
5. *obereoides*, Bates, ibid. p. 204, t. 15. f. 16. Mexico, Guatemala.
6. *laticeps*, Bates, ibid. p. 204. Mexico, Guatemala.
7. *mexicana*, Bates, ibid. p. 204. Mexico, Guatemala.
8. *rotundicollis*, Thomson. Mexico, Guatemala.
9. *ruficollis*, Horn, Trans. Amer. Ent. Soc. vii. p. 44. Mexico (Texas).

Four other species have been described from North America.

Genus 2. Pannychis, Thoms.

1. *sericeus*, Thoms. Mexico.
2. *ducalis*, Bates, Biol. Centr.-Amer., Col. v. p. 205. Mexico.
3. *callicerus*, Bates, ibid. p. 206. Mexico.

Genus 3. Aphilesthes, Bates, antè, p. 145.

1. *rustica*, Bates, antè, p. 145. Venezuela.

Genus 4. Antodyce, Thoms.

1. *picta*, Klug. Brazil.
2. *cretata*, Bates, Biol. Centr.-Amer. t. 15. f. 8. Mexico, Guatemala, Nicaragua.
3. *nympha*, Bates, Biol. Centr.-Amer., Col. v. p. 207. Mexico, Guatemala.
4. *juncea*, Bates, antè, p. 145. Brazil.

Genus 5. Ærenica, Thoms.

1. *hirticornis*, Klug. Brazil.

* In this list I give references only to those genera and species which have been published since the appearance of the tenth volume of Harold and Gemminger's Catalogue, which contains full citations to all species described up to the year 1873.

2. *albicans*, Guérin. Brazil.
3. *canescens*, Klug. Brazil.
4. *hirsuta*, Bates, Biol. Centr.-Amer., Col. v. p. 206. Guatemala.
5. *multipunctata*, Serville. Brazil.
6. *spissicornis*, Bates, antè, p. 145. Brazil.
7. *leucippe*, Bates, antè, p. 146. Brazil.
8. *porosa*, Bates, antè, p. 146. Venezuela.

Genus 6. Phaula, Thoms.

1. *antiqua*, Thoms. Brazil.
2. *Thomsonii*, Lacord. Brazil.
3. *lichenigera*, Perty. Brazil.

Genus 7. Ischnophygas, Thoms.

1. *telephoroides*, Thoms. Mexico.

Genus 8. Apagomera, Bates, antè, p. 146.

1. *triangularis*, Germar. Brazil.
2. *suturella*, Bates, antè, p. 147. Brazil.
3. *azurescens*, Bates, antè, p. 147. Brazil.

Genus 9. Hydraschema, Thoms.

1. *fabulosa*, Thoms. Brazil.
2. *virgata*, Pascoe, Ann. & Mag. Nat. Hist. 1878, ii. p. 377. Brazil.

Genus 10. Eulachnesia, Bates.

1. *sapphira*, Bates. Amazons.
2. *smaragdina*, Bates, Biol. Centr.-Amer., Col. v. t. 15. f. 11. Nicaragua.
3. *cobaltina*, Bates, antè, p. 148. New Granada.
4. *calliste*, Bates, antè, p. 148. Peru.
5. *æquatoria*, Bates, antè, p. 149. Ecuador.
6. *viridipennis*, Bates, antè, p. 149. Ecuador.

Genus 11. Dadoychus, Chevr. (*Daduchus*?)

1. *flavocinctus*, Chevr. Brazil.

Genus 12. Amillarus, Thoms.

1. *apicalis*, Thoms. (*erythrodera*, Chevr., *mutabilis*, Bates), Biol. Cent.-Amer., Col. v. t. 15. f. 14. Nicaragua, New Granada, Amazons.

Genus 13. PRETILIA, Bates.

1. *telephoroides*, Bates. Amazons.

Group AMPHIONYCHIDES.

Genus 14. SPHALLONYCHA, Bates, antè, p. 149.

1. *roseicollis*, Bates. Amazons.

Genus 15. ALAMPYRIS, Bates., Biol. Centr.-Amer., Col. v. p. 219.

1. *fuliginea*, Bates, Biol. Centr.-Amer., Col. v. p. 219. Mexico.
2. *curta*, Bates, ibid. p. 219. Mexico.
3. *nigra*, Bates, ibid. p. 220. Mexico.
4. *melanophiloides*, Thoms. Mexico.
5. *photinoides*, Bates, Biol. Centr.-Amer., Col. v. p. 220. Guatemala.
6. *mimetica*, Bates, ibid. p. 220. Mexico.
7. *marginella*, Bates, ibid. p. 221. Mexico.
8. *quadricollis*, Bates, ibid. p. 221. Mexico.
9. *planipennis*, Bates. Brazil.

Genus 16. TETANOLA, Bates, antè, p. 151.

1. *polita*, Bates, antè, p. 151. Ecuador.

Genus 17. ESSOSTRUTHA, Thoms.

1. *læta*, Newm. Mexico.
2. *fimbriolata*, Bates, Biol. Centr.-Amer., Col. v. p. 210 (*albina*, Pasc. ?) Mexico.
3. *miniata* (Lac.), Bates, ibid. p. 211. Mexico.
4. *cinnabarina*, Bates, ibid. p. 211. Guatemala.
5. *binotata*, Bates, ibid. p. 212, t. 15. fig. 18. Mexico.

Genus 18. ERANA, Bates.

1. *cincticornis*, Bates. Amazons.
2. *pusilla*, Bates. Guatemala, Nicaragua.
3. *pectoralis*, Bates, Biol. Centr.-Amer., Col. v. p. 208. Mexico, Guatemala.
4. *leuconoe*, Bates, ibid. p. 209. Nicaragua.
5. *florula*, Bates, ibid. p. 209. Guatemala.
6. *dispar*, Bates, ibid. p. 209. Mexico, Guatemala.
7. *suavissima*, Bates, ibid. p. 209. Guatemala.
8. *univittata*, Bates, ibid. p. 210. Mexico.
9. *fulveola*, Bates, ibid. p. 210. Guatemala.

Genus 19. CALOCOSMUS, Chevrolat.

1. *venustus*, Chevr. Cuba.
2. *dimidiatus*, Chevr. Cuba.
3. *nuptus*, Chevr. Cuba.
4. *speciosus*, Chevr. Cuba.
5. *Janus*, Bates, antè, p. 151. Cuba.
6. *semimarginatus*, Bates, antè, p. 151. Cuba.

Genus 20. BUTOCRYSA, Thoms.

1. *insignis*, Lucas. Brazil.

Genus 21. CEPHALODINA, Bates, Biol. Centr.-Amer., Col. v. p. 213.

1. *capito*, Bates. Panamá.
2. *crassiceps*, Bates, Biol. Centr.-Amer., Col. v. p. 213, t. 15. f. 5. Nicaragua.
3. *megacephala*, Bates. Amazons.

Genus 22. HILAROLEA, Thoms.

1. *incensa*, Perty (*Saperda*). Brazil.
2. *nigripennis*, Bates (*Amphionycha*). Amazons.
3. *seminigra*, Bates. Amazons.
4. *miniacea*, Bates. Amazons.
5. *tuberculicollis*, Guér. (*Hemilophus*). Ecuador.

Genus 23. CHRYSAPERDA, Bates, antè, p. 152.

1. *metallica*, Bates, antè, p. 152. Ecuador, Peru.
2. ? *circumcincta*, Pascoe (*Amphionycha*). Amazons.

Genus 24. OCHROMIMA, Bates, antè, p. 151.

1. *megalopoides*, Bates (*Amphionycha*). Amazons.

Genus 25. CIRRHICERA, Thoms.

1. *leuconota*, Casteln. Mexico.
2. *Sallei*, Thoms. Mexico, Guatemala, Nicaragua.
3. *Championi*, Bates, Biol. Centr.-Amer., Col. v. p. 214, t. 15. f. 12. Guatemala.
4. *longifrons*, Bates, ibid. p. 214. Guatemala.
5. *niveosignata*, Thoms. Mexico.
6. *nigrina*, Thoms. Mexico.
7. *cristipennis*, Bates, Biol. Centr.-Amer., Col. v. p. 214. Mexico.
8. *cinereola*, Bates, ibid. p. 215. Guatemala.

Genus 26. Phœbe, Serville.

1. *octomaculata*, Serv. (*phœbe*, Serv. olim, *cretifera*, Pasc.). Brazil.
2. *cornuta*, Oliv. Surinam.
3. *bicornis*, Oliv. Amazons.
4. *concinna*, White. Amazons.
5. *cava*, Germar. Brazil.
6. *mexicana*, Bates, Biol. Centr.-Amer., Col. v. p. 215. Mexico.
7. *albaria*, Bates, ibid. p. 215, t. 15. f. 3. Nicaragua.
8. *lutaria*, Bates, ibid. p. 215. Guatemala.

Genus 27. Amphionycha, Leseleuc.

1. *luctuosa*, Leseleuc. Brazil.
2. *Diana*, Thoms. Cayenne, Amazons.
3. *princeps*, Bates, Biol. Centr.-Amer., Col. v. t. 4. f. 2. Nicaragua.
4. *charis*, Bates, antè, p. 197. Ecuador.
5. *leucodryas*, Bates, antè, p. 198. Venezuela.
6. *tribalteata*, Bates, antè, p. 198. Peru.
7. *læta*, Bates, antè, p. 198. Venezuela, Peru.
8. *spilota*, Bates, antè, p. 199. Brazil.
9. *scalaris*, Pascoe. New Granada.
10. *sexguttata*, Lucas. Brazil.
11. *sexlineata*, Bates, antè, p. 199. Brazil.
12. *strigata*, Redtenb. Brazil.
13. *vittata*, Pascoe. Brazil.
14. *diva*, Chabrillac. Brazil.
15. *theaphia*, Bates, antè, p. 199. Ecuador.
16. *hemispila*, Germar. Brazil.
17. *verticalis*, Germar (*nigriceps*, Castl.). Brazil.
18. *spectabilis*, Drury. Mexico, Central America, New Granada.
19. *callizona*, Bates, Biol. Centr.-Amer., Col. v. p. 217. Honduras, Guatemala.
20. *Druryi*, Thoms. Costa Rica.
21. *bifasciata*, Bates, Biol. Centr.-Amer., Col. v. t. 15. f. 4. Nicaragua.
22. *pluricostata*, Bates, Biol. Centr.-Amer., Col. v. p. 217. Guatemala.
23. *dimidiata*, Bates, antè, p. 200. New Granada.
24. *bisellata*, Bates, antè, p. 200. Ecuador.
25. *obesa*, Bates, Biol. Centr.-Amer., Col. v. p. 217. Mexico.
26. *globicollis*, Bates, ibid. p. 218. Mexico.
27. *colligata*, Redt. Brazil.

28. *flavipes*, Lucas (an var. præced.?). Brazil.
29. *pallipes*, Oliv. Surinam.
30. *postilenata*, Bates, antè, p. 201. Brazil.
31. *fumigata*, Germar. Brazil.
32. *suturata*, Bates, antè, p. 201. Brazil.
33. *pubicornis*, Bates, antè, p. 201. Amazons.
34. *rectilinea*, Bates, antè, p. 202. Brazil.
35. *longipennis*, Bates, antè, p. 202. Ecuador.
36. *fraudatrix*, Bates, Biol. Centr.-Amer., Col. v. p. 218. Nicaragua.
37. *fulvicornis*, Bates, antè, p. 203. Brazil.
38. *fenestrata*, Bates, antè, p. 202. Brazil.
39. *fuscipennis*, Bates, antè, p. 203. Peru.
40. *discicollis*, Bates, antè, p. 203. Ecuador.
41. *rubra*, Bates, antè, p. 204. Brazil.
42. *dilaticeps*, Bates, antè, p. 200. New Granada.
43. *cephalotes*, Bates. Amazons.
44. *urocosmia*, Bates, antè, p. 204. New Granada.

Sp. incertæ sedis.

45. *petronæ*, Burmeister. Tucuman.
46. *Mniszechii*, Chabrillac. Brazil.
47. *ocularis*, Hope, Trans. Ent. Soc. iv. p. 181, t. 13. fig. 2 (*Saperda*). South America.
48. *brachialis*, Guérin. Ecuador.

Genus 28. Alicia, Thoms.

1. *flavescens*, Thoms. Brazil.
2. *testacea*, Bates (*Amphionycha*). Amazons.

Genus 29. Isomerida, Bates.

1. *albicollis*, Casteln. Guiana, Amazons.
2. *amicta*, Pascoe. New Granada.
3. *lineata*, Bates. Nicaragua, New Granada.
4. *subdilatata*, Bates, Biol. Centr.-Amer., Col. v. t. 15. f. 9. Nicaragua.
5. *picticornis*, Bates, ibid. t. 15. f. 10. Nicaragua.
6. *ruficornis*, Bates. Amazons.
7. *longicornis*, Bates, antè, p. 292. Brazil.
8. *vittipennis*, Bates, antè, p. 292. Brazil.
9. *picticollis*, Bates, antè, p. 291. Brazil.
10. *crinicornis*, Germar. Brazil.
11. *lanificus*, Germar. Brazil.
12. *plumosa*, Bates, antè, p. 291. Brazil.
13. *fimbriata*, Bates, antè, p. 290. Brazil.

Genus 30. SPATHOPTERA, Serv. (*Photuronta*, Thoms.).

1. *albilatera*, Serv. (*P. gutticollis*, Thoms.). Brazil.

Genus 31. HEMILOPHUS, Serv.

1. *dimidiaticornis*, Serv. Brazil.
2. *infuscatus*, Bates, antè, p. 292. Brazil.
3. *leucogramma*, Bates, antè, p. 293. Brazil.
4. *unicolor*, Bates, antè, p. 293. Brazil.
5. *varians*, Bates, Biol. Centr.-Amer., Col. v. p. 222. Mexico, Guatemala.
6. *longulus*, Bates, ibid. p. 222. Mexico.
7. *prolixus*, Bates, ibid. t. 15. f. 20. Nicaragua.
8. *fasciatus*, Bates. Amazons.
9. *spectabilis*, Blanch. Bolivia.
10. *cayennensis*, Bates, antè, p. 294. Cayenne.
11. *Smithii*, Bates, antè, p. 293. Amazons.
12. *duplicatus*, Bates, antè, p. 294. New Granada.
13. ? *ciliaris*, Klug. Brazil.

Genus 32. TYRINTHIA, Bates (*Cyphometopus*, Thoms.).

1. *scissifrons*, Bates. Amazons.
2. *infacetus*, Thoms. Brazil.
3. *Lacordairei*, Thoms. Colombia.
4. *frontalis*, Guérin (*Hemilophus*). Ecuador.
5. *macilenta*, Bates, antè, p. 294. Brazil.
6. *reversa*, Bates, antè, p. 295. Brazil.
7. *longiscapus*, Bates, antè, p. 294. Brazil.
8. *lycinella*, Bates, Biol. Centr.-Amer., Col. v. p. 223. Costa Rica.
9. *xantha*, Bates, ibid. p. 223. Nicaragua.
10. *xanthotænia*, Bates, antè, p. 295. Brazil.
11. *capillata*, Bates. Amazons.
12. *obtusa*, Bates, antè, p. 295. New Granada.
13. ? *minima*, Pascoe. New Granada.

Genus 33. MALACOSCYLUS, Thoms.

1. *cirratus*, Germar (*dasycerus*, Klug). Brazil.
2. *gonostigma*, Bates, antè, p. 297. Brazil.
3. *Klugii*, Thoms. Colombia.
4. *albens*, Bates, antè, p. 296. Brazil.
5. *fulveolus*, Bates. Brazil.
6. *auricomus*, Bates, antè, p. 296. Peru.
7. *cinctulus*, Bates, antè, p. 297. Bolivia.
8. *gratiosus*, Bates, antè, p. 297. Ecuador.

9. *iodinus*, Bates, antè, p. 296. Ecuador.
10. *thoracicus*, Oliv. Guiana.

Genus 34. Themistonoe, Thoms.

1. *cacica*, Thoms. Brazil.
2. *reticulata*, Waterh. Ann. & Mag. Nat. Hist. ser. 5, vol. v. (April 1880), p. 300. Ecuador.
3. *humeralis*, Waterh. ibid. p. 301. Ecuador.
4. *delectabilis*, Waterh. ibid. p. 302. New Granada.
5. *exilis*, Bates, antè, p. 298. Peru.

Genus 35. Lycaneptia, Thoms.

1. *amicta*, Klug (♀ *ampliata*, Klug). Brazil.
2. *antiqua*, Waterh. Ann. & Mag. Nat. Hist. ser. 5, vol. v. (April 1880), p. 300. Brazil.

Genus 36. Lycidola, Thoms.

1. *palliata*, Klug. Brazil.
2. *togata*, Klug. Brazil.
3. *simulatrix*, Bates. Amazons.
4. *Beltii*, Bates, Biol. Centr.-Amer., Col. v. t. 15. f. 1. Nicaragua.
5. *flavofasciata*, Waterh. Ann. & Mag. Nat. Hist. ser. 5, vol. v. (April 1880), p. 298. Ecuador.
6. *felix*, Waterh. ibid. p. 298. Ecuador.
7. *retifera*, Waterh. ibid. p. 298. Ecuador.
8. *expansa*, Bates, antè, p. 298. New Granada.
9. *mimica*, Bates. Amazons.
10. *capillacea*, Bates. Amazons.

Genus 37. Ites, Waterh.

1. *plagiatus*, Waterh. Ann. & Mag. Nat. Hist. ser. 5, vol. v. (April 1880), p. 298. Ecuador.

Genus 38. Clythraschema, Thoms.

1. *Chabrillacii*. Brazil.

XXX.—*An Account of the Sphinges and Bombyces collected by Lord Walsingham in North America during the Years* 1871–72. By Arthur G. Butler, F.L.S., F.Z.S., &c.

The Sphinges and Bombyces collected by Lord Walsingham consist of thirty-six species referable to twenty-six genera.

The exact localities are in almost every case carefully recorded; but a few species were placed in a separate box from the others, and to these I found no exact record attached.

His Lordship has kindly forwarded the following list of places visited by him in California and Oregon:—

California.

"San Francisco, May 16th, 1871.
"Sonoma County, May 18th to 23rd.
"Mendocino County, May 24th to June 14th.
"Lake County, June 15th to 23rd.
"Colusa County, June 24th to July 4th.
"Tehama County, July 5th to 9th.
"Shasta County, July 10th to 28th.
"Siskiyou County, July 29th to September 15th, part of which time (August 1st to September 1st) being spent upon Mount Shasta."

Oregon.

"Lost River to Crooked Creek, September 16th to 23rd.
"Camp Watson, on John Day's River, North Oregon, up to April 14th, 1872; reached Fort the Dalles, near the mouth of the Columbia River, April 21st, and Portland April 27th; thence by rail and road to Rouge River, May 7th; remained at Rouge River up to June 1st; thence proceeded, *viâ* Jacksonville, to Siskiyou Mountains, June 7th; remained on the Siskiyou range to June 18th, crossing into

"California,

"thence *viâ* Crescent City &c. to mouth of Klamath River, June 23rd, and then to Eureka on July 1st."

In the identification of several of the forms here enumerated I have been assisted through the generosity of Mr. Henry Edwards (formerly of San Francisco, but now of New York), who recently presented a series of named Californian Lepidoptera to the collection of the British Museum.

Four, if not five, of the species appear to me to be new to science, for one of which I have found it necessary to erect a new genus. There are also several well-marked varieties of known species not hitherto recorded, for some of which I have considered it best (for purposes of reference) to propose distinctive names, although I cannot regard them as entitled to specific rank.

Sphingidæ.

HEMARIS, Grote.

1. *Hemaris cynoglossum.*

Hemaris cynoglossum, H. Edwards, Proc. Cal. Acad. Sci. 1875, p. 88.

Rouge River, May 7th to June 1st.

DIENECES, gen. nov.

Allied to *Cinogon*, but the margins of the wings not sinuated, the secondaries smaller, shorter; the anal tuft better developed, expanded in the male; coloration of *Pterogon*.

2. *Dieneces Clarkiæ.*

Pterogon Clarkiæ, Boisduval, Ann. Soc. Ent. France, 2e sér. x. p. 319 (1852).

Between Camp Watson and Fort the Dalles, near the mouth of the Columbia River, April 14th to 21st.

DEILEPHILA, Ochs.

3. *Deilephila lineata.*

Sphinx lineata, Fabricius, Ent. Syst. p. 541 (1775).

No exact locality noted.

SPHINX, Linn.

4. *Sphinx oreodaphne.*

Sphinx oreodaphne, H. Edwards, Proc. Calif. Acad. Sci. v. p. 109 (1874).

California.

ARCTONOTUS, Boisd.

5. *Arctonotus lucidus.*

Arctonotus lucidus, Boisduval, Ann. Soc. Ent. France, 2e sér. x. p. 319 (1852).

California.

Agaristidæ.

ALYPIA, Hübn.

6. *Alypia Ridingsii.*

♂. *Alypia Ridingsii*, Grote, Proc. Ent. Soc. Phil. vol. iii. p. 521, pl. v. fig. 1 (1864); ♀. Stretch, Zyg. & Bomb. p. 12, pl. i. fig. 3 (1872).

Between Camp Watson, on John Day's River, N. Oregon and Fort the Dalles, near the mouth of the Columbia River, April 14th to 21st; also at Rouge River, between May 7th and June 1st.

7. *Alypia Maccullochii.*

Alypia Maccullochii, Kirby, Fauna Boreali-Americana, iv. p. 301. n. 1, pl. iv. fig. 5.

Rouge River, between May 7th and June 1st.

The female appears to be scarce; the spots on its secondaries are equally yellow with those of the primaries.

Arctiidæ.

CTENUCHIINÆ, Butl.*

SCEPSIS, Walk.

8. *Scepsis fulvicollis.*

Glaucopis unicolor fulvicollis, Hübner, Samml. exot. Schmett. i. pl. clxiv. (1806).

One example at Rouge River, Oregon, end of May.

CTENUCHA, Kirby.

9. *Ctenucha ochroscapus.*

Ctenucha ochroscapus, Grote, Trans. Am. Ent. Soc. vol. i. p. 330 (1868).

Cape Mendocena.

Excepting in its superior size, slightly browner primaries, and the paler (more salmon-coloured) borders of the tegulæ, this species might be associated with *C. rubroscapus*, Ménétr. (nec Boisd., which is = *C. multifaria*, Walk.).

PERICOPIINÆ, Butl.

GNOPHÆLA, Walk.

10. *Gnophæla Hopfferi.*

Gnophæla Hopfferi, Grote, Trans. Am. Ent. Soc. vol. i. p. 332 (1868).

Rouge River, Oregon, May 7th to June 1st.

ARCTIINÆ, Stretch.

HYPHANTRIA, Harris.

11. *Hyphantria cunea.*

Bombyx cunea, Drury, Ill. Exot. Ent. i. p. 36, pl. xviii. fig. 4 (1770).

Lord Walsingham had a single example labelled "Wash-

* See Journ. Linn. Soc. vol. xii. p. 429.

ington;" it agrees with the form represented by Stretch (Zyg. and Bomb. pl. viii. fig. 20).

Spilosoma, Steph.

12. *Spilosoma virginica.*

Bombyx virginica, Fabricius, Ent. Syst. Suppl. p. 437 (1798).

No locality recorded.

13. *Spilosoma vestalis.*

Spilosoma vestalis, Packard, Proc. Ent. Soc. Phil. iii. p. 125 (1864).

One female. Jacksonville, Oregon.

Euchætes, Harris.

14. *Euchætes oregonensis.*

♂. *Euchætes oregonensis*, Stretch, Zyg. & Bomb. p. 187. n. 2, pl. viii. fig. 7 (1871–73).

Rouge River and Jacksonville, Oregon, May 7th to June 7th.

Hypercompa, Steph.

15. *Hypercompa virginalis.*

Chelonia virginalis, Boisduval, Lép. Calif. p. 49 (1852).
Var. *Epicallia virginalis*, var. *ochracea*, Stretch, Zyg. & Bomb. p. 71, pl. iii. fig. 2 (1871–73).

Cape Mendocena.

Why Dr. Packard and others have placed this species in *Epicallia*, of which *E. villica* is type, it would indeed be hard to say; setting aside other differences, the utter dissimilarity of the male antennæ should have been sufficient to keep them widely separated. The pattern and colour of the wings, the less woolly and smaller thorax, and the barred abdomen are all characteristic of *Hypercompa*; in fact, with the exception of the rather shorter costal margin of the primaries, which may perhaps be regarded as a generic character, I can see nothing to distinguish it from that genus.

Arctia, Schrank*.

16. *Arctia achaia.*

Arctia achaia, Grote, Trans. Am. Ent. Soc. vol. i. p. 334, pl. vi. figs. 45, 46 (1868).

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* It may be well to note here that the *A. antholea*, Boisd., of California is evidently conspecific with *A. docta*, Walk., from Mexico.

Sonoma County and Mendocino County, California, May 18th to June 14th, also Rouge River, Oregon.

Var. *ochracea*, Stretch, Zyg. & Bomb. p. 125; pl. v. fig. 21 (1871–73), but without pale veins.

Rouge River, May 7th to June 1st.

17. *Arctia simplicior*, sp. n.

Possibly a well-marked variety of *A. achaia*, but apparently intermediate between that species and *A. Saundersii*: primaries as in var. *ochracea*, excepting that the veins are not cream-coloured (this, however, is a variable character in *A. ochracea*): secondaries scarlet, paler along the abdominal border and at base; a small subbasal black spot in the cell, no other basal markings; but the lunate discocellular spot, three semicircular submarginal spots, and an irregular external border (completely divided, however, at the extremity of the first median branch) almost exactly as in Stretch's fig. 19 of *A. achaia*. Expanse of wings 48 millim.

Jacksonville.

Only one female of this form was obtained. The almost entire absence of the large black discoidal patch and of the broad basiabdominal streak seems to bring this insect near to *A. Saundersii* and *intermedia*; the body, however, is coloured as in *A. ochracea*.

18. *Arctia phalerata*, var. *incompleta*.

Differs from typical examples in the absence of the subapical oblique cream-coloured stripe to complete the ⋚-shaped marking on the disk of primaries.

Washington.

ANTARCTIA, Hübn.

19. *Antarctia rubra*.

Antarctia rubra, Neumoegen, "Papilio," p. 79 (1881).

♀. Mendocino Co., California, May 24th to June 14th.

This, if rightly identified, must be the insect figured by Mr. Stretch, Zyg. & Bomb. pl. viii. fig. 11; but the examples obtained by Lord Walsingham are rather larger, of a deeper reddish colour and with blacker secondaries than in the illustration, which seems to me a little undercoloured.

20. *Antarctia Walsinghamii*, sp. n.

Allied to the preceding, but slightly smaller, the primaries bright crimson with a small black spot at the end of the cell; fringes slightly paler than the ground-colour: secondaries deep rose-red with scarlet veins, the discoidal cell and two interno-median streaks irrorated with grey; three almost confluent apical submarginal blackish spots and a squamose blackish submarginal streak in continuation of these spots: thorax bright red; antennæ scarlet; palpi scarlet; abdomen paler red; legs scarlet above, but yellowish in the central line below; pectus yellow, with tufts of orange-red hairs; venter bright orange-yellow, red at the sides. Wings below bright rose-red, with the costal borders and veins brilliant scarlet; a small black spot at the end of each discoidal cell. Expanse of wings 41 millim.

Rouge River, Oregon.

Only one example of this exceedingly beautiful species was obtained. I cannot believe it to be a variety of the preceding; it certainly has a greater claim to specific rank.

Leptarctia, Stretch.

Mr. Stretch recognizes three species, *L. decia*, *lena*, and *dimidiata*, which he distinguishes by the coloration of the secondaries; the fine series obtained by Lord Walsingham shows that *L. dimidiata* belongs to the two divisions of *L. decia* and *L. lena*, since the females always show a trace and sometimes a well-marked band of ochreous or red. As the broad-banded form is exceptional, however, it may perhaps represent another variety.

Judging from the series before me I cannot hesitate to regard the whole as referable to one extremely variable species, consisting of eight fairly marked varieties; and as four of these have already received distinctive names, and, moreover, as the differences in pattern and coloration appear in both sexes, I shall not hesitate to give varietal names to the remaining four, so as to enable lepidopterists to speak of them without the necessity of describing in each case the form to which they refer.

21. *Leptarctia californiæ.*

Var. 1. *Leptarctia Stretchii*, var. n.

♂. *Leptarctia dimidiata*, var., Stretch, Zyg. & Bomb. pl. v. fig. 9 (1871–73).

♀. Band of primaries buff-coloured, a spot of the same colour at base, and a second towards the base of internal border: secondaries with an ill-defined streak of orange scales across the radial and median interspaces, a spot of the same at anal angle, and a scarlet marginal spot at extremity of submedian vein: abdomen with a scarlet lateral stripe. Expanse of wings 36 millim.

♂ ♀. Rouge River, Oregon.

Var. 2. *Leptarctia Boisduvalii*, var. n.

? *Leptarctia decia*, var., Stretch, Zyg. & Bomb. pl. v. fig. 15.

The three specimens obtained by Lord Walsingham differ from Mr. Stretch's figure in having the white band of primaries zigzag and the band of secondaries orange (this band is variable in width).

♀. Rouge River, Oregon.

Although only females of this form have yet come to hand, I do not doubt that similar males exist.

Var. 3. *Leptarctia dimidiata*, Stretch.

♂. *Leptarctia dimidiata*, Stretch, Zyg. & Bomb. p. 123. n. 2, pl. v. figs. 7, 8 (1871–73).

♀. Differs from the male in having no abbreviated white band on the primaries, sometimes one or two white dots towards the apex; a slightly curved series of small ochreous or crimson spots just beyond the middle of the secondaries, one or two marginal spots near the anal angle, and the fringe slightly flecked with the same colour. Expanse 37 millim.

♂ ♀. Rouge River, Oregon (six examples).

Var. 4. *Leptarctia latifasciata*, var. n.

♀ differs from the preceding in its broad red belt, and from figure 15 of Stretch's plate in the absence of any band across the primaries. Expanse of wings 35 millim.

Rouge River (one example).

The male of this variety remains to be discovered.

Var. 5. *Leptarctia fulvofasciata*, var. n.

♂. *Leptarctia lena*, var., Stretch, Zyg. & Bomb. pl. v. figs. 13, 14.

♀ only differs from the male in having no white spots on the primaries. The width of the band of secondaries is somewhat variable.

♂ ♀, Rouge River; ♀ between John Day's River and Fort the Dalles.

Var. 6. *Leptarctia californiæ* (typical).

Nemeophila californiæ, Walker, Cat. Lep. Het. iii. p. 625. n. 3 (1855).
Lithosia adnata, Boisduval, Ann. Soc. Ent. Belg. xii. p. 73. n. 84 (1868).

♂ ♀, Rouge River; ♂ between John Day's River and Fort the Dalles.

This form is represented by Stretch, pl. v. figs. 11 and 16, as *L. lena*; but the black band on disk of secondaries (barely shown on the secondaries of his female) is often broad and well marked in both sexes.

Var. 7. *Leptarctia decia.*

Lithosia decia, Boisduval, Ann. Soc. Ent. Belg. xii. p. 72. n. 83 (1868).

♀. Rouge River, Oregon and Mendocino County, California.

This form chiefly differs from Stretch's fig. 11 in the reddish-orange colour of the secondaries and the less prominent white spots on the primaries.

Var. 8. *Leptarctia lena.*

Lithosia lena, Boisduval, Ann. Soc. Ent. Belg. xii. p. 73. n. 85.

♂ ♀. Between John Day's River and Fort the Dalles (five examples).

No examples of this variety (Stretch, Zyg. & Bomb. pl. v. figs. 3 and 5) were obtained at Rouge River; but *L. fulvofasciata*, regarded by Stretch as a variety of the same species, though distinct from *L. dimidiata* and *L. decia*, occurs there with them.

Lithosiidæ.

Hyaloscotes, gen. nov.

Aspect of *Psyche* and *Comacla*; venation of *Byssophaga*, Behr. (= *Trichromia*, Hübn.)*, but the primaries with longer costal margin, more arched towards apex; wings semitransparent, opalescent; the head and body very hairy, particularly the sides of the abdomen; genitalia prominent; antennæ setose, hairy at the base; legs long and rather slender; palpi very small. Type *H. fumosa*.

22. *Hyaloscotes fumosa*, sp. n.

Wings semitransparent, smoky grey, with darker marginal line, veins, and fringes: primaries slightly darker than secondaries: antennæ brown; body blackish, clothed with long whitish hair; genitalia mahogany-brown; legs pale greyish brown. Expanse of wings 27 to 31 millim.

* See Stretch in Zyg. & Bomb. p. 48, as "*Cisthene.*"

Five male examples, Shasta and Siskiyou Counties; Mount Shasta.

This is a most singular-looking species, which, but for the fact that its neuration locates it among the Lithosiidæ, I should have been almost inclined to place among the Psychidæ.

NOLA, Leach.

23. *Nola minna*, sp. n.

Primaries above silvery grey; a black-brown dash at the base of the costal margin, a black spot at basal third, a larger rhomboidal jet-black spot (immediately below the second costal spot) within the cell, and an oblique series of four blackish dots between the latter and the inner margin; a black dot at the end of the cell, a slightly sinuous series crossing the wing obliquely just beyond the cell, and a slightly zigzag disco-submarginal series of blackish spots; costal margin from before the middle to the apex spotted with blackish; fringe sordid white, traversed by two series of oblong grey spots: secondaries sericeous white, the costal border and fringe slightly sordid: body white, the abdomen sordid and greyish towards the centre; palpi long, porrect, white above, with the sides grey; antennæ greyish. Primaries below grey, with grey-speckled white borders; fringe as above: secondaries white, the costal area slightly irrorated with grey scales; a small grey discocellular spot: body below greyish brown; tarsi and venter banded with white. Expanse of wings 24 millim.

Three specimens. Mendocino County, California.

Of the European species this most nearly resembles *N. centonalis*; its antennæ, however, are longer and more slender. By the description I should judge it to be allied to *N. sexmaculata* of Grote.

Liparidæ.

ORGYIA, Ochs.

24. *Orgyia nora*.

Orgyia nora, Fitch, Eighth Report on Noxious Insects of New York, p. 675 (1864).

One male. Siskiyou County, California.

I am rather sceptical about the distinctness of this species from *O. antiqua*; it is certainly darker (or rather duller) than the majority of specimens of the European species; but the latter is frequently much darker than the example now before me; whilst three specimens, undoubtedly referable to *O. antiqua*, in the Museum collection from Nova Scotia, are paler than the majority of European examples. I believe that *O. nora* is a bad species.

25. *Orgyia gulosa.*

Orgyia gulosa, H. Edwards, "Papilio," p. 61 (1881).

Two males. Lake County, California.

I had already separated these from a series of *O. vetusta* before I was aware that Mr. Edwards had described it. The specimens are smaller than *O. vetusta*, with rather less-pointed primaries; these wings are slightly browner, giving the insect a more uniform coloration; the stripes across the primaries are more regular, the inner one straighter, and the white spot near external angle is a good deal smaller.

26. *Orgyia vetusta.*

Orgya (sic) *vetusta*, Boisduval, Ann. Soc. Ent. Belg. xii. p. 28. n. 94 (1868).

Lake and Colusa Counties, California.

Lasiocampidæ.

Gastropacha, Ochs.

27. *Gastropacha Mildei.*

Gastropacha Mildei, Stretch, Zyg. & Bomb. p. 113. n. 1, pl. iv. fig. 12 (1871–73).

Rouge River, Oregon.

One example. Rather smaller and of a more uniformly lilacine-grey colour than Stretch's figure.

Saturniidæ.

Pseudohazis, Grote.

28. *Pseudohazis eglanterina*, var.

Saturnia eglanterina, Boisduval, Ann. Soc. Ent. France, 2e sér. x. p. 323. n. 95 (1852).

California.

A single extremely melanistic example, in which the orange-yellow areas are reduced to short dashes, those towards the costa of primaries washed with pink.

Drepanulidæ.

Drepana, Schrank.

29. *Drepana arcuata.*

Drepana arcuata, Walker, Cat. Lep. Het. v. p. 1164. n. 8 (1855).

Washington.

Ceruridæ, fam. nov.

Cerura and allies, with their Drepanulidiform larvæ, must be separated from the typical Notodontidæ: their larvæ are broad in front, with a distinct angle or hump at the fourth segment, fourteen legs and a forked pair of projecting tails, from which, when annoyed, bright-coloured filaments are exserted. The cocoon is hard, and the imago very woolly.

Cerura, Schrank.

30. *Cerura bicuspis?*

Bombyx bicuspis, Borkhausen, Eur. Schmett. iii. p. 380. n. 141.

Mendocino County, California.

Notodontidæ.

Nadata, Walk.

31. *Nadata Doubledayi*, var. *oregonensis*.

Differs from typical *N. Doubledayi*, Packard, in the distinctly greyer tint and greater prominence of the markings on the primaries; the lines across these wings are also much more divergent, the inner line being considerably more oblique. Expanse of wings, ♂ 48 millim., ♀ 60 millim.

Rouge River, Oregon.

It is possible that this may be specifically distinct; and therefore I give it a distinctive name; but it does not seem to differ so evidently as *D. Doubledayi* and *D. gibbosa*, though these two were placed together by Walker.

Hepialidæ.

Sthenopis, Packard.

32. *Sthenopis anceps.*

Hepialus anceps, H. Edwards, "Papilio," p. 36 (1881).

California.

Surely this cannot be the species intended by Behrens in his description of *H. Baroni*? That description has puzzled me, since it states that the third and fourth bands are fused, and that the submarginal forms a fifth band, whereas it appears that the insect only possesses three bands in all.

The example in Lord Walsingham's series is rather of a subochreous clay-colour than reddish-brown tint; but different men hold different views respecting colours (possibly they may not even see them alike), as an instance of which I may note that what Hewitson invariably called "rufous brown" I should describe as "fuliginous brown," or, in some cases, as "olivaceous brown," the colour having to my eyes a green rather than a red shade; in the second place, it is possible, though hardly probable, that the specimen before me is referable to another new species of *Sthenopis*.

Hepialus, Fabr.

33. *Hepialus sequoiolus.*

Hepialus sequoiolus, Behrens, Can. Ent. viii. p. 174 (1876).

Mendocino County, California.

34. *Hepialus mendocinolus.*

Hepialus mendocinolus, Behrens, Can. Ent. viii. p. 174 (1876).

Mount Shasta, California.

35. *Hepialus Lenzi.*

Hepialus Lenzi, Behrens, Can. Ent. viii. p. 175 (1876).

Mendocino County, California; Rouge River, Oregon.

The *H. sangaris* of Strecker (pl. xv. fig. 5, 1877) seems to come between this species and the following.

36. *Hepialus inutilis.*

Hepialus inutilis, H. Edwards, "Papilio," i. p. 36 (1881).

Mendocino County, California.

The oblique bands on primaries are much whiter in some examples than in others, sometimes also showing traces of a scarlet margin similar to that of the ochreous bands in *H. Lenzi*.

XXXI.—*Description of a new Species of the Genus* Trichoplus (*Coleoptera, Cremastochilidæ*). By Charles O. Waterhouse.

Trichoplus cordicollis.

Valde oblongus, niger; thorace cordiformi, disco excavato; elytris oblique striatis, singulatim carina longitudinali suturæ proxima et parallela instructis.

Long. $4\frac{1}{2}$ lin.

Very near to *T. Schaumii*, Westw. (Thesaurus, p. 33, pl. ix. fig. 10), but at once distinguished by the thorax being cordiform instead of orbiculate. The thorax is closely and strongly punctured, especially at the posterior border of the discoidal excavation; the base itself is not punctured. Scutellum striolate. Elytra parallel for two thirds their length, then a little narrowed to the apex, which is obtuse; sutural region flat, obliquely vermiculate-striolate, the flattened region bounded on the outer side by a carina which does not extend to the apex. Towards the side there is an indication of a second carina, the surface between the dorsal carina and the sublateral one less obliquely striolate; some very fine striolæ may also be traced on the sides; the apex is dull and has some very fine elongate punctures. The abdomen has some deep, elongate, longitudinal punctures on each side of the middle of the four basal segments. Pygidium transversely quadrate, opaque. All the tibiæ are simple; but the posterior are shorter and broader than in *T. Schaumii*.

Hab. Zulu.

BIBLIOGRAPHICAL NOTICE.

A Handbook of the Vertebrate Fauna of Yorkshire, being a Catalogue of British Mammals, Birds, Reptiles, Amphibians, and Fishes, showing what Species are or have, within Historical Periods, been found in the County. By W. Eagle Clarke and W. Denison Roebuck. 8vo. London: Reeve, 1881.

The title of this book, as given above, renders it almost unnecessary for us to say any thing about the general nature of its contents. It is, as stated, a complete catalogue of the recognized British species of Vertebrata, with certain details with regard to the mode of occurrence and distribution of those which have occurred, or been asserted to occur, within the limits of the great northern county. Those species which have undoubtedly become extinct in Britain are inserted without numbers, and their names printed in old English characters; only two species which have usually been included in the British lists are omitted—namely the beech-marten (*Martes foina*), on the authority of the late Mr. E. R. Alston, and the right whale (*Balæna mysticetus*), on the ground of want of evidence, its supposed occurrence on the British coasts never having been recorded since the distinction was established between that species and *B. biscayensis*, which is certainly known to visit the British seas.

One is not much surprised to find that Yorkshire, the largest of British counties, embraces in its terrestrial fauna (including, of course, the inhabitants of the fresh waters) a very great majority of the British Vertebrates. Thus we find that it possesses 32 out of 45 terrestrial mammals, 4 out of 7 reptiles (and one of the others is British only because it inhabits the Channel Islands), 6 out of 7 amphibians, and 32 out of 53 freshwater fishes. With regard to the birds there would be some difficulty in drawing a distinction between marine and freshwater species; but taking the whole class we find Yorkshire boasting of no fewer than 307 species out of a total of 380.

That the county should be so exceedingly rich is easily explained when we consider its physical characters. It is not only the largest county in Britain, but it possesses a variety of geological structure, and consequently of surface, such as no other county can boast. In its western parts the old palæozoic rocks form an elevated country, rising here and there into actual mountain masses, and reaching in the north-west, towards the borders of Westmoreland, an elevation of some 2600 feet above the level of the sea; and from this lofty region the most beautiful and romantic dales sweep down towards the rich pasture-lands of the Craven district and the Vale of York. Southwards these older rocks form wild high moorlands, stretching away to the borders of Derbyshire. The great central plain, formed chiefly by the Vale of York, although chiefly covered up by clays and gravels, nevertheless presents a considerable variety of surface, and especially some interesting remains of the old forest of Galtres, which formerly spread over its whole northern part, extending up to the very walls of York, and harbouring in its recesses the wolf, the wild boar, and the red deer. In the north-east the Cleveland and Hambleton hills offer high ground of a totally different character from the old mountain-region of the west; and separated from these by the Vale of Pickering, we have the Chalk Wolds, with quite another character of scenery. Between the chalk and the sea again come the low grounds of Holderness. In a region of such diversified character, with an abundance of both wild and cultivated ground, it is no wonder if the terrestrial fauna is very extensive; and the coast-line, which stretches for nearly 120 miles from the mouth of the Tees to Spurn Point, offers in its lofty cliffs the most favourable conditions of existence for many species of sea-birds, whilst others find congenial haunts on the sandy shores of Holderness. Further, as our authors remark, the situation of Yorkshire, nearly in the middle of Britain, gives it an advantage with regard to migratory birds, some southern species finding here their northern boundary, while certain northern immigrants are not known to advance further to the south.

The only point in which Yorkshire shows to a disadvantage in this catalogue is the class of fishes—out of a total of 249 recorded British species, only 148 are known to occur in the county and the sea that washes its coast. Eighty species of marine fishes which occur somewhere in the British seas are unknown on the Yorkshire coast; some of these will probably turn up hereafter; many of them are scarce fishes, which have occurred only once or twice anywhere round our coasts, or species of southern type which can hardly be expected to find their way so far north.

On the whole, Yorkshire has good reason to be proud of its vertebrate fauna; and the authors of this catalogue may with equal justice take a pride in their work, which has evidently been executed with most conscientious care. As already stated, it includes the whole British vertebrate fauna; and the Yorkshire species are indicated by having appended to their names brief statements relating to their occurrence in the county, including the localities where specimens have been obtained in the case of the rarer species, and frequently an indication of the museums in which known Yorkshire specimens are preserved. The authors have given a short introductory exposition of the principles by which they have been guided in the performance of their task, followed by an excellent brief sketch of the physical aspects of Yorkshire, and a summary of the results of their investigation of its Vertebrata. The little book is a most valuable contribution to British zoological literature; and the authors could not have paid a more graceful compliment to the British Association in its year of jubilee than by dedicating it, as they have done, to Sir John Lubbock, as President of the Association at the York meeting.

MISCELLANEOUS.

On the Origin of the Ovum in the Hydroids. By M. A. de Varenne.

Until lately it was supposed that the ova and spermatozoids of the Hydroids are developed in the interior of the gonophores, medusoid buds, and Medusæ; and, in fact, these individuals are regarded as representing the sexual generations of these animals. Various opinions even have been put forward with regard to the endodermic or ectodermic origin of the sexual elements in these gonophores. M. Goette, however, in a memoir on *Hydrella*, published in 1880, showed that, in that species, the ova attain their complete development in the stem instead of being conveyed into a gonophore; and in the same year M. Weismann observed that, in *Plumularia echinulata*, the sexual elements are developed in the stem and afterwards pass into the gonophore; and he has recently demonstrated the same fact with regard to the ova in the genus *Eudendrium*.

Simultaneously with these two authors, but without any knowledge of their labours, I busied myself with the same question last summer at the laboratory at Roscoff; and the following are the results to which my observations have led me.

In *Campanularia flexuosa* the ova are met with in the endoderm of the stem before the appearance of any gonophores; they are true endodermic cells differentiated; and we find all the transitions between an ordinary endodermic cell and a well-developed ovum. They are conveyed, with the neighbouring endoderm and ectoderm, into the gonophore which is in course of development, and which is at first only a simple diverticulum of the body-wall of the Hydroid polype.

In a variety of *Plumularia echinulata* that I found at Roscoff I observed the same phenomena: the stem is filled with ova before the appearance of the gonophores; then the perisarc is perforated at a certain point in the stem where a gonophore is to be developed; the endoderm and ectoderm of the stem form, as it were, a hernia through this fissure, and carry the ova along with them as they advance. A new chitinous envelope is secreted, and we get a young gonophore, in which the ova complete their development. My observations upon *Sertularia pumila* have led me to the the same results.

Thus in these three species, which have their sexual generation represented by gonophores which always remain attached to the Hydroid polype, I was last year led to conclude that the ova are developed, not in the gonophore as was supposed, but in the actual stem of the polype itself, which has been regarded as the asexual generation.

This year I wished to profit by my sojourn at the Laboratory at Roscoff, in order to extend my observations to the species which have not gonophores fixed through their whole life, but free Medusæ.

I commenced with a species which has semimedusæ (that is to say, a gonophore with an umbrella, tentacles, and well-developed canals, but which remains constantly attached to the polype upon which it buds), namely *Gonothyræa Loveni*. Here, again, the ova originated from the endodermic cells of the differentiated stem; they are carried away with the neighbouring tissues into the blastostyle and the gonophore, to the interior of the gonangium, and they complete their development in the semimedusæ which are met with at the summit and exterior of the female capsules.

To study what takes place in the species of which the sexual generation is represented by free medusæ, I selected *Podocoryne carnea*, which lives parasitically upon the shells of *Nassa*, and *Obelia geniculata*. The former belongs to the Tubularian and the second to the Campanularian group.

In the region of the body of the Hydroid polype upon which the Medusæ are to bud we find ova in course of development. They are modified cells of the endoderm. When the Medusæ begin to bud they are at first only a simple diverticulum of the two layers which form the wall of the body of the polype; the ova are carried into the interior of this young bud: they are then much smaller than in the species cited above; but from this moment they are rapidly developed; soon the peduncle of the medusa ruptures, it separates from the Hydroid polype upon which it has budded, swims about freely, and completes its metamorphoses, while, at the same time, the ova it contains attain maturity.

We are thus led to conclude—

1. That in the species above cited, which have their sexual generation represented by gonophores always attached to the hydroid polype, or by semimedusæ or free medusæ, the ova originate in the interior of the hydroid polype itself, and not in these gonophores or medusæ.

2. That the ova are only differentiated cells of the endoderm, and that we can observe all the transitions between an ordinary endodermic cell and a well-developed ovum.

3. That the ova are conveyed into a bud, which is at first only a diverticulum of the body-walls of the polype; that this bud enlarges, and finally becomes a gonophore, destined to be always attached, or a semimedusa or a free medusa.

4. If we accept as demonstrated the facts that I have just expounded, the gonophores, the semimedusæ, and the medusæ cannot be regarded as sexual individuals; consequently it would seem that alternation of generations cannot be accepted for these species.—*Comptes Rendus*, August 16, 1881, p. 345.

Biological Evolution of the Aphis *of the Alder* * (Vacuna alni, *Schrank*). By M. J. Lichtenstein.

Among the Aphidians there exists a small group of insects which is distinguished from all the rest at the first glance by the mode of carrying the wings. Instead of being roof-like, as is the rule, these organs are laid flat upon the back, as in the males of the Coccidæ.

Of these the *Phylloxera* is the best known type. I have already, some ten years ago, traced the evolutive cycle of this genus, showing the *Phylloxera* of the oak with two apterous and two winged forms, the *Phylloxera* of the vine with three apterous and a single winged form, and the *Phylloxera acanthochermes*, which is always apterous.

Besides the genus *Phylloxera*, which has only three joints in the antennæ, only two other genera carry their wings horizontally, namely *Aploneura*, with six joints in the antennæ, and *Vacuna*, with five joints in the antennæ.

Only one species of *Aploneura* was known, namely the *Aphis* of the pistachio (*A. lentisci*); I discovered its sexual forms in a second on the roots of grasses. I regard this second species as a form of that of the pistachio, believing that there is a migration from the pistachio to the grasses, as also in that of the *Phylloxera* from the white oak to the green oak, and *vice versâ*.

It remained to study the *Vacunæ*, of which two species are known —*V. dryophila* on the oak and *V. alni* on the alder and birch.

Vacuna dryophila lives on the green oak and the white oak; and I have hitherto been unable to ascertain any regular migration; but, at any rate, in December, a *winged* form appears under the leaves of the white oak (*Quercus pubescens*), and there deposits sexual

* There is also upon the alder another Aphis (*Aphis alni* of Kaltenbach, Koch, &c.) which is a true *Aphis* with seven joints in the antennæ, and has been placed by Passerini in the new genus *Pterocallis*. I only intend here to examine the Aphis with flat wings, allied to *Phylloxera*, with which it has even been sometimes confounded.

individuals, male and female, which copulate after moulting. This winged form is what I have called the *Pseudogyne pupifère.* The fecundated female deposits, around the buds of the oak, brilliant black eggs without any covering. These eggs hatch in the spring.

Vacuna alni, according to authors (De Geer, Kaltenbach, Koch), appears in the spring in the form of a green founder *Aphis*, and produces young which acquire wings in June.

I do not know these two forms, which are my *Pseudogynes fondatrices* and *émigrantes*; but in July I have found, at Luchon, a large wingless *Aphis* of a brick-red colour, with a median line and four streaks (two on the shoulders and two at the nectaries) white, which deposited along the stems and under the leaves green young of two sizes. Although accustomed hitherto to apterous sexual forms, I immediately suspected that this large red *Aphis* was the *pupiferous* form, although it was wingless.

And, in fact, a very few days afterwards, and after a few very rapid moults, I saw the small individuals become active males, running about in search of the females and copulatimg with them. The *Pseudogyne pupifère*, which is wingless and red, is 1·10 millim. in length; the green female is 1 millim. long, and its transparency shows a large egg in its abdomen.

The male, which is also green, is 0·66 millim. in length. On pressing the abdomen very gently we see the penis issue, of the usual form of that of Aphidians.

After copulation, a shining secretion of a pearly white is seen to make its appearance on both sides of the abdomen of the female; this indicates that oviposition is about to take place. In fact, two or three days afterwards the egg is deposited, and the female indues it all round with the nacreous secretion that exudes from her abdomen, not in filaments, but in the form of small waxy plates. In tubes these eggs are placed upon the cork; I have not witnessed the oviposition in freedom.

The discovery of the sexual forms of *Vacuna alni* completes the knowledge of these forms in all the known species of Aphidians which carry their wings horizontally.

In *Phylloxera* and *Aploneura* the sexual individuals have no rostrum; nevertheless they enlarge and undergo at least one, and perhaps several moults. In the *Vacunæ* the sexual forms have a rostrum and feed. In this they approach the genus *Schizoneura*, several species of which have sexual forms bearing a rostrum. It is curious also to see in the genera *Phylloxera* and *Vacuna* species with a *winged pupiferous* form side by side with others with an *apterous pupiferous form.*

But in any case nothing could be more dangerous than to attempt to judge by analogy of these singular animals. Seeing the two *Vacunæ* side by side, one would take them for the same insect: now one oviposits in August, and the other in December; one has the pupiferous form apterous, the other winged; one has no secretion, the other exudes nacreous plates.

Consequently there still remain many observations to make before we can venture to undertake the classification of the Aphidians from a biological point of view.—*Comptes Rendus*, August 29, 1881, p. 425.

CONTENTS OF NUMBER 46.—*Fifth Series.*

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THE ANNALS AND MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

CONDUCTED BY

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

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

WITH FOUR PLATES.

Illustrative of Dr. L. Örley's Paper on Hair-worms in the British Museum, Prof. T. R. Jones's on Palæozoic Bivalved Entomostraca, Mr. H. J. Carter's on *Spongiophaga Pottsi*, and Mr. E. J. Miers's on Crustacea from Goree Island, Senegambia.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 47. NOVEMBER 1881.

XXXII.—*On Hair-worms in the Collection of the British Museum*. By Dr. L. Örley.

[Plate XVIII.]

The determination of the various species of the Gordiidæ has been much facilitated by Villot's excellent monograph *, in which all the species as yet known are described. About thirty-five were already distinguishable, without paying any attention to the number of varieties included by Diesing in his 'Systema Helminthum,' and which he himself allowed to drop in his "Revision der Nematoden" †. But even among these thirty-five fairly distinguishable species, some are so inadequately described that one might very easily regard them as synonyms; meanwhile, however, we must allow them to stand as distinct species until they shall have been re-examined.

The collection of Gordiidæ in the British Museum is a very good one, as it comprises nearly half the known species, the majority of which are represented by both male and female specimens. Schneider's ‡ assertion that the males in *Gordius* preponderate over the females is a statement that I cannot corroborate; on the contrary, I find that the female specimens predominate, and only in *Gordius subbifurcus* does there

* Archives de zool. expérim. t. iii. (Paris, 1874).

† Sitzungsb. d. k. Akad. d. Wissensch. Wien, 1861, Band xlii. no. 28.

‡ Monographie der Nematoden: Berlin, 1866.

appear to be a preponderance of males. Generally speaking, it is impossible to establish a fixed rule in this matter, either from the form or size of the body, as in certain species it is sometimes the males and at other times the females that attain the greater length. As the existing species are not represented by very many examples, I have not been able to submit any specimens to anatomical investigation, and have been obliged to content myself with a study of their external characters. I have, however, subjected the cuticula of each species to microscopical examination, and grouped them in accordance with the structure of this layer; it is, indeed, the one characteristic feature which, as the best, and, in fact, only practicable one, has been always adopted up to this time. I must remark that the cuticula separated from the muscular system has not been treated with any reagents, as its structure is best observed under water. Indeed it is generally impossible to determine species properly without a knowledge of the structure of their cuticula; and I have therefore given the microscopical structure of the same both in the case of the new species and of Baird's type specimens *.

I find it also desirable to add a table for identifying the existing species in the collection, and to characterize them briefly according to their most striking points. In addition to the literature of the subject, I have given an account of the localities where the specimens were found. This last presents much that is interesting in regard to the geographical distribution of the Gordiidæ, as the same species is found in different zones.

The species are generally divided into two groups, according to the structure of the cuticula, viz. into those that are smooth and those that are granulated. A closer microscopical investigation establishes this, and at the same time enables us to form a more exact division. I arrange the Gordiidæ in two groups, according as the cuticula consists of only one system of lines crossing each other, or, on the other hand, these lines are either wanting or along with the papilliform granulation compose the cuticula. The first group is divided into those that have cross lines, and those that have, together with these, a facetted network (fig. 3). The second group contains species in which either the whole cuticula consists of papilliform granulations (fig. 4), or where they are dispersed, and consequently have the appearance of being imbedded in an intermediate substance (figs. 5 and 7).

* 'Catalogue of the Species of Entozoa contained in the Collection of the British Museum' (London, 1853); and 'Proceedings of the Zoological Society of London,' 1853, pp. 20 & 21.

Table for determining the Species.

Cuticle smooth, marked out into spaces by intercrossing lines ..	Circular elevations and depressions behind the head	Semicircular depressions giving rise to a superficial segmentation; no longitudinal lines		*fasciatus.*
		No superficial segmentation; two brownish longitudinal lines		*fulgur.*
	No circular elevations..	Extremities of the body rounded	Superficial segmentation	*aquaticus.*
			No superficial segmentation....	*æneus.*
		Posterior extremity spoon-shaped in female		*platyurus.*
		Posterior extremity club-shaped in female		*sphærurus.*
Cuticle smooth, with facetted spaces in addition to the intercrossing lines ..	Cuticle with light brown spots			*pustulosus.*
	No spots	Sides of facettes dotted		*violaceus.*
		No dots		*subbifurcus.*
Cuticle with papillæ	Papillæ separated by interspaces	Equal, short	Posterior extremity of female with three lobes, subequal in breadth	*gratianopolensis.*
			One lobe narrower and styliform	*trilobus.*
		Of different sizes, higher and broader	Body slightly swollen at both ends.....................	*diblastus.*
			Body pointed anteriorly; cuticle very thick	*pachydermus.*
	Cuticle closely set with papillæ of various sizes			*verrucosus.*

The characters for distinguishing the species must be looked for in the form of the head and in the end of the tail, as well as in the lines crossing the whole length of the body, which are either wanting or appear single or double. The colour of the cuticula, as also the length of the body, are insufficient to determine the species, as, according to our knowledge, one and the same species may exhibit the most different tints and sizes. The form of the body is so similar that it is not available for the purpose of determination.

1. *Gordius fasciatus*, Baird. (Pl. XVIII. fig. 1.)

Gordius fasciatus, Baird, Proc. Zool. Soc. xxi. (1853) p. 21; id. Ann. & Mag. Nat. Hist. ser. 2, xv. p. 72; Diesing, Revision d. Nem. p. 602; Villot, Monogr. d. Drag. p. 53.

Length 28 centim.; breadth 1 millim.

Anterior extremity as well as posterior of a very dark colour, almost black, and roughened with raised circular ridges, which extend for about 3 lines. Only one specimen (female).

Hab. North America.

2. *Gordius fulgur*, Baird. (Pl. XVIII. fig. 2.)

Gordius fulgur, Baird, Ann. & Mag. Nat. Hist. ser. 3, vii. p. 229.

This gigantic species was collected by Wallace, and named and briefly described by Baird. It is very interesting to me to have discovered several of this species in unnamed bottles from different localities, and moreover to have found the male, which was hitherto unknown to science.

The belief that this worm is luminous is highly probable, its iridescent property proceeding from the crossing lines of the cuticle, which cause also a luminosity in *Lumbricus* and *Piscicola*. The people of Batchjan, moreover, call it the "lightning-snake."

Female: length 100–160 centim.; breadth 1–1·5 millim.

Male: length 40–70 centim.; breadth 1 millim.

The body is of the same breadth throughout, somewhat flattened, with two dark lines running along the sides of its whole length. The free end of the head is thinner than the other extremity; but both are rounded off; the postcephalic region is ringed, as in *G. fasciatus*. The cuticle is very firm, and is marked by lines crossing one another, which are generally set nearly at right angles. The hinder extremity of the male has two lobate processes, swollen at their free ends, and nearly touching; the thickening in the region of the sexual aperture is conspicuous. The males are much thinner and smaller than the females, and nearly quite flat.

Hab. Batchjan ("This curious Annelid is found on the ground in the forests of Batchjan, twisted among dead leaves or twigs."—*Wallace*); Celebes; Nepaul (*coll. by B. H. Hodgson, Esq.*); River Nikko, Central Japan.

3. *Gordius aquaticus*, Linné.

Complete literature in Baird's 'Catalogue of Entozoa,' p. 35.

Hab. Freshwater ponds, ditches, and slow-running streams. Europe.

4. *Gordius æneus*, Villot.

Gordius æneus, Villot, Monogr. d. Drag. p. 52.

Female, length 55 centim.; male, length 25 centim.

Body cylindrical, tapering but very slightly at extremities. Anterior extremity rather narrower than posterior. The tail of the male has two lobate processes with short spines at their ends. The thickening in the region of the sexual aperture is inconspicuous.

Hab. Cumana (Venezuela) and South Africa.

5. *Gordius platyurus*, Baird.

Gordius platyurus, Baird, Cat. of Ent. in Brit. Mus. p. 36; id. Proc. Zool. Soc. 1853, p. 20; id. Ann. & Mag. Nat. Hist. ser. 2, xv. p. 71; Diesing, Revision d. Nem. p. 601; Villot, Monogr. d. Drag. p. 52.

Body of a uniform dull white colour, narrower at anterior extremity and terminating in a broad flattish tail, which is slightly bifid.

Male unknown.

Hab. Jamaica.

6. *Gordius sphærurus*, Baird.

Gordius sphærurus, Baird, Catal. of Entozoa in Brit. Mus. p. 112; id. Proc. Zool. Soc. 1853, xxi. p. 21; id. Ann. & Mag. Nat. Hist. ser. 2, xv. p. 72; Diesing, Revision d. Nematoden, p. 601; Villot, Monogr. d. Drag. p. 56.

Female and male, length 36–40 centim., breadth 1–1½ millim.

Posterior extremity bluntly rounded and marked across with a rather elongated depression. The tail of the female is somewhat swollen and club-shaped. The tail of the male has two lobate processes; the lobes are equally broad, and the interval between them distinct. The thickening in the region of the sexual aperture conspicuous.

Hab. Khassya hills, India.

7. *Gordius pustulosus*, Baird.

Gordius pustulosus, Baird, Cat. Entoz. p. 37; id. Proc. Zool. Soc. 1853, p. 20; id. Ann. & Mag. Nat. Hist. ser. 2, xv. p. 72; Diesing, Revision d. Nem. p. 602; Villot, Monogr. d. Drag. p. 56.

Female, length 20–22 centim.

Tapering considerably at anterior extremity, and becoming gradually thicker at inferior. Along the whole length of the body, on each side, runs a pretty deep sulcus, interrupting the circular lines.

Hab. Abdomen of *Blaps obtusa*. Europe.

8. *Gordius violaceus*, Baird.

Gordius violaceus, Baird, Cat. Entoz. p. 36; id. Proc. Zool. Soc. 1853, p. 20; id. Ann. & Mag. Nat. Hist. ser. 2, xv. p. 71; Diesing, Revision d. Nem. p. 604; Villot, Monogr. d. Drag. p. 60.

Female, length 26–30 centim.

This species is closely allied to *G. subbifurcus*, and not to *G. aquaticus*, as Diesing supposed.

Body tapering slightly at upper extremity, and gradually becoming thicker at inferior. Along the whole length of the body, on each side, runs a pretty deep sulcus, interrupting the circular lines.

Hab. France; Germany (?).

9. *Gordius subbifurcus*, Meissner (= *G. tolosanus*, Duj.). (Pl. XVIII. fig. 3.)

Complete literature in Baird's 'Catalogue of Entozoa.'

Hab. Freshwater ponds and slow-running streams.

10. *Gordius gratianopolensis*, Charvet. (= *G. tricuspidatus*, Meissner). (Pl. XVIII. fig. 5.)

Filaria tricuspidata, L. Dufour, Ann. d. Sc. Nat. 1828, p. 222.
Dragonneaux de Claix, Charv. Nouv. Ann. du Mus. iii. pp. 36–44.
Filaria Grylli bordigalensis, Sieb. Stettin. entom. Zeitung, 1872, p. 154.
Gordius grution, Ch. Diesing, Syst. Helm. ii. p. 106.
Gordius tricuspidatus, Meissner, Zeitschr. f. wiss. Zool. vii. p. 55; Schneider, Monogr. d. Nematoden. Berlin: 1866.

Only one specimen (female).

Hab. Ceylon.

11. *Gordius trilobus*, Villot.

Gordius trilobus, Villot, Monogr. d. Drag. p. 59.

Female, length 30 centim.

The hinder extremity of the female has three lobate processes, somewhat rounded at their free ends and closely touching. One lobe narrower and styliform. I am not quite certain whether our specimen is quite identical with the species of Villot; for he mentions nothing specially of the form of the extremity of the tail, and in our specimen the unequal lobe is so much narrower that it might be rather called a rod than a lobe. The lobes are so closely united that one can hardly distinguish them with the naked eye. In other respects it agrees with Villot's description.

Hab. Lima (Peru).

12. *Gordius diblastus*, n. sp. (Pl. XVIII. fig. 6.)

Female, length 40 centim.; male, length 16–20 centim.

Body slender, tapering at both extremities, especially posteriorly. The extremities are somewhat swollen and button-shaped. The tail of the male has two lobate processes of nearly equal thickness throughout their whole length. Thickening in the region of genital aperture inconspicuous. Cuticle with very slightly raised crossing lines, and covered with pale spots.

Hab. New Zealand.

13. *Gordius pachydermus*, n. sp.
(Pl. XVIII. fig. 7.)

Male, length 16–20 centim.

This species is especially distinguished by the thickness of its cuticle, which is covered with a great many more or less elevated papillæ of various sizes. No crossing lines are to be seen; and the cuticle appears almost structureless.

Body of a red-brownish colour, tapering continuously at the extremities, especially at the anterior. Semicircular depressions giving rise to a superficial segmentation. Tail of the male has two lobate very short processes, equally broad throughout their whole length, running almost parallel and not touching each other. The horseshoe-shaped thickening in the region of the genital aperture inconspicuous.

Hab. New Zealand (*coll. by the Rev. R. Taylor*).

14. *Gordius verrucosus*, Baird.
(Pl. XVIII. fig. 4.)

Gordius verrucosus, Baird, Catal. of Entoz. p. 36, t. i. f. 5; id. Proc. Zool. Soc. 1853, p. 20; id. Ann. & Mag. Nat. Hist. ser. 2, xv. p. 71; Diesing, Revision d. Nem. p. 602; Villot, Monogr. d. Drag. p. 60.

Female, length 16–50 centim., very variable.

Body black, covered all over with innumerable small raised warty papillæ, round and very stiff. Head small.

Hab. South Africa and Ceylon.

EXPLANATION OF PLATE XVIII.

Figs. 1–7. Structure of cuticle in the different species. (Object-glass $\frac{1}{3}$ inch.)

Fig. 1. *Gordius fasciatus*, Baird.
Fig. 2. *Gordius fulgur*, Baird.
Fig. 3. *Gordius subbifurcus*, Meissner.
Fig. 4. *Gordius verrucosus*, Baird.
Fig. 5. *Gordius gratianopolensis*, Charv.
Fig. 6. *Gordius diblastus*, n. sp.
Fig. 7. *Gordius pachydermus*, n. sp.

XXXIII.—*Notes on the Palæozoic Bivalved Entomostraca. No. XII. Some Cambrian and Silurian* Leperditiæ *and* Primitiæ *. By Prof. T. Rupert Jones, F.R.S., F.G.S.

[Plates XIX. & XX.]

Since the publication of my notes on Scandinavian, British, and North-American *Leperditiæ*, in the Ann. & Mag. Nat. Hist. ser. 2, vol. xvii. pp. 81–100, ser. 3, vol. i. pp. 244–257, and pp. 340–342 (1856–58), considerable additions have been made to the list of known species, and to some extent a revision of the members of the group has been carried out. M. Fr. Schmidt † has given a careful monograph of the *Leperditiæ* of Russia and neighbouring countries; and Dr. Lars Kolmodin ‡ has similarly treated those of his own country.

My esteemed friend M. J. Barrande has given us in his admirable 'Système Silurien du Centre de la Bohême' §, a perfect bibliographic history, as well of this genus as of some closely allied genera, as far as the date of his publication reaches; and, besides the descriptive details of the generic characters and an account of the new species discovered by himself in Bohemia, he has elaborated several most useful tables showing the geographical and geological range of the known forms of *Leperditia*, *Isochilina*, *Primitia*, and *Beyrichia*.

* For No. XI. see Ann. & Mag. Nat. Hist. ser. 4, 1875, vol. xv. p. 52.

† "Ueber die russischen silurischen Leperditien," &c., Mém. Acad. Imp. Sc. St. Pétersbourg, sér. 7, vol. xxi. (1873).

‡ 'Bidrag till Kännedomen om Sveriges Siluriska Ostracoder,' Upsala, 1869; and "Ostracoda Silurica Gotlandiæ," &c., Œfvers. Kongl. Vet.-Akad. Förhandl. 1879, no. 9 (Stockholm, 1880).

§ 1e partie: Recherches paléontologiques. Supplément au vol. i. Trilobites, Crustacés divers, et Poissons. 4to, Paris and Prague, 1872.

Our fellow-workers in North America also have contributed to the geological history of these Ostracodes.

The gradual accumulation of specimens, and an improved acquaintance with their special characters, have enabled my colleagues, Dr. Holl, Mr. Kirkby, and Prof. Dr. G. S. Brady, and myself to offer at times some remarks on Palæozoic and other fossil bivalved Entomostraca; but, excepting as to the Carboniferous *Leperditia Okeni* and its varieties and allies, we have had little certain information to add to the general stock about this genus in particular. I have now, however, put together some notes and sketches illustrative of various doubtful points in the alliance of some British and other *Leperditiæ*, endeavouring to improve, if not simplify, their nomenclature. At the same time I have to introduce a few species not previously recognized.

In 1869 Dr. Lars Kolmodin * indicated the difference of form between certain specimens figured in the Ann. & Mag. Nat. Hist. 1856 (namely, pl. vi. figs. 1, 2, 4, and 5, on one hand, and fig. 3, *a–e*, on the other) as giving a varietal distinction; and in 1873 Fr. Schmidt† established a new species for Kolmodin's "var. *b*" (fig. 3, *a–e*, above mentioned) with the name of *L. Hisingeri*, illustrating also two varietal forms by his figs. 22 and 23. Subsequently ‡ Dr. Kolmodin objected to this name, under an erroneous impression that it was the same as "*Cytherina Hisingeri*" § as applied by Münster, and he substituted "*L. Schmidti.*"

There are certain differences between the more *oblong* carapaces of *L. balthica* (*l. c.* figs. 1, 2, 4, 5) and the more *ovate* form (fig. 3, *a–e*), as to both outline and relative convexity, the oblong form having the longest hinge-line, and being thickest at the anterior third, the other having a shorter hinge-line and being most convex in the middle.

In my paper of February 1856 (p. 86) I referred these distinctions to difference in age. The oblong form is rare. Large individuals are by no means common, I believe; and I have seen only one rather small specimen having this shape (in the British Museum), besides the two small valves shown by our figs. 10 and 11, and the imperfect valve shown by fig. 1 of our Plate XIX., which probably belongs to the form

* 'Sveriges Siluriska Ostracoder,' p. 14, figs. 4 and 5.

† Russ. silur. Leperd. p. 16.

‡ "Ostracod. Silur. Gotland." 1880; Œfv. K. Vet.-Akad. Förh. 1879, p. 133.

§ See Ann. & Mag. Nat. Hist. ser. 3, vol. xv. p. 408, pl. xx. figs. 12, *a–c*, where Jones and Kirkby defined Count Münster's Carboniferous species.

under notice. On the other hand, there are many small individuals of the subovate shape among specimens from Gothland. Taking every thing into consideration, I am inclined to think that the oblong specimens may be the *males* of the species. In aspect and structure the thick, smooth, brown carapaces of the two sorts (*oblong* and *ovate*) are remarkably similar. Nevertheless, for the convenience of collector and statist, as the difference of shape is easily recognized, it may be allowable to follow Fr. Schmidt in using the name *Hisingeri* for the ovate and *balthica* for the more oblong form, even if it has not a strictly specific claim.

Aiming at exact results, and trying to avoid unnecessary confusion in the endeavour to determine specifically either gradational forms or casts and damaged specimens (valuable on account of either rare occurrence or their geological position), I have taken pains in tabulating the measurements of my specimens; but the numerical value of relative dimensions has not given me precise grounds for classifying them, and I have had to rely more especially on the usually recognized features and characters.

Characteristic Features of the Leperditiadæ *.

1. Relative dimensions: absolute and proportional.
   - i. Length of valves.
   - ii. Length of hinge-line.
   - iii. Height of valves.
   - iv. Convexity of valves or thickness of carapace; often difficult to determine.

In comparing the *heights* of valves, it is to be remembered that the *right* is the overlapping and therefore the *higher* of the two valves.

2. Shape or outline.

All approach the oblong in outline, with one (upper or dorsal) margin straight for greater or less extent of hingement; but the *Leperditiæ* are subovate, with a more or less elliptical ventral curve.

i.	Approaching	oblong,	with relatively	long	hinge-line.
ii.	”	ovate,	”	”	”
iii.	”	”	”	short	”
iv.	Obliquely	”	”	long	”
v.	”	”	”	short	”
vi.	Cylindroid,		”	long	”

* T. R. Jones, "Palæoz. Biv. Entom.," Geol. Assoc. Proceed. 1869, pp. 2 and 9; Monthly Microsc. Journal, Oct. 1, 1870, pp. 187 and 190.

3. Elevations and depressions of surface.
   In *Leperditiæ*—
   i. Ocular tubercle and escutcheon.
   ii. Muscle-spot (and internal vascular markings).
   iii. Nuchal furrow.

4. Surface-ornament.
   Reticulation, &c.

The subjects of the present paper have long been under observation, some for many years, and have been brought together, by the kind help of friends, from Siluria, Scandinavia, Livonia, Russia, and North America. The drawings have been made at different times and on various scales, some under a grant from the Royal Society, by the aid of which also the careful plates before us have been lithographed.

I believe that figs. 1, 10, 11, and 4 of Pl. XIX. belong to the typical (oblong) *L. balthica*, and that figs. 2, 3, 13, 14, and 17 represent a small and short variety of the same. Figs. 5, 6, and 16 are varieties of the more ovate *L. Hisingeri*, Schmidt. Such dwarfs and varieties of large well-marked forms remind us of the great variations to which the Carboniferous *L. Okeni* was subjected in the varying seas and lagoons of that period. Fig. 9 is a new species from N.W. Canada. Fig. 12 is *Isochilina punctata* (Eichw.); fig. 15, *L. phaseolus* (His.), var. In Pl. XX. figs. 1–3 are simple *Primitiæ* from Newfoundland; fig. 5 answers to the typical *L. canadensis*; and Pl. XIX. fig. 7, and Pl. XX. figs. 4, 7, and 8, are probably *L. fabulites* (Conrad). Pl. XIX. fig. 9 is *L. amygdalina* of Canada; and Pl. XX. fig. 6 is a fresh and correct drawing of *L. Hicksii*, one of the oldest species of the genus.

1. *Leperditia balthica* (Hisinger). (Pl. XIX. figs. 1, 4 *a*, 4 *b*, 10, 11 : all small specimens.)

1837. *Cytherina balthica*, His. Leth. Suec. p. 10, pl. i. fig. 2.
1854. *Cythere baltica*, Römer in Bronn's Lethæa Geogn. ii. p. 528 (parte), pl. ix³. figs. 8, 9.
1856. *Leperditia balthica*, Jones, Ann. & Mag. Nat. Hist. ser. 2, vol. xvii. p. 85 (parte), pl. vi. figs. 1, 2, 4, 5.
1869. *Leperditia baltica*, var. *a*, Kolmodin, Sveriges Siluriska Ostracoder, p. 14. figs. 1–3.
1873. *Leperditia baltica*, Schmidt, Mém. Acad. Imp. Sci. St. Pétersb. sér. 7, vol. xxi. no. 2, p. 15.

Pl. XIX. fig. 10. This is the outline of a small, suboblong, left* valve, somewhat broken at the hinder margin, $\frac{7}{10}$ inch

* The narrower and overlapped valve of the carapace.

in length, from the Upper Silurian of Wisby, Gothland. It was collected by Dr. G. Lindström, and is marked "No. 58689" in the British Museum.

In its sloping ventral border it is very close to fig. 23 in the plate illustrating Schmidt's memoir on the Silurian *Leperditiæ* of Russia, &c., which he regards as a long-backed variety of his *L. Hisingeri*; but in our fig. 10 the contour of the antero-ventral region is too full. Its great length of hinge-line is characteristic of the true *L. balthica*, of which species I take this to be a small individual, with the usual nearly level ventral line of the left valve.

Pl. XIX. figs. 11 *a*, 11 *b*. A rather larger and more convex valve (right), $\frac{11}{20}$ inch long, from the same place and collection (and numbered the same) as the last. In its greater ventral rotundity compared with that of its fellow (fig. 10), this specimen approaches Schmidt's subrotund variety of his *L. Hisingeri* (fig. 22, *loc. cit.*); but its postero-ventral curve falls short to some extent, and its hinge-line is too long. This specimen seems to me to be the right (larger) valve of a small *L. balthica*.

Pl. XIX. figs. 1 *a*, 1 *b*, show the hinder moiety of a damaged right valve from the Wenlock Limestone of the Wren's Nest, Dudley. It belonged to Mr. John Gray's collection, and is marked "No. 58892" in the British Museum.

This imperfect valve (probably $\frac{9}{10}$ inch long when perfect) has relatively a rather long hinge-line; and its nearly oblong outline is by no means sufficiently ovate to match Schmidt's fig. 23 before mentioned. It appears to be a small *L. balthica*, very narrow for a right (overlapping) valve.

In 1864 I saw in the Ludlow Museum a good cast of such an oblong *Leperditia* as the above described, $\frac{5}{8}$ inch in length. It was collected by Mr. Lightbody in the yellowish Downton Sandstone of the Upper Ludlow series, at Ludford Park, Old Leominster Road, near Ludlow.

Pl. XIX. figs. 4 *a*, 4 *b*. These outlines illustrate two specimens of left valves of different sizes, and more or less damaged by crushing, from a band of bluish-grey shale at the Hammond Hill cutting on the Bromyard and Worcester Railway, in Herefordshire. They were collected by Mr. George Reece, of the Worcester Museum; and the Rev. W. S. Symonds, F.G.S., who kindly communicated the specimens in 1877, states that this particular band "lies quite at the base of the Old Red, and is perhaps the equivalent of the grey bands in the passage-beds at Ledbury Tunnel, Herefordshire*, which contain the fishes *Auchenaspis Salteri* and *A. Egertoni*."

* See Quart. Journ. Geol. Soc. vol. xvi. p. 193, and vol. xvii. p. 152.

In the confused mass of casts and crushed valves, adherent in fragments, which compose the hand-specimen before us, it is difficult to find even a tolerably perfect outline, and real features are not easily determined. Fig. 4, *a*, however (a nearly perfect valve, $\frac{3}{20}$ inch long), shows a rather long hinge-line and oblong shape, like that of fig. 1, *a*, and of the large and oblong individuals of *L. balthica* (Ann. & Mag. Nat. Hist. *l. c.* pl. vi. figs. 1, 2, 4, and 5). On the other hand, fig. 4, *b*, a smaller valve, $\frac{1}{11}$ inch long, seems to have an ovate outline, approaching that of Schmidt's fig. 23, before alluded to. In this case small specimens of the two kinds (*oblong* and *ovate*) occur together; but still the latter is the smaller (younger?) of the two. These badly-preserved specimens may be dwarfs of *L. balthica*.

2. *Leperditia balthica* (His.), var. *contracta*, nov. (Pl. XIX. figs. 2, 3, 13, 14, and 17.)

Pl. XIX. figs. 2 *a*, 2 *b*. This small specimen is from the same place and collection as fig. 1, and is marked "No. 58893" in the British Museum. It is $\frac{9}{20}$ inch in length, and is a broadly-ovate right valve, with a decidedly long dorsal edge; but it is well rounded ventrally, and convex at the centre. It altogether wants the oblique ellipticity of Schmidt's fig. 22 (var. of his *L. Hisingeri*) to be the same as that, and its hinge-line is too long; but at the same time it is too short and too much rounded ventrally for a true *L. balthica*.

This specimen approaches some forms of *L. canadensis*, such as fig. 11, *a*, pl. ix. Ann. & Mag. Nat. Hist. ser. 3, vol. i.; but it is larger and its convexity is central. Taking all its features into consideration, I must regard it as a small variety of *L. balthica*, to be distinguished under the name of var. *contracta*.

Casts of small *Leperditiæ*, from about $\frac{2}{10}$ to $\frac{3}{10}$ inch long, similar in shape to fig. 2 *a*, occur in the brown sandstone of the Kington Tilestones, Herefordshire (from Mr. R. W. Banks), and in the green shale of the Passage-beds near Ludlow (from Prof. John Morris), and with *Beyrichia Wilckensiana* in an olive-brown micaceous shale of the same series.

Pl. XIX. fig. 3. This is a brownish internal cast, in greenish fine-grained micaceous mudstone, of a small right valve, about $\frac{3}{10}$ inch long, somewhat crushed, from the Lower Ludlow beds at Leintwardine, near Ludlow*. It was collected by

* Mr. G. Cocking, of Ludlow, has found a similar specimen in the same beds at Church Hill, Leintwardine. In the 'Catalogue of the Fossils in the Museum of Practical Geology,' 1865, p. 38, a *Leperditia* is quoted as "*balthica*" from the Wenlock Limestone of Ferriter's Cove, Dingle, Ireland; but I have not yet examined the specimen.

Dr. H. B. Holl, F.G.S., and will be deposited in the British Museum.

This *cast* somewhat resembles in outline the *perfect valve*, fig. 2, *a*; but it has a relatively shorter hinge-line and a fuller antero-ventral curve, by which differences it approaches *L. Hisingeri*, without, however, identifying itself with that form. Although it has also some resemblance to *L. anticostiana* (fig. 8, *a*) in size and shape, this cast may belong to the same variety of *L. balthica* as fig. 2, namely var. *contracta*.

Pl. XIX. fig. 13. The outline of a small right (overlapping) valve, centrally convex, $\frac{3}{20}$ inch long. It is in the white Upper-Silurian *Pentamerus*-limestone of Talkof, Livonia, with *Primitiæ* * and *Obolus* (?), and was communicated some years ago by the late M. d'Eichwald. This is very much like Schmidt's fig. 22, already referred to; but its postero-dorsal angle is more, and its front angle less, pronounced, thus making its main diameter (diagonal) less oblique than in that variety of *L. Hisingeri*, Schmidt, and giving an outline far more like that of our fig. 2 *a*, though still fuller on the ventral curve. Thus it seems to be a minute individual of *L. balthica*, var. *contracta*.

Pl. XIX. fig. 14. The imperfect outline of a partly-imbedded very small right valve, with eye-tubercle and muscle-spot. Length $\frac{3}{40}$ inch. In this minute specimen we have the long hinge-line of the large *L. balthica*, together with the typical dorsal angles fore and aft. In a dark-grey compact "*Pentamerus*-limestone" from Kamenetz-Podolsk, on the river Zbroutsch. Communicated by the late M. d'Eichwald, and labelled "*L. phaseolus*, His.;" but the shape is against this allocation. The limestone contains other small Entomostraca besides this dwarfish var. *contracta* of *L. balthica*.

Pl. XIX. fig. 17. This is a small left valve in grey limestone, also communicated by M. d'Eichwald, probably from the Baltic provinces; but the label has been lost. It measures $\frac{4}{10}$ inch in length, and has the contour of the long-backed oblong type of *L. balthica* as far as can be seen, its postero-ventral margin being still imbedded in the limestone. The ocular tubercle is visible; but the muscle-spot has been lost by fracture of the convex centre.

Fig. 17 much resembles the cast, fig. 3, but is larger, in the proportion of 8 : 6 in length, and has a more decided postero-dorsal angle. It agrees with *L. balthica*, var. *contracta*.

* Labelled "*Leperditia minuta*, Eichw.," and very near to *P. concinna*.

3. *Leperditia Hisingeri*, Schmidt.
(Pl. XIX. figs. 5, 6, 16: small and varieties.)

1837. *Cytherina balthica*, Hisinger, Leth. Suec. p. 10, pl. xxx. fig. 1.
1854. *Cythere baltica*, Römer in Bronn's Leth. Geogn. ii. p. 528 (parte), pl. ix[3]. fig. 8, *a*, *b*, *c*.
1856. *Leperditia balthica*, Jones, Ann. & Mag. Nat. Hist. ser. 2, vol. xvii. p. 85 (parte), pl. vi. figs. 3, *a–e*.
1858. *Leperditia marginata*, Schmidt, Untersuchungen &c. p. 192 (parte).
1860. *Leperditia baltica*, Eichwald, Leth. Rossica, p. 1329 (parte).
1869. *Leperditia baltica*, var. *b*, Kolmodin, Sveriges Siluriska Ostracoder, p. 14, figs. 4, 5.
1873. *Leperditia Hisingeri*, Schmidt, Mém. Acad. Imp. Sci. St. Pétersb. sér. 7, vol. xxi. no. 2, p. 16 (figs. 22, 23, var.).
1880. *Leperditia Schmidti*, Kolmodin, Œfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, 1879, no. 9, p. 133.

Pl. XIX. figs. 5 *a*, 5 *b*. This fragmentary but interesting relic (front moiety) of a small right valve was collected by the late H. A. Wyatt-Edgell, Esq., in the "Upper Llandovery Sandstone" of Eastnor, near Malvern. It is white, with the outer layer flaking off. When perfect it was probably about $\frac{9}{20}$ inch long.

As far as the imperfect contour allows of reconstruction, this seems to come nearest to Schmidt's *L. Hisingeri* of any of the British specimens that I have seen, being more ovate than any other, and with probably a short hinge-line. It shows the eye-spot, a slight nuchal furrow, and a trace of the muscle-spot. We may refer to it as a dwarfed individual *L. Hisingeri*, Schmidt.

Dr. Holl has collected an apparently similar *Leperditia* (as a cast) from the "May-Hill Sandstone" of Eastnor, which is the same formation.

A perfect carapace, about $\frac{1}{2}$ inch long, but unfortunately partly imbedded, of *Leperditia Hisingeri* (?), has been collected by Mr. G. F. Whidborne, F.G.S., in the Upper-Silurian Limestone of Colwall Copse, near Malvern.

Pl. XIX. figs. 6 *a*, 6 *b*, 6 *c*. This is a ferruginous internal cast of a small left valve, $\frac{3}{10}$ inch long, with short hinge-line, from the Tilestones (uppermost Silurian) of Kington, in Herefordshire. It was collected by Mr. Richard W. Banks, of that place.

In the outline, fig. 6, *a*, we see an approach to Fr. Schmidt's fig. 23, regarded by him as a varietal form of *Leperditia Hisingeri*; but the postero-dorsal slope in fig. 6, *a*, has a lower angle, giving a greater ellipticity to the region below. Our cast somewhat resembles also our fig. 10 at first glance; but its hinge-line is relatively shorter, and its front half has less depth. We must remember that, as a cast, this specimen cannot be so good for such strict determination as either of the valves would be.

It exhibits the nearest approach among British specimens to Hisinger's *L. phaseolus* * that I have met with; but still it does not correspond with it by any means in full, being much too short on the back and too elliptical behind. Moreover it more closely resembles in outline the valve of *L. amygdalina* from Canada (fig. 9, *a*); but its convexity is more central.

I prefer, therefore, to regard it as a small, narrow, and very oblique form (variety *gracilenta*) of *L. Hisingeri*, Schmidt.

To the same category we must relegate the imperfect specimen from Kington, figured in the Ann. & Mag. Nat. Hist. ser. 2, vol. xvii. pl. vii. fig. 15, and (with another cast) quoted as "*Leperditia marginata*?" at pp. 95 and 100. Both of these specimens, from the Downton Sandstone (Tilestones) of Herefordshire, are in the British Museum. For some similar casts in these light-brown micaceous sandstones †, and in the olive shales of the passage-beds near Ludlow, I have been indebted to the late Mr. J. W. Salter and Mr. Lightbody, of Ludlow. One specimen in the Ludlow Museum in 1864, from the passage-beds ("olive shales" or "Tinmill shales") in the railway-cutting at Ludlow, was $\frac{4}{8}$ inch long. Several smaller specimens were collected there by Mr. G. Cocking and the late Mr. Lightbody, together with *Eurypterus*, small Brachiopods, &c.

To this kind of *Leperditia* we must also refer those noticed by Mr. Salter in the 'Catalogue of the Collection of Cambrian and Silurian Fossils in the University Museum at Cambridge,' 1873, pp. 189 and 193, as "*L. marginata*?" from the Upper Silurian of Ledbury and Ludlow.

In the same Downton Sandstone (from Mr. R. Banks, of Kington) and in greenish micaceous shale (from Prof. J. Morris) of the uppermost Ludlow series I have had some casts of small *Leperditiæ*, from less than $\frac{2}{10}$ to $\frac{3}{10}$ inch long, that have the same outline as that shown in our fig. 2, *a*, as above mentioned.

Pl. XIX. fig. 16. This is the outline of a small left valve $\frac{5}{20}$ inch long, $\frac{3\frac{1}{2}}{20}$ inch high, and convex in the middle. It bears the structural marks of eye-spot and muscle-spot, and has a

* Carefully figured from the original type by Dr. Kolmodin in his 'Ostrac. Sil. Gotl.' 1880, pl. xix. figs. 4 and 5.

† With *Lingula* and *Beyrichia Wilckensiana*.

strongly inturned ventral border, fitted to receive the opposite overlapping edge. It exhibits the form of Schmidt's *L. Hisingeri*, having its short hinge-line and ovate outline, but is rather too full in the antero-ventral curve.

This specimen was given to me by the late M. d'Eichwald some years ago, and is from the Upper-Silurian coral-limestone of Randifer, Isle of Oesel. It was labelled "*L. phaseolus*, His."

Except that its hinge-line is rather shorter in proportion and its angles less acute, this minute form resembles in shape my fig. 3, *b*, pl. vi. Ann. & Mag. Nat. Hist. 1856. It has been somewhat cleared of its hard matrix since it came to me; hence its outline, as now visible, is broader than when it was labelled "*phaseolus*," and is more like that of *L. Hisingeri*, Schmidt, to which I refer it as a dwarf variety.

The localities in Scandinavia and Russia where *L. balthica*, *L. Hisingeri*, *L. phaseolus*, &c. occur may be gathered from the memoirs of Kolmodin and Schmidt, by whom the many references made by Hisinger, d'Eichwald, and others are corrected according to the revised nomenclature of the species. In the 'Neues Jahrbuch' for 1867, p. 592, some Lower-Silurian *Leperditia*-marls are mentioned which seem to be the same as the Russian "wayboards of greenish-grey or reddish shale" of Murchison's 'Siluria,' 1867, p. 356. In Scania, at Lake Ringshön, there are Silurian red sandy beds (overlying limestone) which contain small *Leperditiæ* similar to those from the Ludlow Passage-beds (*fide* E. Hébert, 1867).

4. *Leperditia phaseolus* (Hisinger), var. *marginata*. (Pl. XIX. fig. 15.)

Cytherina phaseolus, Hisinger, Anteckn. phys. &c. Heft 5, p. 110, pl. viii. fig. 3, Tableau, p. 2; Lethæa Suec. p. 9, pl. i. fig. 1 (*fide* Kolmodin).
1873. *Leperditia Angelini*, Schmidt (parte), Mém. Acad. Imp. Sci. St. Pétersb. sér. 7, vol. xxi. no. 2, p. 14, figs. 14 and 17 (*fide* Kolmodin).
1880. *Leperditia phaseolus*, Kolmodin, Œfv. K. Vetensk.-Akad. Förhandl. 1879, no. 9, p. 134, fig. 4, *a–e* (Hisinger's original specimen), and fig. 5, *a*, *b*.

Pl. XIX. fig. 15. This is an outline of a small right valve, with the usual ventral overlap and a high convexity along the middle, which cannot be shown in the outline. It is $\frac{4}{20}$ inch long, and has an extremely delicate reticulation on a smooth surface; and the spots of eye and muscle are visible. This valve has also a narrow but distinct flat rim on the anterior and posterior margins. It lies in a compact cream-coloured "calcaire à coraux," one of M. d'Eichwald's specimens from Randifer, Isle of Oesel, and it was labelled by him "*Leperditia phaseolus*, His."

Although this approaches figs. 10 and 11 in shape, it is longer in proportion; and though somewhat shorter relatively than Kolmodin's figures of *L. phaseolus* (from Hisinger's type specimen), it may really belong to that species. A Scandinavian true *L. phaseolus* (from Dr. Lindström) shows a somewhat granulated surface, which, when smoothed down, would give the slight reticulation above noticed; but it has no trace of the slight marginal flange existing in our Baltic specimen (not shown in the outline) on the front and hinder edges, like that seen in Schmidt's fig. 13, *a*, of his *L. Angelini*, and more developed than is shown in Kolmodin's fig. 5, *a*. This variable expression of a feature would scarcely alter the specific place of these specimens; and therefore I refer to this specimen from Oesel as varietas *marginata* of *Leperditia phaseolus* (Hisinger).

Fr. Schmidt's *L. Angelini* and its varieties (*op. cit.* pp. 13, 14, figs. 13–18) seem to comprise *L. phaseolus* (as both Schmidt and Kolmodin surmise) and some closely allied forms.

5, 6, and 7. *Leperditia canadensis*, Jones, and *Leperditia fabulites* (Conrad), with varieties; and *Leperditia amygdalina*, Jones.

The characteristic features of *Leperditia canadensis* and its varieties are described and illustrated in the Ann. & Mag. Nat. Hist. ser. 3, 1858, vol. i. pp. 244, 340, &c., pl. ix. figs. 11–17; and in the Geol. Surv. Canada, decade iii. 1858, pp. 92–95, pl. xi. figs. 6–12, 16, 17. Its stout little valves, with their subquadrate outlines and strong dorsal angles, are easily recognized, however much the variability in some respects affects the surface, margins, and contours. One set, however, of the varieties indicated in the above-mentioned memoir, namely that typified by var. *josephiana*, is somewhat distinct from the others, having the antero-ventral region much contracted, and therefore possessing a more elliptical and graceful outline than the others. It slightly approaches the shape of *L. phaseolus*, but would more closely represent an elliptical, elongate-ovate form of *L. balthica*, if this were taken as the leading type, than any modification of *L. Hisingeri*, Schmidt, which is characterized by a short hinge-line and a very deep and oblique postero-ventral region.

It is this form, moreover, that seems to have been Mr. Conrad's *Cytherina fabulites**, as intimated at page 341, Ann. & Mag. Nat. Hist. May 1858, and p. 95, decade iii. Geol. Surv. Canada, and further supported by Prof. Safford, of

* Philadelph. Acad. N. Sci. Proceed. 1843, vol. i. p. 332.

Tennessee, who wrote, in the winter of 1858, to Mr. Billings, then of the Canadian Geological Survey, at Montreal, as follows:—"The village in which I reside rests upon Trenton and Black-river rocks. Many of the layers abound in *Leperditia fabulites* (Conrad). Thousands of them can be seen in half-an-hour's walk. They are certainly Conrad's species, as Mr. Jones has suspected. Several years ago I compared specimens from Mineral Point, Wisconsin*. The average size is about that of fig. 16, plate xi. of the Decade, or perhaps a little smaller; but they occur of all sizes, from a third larger down to that of the figure of *L. amygdalina* (fig. 19, *a*), and even smaller."

Mr. Billings observed, in his letter of December 20, 1858 (containing the above quotation), that "Mineral Point is at no very great distance from St. Joseph's, and in the same run of rocks; so that we might expect to find the species there; but Tennessee is far from these localities. The geological position, however, is the same."

In view of adopting Conrad's prior name ("*fabulites*") for the common North-American *Leperditia* of the Lower-Silurian (Trenton) Limestone, we have to point out (as intimated above) that *Leperditia canadensis*, Jones, very variable in its individuals, can be grouped into two series: one set (I.) have a more subquadrate outline than the other (II.), which have a rather long hinge and an obliquely ovate body. There is another Lower-Silurian form (III.), typified by *L. amygdalina*, which has a short hinge-line and a very oblique ovate body.

I. *L. canadensis*, var. *nana*, Ann. & Mag. Nat. Hist. 1858, vol. i. p. 244, pl. ix. figs. 11, 12; Geol. Surv. Canada, decade iii. p. 92, pl. xi. figs. 6, 7, 9, 10 (this I take to be typical, though small); and var. *labrosa*, Ann. & Mag. Nat. Hist. *l. c.* p. 245; decade iii. p. 93, fig. 8: both from the Chazy Limestone.

For these I propose to keep the specific designation of *L. canadensis*.

II. Varieties—*josephiana*, Ann. & Mag. Nat. Hist. *l. c.* pp. 340, 341; decade iii. p. 94, fig. 16 ("*fabulites*," Conrad): *anticostiana*, Ann. & Mag. Nat. Hist. *l. c.* pp. 340, 341; dec. iii. p. 95, fig. 17: *louckiana*, Ann. & Mag. Nat. Hist. *l. c.* p. 245, pl. ix. fig. 16; dec. iii. p. 93, fig. 11: *pauquettiana*, Ann. & Mag. Nat. Hist. *l. c.* p. 246, pl. ix. fig. 17; dec. iii. p. 94, fig. 12.

* Mineral Point is mentioned in the 'Geology of Wisconsin; Surveys of 1873–7,' vol. ii. 1877, at p. 682 &c.; and *Leperditia fabulites* is referred to as abundant among the "Trenton" fossils, at pp. 294, 298, 300, 302, and 325.

For these it will be convenient to adopt *Leperditia fabulites* as the specific name.

III. *Leperditia amygdalina*, Ann. & Mag. Nat. Hist. *l. c.* p. 341; decade iii. p. 97, figs. 18, 19.

Of these *L. fabulites*, var. *josephiana*, is the largest, *L. amygdalina* is the next; and the others (varieties of *L. fabulites*) diminish in size in the order given above. *L. amygdalina*, from the Chazy Limestone, and *L. canadensis* (*nana*), from the Chazy Limestone and Calciferous Sandrock, are the oldest; *louckiana*, from the Bird's-eye Limestone, *josephiana* and *pauquettiana*, from the Trenton Limestone, and *anticostiana*, from the Hudson-River group, succeed in geological age. The closely allied *L. ovata* of Pennsylvania* is also from a Lower Silurian rock, namely the Black-River Limestone, next above the Bird's-eye Limestone. The more cylindrical form, *L. Billingsii*, sp. n., from near Lake Winnipeg, is, like some of the foregoing, from the Trenton Limestone.

Pl. XIX. figs. 7, 8, and 9 illustrate some Canadian specimens described in 1858 (Ann. & Mag. Nat. Hist. ser. 3, vol. i. pp. 340–342), but not figured at that time.

Fig. 9, a perfect carapace of *L. amygdalina*, from L'Orignal, Canada West, has a length of $\frac{17}{40}$ inch. This species varies somewhat in relative proportions among individuals, but keeps an elongate oblique ovate form and the forward position of its convexity.

Fig. 8, a perfect carapace of *L. fabulites* (Conrad), var. *anticostiana*, $\frac{19}{40}$ inch long, is rather shorter and higher, in proportion, than the smaller valve figured in the Canad. Surv. decade iii. Besides East Point other localities in Anticosti yield this *Leperditia*. In the 'Catalogue of Anticosti Fossils,' by W. Billings, 1866, at page 68 it is said to occur at the Jumpers and other places in "Divisions 3 and 4 of the Anticosti group."

Fig. 7, a perfect carapace of *L. fabulites* (Conrad), var. *josephiana*, $\frac{1}{2}$ inch long, from St. Joseph's Island, Lake Huron. The ventral margin sloping away from the front end, the well-rounded posterior margin, and the rather long hinge-line are features which bring this form near to the Scandinavian *L. phaseolus*; but the latter is subcylindrical, having rather less ventral depth and a convexity *along* the middle of the valves.

Pl. XX. fig. 7 is a right valve, in outline, of *L. fabulites*, var. *josephiana*, $\frac{11}{20}$ inch long. The specimen came from St. Joseph's Island, at the outlet of Lake Superior, and was given to me by Prof. James Hall in 1872.

* Ann. & Mag. Nat. Hist. ser. 3, vol. i. p. 252, pl. x. fig. 14.

Fig. 8 is a perfect carapace, in outline, of *L. fabulites*, var. *josephiana*, with a length of $\frac{7}{20}$ inch and a height of $\frac{4}{20}$ inch, from Lebanon, Tennessee, U.S., and was also given to me by Prof. J. Hall.

Pl. XX. figs. 4 and 5. The specimens here figured were selected from among many crushed individuals forming a piece of *Leperditia*-rock, labelled "Neile Bay," and communicated by E. B. Tawney, Esq., F.G.S., as a fragment of a larger mass in the Museum of University College, Bristol. If "Neile Bay" be the same as, or near to, Port Neill, in Prince-Regent's Inlet, in extreme North America, the occurrence there of such *Leperditiæ* as these, which have a Lower-Silurian aspect (being apparently identical with *L. canadensis* and *L. fabulites*), would not be strange.

Fig. 4 is the outline of a left valve, broken along the ventral margin, and about $\frac{1}{4}$ inch long. What remains of the valve indicates the proportions of *L. fabulites* (*josephiana*).

Fig. 5 is a left valve, apparently retaining its outline, but broken at the centre, where it shows another similar valve underneath, symmetrically squeezed within it. This specimen is about $\frac{1}{4}$ inch long, and has the subquadrate outline, long hinge, and sharp dorsal angles of the typical *L. canadensis*.

8. *Leperditia Billingsii*, sp. nov. (Pl. XX. fig. 9.)

This is the internal cast, in white limestone, of a subcylindrical carapace, and is not quite perfect at the dorsal corners or ends of the hinge-line. It is from the Lower-Silurian (Trenton?) strata, near (to the west of) Lake Winnipeg and north of Lake Superior. In length it is $\frac{5\frac{1}{4}}{20}$, and in height $\frac{3}{20}$ inch. This unique specimen was sent to me by the late W. Billings, Esq., then palæontologist to the Geological Survey of Canada, in December 1858. In its cylindroid shape and in its relative length, height, and thickness this *Leperditia* differs from all the North-American species, and has too true a parallelism of the upper and lower margins to be compared with any allies of *L. phaseolus*. Nor has it any analogue except the less convex Upper-Silurian *L. parallela* of Schmidt's Russ. silur. Lep. 1873, p. 18, figs. 24–26, and the minute *L. parallela*, J. & K., of the Carboniferous rocks of Bavaria (Ann. & Mag. Nat. Hist. 1865, ser. 3, vol. xv. p. 407, pl. xx. fig. 6). I name it after its discoverer.

9. *Leperditia alta* (Conrad).

Among the Upper-Silurian *Leperditiæ* of North America are two forms which have been called *L. alta* (Conrad). These were figured by Prof. James Hall in the 'Palæontology of New York,' 1852, and were described and figured by myself in the Ann. & Mag. Nat. Hist. 1856, ser. 2, vol. xvi. p. 88, pl. vii. figs. 6, 7; and 1858, ser. 3, vol. i. p. 250, pl. x. figs. 8, 9. Prof. Hall subsequently referred to these forms in the 'Palæontology of New York,' vol. iii. 1859, part i. p. 372, intimating that the larger of the two might be distinguished as *L. Jonesii*; but the illustrations were not published with the text. It seems to me, however, that these larger (higher) specimens should retain the specific name of "*alta*."

In the 'Report of the Geological Survey of Ohio,' part ii. Palæontology, 1873, p. 187, Prof. F. B. Meek redescribed *L. alta* (Conrad), and gave two outlines (pl. xvii. figs. 2, *a*, *b*), analogous to the earlier figures, of the broad and the narrow forms respectively. In this case, as in the others, the two shapes ought to be distinguished, fig. 2 *b* (like fig. 7, pl. vii. Ann. & Mag. Nat. Hist. 1856) being a representative of *L. phaseolus* (His.) of Scandinavia; whilst fig. 2 *a* (like fig. 6, *l. c.*) is a broad or higher form, deserving the name "*alta*."

10. *Leperditia Hicksii*, Jones. (Pl. XX. fig. 6.)

Leperditia Hicksii, Jones, Quart. Journ. Geol. Soc. 1872, vol. xxviii. p. 183, pl. v. fig. 16 (mala).

An incorrect figure (reversed and imperfect) of this Cambrian *Leperditia*, interesting on account of its rarity and age, having been given in the Quart. Journ. Geol. Soc. above referred to, the specimen is here redrawn. It is $\frac{1}{4}$ inch long and pyritous. It was found at St. David's, South Wales, in or about the zone of *Paradoxides Hicksii*, rather below the middle part of the Menevian group.

ISOCHILINA, Jones.

1858. Subgenus, Jones, Ann. & Mag. Nat. Hist. ser. 3, vol. i. p. 248.
1870. Genus, Jones, Monthly Microsc. Journ. October 1870, pp. 187, 191.
1872. Genus, Barrande, Syst. Silur. Bohême, part i, suppl. to vol. i. p. 533.
1873. Genus, Schmidt, Mém. Acad. Imp. Sci. St. Pétersb. sér. 7, vol. xxi. no. 2, pp. 9, 21.

1. *Isochilina punctata* (Eichwald). (Pl. XIX. fig. 12.)

1856. *Leperditia marginata* (Kutorga), Jones, Ann. & Mag. Nat. Hist. ser. 2, vol. xvii. p. 91, pl. vii. figs. 11–13.
1860. *Leperditia phaseolus*, var. *punctata*, Eichw.
1873. *Isochilina punctata*, Schmidt, Russ. sil. Leperd. pp. 10, 22, figs. 36, 37.

Pl. XIX. fig. 12 exhibits the outlines of an impression (inside of a hollow cast) of the outside of the fore part of a left valve, which was probably $\frac{7}{20}$ inch long when perfect. It is in white Upper-Silurian Porambonite Limestone, from Gatschina, near Saretsche, in the Government of St. Petersburg. The rock is crowded with similar specimens, as convex and concave casts. It was sent to me (with other specimens) in 1862, by the late M. d'Eichwald, and is the same as the fragments of white Lower-Silurian Limestone with Entomostraca which I treated of in the Ann. & Mag. Nat. Hist. 1856. The figs. 11 and 12 of pl. vii. in that volume, and referred to at pp. 91 and 100, belong to this species, and not to *L. marginata** (Keyserling). I find that one, at least, of the specimens there concerned shows, under the microscope, casts of those minute pits on the marginal flange of the ventral border which originated d'Eichwald's "*L. phaseolus*, var. *punctata*," and Schmidt's "*Isochilina punctata*."

Fig. 12 is an enlarged drawing of the hollow impression of the antero-dorsal angle (with its eye-tubercle) of a left valve, similar to fig. 12, *a*, pl. vii. Ann. & Mag. Nat. Hist. *loc. cit.*, and belonging to *I. punctata*, Schmidt.

This species has its North-American representative in the Lower-Silurian *Isochilina gracilis*, Jones, of Canada (Ann. & Mag. Nat. Hist. 1858, ser. 3, vol. i. p. 248, pl. x. fig. 2; and Geol. Surv. Canada, decade iii. p. 98, pl. xi. fig. 15).

2. *Isochilina grandis* (Schrenck).

The large specimen from Rupert's Land, described and figured as "*Leperditia marginata*, Keyserling?" in the Ann. & Mag. Nat. Hist. ser. 2, 1856, vol. xvii. pp. 94 and 100, pl. vii. figs. 14, *a–d*, is an *Isochilina*. It differs materially from Keyserling's "*Cypridina marginata*," as pointed out by Dr. F. Schmidt in his memoir on Russian *Leperditiæ*, 1873, p. 19. It is related to *Isochilina formosa*, Barrande (Syst. Sil. Bohême, vol. i. suppl. 1872, p. 534, pl. xxiii. figs. 22–25, and pl. xxxiv. figs. 1–3), and to *Isochilina gigantea* (Römer), described and redrawn by M. Barrande, *op. cit.* p. 535, pl. xxxiv. figs. 4–6. It differs from both sets of figures in the slope of its antero-ventral region, its obliquely ovate body, and the more elliptical curve of its lower margin. It still more closely resembles, however, Schmidt's figures of Schrenck's "*Cypridina grandis*" (Russ. sil. Leperd. figs. 1, 3–6), to which species Schmidt refers Ferd. Römer's "*Leperditia gigantea*" above mentioned. This last is determined by M. Barrande to be an *Isochilina*; and although Dr.

* As pointed out by F. Schmidt, Russ. sil. Leperd. 1873, p. 22.

Schmidt regards it as a *Leperditia*, I think that the former is correct. Among Schmidt's figures of one cast and three valves there are sufficient variations to cover any slight differences that the one specimen from North America may exhibit, as compared with any one of those figures of the large Upper-Silurian form from Scandinavia.

PRIMITIA, Jones & Holl.

Primitia, Jones & Holl, 1865, Ann. & Mag. Nat. Hist. ser. 3, vol. xvi. p. 415, and 1868, ser. 4, vol. ii. p. 55 &c.; Jones, Pal. Biv. Entom. Proceed. Geol. Assoc. 1869, p. 8 &c.; Barrande, 1872, Syst. Sil. Bohême, vol. i. suppl. p. 539.

1. *Primitia simplex*, Jones, varr.

Pl. XX. figs. 1, 2, 3. These are simple *Primitiæ*, common in some pieces of limestone from the "Saint-John group" of St. John's, in Newfoundland, given to me in 1866 by the late Mr. T. G. B. Lloyd. This rock is referred to the "Lower Potsdam" ("Cambrian") by Prof. John Milne, F.G.S., in the Quart. Journ. Geol. Soc. vol. xxx. p. 743.

Figs. 1, *a*, *b*, are the outlines of a right valve, about $\frac{3}{40}$ inch long; figs. 2, *a*–*c*, of a complete carapace $\frac{2}{40}$ inch long; and fig. 3 is a drawing of a right valve, about $\frac{2\frac{1}{2}}{40}$ inch long. These valves differ but slightly among themselves in their shape, having a nearly semicircular ventral curve, with a broadly ovate outline of body and straight back. Figs. 1 and 2 have a relatively high convexity. Fig. 3 shows the most symmetrical ends; fig. 1 has the postero-dorsal slope more expressed; and fig. 2 has the hinge-line extended so far back that this slope is almost lost. Fig. 1 is like the Lower-Silurian *Primitia simplex*, Jones (Ann. & Mag. Nat Hist. ser. 2, 1855, vol. xvi. p. 173, pl. vi. fig. 25; and ser. 3, vol. xvi. p. 417), of Portugal and Shropshire; but it shows no trace of a dorsal notch or furrow. Fig. 2 is also somewhat like *P. simplex*, and is even more comparable with *P. obsoleta*, Jones & Holl (Ann. & Mag. Nat. Hist. ser. 3, vol. xvi. p. 423, pl. xiii. fig. 12), from the Upper Silurian of Scandinavia; but it is more convex than the latter, and has not its marginal rim. Fig. 3 represents *P. simplex* in a general way; but, instead of a simple dorsal notch it has a slight curved, subspiral, comma-shaped elevation, due to a narrow semicircular depression on the convexity of the valve, and a small curved, tapering, concentric furrow within the other on the dorsal region.

Fig. 1. *P. simplex*, var. *Sanctojohannesiana*.
Fig. 2. —— ——, var. *Lloydiana*.
Fig. 3. —— ——, var. *Milneana*.

EXPLANATION OF THE PLATES.

(The specimens here figured, except figs. 7, 8, and 9 of Pl. XIX., either are or will be deposited in the British Museum.)

Plate XIX.

Fig. 1. *Leperditia balthica* (Hisinger), small individual, natural size. Upper Silurian; Wren's Nest, Dudley. *a*, lateral view; *b*, dorsal view.

Fig. 2. *Leperditia balthica* (His.), var. *contracta*, nov., right valve, nat. size. Upper Silurian, Wren's Nest. *a*, lateral; *b*, ventral view.

Fig. 3. *Leperditia balthica* (His.), var. *contracta*, nov., internal cast of a right valve (somewhat crushed), magnified 4 diam. From the Lower-Ludlow beds at Leintwardine, near Ludlow.

Fig. 4. *Leperditia balthica* (His.): *a* and *b*, outlines of two specimens of left valves, of different sizes, and both more or less damaged, and 4 *b*, more ovate, probably in consequence; magnified 11 diam. Uppermost Silurian; from the Bromyard and Worcester railway.

Fig. 5. *Leperditia Hisingeri* (?), Schmidt, small portion of a right valve, magnified 2 diam. From the Upper Llandovery of Eastnor, near Malvern. *a*, lateral; *b*, anterior view.

Fig. 6. *Leperditia Hisingeri*, Schmidt, var. *gracilenta*, internal cast of a left valve, magnified 2 diam. Upper Silurian; Kington, Herefordshire. *a*, lateral; *b*, ventral; *c*, anterior view.

Fig. 7. *Leperditia fabulites* (Conrad), var. *josephiana*, Jones, perfect carapace, with left valve exposed, nat. size. Lower Silurian; St. Joseph's Island, Canada. *a*, lateral; *b*, ventral view.

Fig. 8. *Leperditia fabulites* (Conrad), var. *anticostiana*, Jones, perfect carapace, left valve exposed, nat. size. Lower Silurian; Anticosti, Canada. *a*, lateral; *b*, ventral view.

Fig. 9. *Leperditia amygdalina*, Jones, perfect carapace, exposing left valve, nat. size. Lower Silurian; L'Orignal, Canada. *a*, lateral view; *b*, ventral edge of the left (overlapped) valve; *c*, ventral edge of the right (overlapping) valve.

Fig. 10. *Leperditia balthica* (His.), small, left valve broken at the hinder margin, nat. size. Upper Silurian; from Wisby, Gothland.

Fig. 11. *Leperditia balthica* (His.), small, right valve, nat. size. Upper Silurian; Wisby. *a*, side view; *b*, ventral outline.

Fig. 12. *Isochilina punctata* (d'Eichw.), outline of the inside of a hollow cast of the fore part of a left valve, magnified 4 diam. Lower Silurian; Gatschina, near Saretsche, Russia.

Fig. 13. *Leperditia balthica* (His.), var. *contracta*, nov., outline of a right valve, magnified 9 diam. Upper Silurian; Talkof, Livonia.

Fig. 14. *Leperditia balthica* (His.), var. *contracta*, nov., outline of a partly imbedded right valve, with eye-spot and muscle-spot, magnified 23 diam. Upper Silurian; Kamenetz-Podolsk.

Fig. 15. *Leperditia phaseolus* (His.), outline of a right valve, with eye-spot and muscle-spot, magnified 6 diam. Upper Silurian; Randifer, Oesel.

Fig. 16. *Leperditia Hisingeri*, Schmidt, var., outline of a left valve, with eye-spot and muscle-spot, magnified 6 diam. Upper Silurian; Randifer, Oesel.

Fig. 17. *Leperditia balthica* (His.), var. *contracta*, nov., left valve, with the shell broken in the middle, also imbedded below and behind.

PLATE XX.

Fig. 1. *Primitia simplex*, var. *Sanctojohannesiana*, nov., outline of a right valve, magnified 23 diam. Cambrian; St. John's, Newfoundland. *a*, side view; *b*, end view.

Fig. 2. *Primitia simplex*, var. *Lloydiana*, nov., outline of a complete carapace, magnified 23 diam. Cambrian; St. John's, Newfoundland. *a*, side view, left valve shown; *b*, end view; *c*, edge view.

Fig. 3. *Primitia simplex*, var. *Milneana*, nov., right valve, magnified 23 diam. Cambrian; St. John's, Newfoundland.

Fig. 4. *Leperditia fabulites* (Conrad), outline of a left valve, broken on the ventral margin, magnified 4 diam. Lower Silurian (?); Neile Bay.

Fig. 5. *Leperditia canadensis*, Jones, left valve, broken, and showing another valve squeezed within it symmetrically, magnified 4 diam. Lower Silurian (?); Neile Bay.

Fig. 6. *Leperditia Hicksii*, Jones, imperfect carapace, right valve shown, broken behind, magnified 4 diam. Menevian; St. David's, South Wales. *a*, side view; *b*, ventral outline of one valve.

Fig. 7. *Leperditia fabulites* (Conrad), var. *josephiana*, Jones, right valve, in outline. Lower Silurian; St. Joseph's Island, Canada. *a*, nat. size; *b*, magn. 2 diam.

Fig. 8. *Leperditia fabulites* (Conrad), var. *josephiana*, Jones, perfect carapace, in outline, with left valve outwards, magnified 4 diam. Lower Silurian; Lebanon, Tennessee, U. S. *a*, side view; *b*, hinder end; *c*, ventral edge.

Fig. 9. *Leperditia Billingsii*, nov., internal cast of a carapace, not quite perfect at the dorsal corners, magnified 4 diam. Lower Silurian; near Lake Winnipeg. *a*, side view [right (?) valve seen]; *b*, edge view.

XXXIV.—Ctenoptychius *or Kammplatten*. By T. P. Barkas, F.G.S.

To the Editors of the 'Annals.'

Gentlemen,

Your correspondent Mr. Thomas Stock, of the Museum of Science and Art, Edinburgh, in his communication in your issue of August 1881, pp. 90–95, refers at some length to our present knowledge of the teeth of *Ctenoptychius*, and appears disposed to accept the theory of Professor Fritsch, that those specimens which I have named *Ctenoptychius unilateralis* are "Kammplatten" or "Kammleisten," belonging to *Ophiderpeton*, and associated with the anal orifice of that Coal-measure Labyrinthodont.

The genus *Ophiderpeton* was established by Prof. Huxley on tolerably complete specimens obtained from Jarrow Colliery, Kilkenny, Ireland. The specimens were a few years ago in the natural-history work-rooms of the British Museum, and are now, I suppose, removed to the Kensington British-Museum Department. The matrices in which the specimens lie are of a very fragile character; and the specimens themselves are rather obscure in detail, although their outlines are well preserved.

I have seen the specimens in question, and do not remember any indications of "Kammplatten" in connexion with them; and as Professor Huxley does not, in his description of the fossils, recognize so marked a peculiarity, I infer that the inferior surfaces of the specimens are not presented, or that the "Kammplatten" are not present.

Ophiderpeton has been found in the Northumberland Coal-measures by the late Mr. T. Atthey and myself; but the few specimens discovered are of small size and quite insignificant when compared with the sizes of the alleged "Kammplatten" that have been found in our local Coal-measures.

Ophiderpeton was first discovered in Northumbrian Coal-measures by Mr. T. Atthey; and the specimen, which was 5½ inches long, was described by Messrs. Hancock and Atthey in the 'Transactions of the Tyneside Naturalists' Field-club,' p. 79, pl. v., new series, 1868–70.

Since that time various fragments have been found, all small, and not at all likely to be the bearers of "Kammplatten" 1½ inch long, as some of my specimens are.

The sole evidence of these comparatively large and well-marked comb-like forms being portions of *Ophiderpeton* rests on the researches of Professor Fritsch, as the Scottish and Northumberland specimens point more to varieties of *Ctenoptychius* than to *Ophiderpeton*, specimens of which, so far as I am aware, have only been found in Northumberland; and those are of insignificant size.

The specimens discovered by Mr. T. Atthey are not associated with remains of *Ophiderpeton*. They are five in number, and are now in the admirable museum of the Natural-History Society, Newcastle-on-Tyne. The collections of Mr. Taylor of Shiremoor, Mr. Simm of Cramlington, and the six specimens in my possession are all unassociated with *Ophiderpeton*; and the smallness and rarity of *Ophiderpeton* render their association with it at least very improbable.

Mr. Stock, at page 93 of his paper, credits me with the authorship of *Ctenoptychius marginalis*, and states he has not seen specimens thus labelled. The species was named by Agassiz; and the species *Ctenoptychius unilateralis* was quoted by my son, Dr. W. J. Barkas, from named specimens in my collection, and published by him in the excellent papers describing the external appearance and microscopical structure of the teeth of Coal-measure fishes, which appeared in the 'Monthly Review of Dental Surgery' in the years

1874, 1875, and 1876, copies of which papers were forwarded to the Geological Society of London, Professors Owen, Huxley, Traquair, Etheridge, Marsh, Messrs. Davies, Atthey, Ward, and several other palæontologists, and are the only papers extant in which the minute microscopical structures of the teeth of Coal-measure fishes are given with great elaboration and detail, accompanied by ninety-four admirably drawn engraved figures.

This work Mr. Stock appears not to have seen, or he would not have said that "a microscopic examination would help to settle the point" in reference to the fish or labyrinthodont origin of the alleged "Kammplatten."

My son, Dr. W. J. Barkas (who is now in Australia), in the papers above referred to, describes at length and with great accuracy and minuteness the microscopical structures of *Ctenoptychius pectinatus*, *C. denticulatus*, and *C. apicalis*, and finally, for various substantial reasons, transfers *C. apicalis* to the Petalodi.

He then proceeds to describe *Ctenoptychius unilateralis* as follows (and this passage I quote verbatim):—

"*Ctenoptychius unilateralis* was first described and figured by Mr. T. P. Barkas, F.G.S., in the 'Geological Magazine' for January 1869. It is very rare, but not so much so as *C. apicalis*; and, so far as I know, it has only been discovered in these measures.

"It differs externally from all the preceding varieties with respect to the position of the base, which is situated on one side of the crown instead of at the lower border. The specimen from which fig. xvi. was drawn is a very typical tooth, and is about the average size, though I possess some measuring less than half the length. The teeth having this peculiar lateral base vary much in form; but whether these varieties belong to one fish, though situated in different parts of its mouth, or pertain to distinctly different fishes, I cannot say. The tooth was classified among the *Ctenoptychii* on account of the resemblance between the external characters of its crown and those of the crown of *C. pectinatus*; for if a short base had been attached to the inferior border of the crown of *C. unilateralis* instead of to the side, it would have closely resembled the former tooth; the serrations, however, are not quite so deep in this new variety.

"The crown is separated from the base on the external surface by a vertical concavity, and on the internal by a prominent ridge; the base exceeds the crown in length, and gradually tapers to a point as it proceeds outwards; but the latter is the higher of the two parts. . . . .

"The microscopical structure of this tooth differs somewhat from the preceding three varieties, but has more points of resemblance to *C. pectinatus* and *C. denticulatus* than to *C. apicalis*. It is composed of vascular and unvascular dentine. The unvascular dentine covers the whole of the denticular surface of the crown, and the external surfaces of the coronal end of the base. The vascular dentine is contained within the layers of unvascular dentine, and is continued along the centre of the base nearly to its distal extremity, and tapers to a point in a direct ratio with the tail. The unvascular dentine is a comparatively thick layer; and the sum of the thickness of the layers on the internal and external surfaces of the crown is nearly half the thickness of the crown itself, which is one twentieth of an inch; it is permeated freely by fine calcigerous tubules, which spring from the vascular canals running along its internal surface and pass to the extreme periphery.

"The tubules are rather fine, measuring from one five-thousandth to one ten-thousandth of an inch in diameter at their origin; in their course, which is vertical to the superficies, they are slightly wavy, branch freely but always dichotomously; the branches are given off at an acute angle. . . . .

"The structure of the crown of this tooth does not agree in any one particular with that of *C. apicalis*; but there are many points of resemblance between it and the crowns of *C. pectinatus* and *C. denticulatus*; for they all have a layer of unvascular dentine covering the whole of the external surface, in which the tubules proceed to the extreme periphery; but the tubules differ in being fasciculate in their arrangement and larger in diameter in the two latter varieties, while they are not so in the former; and in all the medullary canals in the vascular dentine branch and anastomose, and the canals are dilated when branching or an anastomosis takes place; they also run parallel with the axis of the tooth and with each other; but in *C. unilateralis* the canals are considerably fewer in number, and give off a greater number of calcigerous tubules.

"The structure of the bases of these teeth cannot be compared; for the base of *C. unilateralis* is altogether unique in position and external characters, differing in this particular from the teeth of all other fishes, whether recent or extinct.

"The arrangement of *C. unilateralis* in the jaw is not known."

Dr. Barkas, in a subsequent paper in the 'Monthly Review of Dental Surgery,' named, described, and figured a new variety of *Ctenoptychius* under the name of *C. aciculatus*; and in the 'English Mechanic,' vol. xii. p. 469, I named a very distinct species now in my possession *C. obtusus*.

Palæontologists interested in the minute structure of Coal-measure fossil teeth should refer to Dr. Barkas's papers in the 'Dental Review;' they embrace *Diplodus*, *Hybodus*, *Cladodus*, *Ctenoptychius*, *Petalodus*, *Petalodopsis*, *Pleurodus*, *Pœcilodus*, *Helodus*, *Janassa*, *Palæoniscus*, *Pygopterus*, *Acrolepis*, *Cycloptychius*, *Gyrolepis*, *Megalichthys*, *Rhizodus*, *Rhizodopsis*, *Strepsodus*, *Orthognathus*, and *Archichthys*, and, had Dr. Barkas not left England for Australia, would have included *Ctenodus*, *Cœlacanthus*, *Acanthodopsis*, *Platysomus*, and *Amphicentrum*.

XXXV.—*On* Spongiophaga Pottsi, *n. sp.*

By H. J. Carter, F.R.S. &c.

[Plate XVII.]

In the 'Annals' for September last I published a short notice of a parasitic growth on *Spongilla* which Mr. Edward Potts of Philadelphia, United States, had sent to me, under the impression, very naturally, that it was a growth of the sponge itself; and so it may be to a certain extent, much as the "gall" on the oak tree is a growth of the latter around the egg deposited by an insect which makes use of the tree for this purpose; but how it is that the oak under these circumstances is treated by the insect parent so as to cause this outgrowth of its cellular structure I am unable to explain, although it is very evident that the excrescence would not be there were it not for the presence of the parasitic egg.

So it is with the freshwater sponge (*Spongilla*): there are specimens of the *same* species, as will be seen hereafter, in which there is *no Spongiophaga Pottsi* present, just as there are specimens of the sea-water sponge *Hircinia* in which there is no *Spongiophaga communis*, which Lieberkühn believed to be so much a part of the sponge itself that he established his genus "*Filifera*" upon this supposed character. I have already gone into the history of the subject when treating of *Spongiophaga communis* in the paper entitled "Parasites of the Spongida" ('Annals,' 1878, vol. ii. p. 165, with woodcut, p. 168), so need not repeat any more of it here.

The metamorphoses of parasites are often veiled in almost impenetrable mystery until some happy observation renders them intelligible. Who, for instance, would have thought that the tapeworm came from a *Cœnurus*—discharged as an egg from one, fostered as *Cœnurus* in another, and finally developed as the tapeworm in the body of a third animal? The nematoid parasites, however, do not appear to be so erratic in their course of development or so very different in their metamorphic forms as the Cestoidea; but they are so numerous in species, throughout the animal and vegetable kingdoms, both independently and parasitically (that is, externally and internally), that there is no saying where they may not present themselves, and, in some instances, considerably altered in form. Thus the guinea-worm (*Filaria medinensis*), which I described and illustrated from specimens in Bombay, some years since ('Annals,' 1859, vol. iv. ser. 3, pp. 28 and 98, pls. i., ii., and iii.), is always filled with full-grown embryos (for no male has yet been found) about 1-33rd inch long, corrugated transversely and possessing a long, straight, attenuated tail, while the parent may measure 32 inches, and in some instances is stated to reach "10 to 12 feet," perfectly smooth on the surface, and equally obtuse at each end, with an oral aperture, not exceeding 1-600th inch in diameter, in the centre of one extremity, and at the other the tail diminished to a minute object, curled up and shut in by a membranous expansion from the body, thus evidencing an amount of metamorphosis which, but for the presence of the well-developed embryo *inside* the parent (pl. i. fig. 6, *l. c.*), would be incomprehensible. Moreover the extremely minute oral orifice and corresponding atrophy of the alimentary canal would seem to indicate that its nourishment must have come through other sources; but be that, in part, as it may, the oral orifice is not near so small as that of the cilium of an *Acineta* (*A. tuberosa*), which, temporarily metamorphosed into a tentacle, may in plurality be seen to transfer the contents of *Paramecium aurelia* (into which they have been projected for this purpose) to its own body, by the passage of glairy, fatty, or albuminous globules through the centre of the tentacle from the *Paramecium* to the *Acineta*. Hence the minute size of the oral orifice in the guinea-worm may be no indication that it receives nourishment in any other way than through the oral aperture, although this is so extremely small.

Slight, however, as the metamorphosis of the guinea-worm may appear when compared with that of the Cestoidea (*ex. gr.* the tapeworm), I think that the conjectured one which I am about to mention, viz. the metamorphosis of a nematoid worm into *Spongiophaga*, is nearly equal to it.

As before stated, I have gone into the history &c. of *Spongiophaga communis* (op. et loc. cit.), so have now only to refer the reader to it for an introduction to what I am about to state.

It has already been noticed (*loc. cit.*) that Mr. Potts kindly sent me a new or undescribed species of *Spongilla* affected with one of *Spongiophaga*, which, to commemorate the circumstance, I have named after him *Spongiophaga Pottsi*, leaving the new species of *Spongilla* to be described by himself hereafter. This came from a small stream in the Centennial Grounds at Philadelphia; while Mr. Potts also states in his letters that he had received another of the same kind from Bethlehem, situated about fifty miles N.N.W. of this city, and a third is mounted in two of his slides affecting a specimen of *Meyenia* (*Spongilla*) *Baileyi*, Bk., from Buffalo, Lake Erie, to which I shall more particularly allude hereafter, as it only presents an initial development of the filament. Meanwhile the following may be taken as a description of *Spongiophaga Pottsi* so far as I have been able to learn from ample fragments of the new species of *Spongilla* affected with it, together with its statoblasts, as arranged by Mr. Potts on four slides, viz. three mounted in balsam, of which two are stained red, and the fourth in glycerine; so that I am most satisfactorily supplied in this respect.

Spongiophaga Pottsi, n. sp. (Pl. XVII. figs. 1–8.)

Vermicular whiplike filaments, very long, round, and more or less tortuous, of which two, three, and sometimes four are attached to a tubular prolongation externally from the nipple-like process of the chitinous coat of the statoblasts, which juts out through the hilous aperture, in some specimens of *Spongilla* only (Pl. XVII. fig. 1). Filament uniformly diminishing in diameter from the fixed end—which is the largest, viz. about 1-900th of an inch thick, and applied to the tubular prolongation mentioned just before its open termination (fig. 1, *g g g*)—to the free end, which is almost immeasurably minute (fig. 2, *l*, *m*). Colour transparent oil-yellow. Consistence (in the marine species) soft, glutinous, and elastic, but extremely fragile on account of its great tenuity; so that in water, when once touched with a needle it so adheres to the latter that it is seldom disunited without fracture; yet drying *en masse* into a tough, fibro-membranous texture tearing like parchment. Proximal end of the filament somewhat enlarged and so blended with the wall of the "prolongation" extended from the process of the chitinous coat, that, both being of the same colour and horny consistence, the former appears to be a direct continuation in growth of the latter (fig. 2, *ff*), while the distal or attenuated end may be curved and pointed (fig. 2, *n*), or bilobate with a curved point between the lobes (fig. 2, *o*), but, as before stated, is almost immeasurably minute; filament presenting a comparatively broad cavity at its union with the prolongation from the process of the chitinous coat (fig. 2, *i*), becoming suddenly contracted into a narrow axial canal about 1-6000th inch in diameter ("Achsenstrang," Schulze), fig. 2, *h h*, in which may be observed little glairy fatty-looking globules in broken linear arrangement for some distance (fig. 2, *k*), connected with those at the bottom that occupy the expanded part of the canal (fig. 2, *i*), and are in direct continuation with the mass which may (so long as there are any left) fill the prolongation from the process of the chitinous coat (fig. 2, *d*), that, again, are supplied from the germinal contents of the statoblast (fig. 2, *a a*), through the aperture in the mammiform process of the chitinous coat (fig. 2, *b*, *c*); so that the germinal contents may thus be traced directly from the sponge into the axial canal of the filament (fig. 2, *e*, *k*). Surface of the filament towards its fixed end presenting transverse parallel rugæ about 1-1200th inch in diameter (fig. 2, *g*). Length of full-grown filament not ascertainable in the slides, from its extreme tortuosity and intermingling with its neighbours.

Hab. Spongilla. Attached, when present, close to the end of a tubular prolongation extended from the process of the chitinous coat of the statoblast, which prolongation is always open at its free extremity (fig. 1, *f*, *g*).

Loc. Centennial Grounds at Philadelphia, and at Bethlehem, Pennsylvania, United States, in a new species of *Spongilla* to be described hereafter by Mr. Potts; and at Buffalo, Lake Erie, in *Meyenia* (*Spongilla*) *Baileyi*, Bk., sent to Mr. Potts by Mr. H. Mills.

Obs. This parasite, like the marine species, is not a commensalist, but a devourer of its host, in the present instance confined to the statoblasts, while in the marine sponges, there being no statoblasts, it feeds upon the sarcode, which here contains the ovules or germinal contents, more especially on *Hircinia*. When in *Spongiophaga Pottsi* we have before our eyes the filament attached to the open tubular prolongation of the process of the chitinous coat, through which the richest part of the sponge (that is, the germinal contents of the statoblast) must issue, and we can trace these contents directly into the axial canal of the filament, as before mentioned—considering the presence of a corrugated surface of the filament externally consisting of transverse parallel rugæ, and that the prolongation from the process of the chitinous coat, together with the filaments, is present in some specimens of the same species of *Spongilla* and not in others, as in those of *Meyenia* (*Spongilla*) *Baileyi*, Bk., from Buffalo and *not* in those from Lehigh Gap, in Pennsylvania, as shown by the slides, I cannot help thinking that the prolongation beyond the process of the chitinous coat of the statoblast, which is always open at its free end, may be in part produced by the sponge itself, to insure, if possible, a safe egress for the reproductive particles against the rapacity of its unwelcome visitor; while the passage of these particles *en masse* into the lower and dilated cavity of the filament, with their presence some way on, arranged linearly in the axial canal, together with the corrugation or transverse striæ on the surface, much more resemble the features of a filiform or nematoid parasite than any thing belonging to the vegetable kingdom—especially when, after inferring that the fixed end is the oral extremity, we find the filament gradually diminishing into an attenuated whip-like form which is terminated by a curved and pointed element like that of many Filariidæ.

The marine species called by Lieberkühn "Faden," by Schmidt "Fibrillen," by Schulze "Filamente," and by myself *Spongiophaga communis*, has been latterly pointed out by Schmidt to have a bulb at each end, in a communication entitled "Die Fibrillen der Spongien," of which he kindly sent me a copy on the 15th May, 1878, just before my 'Parasites on the Spongida' was published; so that I ought to have mentioned it therein. Hence to atone for this accidental omission, in priority, as I had discovered the same thing myself independently, it is here thus mentioned. (Whence the "separate copy" of Schmidt's paper is extracted, however, I cannot say; for it only bears the pagination, viz. 661.) Subsequently Prof. F. E. Schulze of Gratz studied *Spongiophaga communis* in his usual exhaustive manner (Zeitschrift f. wiss. Zoologie, Bd. xxxiii. 1879, "Untersuchungen &c. Die Gattung *Hircinia*, Nardo, &c.," Taf. iv.); and under the heading of "Die Filamente" (Separat-Abdruck, p. 23) he states that the filaments present no trace of cellulose, and have not, apparently, been found through chemical analysis to agree in composition with the horny fibre of the officinal sponge; while further observations are necessary to determine what their real nature is, although they may be assumed to be foreign organisms growing and thriving in the sponge. However, in his fig. 4, Taf. iv. (*loc. cit.*), there is a fragment delineated with a transversely corrugated exterior and a central cord ("Achsenstrang," p. 21, *loc. cit.*), which to a certain extent corresponds with what I have stated to be presented by the proximal part of the filament of *Spongiophaga Pottsi*.

Lastly, as regards the specimen of *Spongiophaga Pottsi* in *Meyenia Baileyi*, Bk., from Buffalo, which Mr. Potts in his letter states to have been sent to him by Mr. H. Mills, the development seems to have only just commenced; for the filaments to the number of from two to four rising from the prolongation extended from the process of the chitinous coat, on which the reproductive elements must have settled, are not only very short but of different lengths in different statoblasts (figs. 5, 6)—namely in one, the shortest, not more than 1-4000th inch long (that is, mere points, fig. 6, *c c*), with the wall of the prolongation from the process of the chitinous coat extremely thin (fig. 6, *a*), and the statoblast from which it proceeds about 1-60th inch in diameter, and in another, the longest, on the slide (fig. 5, *a*) not more than the 1-60th inch long, with the wall of the prolongation much thickened and the statoblast 1-40th inch in diameter, while every variety of length with proportionate thickness in all occurs between these two in different statoblasts on the *same* slide.

Thus, then, we can trace the filament back to two points, one on each side of the tubular prolongation from the process of the chitinous coat towards its termination, where it is dilated, and ends, as usual, in an open mouth; while these "points" (which, as just stated, are not more than the 1-4000th inch long) appear here, as well as in all other instances, to be connected *round* the tube—that is, as it were, to embrace it by a thinner substance or membranous expansion (figs. 6, *d*, and 4, *d*), which, by alteration of the focus, can be seen to make them continuous, whence it has seemed to me that they must be two distinct individuals which have thus grown together, as in the fully developed filament they open *separately* into the tubular prolongation, one on each side (fig. 2, *i*)—or that there was only one embryo, and that, growing in opposite directions, it ended in this development. What the individual embryo may be like I cannot pretend to say; but if still more reduced in size, say to a sphere, it would lose the filiform character and then become undistinguishable from other like objects if not found to bear some special character. When rudimentary, too, these filaments are crooked and bent almost to angularity most irregularly (figs. 7, 8, *b b*), while those in the specimen from Philadelphia are incomparably longer and even (fig. 1, *g g g*), although they also become more or less crooked and irregular towards their respective free ends (fig. 2, *n*, *o*). Still, as may be seen from the illustrations, they too may respectively be terminated by the simply hooked or bilobate extremity, as observed in the *Spongilla* from Philadelphia; at the same time more extended observation is necessary before the persistence of such forms can be satisfactorily established.

Of this development, then, in *Meyenia* (*Spongilla*) *Baileyi*, Bk., from Buffalo, being *Spongiophaga Pottsi*, I have no more doubt than that the mounted fragments from Lehigh Gap (to which I have already alluded, which is about fifty-five miles

N.N.W. of Philadelphia), on two other slides, are statoblasts of *Meyenia Baileyi without both filaments and prolongation* from the process of the chitinous coat.

Returning for a moment to the marine species, viz. *Spongiophaga communis*, it might be observed that the only way to obtain *entire* filaments (that is, with the bulb at each end) is to get a fragment of a *Hircinia* infested with them which has not been allowed to dry, by having been put in spirit of wine immediately after it has been taken from its place of growth. A minute portion of the soft parts, which may be found to be entirely composed of the parasitic filaments, may then be pulled out with a microscopic hook and put into a little shallow vessel containing about half an inch of water, after which this minute portion may be gently taken off the hook and pulled to pieces with fine needles, twisting the latter round and round the vessel so as to dislodge the filaments (which, of course, are now invisible) and cause them to disengage themselves and float about freely and separately. Then taking a glass tube with about one sixth of an inch bore, drawn out to about one sixteenth at the lower end, and closing the upper or larger aperture forcibly with the fore finger, put the free end in the water containing the filaments so as to touch the bottom of the vessel, when, on suddenly withdrawing the finger, the water will rush into the tube, carrying with it perchance one or more *entire* filaments. Now replace the finger gently and transfer the contents to a glass slide by blowing also gently through the tube; cover and examine with the microscope. Repeat the process if necessary until some *entire* filaments are obtained.

Having just examined many in this way I have, by delineating to scale the bulbs at the ends respectively of the *same* filaments in several instances, been able to compare the whole together, both in size and shape, whence it seems to me not only that one is more ovular than the other (fig. 9, *a*, *b*), but that the ovular one is often accompanied by a spiral lineation (fig. 9, *a*), although whether this be in the interior or on the surface I cannot say; yet sometimes it has very much the appearance of the spiral thread of a nematocyst; sometimes also there is a minute point or projection at the apex or on the side of the bulb (fig. 9, *a*); nor is it easy to say, from the minuteness of the latter, whether this is natural or adventitious, even if it be always present when unseen.

To determine satisfactorily whether there is any characteristic difference between the two bulbs, and if so what it is, would require more time than I have at my disposal; nor have I found staining shorten the process or facilitate this result; so I must leave the subject as it is, hoping that Mr. Potts, by obtaining the freshwater species and examining it alive in its natural element, may be able to clear up the mystery that attends the life-history of both, which it seems hardly possible to do with the marine species alone, on account of the rapidity with which the salt water becomes putrescent.

As regards the interunion without appreciable line of demarcation between the fixed end of the filament in *Spongiophaga Pottsi* and the additional "prolongation" and thickening of the chitinous coat of the statoblast (fig. 2, *f*), the latter may be likened to that which takes place in the formation of the gall in the oak tree when the insect deposits its egg on the bark, to which I have before alluded *; while the former is of every-day occurrence in the polyp which imbeds itself in the dermal sarcode of a sponge; and the metamorphosis of the complicated elements of a parasitic crustacean into a single trumpet-shaped sucking-tube is hardly less than would be that of the oral extremity of a nematoid worm into the form of the fixed end of the filament of *Spongiophaga Pottsi*. This, however, must not be regarded as "special pleading;" for as yet I do not see either in the marine or freshwater species, or in both together, enough to point out what the parasite is, further than that I must now renounce the opinion altogether of its belonging to the vegetable kingdom, as I can also now assert that it is to be found in the freshwater as well as in the marine sponges, growing in some specimens, and *not* in others, of the same species of the Spongida.

EXPLANATION OF PLATE XVII.

Fig. 1. Statoblast of undescribed species of *Spongilla* (gen. 2, *Meyenia*, Carter) from Philadelphia, bearing three filaments of *Spongiophaga Pottsi*. Scale 1-48th to 1-1800th inch. *a*, germinal contents of statoblast; *b*, delicate membranous envelope of the same; *c*, chitinous coat (indicated by the dark line); *d*, spiculiferous layer (the dotted line outside); *e*, process of chitinous coat, opening into *f*, tubular prolongation from the same; *g g g*, filaments of *Spongiophaga Pottsi*. The latter are diagrammatic in point of length, which is much longer than that delineated.

Fig. 2. Process of chitinous coat &c. of the same, bearing two filaments of *Spongiophaga Pottsi* truncated. Scale 1-24th to 1-6000th inch, thus much more magnified to facilitate explanation, as follows:—

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* In *Spongilla friabilis*, Leidy, 1851, = *S. Lordii*, Bk., 1863, the prolongation, however, is natural, and, as pointed out by Mr. Potts, bent sharply to one side like the iron ventilators of a steam-vessel; but it appears to me to be produced by an elongation of the process of the chitinous coat itself, and not by an *additional* portion like that accompanying the presence of *Spongiophaga Pottsi* (Pl. XVII. fig. 1, *f*, &c.).

a a, germinal contents; *b*, process of chitinous coat, opening at *c* into tubular prolongation of the same, *d*; *e e*, truncated filaments; *f f*, point of union with chitinous coat; *g*, rugæ on the surface; *h h*, axial canal; *i*, germinal contents in the lower and dilated part of the axial canal; *k*, the same, altered into fatty-looking globules in the axial canal; *l*, small or free end of the filament (pointed form); *m*, the same (bilobate form); more magnified in *n* and *o* respectively, viz. on the scale 1-6th to 1-6000th inch.

Fig. 3. Process of chitinous coat of the same, bearing two filaments truncated, to show fundamental form of tubular open prolongation, *a*. Scale 1-24th to 1-1800th inch.

Fig. 4. The same, bearing two filaments truncated, to show membranous expansions occasionally extended from and connecting the filaments. *a*, process of chitinous coat; *b*, opening into *c*, prolongation from the same; *d*, membranous expansions. Same scale.

Fig. 5. Three representations (*a*, *b*, *c*) of the tubular prolongation from the chitinous coat, bearing respectively rudimentary growths of different lengths of *Spongiophaga Pottsi* in *Meyenia* (*Spongilla*) *Baileyi*, Bk., from Buffalo, Lake Erie. Scale the same as that of figs. 3 and 4, to show the relative size and form of these rudimentary growths when compared with the full-grown filaments in fig. 1.

Fig. 6. The same, on a still more magnified scale, viz. 1-24th to 1-6000th inch, bearing the rudiments of two filaments, each not more than 1-4000th inch long, apparently connected by a membranous expansion round the opening of the tubular prolongation from the process of the chitinous coat. *a*, prolongation; *b*, opening at free end; *c c*, rudimentary filaments; *d*, membranous expansion.

Figs. 7 and 8. The same, magnified on the same scale, but with filaments of longer growth, to show their crookedness at this period. *a a*, prolongations; *b b*, filaments.

Fig. 9. *Spongiophaga communis* in *Hircinia* from the Levant, ends of, on the scale of 1-12th to 1-6000th inch. *a*, ovular end or bulb, presenting the appearance of a spiral line and point at the apex; *b*, globular end or bulb.

XXXVI.—*On* Aphelorrhina simillima, *Westwood* (*Coleoptera, Cetoniidæ*). By Charles O. Waterhouse.

In a former volume of the 'Annals' (Ann. & Mag. Nat. Hist. 1879, iii. p. 87), I wrote a paper on *Ceratorrhina guttata* and the allied species, describing three new species, *Aphelorrhina Julia*, *A. bella*, and *A. tibialis*, and redescribing *A. simillima*, Westwood, from the type in the British Museum.

Dr. Kraatz has recently written (Deutsche ent. Zeit. 1880, xxiv. p. 165) on the same group, particularly with the view of showing that the insect which I have described as *A. simillima* is not the insect described and figured by Westwood, but that my *A. Julia* is the true *simillima*; and he proposes the name *A. Westwoodii* for my *A. simillima*.

He argues that the specimen of *A. simillima* from which I took my description cannot be the one mentioned by Prof. Woodward as in the British Museum*, because I have stated that the posterior tibiæ have no spine on the outer edge, and give the length 9½ lines; whilst Westwood says "hind tibiæ with a minute central tooth on the outside," and gives the length 12 lines. Dr. Kraatz notes that Westwood's figure measures 11½ lines. That in German lines is 12 lines in English measure.

No one with the Museum specimen of *A. simillima* before him could for a moment doubt that it is the one from which Westwood made his drawing; and the figure cannot be mistaken for the broad brightly-coloured *A. Julia.*

As for the apparent discrepancies between Westwood's description and mine, they are easily accounted for in the following way:—

I have no doubt that Prof. Westwood made his drawing from the Museum specimen, and perhaps took a note or two from it. The description was very likely completed afterwards, and the measurement given from the figure.

I do not consider that the posterior tibiæ have any tooth properly so called. On the outer edge there is a *very* slight angular enlargement; this is somewhat exaggerated in the figure on the right side, and still more so on the left.

With regard to the measurements. I gave the length, taken in the ordinary way (from the apex of the clypeus to the apex of the pygidium), 9½ lines; but this was an error on my part; I should have said 10 lines (English). [I very likely accidentally placed my compasses to the French lines, which I have on the same ruler.] Now, taking the separate parts of the insect from the specimen, I get the following result:—Head 2 lines, thorax 2½, elytra 6½, pygidium 1 (or 1¼ from its base to apex), total 12 lines.

The head and thorax being on an incline accounts for the difference when measuring the insect from tip to tip. The male example of *A. Julia*, for which I have given 12 lines as the length from tip to tip, gives 15 lines when measured piece by piece, which is not the ordinary way, and would be very misleading.

I observe a peculiarity in Prof. Westwood's figure which

* There is only one specimen in the British Museum, which has been there since November 1838. Burmeister's label "*Cœlorrhina simillima*, Burm.," is still preserved; and his description (Handb. iii. 1842, p. 209) is better than Westwood's; it was written before, but published after, Westwood's. The specimens of *A. Julia* were received in December 1878.

is perhaps worth noticing. He represents four spots on the margin of the *left* elytron, and three on the margin of the right *; and I notice that this is just the reverse in the type specimen, which has four spots on the margin of the *right* elytron and three on the left; but if Prof. Westwood represented the spots when drawing on the stone as he saw them in the insect, they would be reversed when the plate was printed. The additional spot on the right side is extremely small, which accounts for Burmeister and Westwood having omitted to mention it in their descriptions.

XXXVII.—*On a Collection of Crustacea made by Baron Hermann Maltzan*† *at Goree Island, Senegambia.* By Edward J. Miers, F.L.S., F.Z.S.

[Plates XIII., XIV., XV., & XVI.]

[Continued from p. 281.]

Macrura.

Scyllarus (*Arctus*) *arctus*, var. *paradoxus*, n.

Two small examples are in the collection (length of the largest a little over 1 inch 1 line, 28 millim.), which differ from the typical form of the species in the somewhat broader carapace, the three cardiac prominences of which are more elevated, and in the form of the teeth of the median longitudinal dorsal carina in front of the cervical suture; the most anterior of these teeth is obsolete, the second very minute and situated just in front of, and beneath, the last tooth of the series, which is very prominent; whereas in the typical *S. arctus* these teeth are all well defined and nearly equidistant from one another. In both, the carapace is covered with depressed squamiform tubercles, and the postabdomen marked with impressed lines forming leaf-like patterns.

Whether these characters are of permanent value a larger series of better-grown specimens is needed to determine. There is, however, in the Museum collection a series of small specimens from Madeira (*the Rev. R. B. Watson*), the largest of

* In the Museum copy of the 'Arcana' the colourist has not placed the white on the spots where they are indicated by small circles.

† By an unfortunate oversight on my part, which I regret extremely, Baron Maltzan's name has been misspelled in the earlier parts of this paper. Instead of "Maltzam" *read* "Maltzan," and instead of "*Heterocrypta Maltzami*" read "*Heterocrypta Maltzani*."

which does not reach the size of the Gorean specimens, which present all the characters of the typical form of *S. arctus**.

In two small specimens from Mr. Watson's Madeiran collection, and in the one from the same locality referred to by me in my recent report on the Crustacea collected by Dr. Coppinger, of H.M.S. 'Alert,' under the name of *S. arctus* †, the carapace is much depressed and nearly smooth, but little broader than long, with scarcely any trace of squamiform tubercles and the median dorsal teeth very low; the lateral carinæ distinct, and reaching nearly to the posterior margin; the lateral lobes of the second to fifth postabdominal segments are angulated, but the angles not produced into spines; there is a strong spine on the sternum, at base of each of the fifth pair of legs. I have little doubt that these belong to the species recently described by Prof. S. I. Smith under the name of *S. depressus*, the types of which were dredged in 86 fathoms off the New-England coast ‡.

Possibly, as Prof. Smith remarks, both the depressed form of the carapace and the prominence of the sternal spines may be due to immaturity.

S. Gundlachi, von Martens, from Cuba §, appears to bear a considerable resemblance to *S. arctus*, var. *paradoxus*, if the figure may be trusted; but the spines of the carapace are differently arranged. Prof. S. I. Smith (*t. c.* p. 431), I may add, apparently regards this species as synonymous with his *S. americanus*, which has the median crest of the carapace "high, covered with low squamiform tubercles, tridentate, the anterior tooth small, and situated halfway between the front and second tooth," &c.

Crangon (*Cheraphilus*) *cataphractus*, Olivi.

There is in the collection a single small specimen (a female with ova), length rather over 11 lines (24 millim.), which I refer, with scarcely any doubt, to this species. The position of the spines of the carapace and the sculpture of the postabdominal segments are similar to those obtaining in the Mediterranean examples in the collection of the British Museum; but the spines are much smaller.

Alpheus paracrinitus, sp. n. (Pl. XVI. fig. 6.)

Rostrum triangulate, acute, arising from the frontal margin

* M. Brullé, in Webb and Berthelot's 'Iles Canaries,' Crust. p. 18 (1836–44), mentions the occurrence of *S. arctus* at the Canaries.

† Proc. Zool. Soc. 1881, p. 63.

‡ Proc. U.S. Nat. Museum, iii. p. 429 (1881).

§ Arch. f. Naturg. p. 123, pl. v. fig. 13 (1872).

of the carapace (which is slightly concave on each side of its base), but not prolonged backward as a dorsal carina. Orbital arches entire, arcuated, without spinules. Anterior margin of the carapace sinuated on the sides, without spines. Postabdominal segments smooth, entire, with the lateral margins broadly rounded; terminal segment not three times as long as broad at the base, with its distal end subtruncated. Eyes completely concealed beneath the carapace. Antennules with three joints of the peduncle exposed, of which the middle one is slightly the longest, with a small spine-like scale at base, reaching nearly to the end of the basal joint. Basal scale of antennæ about reaching to the end of the antennal peduncle, with the outer margin nearly straight and ending in a small spine, and the inner margin convergent towards it and clothed with long hairs. Anterior legs or chelipedes having the merus and carpus slender; merus with a small tooth or spine at the distal end of its under margin; palm of larger chelipede rather more than twice as long as broad, smooth, without notches or ridges, largest at its rounded basal end, with an impressed curved line on its upper and proximal end; fingers nearly half as long as the palm; the upper with its superior margin arcuated. Smaller chelipede with the carpus rather longer, and chela very slender, fingers hairy. Second legs with first joint of the carpus longer than the second, the last three joints of nearly equal length, the last a little the longest, the joint preceding these somewhat longer. Ambulatory legs somewhat hairy. Distal ends of the rami of the uropoda clothed with long hairs. Colour light yellowish (in spirit). Fingers of larger chelipede pinkish. Length 7 lines (nearly 15 millim.).

Two females with ova are in the collection.

Several species of this very difficult genus have been recorded from the Cape-Verd Islands; it may therefore be useful to note that *Alpheus paracrinitus* may be distinguished from *Alpheus pugilator* and *A. rugimanus*, A. M.-Edwards*, *Alpheus streptochirus*, Stimpson†, and *Alpheus Edwardsii* (Audouin) ‡, by the absence of spinules from the orbital arches (not to mention other characters), and from *Alpheus Bouvieri*, A. M.-Edwards (*t. c.* p. 231), by the form and insculptation of the larger chela.

From the well-known Mediterranean *A. ruber* it may be distinguished by the form of the rostrum and of the larger chela.

* Bull. Soc. Philomath. de Paris, ser. 7, ii. pp. 229, 230 (1878).

† Proc. Ac. Nat. Sci. Philad. p. 30 (1860).

‡ Explic. des planches in Savigny's Cr. de l'Egypte, pl. x. fig. 1.

It is also evidently very nearly allied to *A. crinitus*, Dana*, from the far distant Balabac Straits; but the front between the eyes in *A. paracrinitus* can scarcely be described as carinated, and the first carpal joint of the second pair of legs is decidedly longer than the second joint.

Sicyonia sculpta, M.-Edwards.

Seven specimens, which apparently do not differ specifically from this species, are in the collection; the length of the largest is nearly 1 inch 3 lines (32 millim.).

If, as appears to be the case, Olivi's name of *carinata* is the earliest applicable to this species†, it will be necessary to apply a new designation to the *Sicyonia carinata* of M.-Edwards and Olivier, which might be named *S. Edwardsii*. For the present, however, I prefer to adopt the generally-received terminology.

Mr. C. Spence Bate‡, in his recent memoir on the Penæidea, has recorded the occurrence of this species at St. Vincent, in the Cape-Verd Islands ('*Challenger*' *collection*).

Penæus brasiliensis (Latr.).

Three females are in the collection; length of the largest about 4 inches 2 lines (106 millim.). They were obtained in the marshes at Rufisque.

I have already noted the occurrence of this species at Whydah, on the West-African coast §. On the American coasts its range extends from New York to Brazil (*vide* Kingsley, Bullet. Essex Instit. x. p. 69, 1878).

Penæus velutinus, Dana.

Thus must be provisionally designated several small specimens in the collection from Goree (length of the largest to base of rostrum, which is broken, about $1\frac{1}{4}$ inch, 32 millim.), and also specimens in the Museum collection which I formerly very doubtfully designated *P. affinis*, M.-Edwards, having only M.-Edwards's short diagnosis for a basis of identification. Mr. Spence Bate, however, has recently examined the type of *P. affinis*; and I am satisfied from his figure (*t. c.* p. 179, pl. xii. fig. 6) that *P. velutinus* is in reality distinct from M.-Edwards's species. Mr. Bate, however, agrees with me in

* U.S. Explor. Exp. xiii. Cr. i. p. 548, pl. xxxiv. fig. 8 (1852).

† *Vide* 'Zoologia Adriatica,' p. 51, pl. iii. fig. 2 (1792).

‡ Ann. & Mag. Nat. Hist. (ser. 5) viii. p. 172 (Sept. 1881).

§ Proc. Zool. Soc. 1878, p. 299.

regarding *P. affinis* (*barbatus*) of De Haan as identical with *P. velutinus*.

The range of this species having now been ascertained to extend to the West-African coast, it is more than ever probable that *P. pubescens*, Stimpson, from St. Thomas (West Indies), which is scarcely to be distinguished by the author's description, will have to be united with *P. velutinus*. Stimpson mentions, however, but a single pair of lateral caudal spines.

Mr. Spence Bate has described several species from New Guinea, the Philippines, and Japan, which (in the short diagnoses published) are separated from one another and from *P. velutinus* by characters largely drawn from the rostrum and postabdomen. I may add, therefore, the following particulars respecting the Gorean examples and others in the Museum collection:—Rostrum nearly straight, sharp, slightly ascending from the base, and armed with from seven to ten spines on its upper margin, besides the gastric spine (the number of spines fewest in the smallest specimens). Second to sixth segments of the postabdomen carinated, the carina terminating on the last segment in a small tooth or spine; terminal segment longitudinally sulcated above and terminating in a strong spine and with four pairs of lateral spines, of which the proximal pair are small and remote from the rest. These are wanting in some specimens, and may have been disarticulated and lost. A similar arrangement of the spines is evident in two specimens from the Gulf of Suez in the Museum collection; in a specimen from the Japanese seas the proximal pair of spines are wanting, and in one from the Australian seas the distal pair. In another specimen from Shark Bay, West Australia, the spines correspond in number and development with the Gorean specimens. In all of the above there is but little variation in the form of the rostrum and number of its teeth and of the postabdominal carina; and in all the body is more or less densely clothed with a short scabrous pubescence. In but few of the specimens I have seen are the external genital appendages fully developed.

Stomatopoda.

Lysiosquilla (*Coronis*) *acanthocarpus*, var. *septemspinosa*. (Pl. XVI. fig. 7.)

I thus designate a small female example in the collection that agrees with examples of *C. acanthocarpus*, from Port Essington, North Australia, and from Penang, in the form of the carapace and postabdomen, the number of the spines on the terminal segment, the existence of a spine on the carpus of the large raptorial limbs, in the form of the spines of the basal prolongation of the uropoda, &c.

It scarcely differs, indeed, except in the somewhat less-elongated, slightly transverse rostral plate (which, as in the typical examples of *C. acanthocarpus*, has its anterior margin armed with a short spine, and its antero-lateral angles not prolonged into spines), its less prominent eyes, and in having the dactylus of the raptorial limbs armed with seven, not six, spines on their inner margins; the penultimate spine is also relatively not so short as in the two specimens of *C. acanthocarpus* above referred to; the small spinules on the latero-posterior margin of the terminal segment are somewhat more elongated. The example from Goree Island measures barely 1 inch 4 lines (34 millim.), whereas the smallest (the type) specimen of *C. acanthocarpus* measures about 2 inches 6 lines (64 millim.); and in the absence of a larger series for comparison I do not venture to regard the distinctions above mentioned as of specific value; yet, in consideration of the widely-separated localities, it appears desirable to apply a distinct designation to the West-African variety. As in the typical form, the lamellate appendage of the antepenultimate joint is less dilated in the last pair of thoracic limbs than in the preceding*.

Lysiosquilla armata, Smith †, from the coast of New England, is a very distinct species from the foregoing, differing (it would appear) in the form of the rostrum and terminal segment, as well as in having ten spines on the prehensile edge of the dactylus of the "raptorial limbs" (second maxillipedes).

Isopoda.

Cirolana Swainsonii.

Nelocira Swainsonii, Leach, Dict. Sci. Nat. xii. p. 347 (1818); Desmarest, Consid. Crust. p. 302, pl. xlviii. fig. 2 (1825); M.-Edwards, Cr. in Cuvier, Règne Anim., Atlas, pl. lxvii. fig. 4.

Eurydice Swainsonii, M.-Edwards, Hist. Nat. Crust. iii. p. 238 (1840); White, List Crust. Brit. Mus. p. 106 (1847).

? *Cirolana hirtipes*, Heller, Verh. zool.-bot. Gesellsch. Wien, xvi. p. 742 (1866); Stalio, Atti Istit. Veneto (ser. 5), iii. p. 1375 (1876–77).

There are in the collection six small specimens that I refer

* *Vide* Ann. & Mag. Nat. Hist. (ser. 5), v. p. 125 (1880).

† Proc. U.S. Nat. Mus. iii. p. 446 (1881).

to this species with little hesitation after comparison with Leach's types in the British Museum, which are from the Mediterranean, and are dried and in fairly good condition. The length of the largest of the West-African examples is not quite 4 lines (8 millim.), whereas that of the largest of the Mediterranean types is about 6 lines (over 12 millim.). It may be useful to subjoin a detailed description of this species, the original diagnoses being very short and insufficient.

Body oblong-oval, convex, and nearly smooth. Head transverse, closely encased in the first segment of the body, smooth above, its anterior margin with only a very small subacute median rostriform lobe that projects somewhat between the bases of the antennules. First thoracic segment more than twice as long as the following, with its antero-lateral angles little prominent; the following segments of the thorax are short, with their posterior margins straight and their postero-lateral angles nearly right angles. The postabdomen has not more than four or five of its segments visible in a dorsal view; of these the first four are very short, the second and third having their sides prolonged, acute, and visible in a lateral view; the penultimate has its posterior margin perfectly straight to within a short distance of the lateral angles; the terminal segment is nearly equilaterally triangulate, flat above, with the apex subacute and fringed with hairs. The eyes, which are placed close to the postero-lateral angles of the head and occupy about half of the lateral margins, are oblong in a lateral view and more or less distinctly faceted. The antennules reach about to the posterior margin of the head; the two visible joints of the peduncle are moderately enlarged and of nearly equal length; flagellum of eight or nine joints. Antennæ barely half as long as the animal, with the last two joints of the peduncle subequal and longer than the preceding; flagellum with numerous joints (twenty to forty). Epimera of second and third segments oblong and transverse; those of the four following segments with the postero-lateral angles slightly prolonged and acute, and with an oblique line on their outer surface. Legs moderately robust, the fourth to sixth joints margined with short stiff setæ; dactylus slightly curved. Uropoda little longer than the terminal segment, the rami arising from a broad and transverse base, margined with hairs, the outer the narower, both somewhat ovate, outer with the apex subacute. Colour more or less of a yellowish brown, with darker punctulations.

Cirolana Swainsonii is regarded (but doubtfully) by Heller (*t. c.*) as synonymous with *C. hirtipes* of Milne-Edwards, a species from the Cape of Good Hope. Stalio, while retaining Dr. Heller's designation of *C. hirtipes* for the Adriatic specimens, is yet of opinion that *Eurydice Swainsonii* may be their proper designation, and *C. hirtipes* be a distinct yet allied species. That *C. hirtipes* is distinct is, I think, certain, since in Milne-Edwards's figure the body is represented as longer and narrower, the terminal segment less acute, and the uropoda subequal and of a more acute and narrow lanceolate shape; moreover, in specimens referred, I think rightly, to *C. hirtipes* in the British-Museum collection, the interantennal process of the epistome is narrower and the median frontal lobe more distinct and prominent.

In all its characters *C. Swainsonii* much more nearly approaches *C. Cranchii* of Leach; and the two species may even be identical; but more specimens of *C. Cranchii* are needed for comparison, and for the present it may suffice to point out the affinity and possible identity of the two species. Neither the degree of granulation of the eyes nor the number of exposed postabdominal segments are characters of importance, since I have seen specimens of *C. Cranchii* having the eyes nearly smooth and but five postabdominal segments exposed; there are, however, slight differences in the form of the uropoda and terminal segment.

Amphipoda.

Ampelisca tenuicornis, Lilljeborg.

Here are referred with little hesitation two Amphipods in somewhat imperfect condition in the collection which agree in all essential characters with A. Boeck's diagnosis of the species *, who, moreover, quotes as synonymous with the Arctic form the *Araneops diadema* of Costa from the Gulf of Naples †. I have thought it well, however, to subjoin the following detailed description of the Gorean specimens:—

The body is compressed and dorsally arcuated, without spines or tubercles; the head projects somewhat beyond the anteriorly-porrected coxa of the first thoracic segment, is nearly twice as long as its greatest vertical depth, and its antero-lateral margins are slightly sinuated. Segments of the postabdomen smooth; the first has its postero-lateral angles rather broadly rounded; in the third postabdominal segment this angle is nearly a right angle; the fourth seg-

* De Skandinaviske og Arktiske Amfipoder, ii. p. 519, pl. xxxi. fig. 1 (1876).

† Mem. R. Accad. Sci. Napoli, p. 178, pl. i. fig. 1 (1856).

ment is dorsally somewhat carinated; the terminal segment is narrow-ovate and divided through rather more than half its length by a narrow fissure. The eye-specks are very small, pale-coloured, and scarcely distinguishable. Antennules scarcely half as long as the antennæ; with two joints of the peduncle visible, the first being thicker and rather shorter than the second; flagellum with from eighteen to twenty joints; the antennæ have the first peduncular joint very short, the next two slender, elongated, and subequal; the flagellum is longer than the peduncle, but broken in the two specimens I have examined; the coxæ of the first four legs are narrow; and the posterior margins of the five succeeding joints in these legs are clothed with long hairs. In the first pair of legs, which are rather shorter than the next pair, the wrist and palm are a little longer than broad and somewhat dilated inferiorly, so that these joints are broadest in the middle of their length; dactylus scarcely more than half as long as the palm and closing against its inferior margin. Second legs with the wrist slender, more than three times as long as broad; palm slender and a little shorter than the wrist (which it resembles in shape), not dilated below; dactylus rather shorter than the palm. The third and fourth legs have the penultimate and antepenultimate joints somewhat dilated, the dilatation greatest in the fourth legs; dactylus very slender and longer than the two preceding joints taken together. In the three posterior pairs of legs the coxæ are very short and the basa or second joints very considerably dilated; in the fifth and sixth pairs these joints are dilated anteriorly as well as posteriorly; in the last pair the anterior margin is straight and the large posterior dilatation is broadly rounded; in the fifth and sixth legs the fifth joints are slightly produced at their posterior and distal angles; and the dactyli in all three are very short. The three posterior pairs of postabdominal appendages are biramose, the rami lanceolate; those of the last pair slightly sinuated. Colour pale yellowish in spirit. Length a little more than 5 lines (11 millim.).

Cirripedia.

Balanus spongicola, Brown.

To this species, as characterized by Mr. Darwin *, are referred numerous small specimens incrusting certain of the shells tenanted by hermit crabs in the collection; two or

* Monograph of the Cirripedia, Balanidæ, p. 225, pl. iv. fig. 1 (1854).

three specimens were also observed attached to the dorsal surface of the carapace of *Lambrus massena*, var. *atlanticus*, and *Ebalia tuberculata*. The valves of the operculum in these specimens are of a pinkish or purplish hue in spirit, and longitudinally ribbed or folded, the ribs often nearly as prominent as in *B. trigonus*; the adductor ridge of the scutum is generally very distinct, the tergum has a short and broadly truncated spur.

Intermingled with the above I have found in one or two instances young specimens apparently referable to *Balanus amphitrite*, which is mentioned by Mr. Darwin (*t. c.* p. 241) as occurring on the west coast of Africa and being, in fact, common in nearly all the warmer temperate and tropical seas; whereas *B. spongicola* has, according to Mr. Darwin, a more restricted range, occurring on the southern and western coasts of Britain, at Madeira, and in the West Indies.

Geographical Distribution of the Species.

In order to facilitate reference to the species enumerated in the foregoing paper, the following systematic list is given, with the geographical range of each, so far as known to me at present. Our knowledge of the distribution of the higher Crustacea is as yet very imperfect, although the attention of carcinologists has been of late years increasingly directed to its study. The following list, however, will suffice to show the marked affinities of the crustacean fauna of Goree (so far as it is represented in the collection now described) with that of the Mediterranean and Eastern American coasts, which I have already referred to above. Of 55 species or well-marked varieties contained in this list, 3 are not included in the Gorean collection, and may be dismissed from present consideration. Of the remaining 52, 17 have been recorded from the temperate European seas; and of these several are now indicated from one or more of the intervening island-groups, *i. e.* the Cape-Verd, Canary, and Madeiran Islands; the European affinity is further exhibited by several of the new species having near allies in Mediterranean forms. Only five species in the following list have been recorded from the West Indies or localities on the east coast of North America; but several others find near allies among their American congeners, *e. g.* *Heterocrypta Maltzani*, *Lophozozymus sexdentatus*, *Leptodius punctatus*, *Neptunus inæqualis*, *Ethusa mascarone*, Roux, *Spiropagurus elegans*, *Scyllarus arctus*, var. *paradoxus*, n., and *Penæus velutinus*, Dana.

Portunus corrugatus, Pennant, *Penæus velutinus*, Dana, and *Balanus amphitrite* have an Oriental range; and the typical forms of *Thalamita integra*, *Pilumnoplax sulcatifrons*, and *Lysiosquilla acanthocarpus* (new varieties of which are in the Gorean collection) are also from Oriental localities. Other species there are, as (*e.g.*) *Goniosoma Milleri*, A. M.-Edw., *Spiropagurus elegans*, and *Alpheus paracrinitus*, which are very closely allied to Oriental congeners.

Several of the new species or varieties described from Goree are also known to occur at the Cape-Verd, Madeira, or Canary Islands; and no doubt all may be expected to have a more or less extended range †.

Systematic List of the Species.

(The species distinguished by an asterisk are those not represented in the collection from Goree.)

Decapoda.

Brachyura.

Stenorhynchus rostratus (Linn.). European seas.
S. rostratus, var. *spinulosus*, n. Vigo Bay ?, Ireland ?
Herbstia (*Micropisa*) *violacea*, A. M.-Edw. Cape St. Vincent (Cape-Verd Isl.), Angola.
Pisa carinimana, Miers. Canaries.
Lambrus (*Parthenopoides*) *massena*, Roux. Mediterranean, Cape-Verds ?
L. (*P.*) *massena*, var. *goreensis* ‡, n.
L. (*P.*) *massena*, var. *atlanticus*, n.
L. (*P.*) *bicarinatus*, sp. n. Canaries.
Heterocrypta Maltzani, sp. n.
Lophozozymus (*Lophoxanthus*) *sexdentatus*, sp. n.
Xanthodes melanodactylus, A. M.-Edw. Madeira, Cape St. Vincent (C.-Verd Isl.), Ascension Island.
Xantho pilipes, A. M.-Edw. ? Senegal.
Leptodius punctatus, sp. n.
**L. Macandreæ*, sp. n. Canaries.
Pilumnus verrucosipes, Stimpson. Cape of Good Hope, Simon's Bay.
Neptunus (*Amphitrite*) *inæqualis*, sp. n.
Thalamita integra, var. *africana*, n. Canaries.

† In connexion with the subject of geographical distribution, I may be allowed to call attention to the remarks of Prof. S. I. Smith on the geographical distribution of the Crustacea recently dredged by the United-States Fish Commission on the New-England coast (*vide* Ann. & Mag. Nat. Hist. ser. 5, 1881, vii. p. 146).

‡ This designation must be given to the variety above named *spinifer*, since Mr. Haswell has quite recently applied the latter name to an Australian species.

Goniosoma Millerii, A. M.-Edw. Cape St. Vincent (Cape-Verd Isl.).
Portunus corrugatus (Pennant). European temperate seas, Red Sea, Japan.
P. pusillus, Leach. European temperate seas, New Zealand?
Atelecyclus rotundatus, Olivi. Mediterranean, west coast of France.
Pilumnoplax sulcatifrons, Stm., var. *atlantica*, n. (The typical form was obtained at Hong Kong.)
Typhlocarcinus integrifrons, sp. n.
Thaumastoplax anomalipes, gen. and sp. nov.
Gelasimus tangieri, Eydoux. North and west coasts of Africa, coast of Portugal, West Indies.
Philyra cristata, sp. n.
P. lævidorsalis, sp. n.
Ilia spinosa, sp. n. Canaries.
Ebalia tuberculata, sp. n.
**E. fragifera*, sp. n. Madeira, Canaries.
E. affinis, sp. n.
Dorippe armata, White (ined.), Miers.
Ethusa mascarone, Roux. Mediterranean, Canaries.

Anomura.

Dromia fulvo-hispida, sp. n.
D. spinirostris, sp. n.
Diogenes varians (Costa). Coasts of Portugal, Mediterranean, Black Sea.
D. varians, var. *ovata*, n.
D. varians, var. *gracilimana*, n.
Pagurus striatus, Latr. Mediterranean, Madeira, coasts of Portugal.
**P. imperator*, sp. n. St. Helena.
P. granulimanus, sp. n.
Isocheles? gracilis, sp. n.
Spiropagurus elegans, sp. n.
Eupagurus excavatus (Herbst). Mediterranean.

Macrura.

Scyllarus (*Arctus*) *arctus*, var. *paradoxus*, n.
Crangon (*Cheraphilus*) *cataphractus* (Olivi). Mediterranean.
Alpheus paracrinitus, sp. n.
Sicyonia sculpta, M.-Edw. Mediterranean, St. Vincent.
Penæus brasiliensis (Latr.). West Africa, Whydah, American coasts from New York to Brazil.
P. velutinus, Dana. Oriental region, from Japan to Gulf of

Suez; West Australia (Sharks Bay), West Indies, St. Thomas? (as *P. pubescens*?).

Stomatopoda.

Lysiosquilla (*Coronis*) *acanthocarpus*, var. *septemspinosa*, n. (The typical form was from Port Essington, North Australia.)

Isopoda.

Cirolana Swainsonii (Leach). Mediterranean.

Amphipoda.

Ampelisca tenuicornis, Lilljeb. North-European and Mediterranean seas.

Cirripedia.

Balanus amphitrite, Darwin. Warmer temperate and tropical seas of the globe.

B. spongicola, Brown. South and west coasts of Britain, Madeira, West Indies.

EXPLANATION OF THE PLATES.

Plate XIII.

Fig. 1. *Heterocrypta Maltzani*, sp. n., × 3 diam.
Fig. 1 *a*. Inferior view of the front of the cephalothorax, showing the position and structure of the antennæ and outer maxillipedes, × 3 diam.
Fig. 2. *Lophozozymus* (*Lophoxanthus*) *sexdentatus*, sp. n., × 3 diam.
Fig. 2 *a*. Outer view of chela of the same, × 3 diam.
Fig. 3. Outer view of chela of *Leptodius punctatus*, sp. n., × $1\frac{1}{2}$ diam.
Fig. 4. Outer view of chela of *Leptodius Macandreæ*, sp. n., × 2 diam.
Fig. 5. Similar view of a chela of *Pilumnus verrucosipes*, Stm., × 3 diam.
Fig. 6. *Neptunus* (*Amphitrite*) *inæqualis*, sp. n., × $1\frac{1}{2}$ diam.

Plate XIV.

Fig. 1. *Typhlocarcinus integrifrons*, sp. n., × about 3 diam.
Fig. 1 *a*. Frontal and orbital region of the same, further magnified.
Fig. 2. *Thaumastoplax anomalipes*, gen. and sp. n., × 2 diam.
Fig. 2 *a*. Frontal and orbital region of the same, further magnified.
Fig. 2 *b*. Outer maxillipede of the same, considerably magnified.
Fig. 2 *c*. Outer view of chela of the same, × 2 diam.
Fig. 3. *Ebalia tuberculata*, sp. n., × 3 diam.
Fig. 3 *a*. Outer maxillipede of the same, showing the form of the exognath, further magnified.
Fig. 4. Outer maxillipede of *Ebalia affinis*, sp. n., considerably magnified.

PLATE XV.

Fig. 1. *Philyra cristata*, sp. n., × 4 diam.
Fig. 1 *a*. Outer maxillipede of the same, considerably magnified.
Fig. 1 *b*. Postabdomen of a male, considerably magnified.
Fig. 2. Chela of *Philyra lævidorsalis*, sp. n., magnified.
Fig. 3. *Ilia spinosa*, sp. n., × 2 diam.
Fig. 4. *Dorippe armata*, White (ined.), nat. size.
Fig. 4 *a*. Outer view of larger chela of the same, nat. size. (The figures are taken from White's typical specimen in the Museum collection.)

PLATE XVI.

Fig. 1. Outer view of chela of *Dromia fulvo-hispida*, sp. n., × about 4 diam.
Fig. 2. Dorsal view of frontal region of *Dromia spinirostris*, showing the form of the rostral spines, × $1\frac{1}{2}$ diam.
Fig. 3. *Pagurus granulimanus*, sp. n., nat. size.
Fig. 3 *a*. Outer view of larger (left) chela of the same, nat. size.
Fig. 4. Outer view of third (right) leg of *Isocheles*? *gracilis*, sp. n., × $1\frac{1}{2}$ diam., showing the form of the long and slender dactylus.
Fig. 5. *Spiropagurus elegans*, sp. n., × $1\frac{1}{2}$ diam.
Fig. 5 *a*. The spirally-coiled genital appendage of the left leg of the fifth pair, × 3 diam.
Fig. 6. Rostrum and orbital region of *Alpheus paracrinitus*, sp. n., × 8 diam.
Fig. 7. Large raptorial limb (second maxillipede) of *Lysiosquilla acanthocarpus*, var. *septemspinosa*, sp. n., × 2 diam.

XXXVIII.—*Description of the Animal of* Durgella Christianæ, *a Species of Land-Shell from the Andaman Islands.* By Lieut.-Colonel H. H. Godwin-Austen, F.R.S., F.Z.S., &c.

My friend Mr. Geoffrey Nevill, a short time since, was good enough to send me some specimens of Andaman and Nicobar land-shells in spirit, and among them a specimen named *Helicarion Christianæ*, Theobald. This I took an early opportunity of examining; and it proved a most interesting species. The form of the shell-lobes at once recalled the genus *Durgella*, W. Blf., described in full in Journal Linn. Soc. vol. xv. 1881, p. 291; and after dissecting out the generative organs and odontophore, there was no doubt of its relationship to *D. levicula*, Bs., of Tenasserim, and *D. assamica* of the Brahmaputra valley, Assam, thus extending in an interesting way the range of this very well-marked genus. I give below a full description of the animal of this the largest species of it; and I only wish that I could give one from life; for from the spirit-specimen it would appear to be of a very fine dark colour, contrasting remarkably with very much paler-coloured shell-lobes.

The species was first described (on shell-character alone), under the title *Vitrina Christianæ*, by Mr. W. Theobald, in J. A. S. B. 1864, p. 245; but he had apparently never seen the animal. In his 'Catalogue of the Land and Freshwater Shells of India,' published in 1876, it is placed in Section C of the genus *Helicarion*. The five sections into which this genus is divided are quite artificial, and apparently based on shell-characters, which in these slug-like forms are of no value whatever. For instance, *H. Bensoni*, to which *Christianæ* is compared in the original description, is closely allied to *Macrochlamys*.

Shell (original description). Testa subglobosa, tenuis, polita, diaphana, nitida, supra costulate striata, infra planior, colore succineo; apice pallido, vix elevatiusculo; peripheria rotundata; apertura parum obliqua; anfractibus $3\frac{1}{2}$, lente crescentibus. Long. 13, lat. 11, alt. 8 millim.

Habitat in insulis Andamanicis.

It is figured in 'Conchologia Indica,' pl. lxvi. figs. 7–10.

Descr. Animal from spirit-specimen about $1\frac{1}{2}$ inch long when fully extended. Whole body very dark (probably indigo-grey), with the shell-lobes conspicuously pale-coloured. Apparently long, and foot narrow, with a distinct central area and lateral pallial line. The right neck-lobe is small, dark-coloured, of triangular form, the left neck-lobe commencing as a very narrow strip at the respiratory orifice, and widening gradually, but to no great extent, towards the left side. The right shell-lobe is largely developed even as contracted in the spirit, and in life must extend over all the right and posterior side of the shell. The left shell-lobe is given off from the edge of the mantle on the left anterior margin, and is broadly tongue-shaped, in length about four times its breadth, and must also cover a very large surface of shell when fully extended. The extremity of the foot is square, with a mucous gland overhung by a large lobe. The generative orifice is just behind and a little below the right eye-tentacle. The generative organs are the same as in *Durgella assamica**, there being no amatorial organ. The spermatheca is long and small, expanding at the end into a large pear-shaped sac. The albumen-gland is large and granular; but I failed to trace out the hermaphrodite duct and ovo-testes.

Odontophore. The buccal mass is large and broad, with a

* *Vide* Linn. Soc. Journ. Zool. vol. xv. pl. xxi. fig. 2, &c.

broad lingual ribbon, extremely brittle, so that I was unable to get it out complete; it consisted of rows of similar and equal-sized teeth; however, I was fortunate enough to secure the central portion. A very minute central bicuspid tooth, succeeded by much-curved bicuspid laterals, the first on either side of the central being slightly shorter than the second; thence and outwards there is no change in form, except that those further removed nearer the margin show the pectiniform edges so characteristic of the odontophore in *D. levicula.* The jaw is straight, with a slightly convex central margin, by no means of solid form, and longitudinally striate.

XXXIX.—*Descriptions of some new Species of Heterocerous Lepidoptera from Sumatra.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

The species now described were chiefly collected by Mr. Charles Curtis, and were added to the Museum series during the present year; they are referable to the Bombycina and Geometrina.

Lithosiidæ.

1. *Miltochrista Curtisii*, sp. n.

Allied to *M. rubricostata* of Herrich-Schäffer, but considerably larger and somewhat differently coloured: primaries above greyish brown, with bright yellow markings, upon which the internervular folds are represented by thick crimson lines; these markings are as follows—a basicostal patch, a triangular costal patch immediately beyond it, an irregular transverse band before the middle, a tapering costal streak from just beyond this band to the apex, and a rather broad irregular external border; there are also a short narrow streak at base of inner margin, a spot just below the cell and before the transverse band, and two narrow longitudinal lines on the radial interspaces, all crimson; fringe yellow: secondaries rose-pink, with pale yellow fringe: thorax greyish brown, spotted with yellow and red; abdomen rose-pink. Primaries below rose-red, slightly purplish below the upper radial vein, and inclining to crimson above it (thus indicating the broad brown area of the upper surface); costa and discoidal cell clouded with orange-yellow; veins and external border yellow: secondaries pale rose-pink: body below pale yellow; hind legs tinted with rose-colour. Expanse of wings 47 millimetres.

One female.

2. *Miltochrista collivolans*, sp. n.

Hypocrita meander (part.), Snellen, Nat. Hist. Sumatr. p. 35 (nec Tijd. v. Ent. xxii. pl. vii. fig. 11).

General aspect of *M. meander* from the Celebes, but certainly distinct: primaries ochreous, with pale grey-brown markings, as follows—two convergent basicostal dashes, a slightly sinuous oblique stripe, inarched at costa, across the basal fourth, a zigzag stripe (the first angle of which unites with the first stripe) just before the middle, a sigmoidal stripe, and a series of longitudinal discal dashes, the fifth and seventh of which are longer than the others; there are also two blackish dots at base of costa; fringe greyish: secondaries pale stramineous: body above ochreous, the head and thorax spotted with grey. Wings below creamy stramineous, without markings, the primaries of a deeper colour than the secondaries: body ochreous. Expanse of wings 41 millimetres.

A specimen of this species was taken on the 7th of August, 1879, on hilly ground at Bankala.

Nyctemeridæ.

3. *Secusio picatus*, sp. n.

Allied to *S. mundipictus*, but larger, the interno-median streak of primaries wider, the white band longer and more oblique, its inner edge notched at origin of first median branch; the external border of secondaries considerably narrower, and on the upper surface terminating abruptly at the first median branch, but reappearing as a narrow greyish marginal dash near to anal angle; abdomen grey, with white edges to the segments, black lateral (but not dorsal) spots, and ochreous anus; in other respects similar to the well-known species with which I have compared it. Expanse of wings 4 inches 4 lines.

One female example.

4. *Trypheromera zerenoides*, sp. n.

Wings above snow-white, semitransparent; primaries with the costal border grey, crossed by an oblique white line near apex; two unequal, almost confluent longitudinal grey streaks on the basal half of the cell; three transverse series of more or less fusiform unequal grey spots, the first series just before the middle and uniting at its inferior extremity with the second series (which is interrupted on the first median interspace); second series discal; third series abbreviated, marginal, decreasing, the second spot being, however, as small as the fifth and sixth; secondaries immaculate: body ochreous, spotted with black, the spots of the dorsal abdominal series being large. Primaries below with the costal border blackish, the subcostal spots of the first two series dark grey, but the other spots of these series obsolete, the terminal spots dark grey; secondaries with a black line along the centre of the costal margin: body below ochreous dotted with black. Expanse of wings 50 millimetres.

One example.

This singular species has the general aspect of some of the Zerenidæ, but agrees in neuration with *Tripheromera*.

Euschemidæ.

5. *Milionia Guentheri*, sp. n.

Wings velvety black, shot with ultramarine blue towards the base of the primaries, and almost to the outer margin of the secondaries on the upper surface; the basal third of primaries and the interno-median area of secondaries with broad diffused shining emerald-green streaks along the veins, these streaks, however, changing to ultramarine blue in certain lights: primaries crossed before the middle from costal margin to inner margin just before the external angle by a vivid scarlet oblique band (almost as in *M. fulgida* of Java): secondaries crossed by a discal scarlet band, acutely angulated upon the radial vein, trisinuated externally between the angulation and the anal angle of the wing, the inferior half shot with magenta, enclosing a small black spot at the anal angle; a marginal series of depressed triangular spots and the fringe bright orange-red; a series of slaty-blue spots upon the fringe at the extremities of the nervures; body brilliant metallic emerald-green with blue shades in certain lights; anal tuft tipped with stramineous; antennæ, palpi, and inferior surface of legs dark fuliginous brown. Wings below less brilliant in colouring than above, the band on the wings of a more orange-red colour; primaries with the external and internal areas somewhat greyish; secondaries with an additional basicostal emerald-green streak. Expanse of wings 65 millimetres.

Two specimens.

I have named this superbly beautiful moth in honour of Dr. Albert Günther, Keeper of the Zoological Department, as a slight acknowledgment of the deep interest which he has always manifested in the Lepidoptera. Its natural position is doubtless between *M. fulgens* from Java and *M. basalis** from the same island.

* Speaking of *M. basalis*, it may be well to note that its representative from Malacca has the orange bands double the width of those of the Javan species; it should therefore be regarded as distinct, and may take the name of *Milionia latifasciata* (expanse 57 millim.).

BIBLIOGRAPHICAL NOTICES.

A Treatise on Comparative Embryology. By FRANCIS M. BALFOUR. Vol. II. 8vo. London: Macmillan, 1881.

IN January last we noticed the publication of the first volume of Dr. Balfour's 'Treatise on Comparative Embryology;' and the second volume, which has since made its appearance, affords a most brilliant justification of the high terms in which we ventured to speak of this work. In the presence of such a book the ordinary critic, if he has any modesty in him, must perforce be dumb; and although we are quite prepared to hear that specialists may discover small errors or omissions in its pages, the excellence of the work is such that to dwell upon them would be an ungracious as well as an ungrateful proceeding. The author may certainly congratulate himself on having produced one of the grandest contributions to zoological literature that has appeared for years.

The embryology of the Invertebrate groups having been treated of in the first volume, this second volume deals, in the first place, with the Vertebrates; but here we must note a peculiarity of classification which may not meet with general approval. Dr. Balfour includes in the subject matter of this volume the embryology of the Ascidia; that is to say, he not only regards these animals as relatives of the Vertebrates, in accordance with the views of Kowalevsky and others, but actually places them with the Vertebrates, as forming part of the same highest group of animals, which he proposes to name Chordata. This great group is then divided into three subordinate ones—namely the Cephalochorda, including only *Amphioxus*, the Urochorda, consisting of the Ascidia, and the Vertebrata, or animals which show more or less distinctly a regular backbone. The members of the first two groups have probably, in the author's opinion, undergone degeneration; and the collocation of the three divisions seems to be borne out by their embryology. The Cephalochorda "undergo a less modified development than that of other Chordata."

The details of the development of the various great groups of the Chordata are worked out in the earlier chapters of the present volume with a care and patience deserving of all praise; and the whole subject is wound up by an excellent chapter giving a comparison of the formation of the germinal layers and of the early stages in the development of the Vertebrates. This is followed by another most interesting chapter on the ancestral form of the Chordata, which the author thinks must have belonged to a type allied to the Nemertine worms, which has now become totally extinct. According to his table of the phylogeny of the Chordata, both the Ascidians and *Amphioxus* lie out of the direct line of descent from these hypothetical ancestors of all Vertebrates. The final chapter of this section of the book, devoted to systematic embryology, contains a discussion of the mode of origin and homologies of the germinal layers, and a most important consideration of the nature, origin, and affinities of larval forms.

The second part of his Treatise Dr. Balfour devotes to Organogeny; and in it he describes in considerable detail the origin and development of the various organs throughout the animal kingdom, so far as such a treatment is possible, in the present state of our knowledge of the organogeny of the Invertebrata. The different organs are classified roughly in accordance with the germinal layers from which they are principally derived.

It has been impossible for us here to give more than a brief indication of the mode of treatment adopted by Dr. Balfour in this most valuable book, which certainly ought to be upon the shelf of every student who wishes to understand and follow the progress of zoology in these modern days. The second volume, like its predecessor, is copiously illustrated with excellent wood-engravings.

Compte Rendu des Excursions (1) *aux Environs de Renaix*, (2) *aux Environs de Bruxelles*, (3) *dans le Boulonnais*, (4) *dans le Quaternaire de la Vallée de la Somme.* Par A. Rutot.

(5) *Sur les Restes de Mammifères Terrestres dans les couches de l'Éocène de Belgique.* Par A. Rutot.

(6) *Les Terrains Tertiaires de la Belgique.* Par A. Rutot et G. Vincent. Liége, 1879.

The first four papers have appeared in the 'Annals' of the Malacological Society of Belgium, and comprise notices by M. A. Rutot of excursions to some localities of geological interest. Thus the Mont de la Musique, in the environs of Renaix, afforded sections of the Lower and Upper Eocene deposits, in which a different interpretation of the strata there exposed is assigned from that given by M. Dumont. The Brussels excursion extended over three days, during which the most interesting exposures of the Middle and Upper Eocene and superficial deposits around the city were examined. The extraordinary meeting of the French Geological Society was held at Boulogne in 1880; and M. Rutot gives a short account of the geological character of the Secondary rocks of the coast-section and of the Palæozoic rocks of the interior. The Quaternary strata of the vicinity of Abbeville, their characters and fossil contents, form the subject of the fourth paper. In the fifth paper M. Rutot, after noticing the oscillations of the Eocene series and the continental periods resulting therefrom, describes the stratigraphical position of the terrestrial Mammalia found in the Eocene strata of Belgium.

The memoir by MM. A. Rutot and G. Vincent is intended to comprise a general but concise account of what is known (to 1879) relative to the stratigraphy and palæontology of the Belgian Tertiary strata, more especially of the subdivisions of the Eocene period, the descriptions of which occupy the greater part of the paper (pp. 5–85). Besides copious lists of fossils of the different subdivisions, a table is given showing the synchronism of the Eocene strata of Belgium, France, and England. Four pages only are devoted to the Oligocene and Pliocene; but these will be further illustrated and described by the authors and M. E. Vanden Broeck. With regard to the strata referable to the Oligocene, M. Rutot considers that the Bolderien, Upper and Lower Rupelien, and Upper Tongrien systems of Dumont correspond to the Middle Oligocene of the Germans, to the Fontainebleau sands of France, and to the Osborne, Bembridge, and perhaps the Hempstead series of England. The Lower Oligocene will include the Lower Tongrien of Dumont, the upper part of the Paris gypsum, and the Headon series of the Isle of Wight.

Monograph of the British Aphides. By George Bowdler Buckton. 3 vols. 8vo. London: Ray Society, 1876–1881.

Some months ago we noticed the completion of Mr. G. S. Brady's treatise on the British non-parasitic Copepoda, published by the Ray Society. Another work, scarcely of less interest, has since been completed under the auspices of the same valuable institution, namely Mr. Buckton's 'Monograph of the British Aphides,' which has been in progress since the year 1876. This book may perhaps be regarded as hardly taking so high a position in zoological literature as that above mentioned, seeing that, although denominated a Monograph, it does not profess to include all the British species of the group of which it treats; but, as dealing with a group of animals representatives of which are almost constantly under our eyes wherever we go, and which present some of the most extraordinary developmental phenomena that can be met with in the animal kingdom, it may fairly be regarded as appealing to a wider circle of students than Mr. Brady's complete and elaborate essay. Moreover, so far as we can see, the number of British types omitted cannot be very great, and we have the further advantage that the whole of the species are described from the author's personal observations.

Mr. Buckton opens his first volume with a general introductory chapter on the Aphides, describing the structural peculiarities of the group, both external and internal, the remarkable phenomena of their development as understood five years ago, and certain other points in the general natural history of the family, and also giving a brief sketch of the bibliographical history of the group. This introduction is followed by the systematic descriptions of the species and genera, in which, as regards classification, the author follows generally in the steps of his predecessors. His descriptions are sufficiently detailed, and treat separately of the different forms under which the species make their appearance; and they are founded, as already stated, upon the author's own observations, which have been continuously carried on during many years in spite of physical disadvantages which it might be thought were hardly compatible with such labours. A few new genera are proposed by the author, sometimes, as it seems to us, upon insufficient characters; but without a special knowledge of so difficult a group it is hard to form any sound opinion upon such a point as this. Undue multiplication of genera is not by any means an unusual fault in zoological writers of the present day; and it does not stand in the way of what, after all, is our author's principal object, namely to enable students to determine the species of Aphides, and to give them a notion of the natural history of the insects.

Besides giving a general account of the natural history of the group in his introductory chapter, the author indicates under the head of each species any thing that there may be peculiar in its habits and mode of life, and especially notes the injuries done to vegetation by the inordinate multiplication of some of the species. Further he mentions the various enemies of the Aphides, which serve more or less effectively to keep their multiplication within bounds; and certain special sections of his book are devoted to the description of the habits of Aphidivorous groups of insects, such as the Hymenopterous parasites of various families, the fossorial Hymenoptera, which provision their nests with Aphides, and the Hemerobiidæ and Syrphidæ, whose larvæ prey upon them. Throughout the book we find evidence of the most conscientious work; and this work has been directed to a most successful end.

We have yet a few words to say about the illustrations, which are exceedingly numerous and characteristic. There are in all 114 coloured plates illustrating the systematic part of the three volumes, besides three plates of anatomical details appended to the general introduction. The whole of these figures have been drawn by the author, the outlines being obtained by means of the camera lucida; so that their accuracy may be depended upon, although, perhaps, we miss that elegant arrangement of the limbs to which one is accustomed in entomological plates. As a matter of course the possession of such a quantity of reliable figures will facilitate in no small degree the identification of the species described; and for their publication we have to thank the Ray Society, seeing that, in all probability, no publisher would embark his capital in such a risky undertaking. It is in the production of illustrated works like this that such societies as the "Ray" find their *raison d'être*; and it is a matter for regret that this valuable institution, which has already published so many important works, should at present be in a somewhat languishing condition for lack of subscribers.

MISCELLANEOUS.

On a Curious Phenomenon of Prefecundation observed in a Spionide Worm. By M. A. Giard.

The Annelide that forms the subject of this notice is a Spionide, the rather complicated synonymy of which may be stated as follows:— *Spio crenaticornis*, Montagu; *Aonis Wagneri*, Leuckart; *Colobranchus ciliatus*, Keferstein; *Uncinia ciliata*, Quatrefages; *Scolecolepis vulgaris*, Malmgren (pro parte).

It has been found on the south coast of England, at Heligoland, at St. Vaast-la-Hougue, &c. It is common at Wimereux in a bed of shifting sand, where it lives in company with *Magelona mirabilis*, *Echinocardium cordatum*, *Bathyporeia Robertsoni*, *Carinella linearis*, &c. *Spio crenaticornis* is very nearly allied to *Spio bombyx*, Claparède, of the Bay of Naples. The first fourteen setigerous segments present, at the base of each foot, sacs containing a coil of chitinous setæ rolled up together. These organs, discovered by Claparède in *Spio bombyx*, and named by him "filières," should be sought for in the other *Spiones*. Their presence would furnish a good character for the generic distinction of *Spio* and *Nerine*, which are so frequently confounded. The "filières" evidently seem to protect the Annelide from the sand which presses upon on all sides; similar organs exist in the *Magelonæ* in the posterior part of the body beyond the ninth segment.

The mature ovum of *Spio crenaticornis* has the form of a spheroid strongly flattened at the two poles. The equator is ornamented with about twenty transparent vesicles, arranged like a circlet of beads at the periphery of the greyish vitellus. These vesicles belong to the capsule, which is very thick and sprinkled with papillæ. This is shown by the action of picrocarmine; the vitellus contracting, each vesicle escapes from the vitelline mass, and assumes the appearance of a small hyaline phial suspended from the capsule by a slender neck. Similar ampullæ exist, in variable numbers, in the ova of the Spionidæ that I have examined, except those of the genus *Magelona*, which, moreover, differs in many respects from the typical Spionidæ. With very weak carmine one can colour the ampullæ, as was done by Claparède; they fill through the uncontracted neck. It is very evident that these elements have nothing to do with the formation of the blastoderm, contrary to the opinion of the illustrious zoologist just mentioned. Nor can we call them, as he does, *protoplasmic spheres*. I can only compare them to the follicular elements of the capsule in the Ascidia. Their physiological function is perhaps that of micropyles.

The germinal vesicle is very large; its radius is about one third of the equatorial radius of the ovum. Its contour is not at all well defined in the fresh ovum; the employment of picrocarmine renders it more distinct. The nucleolus is very bright and voluminous. Its position is strictly central.

Some time before the maturation of the ovum we see in the germinal vesicle, besides the nucleolus, a cellular element rather smaller than the nucleolus, and situated at a variable distance from the latter. This excentric element is itself provided with a small, very distinct nucleus. At first widely separated from the nucleolus, it approaches this by degrees, and finally becomes applied to its surface, when it flattens out and assumes the form of a double hood (*calotte*). Becoming more and more closely applied to the nucleolus, it loses its nucleus, and in the end becomes reduced to a double membrane which surrounds the nucleolus as the pericardiac serous membrane surrounds the heart. Finally its substance unites with that of the nucleolus; and the mature ovum then presents no trace of this singular phenomenon.

I repeated this observation many times at the end of last September. The whole process is perfectly visible in the fresh ovum taken from the interior of the maternal organism, and *without* the employment of any reagent. Verick's objective is quite sufficient for following the phenomenon. The employment of picrocarmine, by distinctly limiting the germinal vesicle, shows clearly that it is not the *nucleus* of the ovum, but its *nucleolus* (Wagner's spot) that conjugates with the excentric cellular element.

I do not know how this element penetrates into the germinal vesicle, or what is its origin. I have met with it once or twice outside the germinal vesicle in the vitellus, where it is more difficult to distinguish it and to follow its progress, in consequence of the greyish granules of the vitelline mass.

The significance of this phenomenon of prefecundation I am still unable to understand. I have nevertheless thought that I ought to make known these facts, on account of their importance and the facility with which they can be checked.

I think that there are great differences between this observation and the more or less analogous observations formerly published by M. Balbiani. Perhaps there would be no difficulty in observing the same process in the ovarian ovum of *Sternaspis scutata*. It is in this way, at least, that I think we may interpret the appearances figured by M. Franz Vejdovsky, in an excellent memoir quite recently published*. The element designated the "Buckelchen" by the Prague professor seems to be nothing but the migratory cell in conjugation with the nucleolus.—*Comptes Rendus*, Oct. 17, 1881, p. 600.

Some new Genera of Freshwater Sponges.

Mr. E. Potts referred to a recent paper by H. J. Carter, F.R.S. (Ann. & Mag. Nat. Hist., Feb. 1881), entitled "The History and Classification of the Known Species of *Spongilla*," in which the writer has distributed the species, heretofore grouped under one generic title, among five genera, founded upon the differences in form and arrangement of the spicula surrounding the statospheres.

* F. Vejdovsky, 'Untersuchungen über Anatomie, Physiologie und Entwicklung von *Sternaspis*' (Vienna, 1881), pl. viii. figs. 2, 11, 12, and 13.

He spoke of the arrangement as a timely step well taken in advance in the history of this branch of the animal kingdom.

He believed that the characteristics of the statospheres and their spicula were those which furnished the only reliable distinctions among freshwater sponges; but the recent discovery of novel forms in American waters had already required an increase in the number of genera, and seemed to make it desirable to modify the terms of some of those already established.

In illustration he referred to several forms observed in this neighbourhood, resembling in many points the English *Spongilla lacustris* (taken as a type of the genus *Spongilla* in the new arrangement), in which, however, the spicula were not acerate, but irregular in shape, were not placed "tangentially" upon the surface, or were altogether wanting. Specific names were suggested for these, but were held under advisement, awaiting a decision as to whether it would be better to create new genera for them or to enlarge the scope of those already defined by Dr. Carter.

The two new genera already decided upon were then described. Under the generic head *Meyenia* Dr. Carter has grouped those species in which the statosphere is surrounded by birotulate spicula, radiately arranged, one disk resting upon the surface. Throughout the genus as already constituted, the shafts of these spicules are of a nearly uniform length, and the outer disks, nearly or quite touching at their edges, give the appearance of a second coat to the statosphere. In two species, however, observed by Mr. Potts last summer, this uniform series was broken by another of about double their length, much fewer in number, somewhat regularly arranged, interspersed among them. He proposed to group these under the genus *Heteromeyenia*, as *H. argyrosperma* and *H. repens*, suggesting that the latter may possibly be the same as Bowerbank's *Spongilla* (now *Meyenia*) *Baileyi*.

Another new genus had been formed and dedicated to Dr. Carter under the name *Carterella*, to include the singular form described by the speaker last year in the 'Proceedings of the Academy,' and then called *Spongilla tentasperma*, changed later to *S. tenosperma*. The distinguishing peculiarity of this genus is that the tube surrounding the foramen of the statosphere is elongated, and divides into from two to five long curling or twisted tendrils, by means of which during the winter the statosphere remains attached to the stems or roots upon which the sponge had grown. This will now be *Carterella tenosperma*.

A second species has been added to this genus, the discovery of Professor Kellicott and Mr. Henry Mills, of Buffalo, under the name of *Carterella tubisperma*. In this the tube is much longer than in any sponge heretofore described, terminating in several straggling rather weak tentacles, much shorter than in the former species. The birotulate spicula in the two forms are quite different; and the species are unquestionably distinct.—*Proc. Acad. Nat. Sci. Philad.*, June 14, 1881.

A new Form of Freshwater Sponge.

A note was read from Mr. Edward Potts, reporting the discovery in Chester Creek of another curious form of freshwater sponge, a third species of *Carterella*, resembling *C. tubisperma* in the character of its birotulates and the length of its foraminal tubes, but much more robust than that species. The tendrils are nearly as long as those of *C. tenosperma*, but broad, flat, and riband-like.

Thus far it is the most conspicuous and peculiar of our American forms. He proposed for it the name *Carterella latitenta*.—*Proc. Acad. Nat. Sci. Philad.*, July 26, 1881, p. 176.

Note on the Structure of the Posterior Foot of Toxodon. By E. D. Cope.

The position of the genus *Toxodon* in the system of Mammalia is a question upon which few authorities have expressed positive opinions, and which is generally regarded as still an open question. In the lack of certainty on the subject, a separate order, the "Toxodontia," has been proposed for its reception. It is known that the genus is ungulate, but the opinions of authors are much divided as to its relations to the three principal orders included under that head. Resemblances to the Proboscidea have been detected; but Prof. Gervais ('Comptes Rendus,' 1878) asserts that there is a close resemblance to the genus *Hippopotamus* in the structure of the posterior foot.

Having come into possession of remains of *Toxodon*, which include the greater part of the skeleton, I make a few observations on the affinities suggested by the posterior foot, the only portion just now accessible in my collection. The calcaneum and astragalus have been more or less imperfectly figured by De Blainville and Burmeister, but no one has, to my knowledge, represented the entire foot. The calcaneum is rather short and stout and its external convex tuberosity is of unusual size. Its articular surface is divided into two subequal parts, the internal of which supports the astragalus, the external the fibula. Thus the fibular articulation is of unusual size. The cuboid facet is on the inferior face of the extremity of the calcaneum, thus looking directly downwards when the bone is prone. In order to articulate with the remainder of the foot, the calcaneum must have been inclined upwards and forwards at an angle of 45°, and the cuboid inclined downwards and forwards at a similar angle. That the axis of the astragalus had the latter inclination is proven by the fact that the superior plane of the sustentaculum lies at that angle to the axis of the remainder of the calcaneum. The great convexity of the external tuberosity for the astragalus will also permit of such a position for the astragalus. The navicular facet of the astragalus is plane and truncates the bone somewhat inferiorly as well as distally, so as to present in the same way as the cuboid. There is probably no cuboid facet. I have not seen the cuneiform bones. The metatarsals and phalanges are robust and rather short. The distal keels of the former are posterior and rudimental; their proximal extremities have a small lateral tarsal facet as well as the principal one. The median digits are of unequal length, and the lateral ones are much shorter, but robust. Whether there are four or five digits I cannot definitely ascertain.

The above characteristics are very significant. They at once refute any supposition of affinity to the Artiodactyla, whether suilline or ruminant. The form of the astragalus and wide fibular condyle of the calcaneum opposes the reference of the genus to the Perissodactyla. On the other hand, all the characters of the feet thus far adduced are found in the Proboscidea. They are not only those of that order, but they are carried to a degree of exaggeration, as though *Toxodon* represented a high grade of specialization of that order. The posterior feet were more truly plantigrade, for the extremity of the calcaneum reached the ground, while the instep was elevated above it, being supported, no doubt, by a more or less elastic pad. This arched or angulate plantigrade type of foot has a remote parallel in that of man. It is quite unique among ungulate Mammalia.

What difficulties the other parts of the skeleton may present I do not yet know, but I perceive nothing in the dentition which forbids the reference of *Toxodon* to the Proboscidea. The dentition is scarcely more different from that of *Mastodon* or *Dinotherium* than that of *Bos* is from *Dicotyles* or *Hippopotamus*. The former genera may be the extremities of a series whose intermediate members are as yet undiscovered. In the latter case the intermediate forms are mostly known.—*Proc. Amer. Phil. Soc.*, April 15, 1881, p. 402.

Contributions to the Study of the Flagellata. By M. J. KUNSTLER.

Cryptomonas ovata, Ehrbg., presents at its superior terminal part a narrow cavity extending from the dorsal to the ventral surface, and forming a sort of vestibule of the digestive tube. At the boundary of the left surface and the anterior surface of the body there is an emargination of the margin of this vestibular cavity, which descends to about one fifth of its length, and thus passes the bottom of the cavity, which is not deep. The two flagella are inserted in the centre of this cavity, at the bottom of a tube which projects from its interior; they present a distinct *transverse striation*, and absolutely resemble a muscular fibrilla. I have observed an analogous striation in several other forms, such as *Euglena oxyuris*, *Trachelomonas hispida*, *Phacus pleuronectes*, *Chlamydomonas pulvisculus*, *Chilomonas paramœcium*, *Astasia costata*, and *Entosiphon costatum*. In *Chlamydomonas pulvisculus* only two flagella are described; but in reality there are four. In *Trachelomonas hispida* the enormous flagellum, which is so striking, is the only one known, while at its base there are two other analogous organs which have not been described; they are much shorter and more delicate. The two terminal flagella of *Cryptomonas ovata* serve exclusively for locomotion.

Besides these terminal locomotory organs, there are further in these creatures a whole group of flagella the existence of which has hitherto been entirely unknown. Along each of the two margins of the superior emargination there exists a series of these appendages almost as long as the others, but of excessive fineness and transparency; they are also striated. These organs serve exclusively for the prehension of food.

The walls of the body are composed of *four layers*, the outer one of which alone (the cuticle) is colourless, while the others are impregnated with chlorophyll.

In the deepest of them there are polygonal grains of starch, which, when well developed, nearly touch each other by their edges, and give to the creature a reticulate aspect. Its inner surface presents a regularly mamillated appearance, and the gibbosities observed upon it appear to be an indication of an actual division of the substance of this layer into small protoplasmic spheres; each of them produces a grain of starch in its interior. Sometimes certain mamillæ become elongated and then constricted in the middle, finally forming new mamillæ. The peripheral material of these protoplasmic spherules is much more dense and resistant than that of the centre, which appears to be absolutely aqueous, for the fine granules which occur there are frequently animated by a Brownian movement, and thus each of them presents in its interior a large vacuole. This deep-seated layer of the integument is not much coloured, and its thickness varies considerably, according to the part of the body that is examined; it is even completely deficient at certain points. The grains of starch which are produced in it have the form of thin polygonal lamellæ; they also divide at the same time as the mamilla that has produced them.

The other two tegumentary layers, which are much thinner, are perforated by a multitude of extremely small vacuoles, filled with an aqueous protoplasm, regularly arranged, and separated from each other simply by thin portions of a denser substance. The cuticle which forms the outermost envelope of the body presents an analogous structure; but the small vacuoles are much flattened parallel to the surface of the body.

The œsophageal tube which has been described in *Cryptomonas* has no existence; but, on the other hand, we find in these creatures a spacious *stomach*, well defined, in which the food is digested. The *walls* of this organ are thick, and present a remarkable appearance; throughout they show numerous close-set granules arranged in a single layer and forming regular rectilinear series; these are starch-grains. In certain cases, when these granules are absent, we can easily see that the protoplasm forming the stomachal walls presents a regularly vacuolar structure, and does not owe its remarkable aspect only to the presence of these grains. At the bottom of the stomach is the origin of a tube, which is the intestine, and which terminates at the anus, which is situated at the lower extremity of the body towards the dorsal surface. Contrary to the generally received opinion, according to which the *Cryptomonades* only absorb liquid food, there are frequently in their digestive tube small creatures upon which they feed.

The contractile vesicle *communicates with the exterior by a pore* opening into the interior of the canal projecting from the bottom of the digestive vestibule; it has distinct, vacuolar proper walls, like those of the stomach; from its lower part there issues a transparent canal which soon loses itself.

The nucleus, the substance of which possesses a regularly and finely vacuolar structure, like that of the integuments, usually possesses a *certain number of nucleoli*, around each of which the surrounding substance seems to be massed; these vesicular corpuscles divide transversely, pretty actively, and frequently we see some of them surrounded by a zone of clear protoplasm, projecting at the surface of the nucleus, and finally detaching themselves completely and falling into a special cavity; these are germs, a part of the development of which takes place in this cavity. It consists of a tube commencing at the bottom of the vestibular duct, soon dilating into an incubatory chamber, and terminating at the nucleus.

Above the stomach, in front and to the right of the nucleus, there is a large mass of protoplasm with a finely vacuolar structure and remarkably distinct, within which are distributed a certain number of corpuscles resembling nucleoli, and from which starts a tube which terminates at the vestibular duct. It is an excretory organ or a male apparatus; and the latter hypothesis is rendered probable by the fact that in these creatures there occurs a sort of copulation, in which they adhere together, two by two, and mouth to mouth, and in this way wander about freely.

In order to investigate the oculiform point of the Flagellata I selected an organism in which this organ is usually well developed, namely *Phacus pleuronectes*, Dujard. Starting from the observation that in individuals brought up in a certain obscurity the oculiform point was but little developed, I assumed *à priori* that an intense light would, on the contrary, be favourable to its development, and I made these creatures live in a strong light. The result of this arrangement was that I obtained individuals with the oculiform point large, brilliant, and very red. This organ is formed by a collection of red granules, irregularly pyriform in shape, and with the enlarged extremity turned always in the same direction; the pigment which colours them is diffused only over their surface, while their internal substance is hyaline. All these granules are arranged side by side upon a curved plane; in the concavity thus formed there is lodged a transparent, refringent, lenticular corpuscle. Judging from this structure it seems to me that the visual functions of the oculiform point can no longer be doubted*.—*Comptes Rendus*, Oct. 17, 1881, p. 602.

* As *Cryptomonas ovata* is only about ·04 millim. in length, it is a pity that M. Kunstler has not informed us with what sort of microscope and under what power he was enabled to arrive at such extraordinary results.

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INCLUDING

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ERRATA ('Annals,' November 1881).

Page 363, line 3, *for* Woodward *read* Westwood.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 48. DECEMBER 1881.

XL.—*On some Arctic Foraminifera from Soundings obtained on the Austro-Hungarian North-Polar Expedition of* 1872–1874. By HENRY B. BRADY, F.R.S.*

[Plate XXI.]

TOWARDS the end of last December I received from my friend Dr. F. Karrer, of Vienna, a parcel of soundings from Franz-Josef Land and the Novaya-Zemlya sea, obtained during the Austro-Hungarian North-Polar Expedition, with the intimation that he had been authorized by the Imperial Academy of Sciences to place them in my hands for investigation, and the suggestion that I should draw up a report upon the Microzoa contained in them for presentation to the Academy.

My first duty under these circumstances is to express my thanks to the Academy for the courtesy which has afforded me the opportunity of reverting to a subject to which I have before given some attention, namely the distribution of minute forms of animal life in the seas of high latitudes.

Before enlarging upon the results of the examination of the

* Report presented to the Imperial Academy of Sciences of Vienna—"Ueber einige arktische Tiefsee-Foraminiferen, gesammelt während der österreichisch-ungarischen Nordpol-Expedition in den Jahren 1872–1874," Denkschriften d. math.-naturw. Cl. d. k. Akad. d. Wissensch. vol. xliii. p. 91, map and plate.

material, it may be interesting to recapitulate briefly the successive steps that have heretofore been made towards a knowledge of the Rhizopod-fauna of the polar seas, that we may be in a position to determine the precise value to science of the instalment now furnished by the explorations of Lieuts. Weyprecht and Payer.

The first record of any importance concerning the Rhizopoda living at the sea-bottom within the Arctic Circle is contained in a short paper by Profs. W. K. Parker and T. Rupert Jones, published in 1857, entitled "Description of some Foraminifera from the Coast of Norway" *. The specimens therein described were chiefly found in dredgings made by the late Mr. M'Andrew at points not far from land, between lat. 65° N. and 71° N., in depths of from 30 to 200 fathoms (55 to 366 metres). The total amount of material, however, appears to have been small; and the number of species described and figured is only twenty-six.

In 1864 the same authors presented to the Royal Society their well-known memoir "On some Foraminifera from the North Atlantic and Arctic Oceans, including Davis Straits and Baffin's Bay" †, a work which has, since that time, been generally accepted as the text-book of the subject. It contains the results of the examination of soundings taken by Sir E. Parry in Baffin's Bay, between latitudes 74° 45′ and 76° 30′ N., and of those made by Dr. Sutherland off the Hunde Islands in lat. 68° 50′ N., together with a revised and extended list from Mr. M'Andrew's Norwegian dredgings in the latitudes already named. One of the distribution-tables which accompany the memoir is devoted to the Arctic fauna. It comprises twenty localities, of which seven belong to the group of soundings from Baffin's Bay, five to the Hunde Islands, and eight to the coast of Norway. In all seventy-five species of Foraminifera are included; and of these twenty appear only in the Norwegian list.

On the departure of the last British North-Polar expedition in 1875, the steam-ship 'Valorous' accompanied the exploring vessels as far as Davis Straits, with Dr. J. Gwyn Jeffreys as naturalist; and on the return voyage some dredging was accomplished. A preliminary report on the Foraminifera obtained on this cruise was drawn up by the Rev. A. M. Norman‡; and a brief notice of some of the larger species was supplied by Dr. Carpenter. The record of Mr. Norman's

* Ann. & Mag. Nat. Hist. ser. 2, vol. xix. p. 273, pls. xi., xii.

† 'Philosophical Transactions,' vol. clv. p. 325, pls. xii.-xix.

‡ Proc. Royal Soc. vol. xxv. p. 202.

observations on the Rhizopoda, which, as far as they affect the Arctic area, were confined to four stations, is unfortunately incomplete, as no detailed report on the subject has as yet appeared; and this is the more to be regretted as the preliminary notice gave promise of valuable additions to our knowledge of the distribution of the northern types.

On the return of this expedition in the following year, the soundings and other similar material which had been collected by Capt. H. W. Feilden, R.A., the naturalist in charge, were placed in my hands for examination; and a report upon the Rhizopoda contained in them was published soon afterwards*. This material comprised gatherings made in twenty-four localities, between latitudes 71° 15′ N. and 83° 19′ N., and yielded altogether fifty-three species of Foraminifera besides a considerable list of Radiolaria. From a geographical point of view it represented a district considerably further north than any previously investigated, the most northerly, indeed, that has yet been attained; and it furnished conclusive evidence that there was no diminution in the lower types of animal life inhabiting the sea-bottom, at any rate to a point within seven degrees of the North Pole. A tabular summary of the Foraminifera of the polar seas accompanied this memoir.

A brief but interesting paper "On Foraminifera from the Gulf and River St. Lawrence"†, was contributed to the pages of the 'Canadian Naturalist' in 1870 by Dr. G. M. Dawson. Though pertaining to an area far to the south of those which have been already mentioned, namely to about lat. 49° or 50° N., the Rhizopod-fauna therein described, owing probably to the influence of a cold polar current, presents a remarkable analogy to that existing at many points within the Arctic Circle.

The various memoirs that have been enumerated all refer to those portions of the Arctic sea which lie to the west of the European coast-line (that is to say, from the Norwegian coast westward to the shores of Greenland, Davis Straits, and the adjacent regions); and until a year ago, when some soundings made by Capt. Markham during a holiday voyage in the Novaya-Zemlya Sea, were brought home for examination, little or nothing was known of the Microzoa of the sea-bottom north of the European continent. A brief report upon Capt. Markham's soundings has recently been published ‡; and

* Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 425, pls. xx., xxi.

† 'Canadian Naturalist,' ser. 2, vol. v. p. 172, woodcuts.

‡ "Notes on Rhizopoda obtained from Capt. Markham's Soundings on the Shores of Novaya Zemlya, by Henry B. Brady," in 'A Polar Reconnaissance,' by Capt. A. H. Markham, R.N., p. 346 (London, 1881).

though the quantity of the material was too small to yield results of any great value taken alone, the information it affords is of considerable interest in connexion with the still more northerly fauna brought to light by the enterprise and perseverance of Lieuts. Weyprecht and Payer. A summary of the report, with some slight corrections, is therefore presented herewith as a supplementary note, and will be found on a later page.

We may now turn to what is more particularly the subject of the present paper—the material procured on the Austro-Hungarian expedition.

The parcel of soundings contained in all sixteen samples of the sea-bottom, varying in quantity from 0·15 to 12·0 grammes, but, for the most part, between one and two grammes in weight. Their physical characters and contents are described in general terms in the following summary. The letters A to P correspond to the headings of the columns of the Distribution Table. The depths are given approximately in fathoms as well as in metres, for more ready comparison with the Tables contained in the memoirs which have been referred to.

A. No. 500. 29th July, 1872. Lat. 74° ? 46′ N., Long. 53° ? 36′ E. Depth 400 metres (219 fathoms).

Fine grey siliceous sand with fragments of slate and occasional grains of magnetite. In this as well as in some other of the soundings there occur little masses of red earth, probably the result of the decomposition of some volcanic mineral. In sounding 522 (N) the shells of many of the calcareous Foraminifera are more or less stained brown by it.

This sounding is the richest of the whole series in the variety of the Foraminifera it contains, thirty-two species in all having been found. Of Ostracoda* only a single species was noticed, *Krithe glacialis*, Brady, Crosskey, and Robertson. There were also a number of sponge-spicula and fragments of Polyzoa.

B. No. 501. Lat. 74° 48′ N., Long. 54° 53′ E. Depth 130 metres (70 fathoms), mud.

Siliceous sand, with fragments of black shale and of hypersthene or some similar mineral. The total amount of material

* The Ostracoda were in all cases reserved when picking out the Foraminifera; but the number of specimens obtained was too small for separate treatment. My brother, Dr. G. S. Brady, has been kind enough to to examine them; and the results are embodied in the present report.

is too small (less than 0·2 gramme) to be considered in any respect representative.

C. No. 502. 12th August, 1872. Lat. 76° 14′ N., Long. 58° 54′ E. Depth 100 metres (55 fathoms).

Siliceous sand, with a large proportion of dark-coloured grains of slate, trap, hypersthene, &c.

Only a small sounding, but tolerably rich in Foraminifera. It also contained specimens of one species of Ostracoda, *Cytheridea Sorbyana*, Jones.

D. No. 503. 30th August, 1872. Lat. 76° 25′ N., Long. 62° 43′ E. Depth 130 metres (70 fathoms).

Grey siliceous sand, with fragments of a dark-coloured porous rock, probably volcanic, and occasional grains of magnetite. Rich in Foraminifera, twenty-seven species in all, of which *Nonionina scapha* is especially remarkable for size and abundance.

E. No. 504. 16th September, 1872. Lat. 76° 36′ N., Long. 61° 7′ E. Depth 100 metres (55 fathoms), mud.

Grey siliceous sand, with fragments of slate and particles of the red earth before mentioned.

Contained thirty species of Foraminifera, as well as the following Ostracoda :—

Cythere leioderma, *Norman.*
Cytheridea Sorbyana, *Jones.*
Cytheridea punctillata, *Brady.*
Cytheropteron angulatum, *Brady.*

F. No. 506. 2nd October, 1872. Lat. 76° 59′ N., Long. 65° 49′ E. Depth 170 metres (93 fathoms), mud.

Siliceous sand, with particles of slate and schist, and fragments of trap, possibly basalt.

Moderately rich in Foraminifera, especially the smaller arenaceous forms. Contained also broken bits of an Ophiurid and some small Echinus-spines, together with the following species of Ostracoda :—

Cythere leioderma, *Norman.*
—— dunelmensis, *Norman.*
Cytheridea punctillata, *Brady.*
Eucythere argus, *G. O. Sars.*

G. No. 514 *a.* 17th May, 1873. Franz Josef Land. Depth 230 metres (125 fathoms), mud.

Consists almost entirely of the tests of *Saccammina sphærica*, either entire or broken. These are constructed of siliceous sand. There are also a few fragments of slate present.

Tolerably rich in Foraminifera; the only sounding in which *Haplophragmium subglobosum* (one of the most important constituents in the "*Biloculina*-ooze" of the cold area of the North Atlantic) was found, if we except a chance specimen or two in No. 518.

Two species of Ostracoda were noticed, namely:—

Krithe glacialis, *B. C. & R.* Cytheropteron arcuatum, *B. C. & R.*

H. No. 515. 23rd May, 1873. Franz-Josef Land. Depth 163 metres (89 fathoms), mud.

Chiefly reddish siliceous sand, with fragments of *Saccammina*-tests. The quantity was too small to yield an extensive list of Foraminifera.

Two species of Ostracoda were found:—

Cythere mirabilis, *Jones.* Krithe glacialis, *B. C. & R.*

I. No. 515 *a.* 23rd May, 1873. Franz-Josef Land. Depth 163 metres (89 fathoms), light-coloured mud.

Very similar to the foregoing, but somewhat richer in the smaller Rhizopoda.

J. No. 516. 1st June, 1873. Franz-Josef Land. Depth 238 metres (130 fathoms), light-coloured mud.

Siliceous sand, with fragments of soft brown rock and red earth.

The entire quantity of material was less than a gramme; it yielded nevertheless seventeen species of Foraminifera.

K. No. 518. 4th June, 1873. Franz-Josef Land. Depth 207 metres (113 fathoms), light-coloured mud.

Fine clean siliceous sand. One of the richest samples in the variety of its Rhizopod-fauna.

Contained also specimens of a single species of Ostracoda, namely *Krithe glacialis*, B. C. & R.

L. No. 519 *b.* 5th June, 1873. Franz-Josef Land. Depth 198 metres (108 fathoms), dark-coloured mud.

Siliceous sand, with some brown clay.

Contained very few species, and nothing of much interest.

M. No 519, *a.* 6th June, 1873. Franz-Josef Land. Depth 198 metres (108 fathoms), dark-coloured mud.

Siliceous sand, with fragments of a brown variety of quartz and a good deal of red earth.

Like the foregoing, contained only a small number of Foraminifera. Of Ostracoda, *Krithe glacialis*, B. C. & R., was the only species observed.

N. No. 522. 17th June, 1873. Franz-Josef Land. Depth 222 metres (121 fathoms), mud.

Fine, white, siliceous sand, with numerous grains of magnetite and a little red earth. Many of the calcareous Foraminifera are stained brown by this or some similar colouring-matter.

Not very rich in organisms; the Foraminifera belong chiefly to the smaller species.

O. No. 523. 20th June, 1873. Franz-Josef Land. Depth 220 metres (120 fathoms), dark-coloured mud.

Siliceous sand with red earth; quantity of material very small. List of organisms manifestly imperfect.

P. No. 525. 12th July, 1873. Franz-Josef Land. Depth 265 metres (145 fathoms), light-coloured mud.

Siliceous sand, with fragments of soft brown rock and some red earth, also bits of hypersthene or epidote.

Affords a good representative list of Foraminifera. Some valves of *Cythere mirabilis*, Jones, were also found.

On reference to the map it will be seen that these soundings refer to two tolerably distinct areas. The more southern area, represented by Nos. 500–506 (A–F), embraces the western shores of Novaya Zemlya between latitudes 74° and 77° N.; whilst the more northern, represented by Nos. 514–525 (G–P), lies in the latitude of Franz-Josef Land—that is to say, at about 79° or 80° N.

There is not much that is new to be said respecting the general aspect of the Rhizopod-fauna brought into view by the careful investigation to which the material has been subjected. The total number of species obtained from it is seventy-one, which suggests a somewhat greater variety in the Rhizopod life of the eastern arctic area than exists in the western region explored by the British North-Polar expedition of 1875–76. The soundings obtained on the latter occasion yielded on examination fifty-three species of Foraminifera. Too much reliance must not be placed upon these figures in either case, inasmuch as the total amount of material that has as yet been secured is insufficient to furnish what can be regarded as even approximately exhaustive lists.

The Distribution Table, which will be found facing page 418, indicates the prevalence over the whole area of certain species which previous researches had shown to be common denizens of polar seas—namely *Globigerina bulloides* and its arctic variety, *Pulvinulina Karsteni*, *Truncatulina lobatula*, *Cassidulina lævigata*, *Cassidulina crassa*, and *Polystomella striatopunctata*; but over this eastern ground there appear in addition three arenaceous species with the same very general distribution—*Reophax difflugiformis*, *Reophax scorpiurus*, and *Haplophragmium nanum*. These forms, so far as is known, are very rare or entirely absent in corresponding latitudes on the western or American side of the Arctic Ocean.

Comparing the set of soundings in the Novaya-Zemlya sea (A–F) with those from Franz-Josef Land (G–P) it may be noticed that one or two species, such as *Nonionina scapha*, which are abundant in the former, are absent, or nearly so, from the latter series; and the genus *Lagena*, though still represented by a few specimens, diminishes in frequency as we proceed northwards. On the other hand, *Saccammina sphærica*, which is the most prominent Foraminifer on the shores of Franz-Josef Land, has not been found in any of the southern group of soundings; and the other arenaceous species are also conspicuous by their size and abundance in the more northern region.

The influence of climate and other external conditions in modifying morphological characters is a subject full of interest, though it is much more easy to observe the changes that take place than to account satisfactorily for them. Some of the coarse arenaceous types, such as *Saccammina sphærica* and, in deeper water, *Rhabdammina abyssorum*, attain their maximum size and importance in the polar seas; whilst upon other sandy forms the more northerly conditions appear to have a starving or depauperating effect. For example, *Haplophragmium globigeriniforme*, which in the North Atlantic is often 1·6 millim. in diameter, is represented in the soundings from Franz-Josef Land by specimens not much more than one tenth of that size (0·18 millim.). *Globigerina bulloides*, of which the North-Atlantic specimens are often 0·6 millim. or more in diameter, and have the typical subglobular segments, is represented in the arctic area by a thick-shelled variety, with a diameter of about 0·3 millim. and much more compactly built.

There is another peculiarity, common amongst northern specimens of certain clear-shelled perforate species, that I do not think has been previously noticed, namely the habit of covering the shell with a coat of very fine loose sand. This may be seen in the genera *Nonionina* and *Polystomella*, and in adherent specimens of *Truncatulina lobatula*. The latter species, in its young parasitic condition, frequently constructs a perfect *nidus*, in the form of a convex tent-like covering of light-coloured sand, that may easily be mistaken for the test of some Lituoline organism, like *Webbina hemisphærica* or *Placopsilina vesicularis*. Many of the specimens of *Polysto-*

mella striatopunctata contained in these soundings had originally a thin coating of adherent sand. In all cases this sandy investment is easily removed, without mechanical interference beyond washing in warm water. Amongst the adherent arenaceous types a similar tendency may be observed. *Valvulina conica* is commonly surrounded at its base by an accumulation of fine sand, easily distinguished from the test itself by its colour; and the same is the case with certain true *Textulariæ*, of rough arenaceous texture, when found growing attached to other bodies. If the shell of any of these be detached, the sandy environment remains behind, showing that it has no real connexion with the proper test.

The following is a list of the species found, with notes on some of the more interesting and important forms. The numbers prefixed correspond with those in the Distribution Table.

Cornuspira, Schultze.

1. *Cornuspira involvens*, Reuss.

Operculina involvens, Reuss, 1849, Denkschr. k. Akad. Wien, vol. i. p. 370, pl. xlv. fig. 20.
Cornuspira involvens, Reuss, 1863, Sitzungsb. k. Akad. Wien, vol. xlviii. p. 39, pl. i. fig. 2.

Very rare; represented by a few broken specimens.

Biloculina, D'Orbigny.

2. *Biloculina ringens*, Lamarck, sp.

Miliolites ringens, Lamarck, 1804, Ann. Mus. vol. v. p. 351, vol. ix. pl. xvii. fig. 1.

Very rare; the specimens are of long, oval form, scarcely typical.

3. *Biloculina bulloides*, D'Orbigny.

Biloculina bulloides, D'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 297, pl. xvi. figs. 1–4; Modèles, no. 90.

A single specimen in one of the soundings off Franz-Josef Land.

Miliolina, Williamson.

4. *Miliolina tricarinata*, D'Orbigny, sp.

Triloculina tricarinata, D'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 299. no. 7; Modèles, no. 94.

Very rare; occurs in only two of the soundings; specimens small and thin-shelled.

5. *Miliolina seminulum*, Linné, sp.

Serpula seminulum, Linné, 1767, Syst. Nat. 12th ed. p. 1264. no. 791.

Very rare in the more northern soundings, but abundant in the shallow water of the Matyushin Shar.

6. *Miliolina subrotunda*, Montagu, sp.

Vermiculum subrotundum, Montagu, 1803, Test. Brit. pt. 2, p. 521.

In the Matyushin Shar, very rare.

7. *Miliolina agglutinans*, D'Orbigny, sp.

Quinqueloculina agglutinans, D'Orbigny, 1839, Foram. Cuba, p. 168, pl. xii. figs. 11–13.

In shallow water, Matyushin Shar, rare.

SACCAMMINA, M. Sars.

8. *Saccammina sphærica*, M. Sars.

Saccammina sphærica, M. Sars, 1868, Vidensk.-Selsk. Forhandl. 1868, p. 248.

Very common in the soundings off Franz-Josef Land.

Saccammina sphærica, in its typical condition, has a rough arenaceous test, subspherical or somewhat pyriform in contour, with a single orifice situate in a nipple-shaped protuberance; but in localities where the species is abundant the specimens often assume anomalous forms. Sometimes a number of these spherical chambers are adherent to each other, in which case they either have separate orifices and remain, in fact, independent organisms, or, as is more common, they open into each other and constitute a sort of polythalamous test. Occasionally a larger fragment of rock is built into the wall, and the test has the characters of an adherent species. Specimens in all these conditions exist where the individuals are crowded together at the sea-bottom, as, to judge by the samples, they must be in the area represented by the northernmost series of dredgings. Such variations from the typical form are purely the result of accident, and have no zoological significance.

The distinction between *Saccammina* and *Psammosphæra*, which depends upon the presence in the former genus of a general aperture, whilst *Psammosphæra* has none, but protrudes its pseudopodia through interstitial openings between the sand-grains which form the test, is far from satisfactory; for many specimens of undoubted *Saccammina* are found in dredged sands, like some of those from Franz-Josef Land, without any conspicuous general aperture. In polythalamous specimens of this species the additional chambers are often smaller than the primordial one, and to some extent, therefore, supplementary; in such cases the sandy investment of the terminal sphere is often incomplete, and shows numerous large openings between the sand-grains.

Pelosina, Brady.

9. *Pelosina variabilis*, Brady.

Pelosina variabilis, Brady, 1879, Quart. Journ. Micr. Sci. vol. xix. n. s. p. 30, pl. iii. figs. 1-3.

Amongst the numerous chitino-arenaceous and muddy Rhizopod-tests found in No. 514 *a* (G) are some which are composed of a thickish layer of fine homogeneous mud with a chitinous lining. Unfortunately all the specimens are more or less broken; but the fragments are sufficiently large to leave no doubt that they belong to this species.

Rhabdammina, M. Sars.

10. *Rhabdammina abyssorum*, M. Sars.

Rhabdammina abyssorum, M. Sars, 1858, Vidensk.-Selsk. Forhandl. 1868, p. 248.

It is impossible to identify this species with certainty except by the central portion of the test, as the broken arenaceous arms, by themselves, cannot be distinguished from similar portions of several allied organisms. There are, however, two fragments that may be said, without any doubt, to belong to it. *Rhabdammina abyssorum* is very common in some parts of the North Atlantic; and Prof. G. O. Sars's researches suggested the idea that it might be found abundantly in this section of the eastern Polar Sea; its rarity therefore is probably due to insufficient depth of water.

Hyperammina, Brady.

11. *Hyperammina elongata*, Brady.

Hyperammina elongata, Brady, 1878, Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 433, pl. xx. fig. 2.

The specimens are small and rough, chiefly in fragments, only a few having the closed broad end entire. They closely resemble the examples obtained in the western Arctic seas. This species, or one nearly allied to it, attains a very large size in more southern latitudes.

12. *Hyperammina ramosa*, Brady.

Hyperammina ramosa, Brady, 1879, Quart. Journ. Micr. Sci. vol. xix. n. s. p. 33, pl. iii. figs. 14, 15.

Small fragments of the branching variety of *Hyperammina* occur in three of the soundings; but in only one instance is the primordial chamber present. Owing to the thin brittle nature of the shell-wall, the organism is never found entire; but the tubes are usually identified without much difficulty, even in the absence of the primordial chamber.

PSAMMOTODENDRON, Norman (MS.).

13. *Psammotodendron arborescens*, Norman (MS.).

Amongst some Rhizopoda recently dredged by the Rev. A. M. Norman on the coast of Norway is a very remarkable arenaceous form growing like a little tree rooted on a piece of a Polyzoan. The main stem and branches are of nearly even diameter (about 0·07 millim.), cylindrical, compactly cemented, nearly smooth externally, and brown in colour. The ends of the branches are rounded, and have an irregularly shaped orifice with thickened lip. Amongst the arenaceous tubes of various sorts which occur in many of the soundings, a few of the minuter specimens may be recognized as pertaining to this or some very similar species, though they are but small fragments and give but little idea of the general character and appearance of the organism in its living condition *.

REOPHAX, De Montfort.

14. *Reophax difflugiformis*, Brady.

Reophax difflugiformis, Brady, 1879, Quart. Journ. Micr. Sci. vol. xix. n. s. p. 51, pl. iv. fig. 3 *a, b*.

This is a common species in the far north, and has been found in nearly all the soundings. The specimens are of larger size and much rougher externally than that originally figured *loc. cit.* There appeared at first some question whether *Reophax difflugiformis* was an independent species or only the first chamber of *R. scorpiurus*. The size of the test and its apparent completeness led to the conclusion that it was specifically distinct; but recently the question as been set at rest in another way. In one of the dredgings made by Sir Wyville Thomson, during the 'Knight-Errant' Expedition, in

* Since the presentation of this report my friend David Robertson, F.G.S., has obtained a beautiful series of specimens of *Psammotodendron arborescens* in dredgings off Cumbrae, on the west coast of Scotland.

the summer of 1880 (lat. 59° 37′ N., long. 7° 19′ W.), *R. difflugiformis* was found in abundance, whilst *R. scorpiurus* was entirely absent.

15. *Reophax fusiformis*, Williamson, sp.

Proteonina fusiformis, Williamson, 1858, Rec. For. Gt. Br. p. 1, pl. i. fig. 1.

A starved variety of *R. scorpiurus*; occurs in the shallow water of the Matyushin Shar.

16. *Reophax scorpiurus*, De Montfort.

Reophax scorpiurus, De Montfort, 1808, Conchyl. Systém. vol. i. p. 330, 83e genre.

Very common over the whole area.

17. *Reophax nodulosa*, Brady.

Reophax nodulosa, Brady, 1879, Quart. Journ. Micr. Sci. vol. xix. n. s. p. 52, pl. iv. figs. 7, 8.

Small specimens occur in most of the soundings on the shores of Franz-Josef Land; but it is absent from those further south. It is nevertheless a very widely distributed species, and specimens an inch (25 millim.) or more in length have been found in some of the 'Challenger' deep-water dredgings.

18. *Reophax arctica*, sp. nov. (Pl. XXI. fig. 2 *a*, *b*.)

Test elongate, tapering, often more or less irregular, compressed, only slightly constricted at the septal lines. Segments numerous; septation indistinct; aperture simple; walls arenaceous, very thin. Length 0·3 millim.

This is an exceedingly minute and obscure species, which may be regarded as the sandy isomorph of *Lingulina*. With the exception of a single specimen from Station 504, and one which had been previously recorded, without a specific name, from Capt. Markham's soundings, all the specimens are from Station 503; so that the distribution appears confined to the Novaya-Zemlya Sea.

HAPLOPHRAGMIUM, Reuss.

19. *Haplophragmium canariense*, D'Orbigny, sp.

Nonionina canariensis, D'Orbigny, 1839, Foram. Canaries, p. 128, pl. ii. figs. 33, 34.

A very widely distributed species; some of the more northern specimens are rougher and thicker-shelled than usual.

20. *Haplophragmium nanum*, Brady.
(Pl. XXI. fig. 1 *a*, *b*, *c*.)

Haplophragmium nanum, Brady, 1881, Quart. Journ. Micr. Sci. vol. xxi. n. s. p. 50.

The commonest of all the smaller arenaceous forms, over the whole area represented by these soundings.

The Arctic specimens are rather smaller than those described from the 'Challenger' dredgings (*loc. cit.*), and seldom exceed 0·25 millim. in diameter; they are generally less convex on the superior surface and altogether somewhat thinner; but these are minor and very variable characters.

21. *Haplophragmium glomeratum*, Brady.

Lituola glomerata, Brady, 1878, Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 433, pl. xx. fig. 1 *a*, *b*, *c*.

A minute species widely distributed in the North Atlantic and Arctic Oceans, but not common anywhere. It is more frequent in the Novaya-Zemlya Sea than further northwards.

22. *Haplophragmium subglobosum*, M. Sars, sp.

Lituola subglobosa, M. Sars, 1868, Vidensk.-Selsk. Forhandl. 1868, p. 250.

Common at one station only, 514 *a* (G), where it flourishes in company with *Saccammina sphærica*, *Reophax scorpiurus*, and other strong arenaceous types.

23. *Haplophragmium globigeriniforme*,
Parker & Jones, sp.

Lituola nautiloidea, var. *globigeriniformis*, Parker & Jones, 1864, Phil. Trans. vol. clv. p. 407, pl. xv. figs. 46, 47, pl. xvii. figs. 96–98.

This occurs at five of the Franz-Josef Land stations, but in none of the more southern soundings. The specimens are few in number, and all extremely minute and thin-shelled.

Ammodiscus, Reuss.

24. *Ammodiscus gordialis*, Jones and Parker, sp.

Trochammina squamata, var. *gordialis*, Jones & Parker, 1860, Quart. Journ. Geol. Soc. Lond. vol. xvi. p. 304.

Represented only by single specimens from four stations.

Trochammina, Parker and Jones.

25. *Trochammina nitida*, Brady.

Trochammina nitida, Brady, 1881, Quart. Journ. Micr. Sci. vol. xxi. n. s. p. 52.

Very rare; only a single specimen from Franz-Josef Land, Station 518 (K), and one from the Matyushin Shar.

Hippocrepina, Parker.

26. *Hippocrepina indivisa*, Parker. (Pl. XXI. figs. 3 *a*, *b*, & 4.)

Hippocrepina indivisa, Parker, 1870, in Dawson's paper, 'Canadian Naturalist,' n. s. vol. v. p. 176, fig. 2.

This is an exceedingly interesting arenaceous type. The test is long, tapering to a point at the inferior extremity, broad and rounded at the superior end. The aperture is at the centre of the broad end, and is irregular in shape, often more or less curved so as to resemble a horseshoe. The shell-wall is thin, finely cemented, and smooth externally; the cavity of the shell is undivided. In colour it is brown at the inferior extremity, lighter near the apex. Length of full-sized specimens about 1·0 millim.; those from the Matyushin Shar are somewhat smaller.

Hippocrepina indivisa was originally found by Dr. G. M. Dawson in Gaspé Bay at a depth of from 16 to 20 fathoms (29 to 36 metres), and has since been dredged by the Rev. A. M. Norman in deeper water off the coast of Norway.

Textularia, Defrance.

27. *Textularia agglutinans*, D'Orbigny.

Textularia agglutinans, D'Orbigny, 1839, Foram. Cuba, p. 136, pl. i. figs. 17, 18, 32–34.

Very rare, specimens minute and varying a good deal in contour, possibly belonging to more than one species.

Spiroplecta, Ehrenberg.

28. *Spiroplecta biformis*, Parker & Jones, sp.

Textularia aggutinans, var. *biformis*, Parker & Jones, 1864, Phil. Trans. vol. clv. p. 370, pl. xv. figs. 23, 24.

Moderately common and widely distributed.

Verneuilina, D'Orbigny.

29. *Verneuilina polystropha*, Reuss.

Verneuilina polystropha, Reuss, 1846, Verstein. böhm. Kreid. vol. ii. p. 109, pl. xxiv. fig. 53.

Common in Capt. Markham's material from the Matyushin Shar, but does not occur in any of the Austrian soundings.

Bulimina, D'Orbigny.

30. *Bulimina subteres*, Brady.

Bulimina elegantissima, var., Brady, 1878, Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 436, pl. xxi. fig. 12.
Bulimina subteres, Brady, 1881, Quart. Journ. Micr. Sci. vol. xxi. n. s. p. 55.

A single specimen of this species was found in the sounding from Station 500 (A). It somewhat resembles the *Robertina arctica* of D'Orbigny, but is stouter and has much fewer segments.

31. *Bulimina elegantissima*, D'Orbigny.

Bulimina elegantissima, D'Orbigny, 1839, Voyage dans l'Amér. Mérid. p. 51, pl. vii. figs. 13, 14.

Only found in one sounding, in which it is moderately common (No. 503, D); the specimens all very minute, thin-shelled, and delicate.

Virgulina, D'Orbigny.

32. *Virgulina Schreibersiana*, Czjzek.

Virgulina Schreibersiana, Czjzek, 1847, Haidinger's Naturw. Abhandl. vol. ii. p. 147, pl. xiii. figs. 18–21.

Tolerably common and generally distributed; many of the specimens have a shorter, stouter contour than the typical form.

Bolivina, D'Orbigny.

33. *Bolivina punctata*, D'Orbigny.

Bolivina punctata, D'Orbigny, 1839, Voyage dans l'Amér. Mérid. p. 63, pl. viii. figs. 10–12.

In the Novaya-Zemlya Sea; rare and small.

Cassidulina, D'Orbigny.

34. *Cassidulina lævigata*, D'Orbigny.

Cassidulina lævigata, D'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 282, pl. xv. figs. 4, 5; Modèles, no. 41.

Abundant; generally distributed.

35. *Cassidulina crassa*, D'Orbigny.

Cassidulina crassa, D'Orbigny, 1839, Voyage dans l'Amér. Mérid. p. 56, pl. vii. figs. 18–20.

Common over the whole area.

LAGENA, Walker & Jacob.

36. *Lagena globosa*, Montagu, sp.

Vermiculum globosum, Montagu, 1803, Testac. Brit. p. 523.

Novaya-Zemlya Sea, very rare.

37. *Lagena lævis*, Montagu, sp.

Vermiculum læve, Montagu, 1803, Testac. Brit. p. 524.

Widely distributed, specimens rare.

38. *Lagena apiculata*, Reuss.

Oolina apiculata, Reuss, 1850, Haidinger's Naturw. Abhandl. vol. iv. p. 22, pl. i. fig. 1.
Lagena apiculata, Reuss, 1862, Sitzungsb. k. Akad. Wien, vol. xlvi. p. 319, pl. i. figs. 4–8, 10, 11.

Novaya-Zemlya Sea, very rare.

39. *Lagena gracillima*, Seguenza, sp.

Amphorina gracillima, Seguenza, 1862, Foram. Monotal. Mioc. Mess. p. 51, pl. i. fig. 37.

Novaya-Zemlya Sea, very rare.

40. *Lagena distoma*, Parker & Jones.

Lagena sulcata, var. *distoma*, Parker & Jones, 1865, Phil. Trans. vol. clv. p. 356, pl. xiii. fig. 20.

Novaya-Zemlya Sea, very rare.

41. *Lagena gracilis*, Williamson.

Lagena vulgaris, var. *gracilis*, Williamson, 1858, Rec. For. Gt. Br. p. 7, pl. i. figs. 12, 13.

Novaya-Zemlya Sea, very rare.

42. *Lagena semistriata*, Williamson.

Lagena striata, var. *β. semistriata*, Williamson, 1848, Ann. & Mag. Nat. Hist. ser. 2, vol. i. p. 14, pl. i. figs. 9, 10.

Novaya-Zemlya Sea, very rare.

43. *Lagena sulcata*, Walker & Jacob, sp.

Serpula (*Lagena*) *sulcata*, Walker & Jacob, 1798, Adams's Essays on the Microsc. 2nd ed. p. 634, pl. xiv. fig. 5.

Novaya-Zemlya Sea; a small number of specimens, generally distributed.

44. *Lagena striatopunctata*, Parker & Jones.

Lagena sulcata, var. *striatopunctata*, Parker & Jones, 1864, Phil. Trans. vol. clv. p. 350, pl. xiii. figs. 25–27.

Novaya-Zemlya Sea, very rare. This is a widely distributed North Atlantic and Arctic species, though the number of specimens is generally very small.

45. *Lagena squamosa*, Montagu, sp.

Vermiculum squamosum, Montagu, 1803, Testac. Brit. p. 526, pl. xiv. fig. 2.

Novaya-Zemlya Sea and Franz-Josef Land, very rare in both areas.

46. *Lagena lævigata*, Reuss, sp.

Fissurina lævigata, Reuss, 1849, Denkschr. k.-k. Akad. Wien, vol. i. p. 366, pl. xlvi. fig. 1.

Novaya-Zemlya Sea and Franz-Josef Land; very rare in both areas.

47. *Lagena tricincta*, Gümbel *.

Lagena tricincta, Gümbel, 1868, Abh. II. Cl. k. Akad. Wiss. vol. x. p. 606, pl. i. fig. 8, *a, b*.

Novaya-Zemlya Sea, very rare.

48. *Lagena lagenoides*, Williamson, sp.

Entosolenia marginata, var. *lagenoides*, Williamson, 1858, Rec. For. Gt. Br. p. 11, pl. i. figs. 25, 26.

Novaya-Zemlya Sea and Franz-Josef Land; very rare in both areas.

49. *Nodosaria radicula*, Linné, sp.

Nautilus radicula, Linné, 1767, Syst. Nat. 12th ed. p. 1164, p. 285.

Widely distributed, but the number of specimens very small.

50. *Nodosaria* (*Dentalina*) *pauperata*, D'Orbigny.

Dentalina pauperata, D'Orbigny, 1846, For. Foss. Vien. p. 46, pl. i. figs. 57, 58.

One or two fine specimens from Franz-Josef Land.

* I find that Prof. Seguenza has figured this form under the name *Fissurina Orbignyana*, Foram. Monotal. Mioc. Mess. 1862, p. 67, pl. ii. figs. 25, 26; his specific term therefore takes precedence.

51. *Nodosaria (Dentalina) mucronata*, Neugeboren.

Dentalina mucronata, Neugeboren, 1856, Denkschr. k. Akad. Wiss. Wien, vol. xii. p. 83, pl. iii. figs. 8–11.

A single broken specimen of this species was found in the sounding No. 514 *a*, off Franz-Josef Land.

Polymorphina, D'Orbigny.

52. *Polymorphina lactea*, Walker & Jacob, sp.

Serpula lactea, Walker & Jacob, 1798, Adams's Essays, 2nd ed. p. 634, pl. xxiv. fig. 4.

Novaya-Zemlya Sea; very rare, specimens minute.

53. *Polymorphina oblonga*, D'Orbigny.

Polymorphina oblonga, D'Orbigny, 1846, For. Foss. Vien. p. 232, pl. xii. figs. 29–31.

A single characteristic specimen and one or two fragments from the Novaya-Zemlya Sea.

54. *Polymorphina compressa*, D'Orbigny.

Polymorphina compressa, D'Orbigny, 1846, For. Foss. Vien. p. 233, pl. xii. figs. 32–34.

One specimen from the Matyushin Shar.

Uvigerina, D'Orbigny.

55. *Uvigerina pygmæa*, D'Orbigny (var.).

Uvigerina pygmæa, D'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 269, pl. xii. figs. 8, 9; Modèles, no. 67.

Sparingly distributed over the whole area; very rare off Franz-Josef Land. All the specimens are of the Arctic variety (*vide* Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 435, pl. xx. fig. 7 *a*, *b*), an intermediate form partaking more or less of the characters of *U. angulosa*, Will. They differ from the typical *U. pygmæa* in the partial nature of the surface-ornamentation, and in their tendency to assume a more elongate and subangular shape. These, however, are very variable characters, indicating rather the different life-conditions of a polar climate than any specific distinction; and as we proceed southwards the specimens gradually assume the normal form.

Globigerina, D'Orbigny.

56. *Globigerina bulloides*, D'Orbigny.

Globigerina bulloides, D'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 277. no. 1; Modèles, no. 17 & 76.

Minute specimens of the typical *Globigerina bulloides* are found in many of the soundings, especially in those of the more southern series; but the small, compactly built, subspherical variety for which I have proposed the trivial term "*borealis*" * is comparatively common over the whole area. This has been figured as the "Arctic variety of *Globigerina bulloides*," in the Ann. & Mag. Nat. Hist. ser. 5, vol. i. pl. xxi. fig. 10 *a*, *b*, *c*; and a further notice of it is now in the press. It prevails, sometimes to the exclusion of the typical form, in the cold area of the North-Atlantic and in some parts of the Arctic Ocean; but there is quite sufficient evidence to show that its morphological peculiarities are merely the result of climatal conditions. Under these circumstances no attempt has been made to separate the *type* from the *variety* in the Distribution Table. In some of the soundings both forms occur, as well as specimens with intermediate characters.

Orbulina, D'Orbigny.

57. *Orbulina universa*, D'Orbigny.

Orbulina universa, D'Orbigny, 1839, Foram. Cuba, p. 35, pl. i. fig. 1.

Novaya-Zemlya Sea, rare.

Pullenia, Parker & Jones.

58. *Pullenia sphæroides*, D'Orbigny, sp.

Nonionina sphæroides, D'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 293. no. 1; Modèles, no. 43.

In one of the soundings of the Novaya-Zemlya Sea (No. 500, A) this species is not uncommon; but it has not been found in any of the others.

Patellina, Williamson.

59. *Patellina corrugata*, Williamson.

Patellina corrugata, Williamson, 1858, Rec. For. Gt. Br. p. 46, pl. iii. figs. 86–89.

Novaya-Zemlya Sea, very rare.

* In a report upon the Foraminifera obtained on the cruise of the 'Knight Errant' in the summer of 1880, not yet published.

Discorbina, Parker & Jones.

60. *Discorbina Bertheloti*, D'Orbigny, sp.

Rosalina Bertheloti, D'Orbigny, 1839, Foram. Canaries, p. 135, pl. i. figs. 28–30.

Novaya-Zemlya Sea, Station 500 (A); very rare. The specimens all very small, and similar in character to those found off the Shetland Islands and at some other points to the north of Great Britain.

61. *Discorbina Wrightii*, sp. nov. (Pl. XXI. fig. 6 *a*, *b*, *c*.)

Discorbina parisiensis, Wright (in part), 1877, Proc. Belfast Nat. Field-Club, 1876–77, App. p. 105, pl. iv. fig. 2 *a*, *b*, *c*.

Test free, trochoid; superior surface subconical; inferior flat; peripheral margin subangular or somewhat rounded, very slightly excavated at the sutural lines. The shell consists of about three convolutions, the whole of which are visible on the superior surface, the final one only on the inferior. Inferior surface ornamented with beaded lines radiating from the umbilicus. Segments numerous, seven or eight in the final convolution; septation of the earlier portion indistinct. Diameter $\frac{1}{50}$ inch (0·5 millim.).

Mr. Wright, in his careful paper on the "Recent Foraminifera of Down and Antrim" (*loc. cit.*), describes and figures certain small *Discorbinæ* occurring in shallow water in the north of Ireland under the general name of *D. parisiensis*, D'Orb. The figures represent two varieties, differing considerably in contour and in minor characters, which there was reason to think were only individual modifications of the same species. Of the close affinity of the two there can be no question; and that the thinner specimens have all the essential characters of D'Orbigny's Modèle no. 38 is equally beyond doubt; but further research has led to the conclusion that it will be convenient to recognize the conical form, which is more particularly an inhabitant of northern seas, by a distinctive term; and under these circumstances it is proper to associate Mr. Wright's name with the species.

Discorbina Wrightii is very rare in the Novaya-Zemlya Sea; and a single young specimen has been found in the Matyushin Shar. It is not uncommon on the north-eastern coast of Ireland, and is occasionally met with in deeper water in the North Atlantic.

Truncatulina, D'Orbigny.

62. *Truncatulina lobatula*, Walker & Jacob, sp.

Nautilus lobatulus, Walker & Jacob, 1798, Adams's Essays, 2nd ed. p. 642, pl. xiv. fig. 36.

Common over the whole area.

Pulvinulina, Parker & Jones.

63. *Pulvinulina Karsteni*, Reuss, sp.

Rotalia Karsteni, Reuss, 1855, Zeitschr. deutsch. geol. Gesellsch. vol. vii. p. 273, pl. ix. fig. 6.

Abundant both in the Novaya-Zemlya Sea and off Franz-Josef Land.

Nonionina, D'Orbigny.

64. *Nonionina depressula*, Walker & Jacob, sp.

Nautilus depressulus, Walker & Jacob, 1798, Adams's Essays, 2nd ed. p. 641, pl. xiv. fig. 33.

Franz-Josef Land, not uncommon; Novaya-Zemlya Sea, rare.

65. *Nonionina umbilicatula*, Montagu, sp.

Nautilus umbilicatulus, Montagu, 1803, Testac. Brit. p. 191, 1808, Suppl. p. 78, pl. xviii. fig. 1.

Distributed over the whole area.

66. *Nonionina turgida*, Williamson, sp.

Rotalina turgida, Williamson, 1858, Rec. For. Gt. Brit. p. 50, pl. iv. figs. 95–97.

Novaya-Zemlya Sea, very rare. Only a single specimen in sounding No. 500 (A).

67. *Nonionina scapha*, Fichtel & Moll, sp.

Nautilus scapha, Fichtel & Moll, 1803, Testac. Micr. p. 105, pl. xix. figs. *d–f*.

A characteristic form in the Novaya-Zemlya Sea; specimens large and abundant, often with very thick terminal chamber, like *N. labradorica*, Dawson.

68. *Nonionina stelligera*, D'Orbigny.

Nonionina stelligera, D'Orbigny, 1839, Foram. Canaries, p. 128, pl. iii. fig. 12.

Widely distributed, especially in the southern area, but the specimens not numerous.

69. *Nonionina orbicularis*, sp. nov. (Pl. XXI. fig. 5 *a*, *b*.)

Test symmetrical, nautiloid, subglobular, somewhat compressed, convex or slightly umbonate at the umbilici; peripheral margin more or less lobulate. Segments numerous, about ten in the final convolution; sutural lines somewhat excavated, especially near the umbilici. Aperture arcuate, either simple or divided by projections from the upper margin. Diameter 0·5 millim.

This species resembles *N. pompilioides* in its subspherical contour, but may be distinguished by its larger number of segments and their less regular disposition, as well as by the thickened umbilici. The aperture is frequently subdivided by cross bars of shell, suggesting its affinity with the weaker forms of *Polystomella*.

Nonionina orbicularis only occurs in one of the soundings, No. 502 (C); but a number of specimens, of somewhat larger size than those now described (0·75 millim.), have been obtained from the 'Porcupine' dredgings in the North Atlantic.

POLYSTOMELLA, Lamarck.

70. *Polystomella arctica*, Parker & Jones.

Polystomella crispa, var. *arctica*, Parker & Jones, 1865, Phil. Trans. vol. clv. p. 401, pl. xiv. figs. 25–30.

Widely distributed; the specimens large and abundant in many of the soundings.

71. *Polystomella striatopunctata*, Fichtel & Moll, sp.

Nautilus striatopunctatus, Fichtel & Moll, 1803, Testac. Micr. p. 61, pl. ix. figs. *a–c*.

Abundant over the whole area.

In addition to the species which have been enumerated, there are a few specimens concerning which it is impossible to speak with certainty. One of these is a minute or young *Cristellaria*; another is probably a worn example of *Lagena hispida*. But in the absence of well-defined examples these and other doubtful forms have been excluded from the list.

Supplementary Note on some Foraminifera from Soundings obtained by Capt. A. H. Markham, R.N., on the Shores of Novaya Zemlya in 1879.

From a region so difficult of access, and on a subject concerning which so little has hitherto been known, every addition to the common fund of knowledge is welcome; and each instalment, however small and fragmentary in itself, serves to fill a vacant place. Under these circumstances a few soundings made by Capt. Markham on the shores of Novaya Zemlya possess considerable interest; and as they refer to an area contiguous to that embraced by the southern section of the Austro-Hungarian series, the details of their examination supply a fitting supplement to the present report.

The material consists of eleven samples of the sea-bottom; but the quantity is in every case very small. The lists of species therefore cannot be regarded as even approximately complete, though they serve *collectively* to indicate the general aspect of the Rhizopod fauna.

Four of the soundings contained no Foraminifera; and of these, three showed no evidence of animal or vegetable life of any sort; the remaining seven were labelled as follows :—

1. "Soundings, 10 fathoms, Matyushin Shar, June 21st, 1879."
2. "Soundings, 10 fathoms, Matyushin Shar, June 24th."
3. "Soundings (no depth given), Cairn Bay, Matyushin Shar."
4. "Soundings, 15 fathoms, north side Matyushin Shar, July 28th."

These four samples may be considered collectively as representing the bottom-fauna of the Matyushin Shar at a depth of from 10 to 15 fathoms. The sample without memorandum of depth differs in no particular from the rest. The Matyushin Shar or Matotschkin Schar is the strait dividing the two islands that together form Novaya Zemlya, the latitude being about 73° N.

Mineralogically the soundings were very much alike. They were dark-coloured more or less muddy sands, consisting of flattish felspathic grains, with a small proportion of white angular siliceous particles. Foraminifera were present in all four specimens, but abundant in none; there were also a few Ostracoda and small fragments of Polyzoa, Ophiurids, and Echinoderms.

The following is a revised list of the Foraminifera obtained from them :—

Cornuspira involvens, *Reuss.*
Biloculina ringens, *Lamk.*
Miliolina seminulum, *Linné.*
—— agglutinans, *D'Orb.*
Hippocrepina indivisa, *Parker.*
Hyperammina elongata, *Brady.*
Reophax nodulosa, *Brady.*
Reophax fusiformis, *Will.*
—— arctica, *Brady.*
Haplophragmium canariense, *D'Orb.*
—— nanum, *Brady.*
Trochammina nitida, *Brady.*
Verneuilina polystropha, *Reuss.*

Polymorphina compressa, *D'Orb.*
Cassidulina lævigata, *D'Orb.*
—— crassa, *D'Orb.*
Discorbina Wrightii, *Brady.*
Truncatulina lobatula, *W. & J.*
Pulvinulina Karsteni, *Reuss.*
Nonionina umbilicatula, *Mont.*
—— stelligera, *D'Orb.*
Polystomella striatopunctata, *F. & M.*

The three remaining soundings are from somewhat greater depths; and their examination has yielded but a poor list of species. Whether this arises from the smaller quantity of material secured, or from the less plentiful distribution of animal life, may be difficult to decide; but the former is the more probable explanation.

5. "Soundings, June 19th, lat. 73° 10′ N., long. 50° E. Depth 30 fathoms." Clean siliceous sand with dark felspathic grains; contained but little evidence of animal life. There were a few Rhizopoda, belonging to half a dozen species, namely:—

Miliolina seminulum, *Linné.*
Verneuilina polystropha, *Reuss.*
Truncatulina lobatula, *W. & J.*
Pulvinulina Karsteni, *Reuss.*
Nonionina scapha, *F. & M.*
Polystomella striatopunctata, *F. & M.*

6. "Soundings, lat. 70° 45′ N., long. 47° E. Depth 80 fathoms." The material in this case consisted only of a pellet of mud weighing about 0·3 gramme, which, after washing, left scarcely any residuum. This, however, yielded specimens of two arenaceous species:—

Haplophragmium glomeratum, *Brady.*
Haplophragmium nanum, *Brady.*

7. "Soundings, lat. 74° 16′ N., long. 53° 50′ E. Depth 90 fathoms." Quantity of material not much greater than the last, contained the following forms:—

Haplophragmium glomeratum, *Brady.*
Cassidulina crassa, *D'Orb.*
Nonionina stelligera, *D'Orb.*
—— scapha, *F. & M.*

The only species of unusual interest contained in these lists is *Hippocrepina indivisa*, concerning which a note will be found on a previous page (p. 407). The specimens of *Nonionina scapha* often approach in character the variety named by Dawson *N. labradorica.* It is frequently difficult to decide whether some of the flat outspread *Nonioninæ* are more correctly placed with *N. asterizans*, F. & M., or *N. stelligera*, D'Orb.; but as the distinction between the two depends primarily on the extent to which the stellate sutural limbation is developed (a comparatively trivial character), they have been associated with similar specimens from the more northern stations under the latter species.

These lists collectively furnish the final column (Q) of the Distribution Table.

Polyzoa.

A few of the soundings contained specimens of Polyzoa in more or less fragmentary condition. These have been identified by my good friend the Rev. A. M. Norman as follows:—

No. 500. *Menipea arctica*, Busk.
Crisia eburneo-denticulata, Busk.

In this sounding, and also in No. 516, there are examples of a very interesting simple form, the type of an undescribed genus.

No. 514 *a*. *Idmonea atlantica*, Forbes.
Crisia eburneo-denticulata, Busk.
No. 515. *Crisia eburneo-denticulata*, Busk.
No. 525. *Lepralia Jeffreysii*, Norman.
Idmonea atlantica, Forbes.
Hornera lichenoides, Linné.

EXPLANATION OF PLATE XXI.

Fig. 1. *Haplophragmium nanum*, Brady, magnified 120 diam.: *a*, superior lateral aspect; *b*, inferior lateral aspect; *c*, periphero-lateral aspect.

Fig. 2. *Reophax arctica*, Brady, magnified 120 diam.: *a*, lateral aspect; *b*, end view, with aperture.

Figs. 3, 4. *Hippocrepina indivisa*, Parker, magnified 60 diam.: *a*, lateral aspect; *b*, end view, with aperture. 4. Section, showing the interior.

Fig. 5. *Nonionina orbicularis*, Brady, magnified 65 diam.: *a*, lateral aspect; *b*, periphero-lateral aspect.

Fig. 6. *Discorbina Wrightii*, Brady, magnified 85 diam.: *a*, superior lateral aspect; *b*, inferior lateral aspect; *c*, periphero-lateral aspect.

XLI.—*On certain Points in the Morphology of the* Blastoidea. By P. Herbert Carpenter, M.A., Assistant Master at Eton College.

Since the appearance of the classical memoir by Römer scarcely any attention has been paid upon this side of the Atlantic to the morphology of the Blastoidea. In America, however, the case has been very different. White, Shumard, Billings, Lyon, Hall, Meek and Worthen, and various other

DISTRIBUTION TABLE.

		West side of Novaya Zemlya, from lat. 74° to 77° N., and long. 53° to 65° E.						Shores of Franz-Josef Land, from lat. 79° to 80° N., and long. 58° to 64° E.										About lat. 73°.	
		500.	501.	502.	503.	504.	506.	514 a.	515.	515 a.	516.	518.	519 b.	519 a.	522.	523.	525.		
		A.	B.	C.	D.	E.	F.	G.	H.	I.	J.	K.	L.	M.	N.	O.	P.	Q.	
1.	Cornuspira involvens, *Reuss*	..	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	*	1.
2.	Biloculina ringens, *Lamk.*	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	*	2.
3.	—— bulloides, *D'Orb.*	..	..	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	3.
4.	Miliolina tricarinata, *D'Orb.*	*	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	..	4.
5.	—— seminulum, *Linn.*	*	..	..	..	..	*	..	..	..	*	..	..	*	..	..	..	*	5.
6.	—— subrotunda, *Montagu*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	6.
7.	—— agglutinans, *D'Orb.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	7.
8.	Saccammina sphærica, *M. Sars*	..	..	..	..	..	..	*	*	*	*	*	*	*	..	..	*	..	8.
9.	Pelosina variabilis, *Brady*	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	9.
10.	Rhabdammina abyssorum, *M. Sars*	*	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	10.
11.	Hyperammina elongata, *Brady*	..	..	..	..	..	..	*	*	*	*	*	..	..	..	..	..	*	11.
12.	—— ramosa, *Brady*	*	..	..	..	..	..	..	*	..	..	*	..	..	..	..	..	..	12.
13.	Psammotodendron arborescens, *Norman, MS.*	..	..	*	..	..	*	..	..	..	..	*	..	..	..	..	..	..	13.
14.	Reophax difflugiformis, *Brady*	*	*	..	*	*	*	*	..	*	*	*	*	*	*	..	*	..	14.
15.	—— fusiformis, *Will.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	15.
16.	—— scorpiurus, *De Mont.*	*	..	*	*	*	*	*	*	*	*	*	*	*	*	*	*	..	16.
17.	—— nodulosa, *Brady*	..	..	..	..	..	..	*	*	*	*	*	..	*	*	..	*	..	17.
18.	—— arctica, *Brady*	..	..	..	*	*	..	..	..	..	..	..	..	..	..	..	..	*	18.
19.	Haplophragmium canariense, *D'Orb.*	..	..	*	*	*	*	..	*	..	..	..	..	..	*	..	*	*	19.
20.	—— nanum, *Brady*	*	..	..	*	*	..	*	*	*	*	*	*	*	*	*	*	*	20.
21.	—— glomeratum, *Brady*	*	..	*	*	*	*	..	..	*	..	*	..	..	..	..	..	*	21.
22.	—— subglobosum, *M. Sars*	..	..	..	..	..	..	*	..	..	..	*	..	..	..	..	..	..	22.
23.	—— globigeriniforme, *P. & J.*	..	..	..	..	..	..	..	..	*	*	*	*	..	..	..	*	..	23.
24.	Ammodiscus gordialis, *J. & P.*	*	..	*	..	..	..	..	..	..	..	*	..	..	..	..	*	..	24.
25.	Trochammina nitida, *Brady*	..	..	..	..	..	..	..	..	..	..	*	..	..	..	..	..	*	25.
26.	Hippocrepina indivisa, *Parker*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	26.
27.	Textularia agglutinans, *D'Orb.*	..	..	..	*	..	*	..	..	*	..	*	..	..	..	*	*	..	27.
28.	Spiroplecta biformis, *P. & J.*	..	..	..	*	*	..	..	..	..	..	*	..	..	..	..	*	..	28.
29.	Verneuilina polystropha, *Reuss*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	29.
30.	Bulimina subteres, *Brady*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	30.
31.	—— elegantissima, *D'Orb.*	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	31.
32.	Virgulina Schreibersiana, *Czjzek*	..	..	*	*	*	..	..	..	*	*	*	..	..	*	..	*	..	32.
33.	Bolivina punctata, *D'Orb.*	..	..	..	*	*	..	..	..	..	..	..	..	..	..	..	..	..	33.
34.	Cassidulina lævigata, *D'Orb.*	*	*	*	*	*	*	*	*	*	*	*	..	..	*	..	*	*	34.
35.	—— crassa, *D'Orb.*	*	*	*	*	*	*	*	..	*	*	*	..	..	..	..	*	*	35.
36.	Lagena globosa, *Montagu*	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	36.
37.	—— lævis, *Montagu*	*	..	..	*	*	..	..	..	*	..	*	..	..	..	..	..	..	37.
38.	—— apiculata, *Reuss*	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	38.
39.	—— gracillima, *Seg.*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	39.
40.	—— distoma, *P. & J.*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	40.
41.	—— gracilis, *Will.*	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	41.
42.	—— semistriata, *Will.*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	42.
43.	—— sulcata, *W. & J.*	*	..	*	*	*	..	..	..	..	..	..	..	..	..	..	..	..	43.
44.	—— striatopunctata, *P. & J.*	..	..	*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	44.
45.	—— squamosa, *Montagu*	..	..	*	..	*	..	..	..	..	..	*	..	..	..	..	..	..	45.
46.	—— (F.) lævigata, *Reuss*	*	..	..	..	*	..	..	..	..	..	*	..	..	*	..	..	..	46.
47.	—— tricincta, *Gümbel*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	47.
48.	—— lagenoides, *Will.*	..	..	..	..	*	..	..	..	..	..	*	..	..	..	..	..	..	48.
49.	Nodosaria radicula, *Linn.*	..	..	..	..	*	..	*	..	..	..	*	..	..	..	..	..	..	49.
50.	—— (D.) pauperata, *D'Orb.*	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	50.
51.	—— (D.) mucronata, *Neug.*	..	..	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	51.
52.	Polymorphina lactea, *W. & J.*	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	52.
53.	—— oblonga, *D'Orb.*	..	..	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	53.
54.	—— compressa, *D'Orb.*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*	54.
55.	Uvigerina pygmæa, *D'Orb.*, var.	*	..	*	*	*	..	..	..	..	..	*	..	..	*	..	..	..	55.
56.	Globigerina bulloides, *D'Orb.*	*	*	*	..	*	*	*	*	*	*	*	*	*	*	..	*	..	56.
57.	Orbulina universa, *D'Orb.*	*	..	*	..	..	*	..	..	..	..	..	..	..	..	..	..	..	57.
58.	Pullenia sphæroides, *D'Orb.*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	58.
59.	Patellina corrugata, *Will.*	..	..	..	*	*	..	..	..	..	..	..	..	..	..	..	..	..	59.
60.	Discorbina Bertheloti, *D'Orb.*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	60.
61.	—— Wrightii, *Brady*	..	..	..	*	*	..	..	..	..	..	..	..	..	..	..	..	*	61.
62.	Truncatulina lobatula, *W. & J.*	*	*	*	*	*	*	*	*	*	*	*	..	*	*	*	*	*	62.
63.	Pulvinulina Karsteni, *Reuss*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	63.
64.	Nonionina depressula, *W. & J.*	*	..	..	..	..	..	*	*	..	*	..	..	..	*	*	*	..	64.
65.	—— umbilicatula, *Mont.*	*	..	..	*	..	*	..	..	*	*	*	*	*	..	..	*	*	65.
66.	—— turgida, *Will.*	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	66.
67.	—— scapha, *F. & M.*	*	..	*	*	*	*	..	..	..	..	..	..	..	..	..	..	*	67.
68.	—— stelligera, *D'Orb.*	*	..	*	*	*	..	*	..	*	..	..	..	..	..	..	..	*	68.
69.	—— orbicularis, *Brady*	..	..	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	69.
70.	Polystomella arctica, *P. & J.*	..	..	*	..	*	*	*	..	..	..	..	..	*	..	..	*	..	70.
71.	—— striatopunctata, *F. & M.*	*	..	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	71.

writers have all added more or less to our knowledge of this interesting but difficult group. Although some of their conclusions have not borne the test of further investigation, yet their observations have been mostly confirmed by later workers, while their descriptions of them are clear, accurate, and scientific. Two other palæontologists have recently taken up the subject, and have treated it in very different ways, as I propose to show in the following pages.

Mr. Charles Wachsmuth, of Burlington, Iowa, who is so well known by his writings on the Palæocrinoids, has published incidentally, in the revision of that group by himself and Mr. Springer, some extremely valuable notes on the structure of the Blastoids, which are illustrated by excellent diagrams *. The chief novelty discovered by him is the presence in *Pentremites* of a plate lying directly below the lancet-piece, with a tubular passage running through it. He does not, however, either describe or figure any perforation of the lancet-piece itself; and in the case of *Granatocrinus* he merely figures one subambulacral † plate, pierced by a longitudinal canal.

Dr. Hambach ‡, on the other hand, figures a section of a ray (of *Granatocrinus Norwoodi* ?), the lancet-piece of which is not only "pierced through the centre in its whole length by a very fine canal," but also has a posterior (*sic*) side which is "concave, semilunar, and grooved in its whole length for the reception of some duct or vessel." At the summit this duct or vessel "connects with a circular duct (œsophageal ring?), surrounding, on the interior side, the central orifice or *annulus centralis*." Thanks to the kindness of Mr. Wachsmuth, I have been enabled to examine many beautiful internal casts of *Granatocrinus Norwoodi*, a well-preserved specimen of which is the original of Dr. Hambach's description; but, despite this advantage, I am at a loss to understand his

* Part I. of the "Revision of the Palæocrinoidea" appeared in the 'Proceedings of the Philadelphia Academy' for 1879; and Mr. Wachsmuth has been good enough to favour me with advance sheets of Part II., which will be issued shortly. In this valuable work the authors have reduced the chaos of the Palæocrinoids to something like order; and the illustrated memoir, of which it is but the precursor, will be heartily welcomed in Europe, as it is utterly impossible to gain clear ideas about many of the American species, owing to the difficulty of obtaining the literature on this side of the Atlantic.

† I use this word simply to denote the parts beneath the food-groove, without thereby implying any homology with similarly-named structures in the Echinozoa.

‡ "Contributions to the Anatomy of the Genus *Pentremites*, with Descriptions of new Species," Trans. St. Louis Acad. vol. iv. no. 1, pp. 145–160.

meaning, and can only hope for a further explanation of it in his forthcoming monograph.

An extensive series of observations which have been made conjointly by Mr. R. Etheridge, Jun., and myself *, enables us to give a general confirmation to the results of Wachsmuth and Hambach. We cannot with certainty detect more than one subambulacral plate in any species of *Granatocrinus*, either British or American; but we cannot agree with Wachsmuth in considering its longitudinal canal as corresponding to the dorsal canal of a Crinoid arm, which lodged the axial cord; for we believe it to have contained the water-vessel. We think, however, that he is correct in describing two subambulacral pieces in *Pentremites*; but we are not quite clear as to whether both of these were perforated, or only one, and if so, which of them. It is a matter of no little difficulty to attempt to solve problems of this kind on material which is so highly mineralized as most of these Blastoid calices are; and it is therefore satisfactory to find that the observations of three independent sets of workers are fairly in accordance with one another.

Besides the lancet-piece and the poral pieces, there is, according to Dr. Hambach, another element which enters into the composition of the ambulacra of the Blastoids, viz. "the zigzag plicated integument. This may be regarded as a band which is transversely plicated and covers the whole ambulacral field; it was probably of an elastic texture during the lifetime of the animal. It commences at the apex of the ambulacral field, running in a zigzag from the lateral margin to the median line, so that the poral openings are always placed between two returning folds, which are flattened here to form a sort of articulating surface for the pinnulæ. It ascends in this manner, covering half of the ambulacral field, to the summit of the calyx, where it surrounds in a very acute angle two of the ovarian openings, and descends in a like manner on the following ambulacral field."

Two figures are given by Dr. Hambach in illustration of the novel statement which I have quoted. One of them represents a portion of an ambulacral field considerably magnified; and in some points it is more correct than any which has yet been published. Thus the pinnule-sockets are shown to be distinct from the marginal pores, as was long ago described, though not figured, by Billings †, whose observa-

* "Remarks upon the Structure and Classification of the Blastoidea," 'Nature,' vol. xxiv. p. 497, and Geol. Mag. October, 1881, p. 464.

† 'Canadian Naturalist,' 1870, p. 184.

tions seem to have escaped the notice of both Wachsmuth and Hambach. The other figure, published by the latter author, professes to represent the summit of *P. sulcatus*, and, though small, is clear enough to show that the "zigzag plicated integument" which passes round the ovarian openings from one ambulacral field to the other is nothing but the crenulation on the central ends of the deltoid pieces. This is excellently shown in Römer's figures of *P. crenulatus* *, and also its continuation up onto the lancet-piece along the margins of its median groove. In all the best-preserved specimens of *Pentremites* that I have seen, the edges of the minute transverse grooves on the ambulacral fields, which join their median grooves alternately on opposite sides, are also crenulated, as is shown in Dr. Hambach's figure. But the markings are not due to the presence of any probably elastic "integument" overlying the plates, as Dr. Hambach seems to suppose, as they are merely delicate surface-ornamentation. In the case of the lancet-plate of *Granatocrinus* this is very well seen on ambulacra from which the pore-plates have disappeared; so that the contrast between the crenulated edges to the median groove of the plate and its smooth peripheral portion is very marked.

It is very singular that, although Dr. Hambach has "had an opportunity to study a large and excellent material . . . . numbering several thousand specimens in almost every stage of preservation," he does not make the slightest mention of the minute plates which have been described by so many authors as covering in the ambulacral furrows of the Blastoids. He is less reticent, however, about the so-called summit-plates, which are generally supposed to have roofed in the peristome, and to represent on a small scale the vault of the Palæocrinoids. For he says that the acute points of the zigzag plicated integument, "which almost come in contact with each other at the summit, are the only covering of the central opening, which was never closed by additional plates, as intimated by some authors †; although specimens are frequently found (and I have such in my collection) where it appears as if the summit were closed by additional plates, which on close examination, however, prove to be Bryozoa or ovulum-like bodies. Again, it seems improbable to suppose that the central opening was closed if we compare our fossils with *Echinoderms*, with which they have unquestionably most affinity, both as regards the calcareous shell as well as the interior of

* Wiegmann's Archiv, Jahrg. xvii. Band i. fig. 15 (1851).
† Billings and Shumard.

the visceral cavity (except as regards the number and arrangement of pieces)."

One scarcely knows how to criticise the remarkable statements contained in the passage just quoted. For myself, I should greatly like to learn something more about the evidence which satisfied Dr. Hambach that the structures in question *are* "Bryozoa or ovulum-like bodies." If they be Bryozoa, they must certainly represent a most aberrant type of that group, and it would be well worth Dr. Hambach's while to investigate and describe them. If, on the other hand, they are "ovulum-like bodies," one would like to know more about the "ovulum" which they resemble. Does Dr. Hambach mean to suggest that they are partially hatched "ovula" of the Blastoid?

After Dr. Hambach's astounding statements about the summit-plates of the Blastoids, his remark that this group has "unquestionably most affinity" with Echinoderms falls rather flat, as I am not aware that any one has ever proposed to consider these fossils otherwise than as members of that subkingdom. As a general rule, too, the nearest allies of the Blastoids have been sought for among the Crinoids. But, according to Dr. Hambach, the affinity of the Blastoids with Echinoderms "can easily be comprehended if we divide the calyx into two equal halves, *i. e.* an upper or dorsal and an under or ventral one, of which the ventral one would be composed of the pelvis and fork-pieces, and the dorsal one of the deltoid pieces and ambulacral fields. Supposing the column to be absent, we would have an analogue of an *Echinus*, except that mouth and vent are placed, together with the ovarian openings, on the dorsal part of the shell instead of being on the ventral side, as in true Echinoids."

I must confess that I cannot easily comprehend the advantage of inverting the generally received nomenclature in such a manner as to place the mouth and vent of a Blastoid on its dorsal side; and when this is done and the column supposed to be absent, I altogether fail to see the analogy between the Blastoids and the (true) Echinoids, in which last group Dr. Hambach admits that the mouth and vent are on the ventral side. Even if I am right in supposing that the word "Echinoderms" in the passage quoted above should be read "Echinoids," I am unable to see the affinity between this group and the Blastoids, "both as regards the calcareous shell as well as the interior of the visceral cavity (except as regards the number and arrangement of pieces)." If the pieces of the calcareous shell in the two groups do not agree in number and arrangement, I should be glad to know the characters wherein their affinity lies; and as no living Blastoids are known, it is difficult to understand the similarity of the visceral cavities of the two groups, especially when one remembers that the hydrospires of the Blastoids are wanting in the Echinoids.

The jointed appendages of the ambulacra of the Blastoids, the so-called pinnules, are briefly described by Dr. Hambach, who rightly states that they are not placed over the marginal pores of the ambulacra, as supposed by many authors; but he goes on to make the following extraordinary statement:—"These poral openings, as it appears, must have remained free; because we frequently find the remains of collapsed tentacles preserved in them, the so-called supplementary poral pieces." Further on also he speaks of the poral fissure at the side of the ambulacra "from whence the tentacles originate, leaving the interior of the calyx through the poral openings, and forming in their collapsed state the supplementary poral plates of Dr. Römer. This can easily be observed in good and suitable specimens by grinding off the lateral margin of an ambulacral field, where we will find that the interior circumference of a poral opening is lined with a membranaceous integument."

He explains rightly enough that the cavities of the hydrospires communicate above with a tube extending along the length of the ambulacrum, and that this "ovarian tube" has its outlet through one of the spiracles at the summit; but he totally ignores the proofs given by Rofe, Billings, Wachsmuth, and others that the marginal pores along the ambulacra lead down into this ovarian tube. Surely this obvious fact cannot have escaped his notice during "his numerous examinations of cross sections" of the ambulacra, unless, indeed, he means to imply that the "ovarian tube" also lodged a vessel from which the tentacles were filled.

I had quite hoped that, since the researches of Rofe and Billings, the old doctrine of the ambulacra of the Blastoidea being fringed with tentacles like those of the Crinoids had been finally got rid of; and I am somewhat surprised at its revival by Dr. Hambach, who must have a wonderful power of imagination; for he actually believes that "soft and membranaceous organs, such as occupy the pores of the ambulacral field in Echinoderms," can have been preserved (in a collapsed state, it is true) through all the ages between the Carboniferous period and the present time. He does not, however, vouchsafe to tell us when or how they underwent such changes as rendered them now liable to be described and figured as calcareous plates of definite shapes in different species of Blastoids. It is certainly a very singular phenomenon that the "collapsed tentacles" of *Pentremites obliquatus* and of *P. crenulatus* respectively should have assumed shapes *in limestone* which are so very different, but yet constant for those particular species.

Dr. Hambach is understood to be at work upon a monograph of all the known American and European species of the Blastoidea. Its appearance will be awaited with no ordinary interest, in the hope of finding therein some further development of the remarkable new theories of the morphology of the group which have been criticised above.

XLII.—*On the Genera* Ctenoptychius, *Agassiz*; Ctenopetalus, *Agassiz*; *and* Harpacodus, *Agassiz*. By James W. Davis, F.G.S., F.L.S.

Prof. L. Agassiz, in his great work on Fossil Fishes, defined the genus *Ctenoptychius* (Poiss. Foss. vol. iii. p. 99) as embracing small teeth presenting the appearance which would be produced if small teeth of *Orodus* were strongly compressed so that the transverse ridges of that genus were disposed in the form of comb-like projections more or less round and detached. The teeth of *Ctenoptychius* are remarkable for their pectinated appearance and compressed form.

Three species of this genus are described by Prof. Agassiz, viz.:—1, *Ctenoptychius apicalis* (p. 99, pl. xix. figs. 1, 1*a*) from the Staffordshire coal-fields and the coal strata near Manchester; 2, *C. pectinatus* (p. 100, pl. xix. figs. 2, 3, and 4) from Burdie House and Lancashire; and 3, *C. denticulatus* (p. 101, pl. xix. figs. 5, 6, 7). To those described were also added (p. 173) others which were named but not described, the description being left for a supplement, which unfortunately has not been written. They are:—

Ctenoptychius cuspidatus. Coal, Glasgow.
C. dentatus. Mountain Limestone, Armagh.
C. serratus. " "
C. macrodus. " "
C. crenatus. Coal, Carluke, near Glasgow.

In 1843 *C. macrodus* was described and figured in Portlock's Report on the Geology of Fermanagh &c. (p. 467, pl. xiv. fig. 7). It differs from *C. apicalis*, Ag., "by the form of the crest, which is round, and not tending to a point as in that species." The crest is denticulated, the denticles being tolerably large and blunt.

Prof. M'Coy, 1854 (Brit. Palæoz. Foss. p. 626), defined the genus *Ctenoptychius* and redescribed the species *C. apicalis*, Ag., including therein *C. apicalis*, Ag. (Binney, Trans. Manch. Geol. Soc. vol. i. t. 5. fig. 19), *Petalodus dentatus*, Owen (Odont. p. 62), and *C. macrodus*, Ag. ined. (and Portl. Geol. Rep. t. 14. fig. 7). A second species is described, *C. serratus*, Ow.? (Owen, Odontog. p. 62), and figured on pl. 31. figs. 21, 22, 23. During 1858 Prof. Agassiz visited the Earl of Enniskillen at Florence Court, and revised his genus *Ctenoptychius*. He divided it into three genera. *C. apicalis* being taken as the type of the old genus, *C. serratus* forms the type of a new genus *Ctenopetalus*, and *C. dentatus* the type of the third genus *Harpacodus*.

Since Prof. Agassiz made these determinations many additions have been made to the species, both in this country and more especially in America, and the whole group has reached a state of considerable confusion. It was the intention of Prof. Agassiz to greatly amend and rewrite his work on the fish-palates of the Mountain Limestone; but the great pressure of engagements in connexion with his labours in America prevented, from time to time, this being accomplished; and by his premature death all chance of its being done has been cut off. The work has been rendered comparatively easy, however, by the careful determinations of Agassiz and the knowledge possessed by Lord Enniskillen of his intentions with regard to them, as well as from the fact that all the type specimens are in the Florence-Court collection.

The following descriptions of the genera are derived principally from a study of the type specimens. The enumeration of species appended to each may be taken as suggestive rather than any thing else.

Genus Ctenoptychius, Agass. ined.

Gen. char. Teeth small; crown strongly compressed, more or less acuminate and often irregular in form; cutting-edge divided into several strong denticulations, the central one largest and most prominent; base of crown with a few imbricating folds of ganoine; bony root thin, flattened in the same direction as, and longer than, the crown.

Ctenoptychius apicalis, Agass. Poiss. Foss. t. iii. p. 99, pl. xix. figs. 1, 1 *a*. (Type.)
C. pectinatus, Ag. P. Foss. vol. iii. p. 100, pl. xix. fig. 4 (only).
C. pretenuis, St. J. & W. Palæont. Illin. vol. vi. p. 382, pl. x. A. fig. 27.

C. Stevensoni, St. J. & W. Palæont. Illin. vol. vi. p. 383, pl. xii. fig. 15.

C. semicircularis, N. & W. Palæont. Illin. vol. ii. p. 72, pl. iv. figs. 18, 18 *a*, 18 *b*.

C. Ordii, Davis, Quart. Journ. Geol. Soc. 1881, p. 422, pl. xxii. fig. 8.

Genus Ctenopetalus, Agass. ined.

Gen. char. Teeth of small or medium size; crown broad, compressed, gently rounded in outline; cutting-edge divided into from twenty to thirty small denticles; base of crown possessing three or four imbricating ganoine folds descending lower on posterior than anterior surface; root narrower than crown, flattened, and about equal to it in height.

Ctenopetalus (*Ctenoptychius*) *serratus*, Agass. ined. (Type.) M'Coy, Brit. Palæoz. Foss. p. 626, pl. 3 I. figs. 21, 22, and 23 (Owen, Odont. p. 62).

C. (*Ctenoptychius*) *denticulatus*, Agass.? Poiss. Foss. vol. iii. p. 101, pl. xix. figs. 5–7.

C. vinosus, St. J. & W. Palæont. Illin. vol. vi. p. 396, pl. xii. fig. 13.

C. occidentalis, St. J. & W. Palæont. Illin. vol. vi. p. 401, pl. xii. fig. 14.

Genus Harpacodus, Agass. ined.

Gen. char. Teeth small; crown slightly convex, strong; cutting-edge very slightly circular, divided into from five to eight deeply-cut, broad, and strong denticulations; base of crown prominent, with a single broad fold of ganoine deeper posteriorly than in front; root at its junction with the crown much constricted; lower it is expanded, large, and tumid.

Harpacodus (*Ctenoptychius*) *dentatus*, Ag. ined. (Type.)

H. (*Ctenoptychius*) *apicalis*, M'Coy, Brit. Palæoz. Foss. p. 626.

H. (*Ctenoptychius*) *macrodus*, Ag. ined.

H. (*Ctenoptychius*) *macrodus*, Portl. Geol. Rep. p. 467, pl. xiv. fig. 7.

H. (*Ctenoptychius*) *pectinatus*, Ag. Poiss. Foss. vol. iii. p. 100, pl. xix. figs. 2, 3.

H. (*Petalodus*) *dentatus*, Owen, Odont. p. 62.

H. (*Ctenopetalus*) *limatulus*, St. J. & W. Palæont. Illin. p. 399, pl. xii. fig. 18.

H. (*Ctenopetalus*) *medius*, St. J. & W. Palæont. Illin. p. 400, pl. x. A. fig. 26.

H. (*Ctenoptychius*) *pectinatus*, Davis, Q. J. G. S. 1881, p. 424.

The crown of the teeth in all three genera is thickly coated with enamel; and they have all a general family resemblance. They appear, however, to be much more nearly related to the Petalodonts than to *Orodus*, as suggested by Prof. Agassiz. The convex surface of the crown in front, and the corresponding concave surface behind, form a petal-shaped tooth very similar to that of some of the Petalodonts; they are distinguished by the deeply denticulated or pectinated cutting-surface. Whilst agreeing in the possession of a family likeness one with the other, they exhibit considerable generic distinctions. The genus *Harpacodus* differs from the other two in its thick, strong crown and the almost straight contour formed by the enamelled tips of its denticles. The constricted, tumid, and prominent bony base is quite different from the flattened bases of *Ctenopetalus* and *Ctenoptychius*. The denticulation of the three genera is sufficiently distinct. *Ctenoptychius*, though possessing about an equal number of denticles with *Harpacodus*, is distinguished by their peculiar irregularly acuminate arrangement, whilst in *Harpacodus* they extend almost straight across the tooth. The denticulation of *Ctenopetalus* is easily discriminated by the large number of denticles and their comparative smallness in proportion to the size of the tooth.

XLIII.—*The Organization of* Cœnogonium, *and the Theory of Lichens.* By Dr. J. Müller *.

The genus *Cœnogonium*, established in the class of Lichens by Ehrenberg in 1820, at present consists of about twenty species, all of which grow in the warmer regions of the two hemispheres. Their fruits, or apothecia, and their spores are like those of the section *Biatorina* of the genus *Patellaria*, while their thallus, or vegetative part, has a totally different structure, approximating the genus to *Graphis*.

The constituent elements of this thallus are filiform, not much branched, more or less parallel to one another, and very loosely combined into a felted mass, which, according to the species, may have the form of a small sod or flattened cushion, or may become developed horizontally in the form of a fan about 2–8 centim. in diameter; and on examining them one is struck with the great resemblance which these filamentous elements show to the filaments of the Confervæ. Tubes (filaments) about 5–30 μ in width, according to the

* Translated by W. S. Dallas, F.L.S., from the Bibliothèque Universelle, Arch. des Sci. 15th October, 1881, p. 370.

species, contain a simple series of green cells charged with chlorophyll, which touch each other at their ends, and are usually several times as long as broad. But the details stop here if we are working with an ordinary microscope; and it was by this means that Ehrenberg drew the analysis of his new genus.

By a better method of analysis, and by the aid of very superior objectives, Dr. Karsten and Prof. Schwendener, in 1862, ascertained that round the large confervoid filaments there exist others which are much more slender, about 1–2 μ in diameter, which appear to be hyaline, and creep, as it were, over the surface of the large green filaments. There is only a single series around the green filaments; and, moreover, this series is interrupted, the slender filaments not touching each other laterally in a regular manner; but they often show anastomoses, and sometimes form here and there a very close network. Thenceforward we had in the thallus of the *Cœnogonia*, as in the other Lichens, two constituent elements:—that of the large green cells still enclosed in their mother cell, corresponding to the gonidia; and that of the slender hyaline filaments, corresponding to the hyphoidal filaments. But no genetic connexion between the two had been observed as late as 1866 (De Bary, Morphol. und Physiol. der Pilze und Flechten, p. 270).

It is therefore clear that, according to the celebrated theory of Prof. Schwendener, put forward in 1867, the large green filaments would represent the nutritive alga, and the slender hyphoidal filaments would be the parasitic fungus, the two forming together the thallus of a plant which, as a mixture, would no longer have its legitimate place in the series of the classes of plants.

Along with this normal structure we sometimes find incomplete individuals, in which the slender enveloping filaments are deficient, as in *C. confervoides*, Nyl., and others. In this case the plants are necessarily barren, without apothecia; for these, according to the researches of Prof. Schwendener (Flor. Ratisb. 1862, tab. i.), are formed exclusively by means of the hyphoidal filaments. This difference, however, is not absolute throughout; for the new *Cœnogonium pannosum* (just published by me in the Flora de Ratisb. of the present year, Lichenol. Beitr. no. 309), which is a native of Brazil, and was sent by M. Puiggari, presents the two cases at once: certain filaments show only the large green tube, the gonidia; and others of the same clump, charged with apothecia, are surrounded by a small number of slender hyphoidal filaments.

Now it is precisely some filaments of this latter category that showed me, when I analyzed the above-mentioned species for its specific characters, a remarkably demonstrative case, which forms the subject of this note, and confirms the fine general results recently published in the splendid work of Dr. Minks.

This filament for a great part of its length measured 8 μ in diameter, and consisted only of the large green tube. It agreed with the large green tube of the other filaments of the same clump, the greater number of which were loosely covered or coated with a small number of slender hyphoidal filaments. It therefore contained the cylindrical green gonidia, which simulated the joints of a conferva; it was the alga of the theory. But at a certain point this large gonidiophorous tube became suddenly constricted, in the form of a cone a little longer than broad, and afterwards continued in the form of a very slender capillary tube, only 2 μ in diameter, without there being any discontinuity of the cavity between the large tube and the very slender part. The whole was formed only of a single cell, at first wide, and afterwards very narrow; and the narrow part was comparatively hyaline, and in other respects perfectly agreed with the slender hyphoidal tubes of the theoretical fungus, which cover the large green tube or theoretical alga in other filaments of the same species. Moreover the narrow part, when examined with powerful immersion objectives, and with the assistance of Prof. Abbé's light-condenser, showed clearly the microgonidia, the gonidia, in their preliminary state, of normal form, size, and arrangement; and in this respect also there was conformity between the narrow part and the enveloping hyphoidal tubes of the coated filaments.

It follows that one and the same cell would have been the theoretical alga on the widened and gonidiophorous side, and the theoretical fungus on the other side, which remained narrow and contained microgonidia—which proves, in the most absolute manner, the falsity of the theory, as the same cell could not belong at once to two classes of plants. We have here neither fungus nor alga: the whole is lichen, and nothing but lichen; and the two kinds of tubes, so different at the first glance, are only different states of development of one and the same organ. The very slender hyphoidal tubes are the primary part containing the microgonidia. This primary part may remain always in that state; or it may become enlarged and elongated, whilst its microgonidia, produced by free formation, will pass to the state of gonidia; and then the slender hyphoidal tubes will have become large gonidiophorous tubes.

XLIV.—*Report on a Collection made by Mr. T. Conry in Ascension Island.*

Fishes. By A. Günther.
Mollusca. By E. A. Smith.
Crustacea. By E. J. Miers.
Myriopoda and Insecta. By C. O. Waterhouse.
Echinodermata. By F. J. Bell.
Madreporaria. By S. O. Ridley.

Staff-Surgeon T. Conry, who at present is stationed in the Island of Ascension, has kindly forwarded a small collection of zoological specimens to the British Museum. And as it is always of interest to record the occurrence of animals in an oceanic island, the fauna of which must be ever changing from physical causes as well as owing to the agency of man, we have thought it useful to prepare a list of the specimens collected, and to give the result of our examination in a collective form.

Fishes.

The species were four in number, three of which are additional to the list of Ascension-Island fishes given in the 'Challenger' Reports (Shore-fishes, p. 4), viz. *Scorpæna Plumieri*, *Ostracion quadricornis*, and *Salarias vomerinus* (= *S. textilis*). The last-named species is said to make jumps twenty times its own length.

Mollusca.

The specimens collected belong to the following species:—1. *Purpura ascensionis*, Quoy & Gaimard; 2. *P. hæmastoma*, Lamarck; 3. *Nerita ascensionis*, Gmelin; 4. *Cypræa lurida*, Linn.; 5. *C. spurca*, Linn.; 6. *Hipponyx antiquata*, Linn.; 7. *Malleus regula*, Forskål, ? jun.; 8. *Helix similaris*, Férussac.

Of these species it is interesting to note that nos. 2, 4, and 5 are extensively distributed throughout the Mediterranean and down the west side of Africa as far as St. Helena. The *Hipponyx* extends along the same African region, but does not enter the Mediterranean. This, *Purpura hæmastoma*, and *Cypræa spurca* also inhabit the shores of the West Indies. Although it is possible that their range will eventually prove still more extensive, (as far as I can ascertain) neither of them has as yet been met with further south than St. Helena. This distribution may be attributable, as suggested by Dr. Gwyn Jeffreys, to the action and influence of the great

Agulhas current, which issues from the Indian Ocean and flows round the Cape of Good Hope northwards towards St. Helena, and thence past Ascension to the West Indies; and to the Guinea current, as well as to a passage which formerly existed across Africa in the line of the Sahara, may be owing the partial correspondence between the Mollusca of the Indian Ocean and of the Mediterranean. Yet, if these ocean currents be the cause of such distribution (and doubtless they must influence it considerably), we should expect to find these same species in the Indian Ocean or at the Cape. We do not; and are we therefore to consider St. Helena the starting-point of these species? Unfortunately the *Hipponyx* is found on the west side of both North and South America, a fact eminently perplexing; and *Purpura hæmastoma* has yet to be proved distinct from *P. biserialis* of the Californian and Panama coasts.

Purpura ascensionis appears to be peculiar to the island, and, although living under the same conditions as the other species, has not been similarly affected by these oceanic currents, unless the *P. neritoidea* found at the Cape-Verd Islands and Benguela (*Dunker*) is to be considered a modified form of it, or *vice versâ*.

Nerita ascensionis is also limited in range; and the only other locality known to me whence it has been obtained is the island of Trinidad, off the Brazilian coast, about 20° south of the equator. In this instance also to the ocean currents may be attributable such distribution; for, according to certain maps which I have consulted, a branch of the great Indian-Ocean current passing Ascension sweeps southward along the Brazilian coast past the island of Trinidad. But whether such speculations respecting the range of these mollusks possess any real value is very questionable, seeing how extremely imperfect up to the present time has been the investigation of both the east and west shores of the South Atlantic or even of the whole of the Caribbean Islands.

The species of *Malleus* is very closely represented in the West Indies by *M. candeana* of D'Orbigny, which, however, may be specifically distinct. The only land-snail, *Helix similaris*, is, with regard to distribution, quite an anomaly among terrestrial gastropods, being met with in Brazil, Cuba, Natal, Mauritius, Madagascar, Seychelles, Rodriguez, Bourbon, Bengal, China, Java, Philippines, Australia, Sandwich Islands, and other places. Monsieur Morelet thinks that it probably originated in the eastern parts of Asia, whence it has spread on the one hand to Polynesia, and on the other to America.

Crustacea.

The crabs are few and unimportant. They include a very small male specimen that I refer to *Xanthodes melanodactylus*, A. M.-Edw., whose occurrence at Ascension I have already recorded*, three specimens of *Pachygrapsus transversus*, Gibbes, three of *Leiolophus planissimus* (Herbst), a small specimen of the anomurous genus *Petrolisthes* that is very probably referable to the West-Indian *P. armatus*, Gibbes, since it agrees with Gibbes's description in nearly all particulars, having, however, the spines on the upper margin of the third joints of the ambulatory legs very small and almost concealed by the stiff setæ and slenderer pinnated hairs with which the margins are clothed; the carapace and legs are covered with a close, thick, whitish pubescence; but there are scarcely any traces of its disposition in transverse lines except on the merus joints of the chelipedes; the carapace and legs are very prettily mottled with pink. Length of carapace nearly $2\frac{1}{2}$ lines (5 millim.).

Besides the above there are in the collection two small specimens of a crab in a larval (*Megalops*) stage of development, which cannot be certainly identified with any known species.

To render this brief account of the Crustacean fauna of this isolated rock the more complete, I subjoin the description of a species in the British-Museum collection which is apparently undescribed.

Pseudozius Mellissi, sp. n.

In this handsome species the carapace is transverse, much broader than long, its surface punctulated, the punctulations numerous and crowded in front, sparser posteriorly, and nearly obsolete near the postero-lateral and posterior margins. Some larger pits occur here and there near the antero-lateral margins; and the upper margins of the carpus and hand of the chelipedes are also punctulated. The front is four-lobed; the two median lobes are prominent and rounded and separated by a well-defined median notch; the outer lobes (or inner orbital angles) very little prominent, and separated from the median lobes only by a rather shallow sinus. The antero-lateral margins are longer than the postero-lateral margins, and are defined along the greater part of their length by an obliquely striated entire line or crest, after which follow, at the broadest part of the carapace, two small but distinctly-defined teeth. All the joints of the postabdomen are distinct in both sexes. The

* *Vide* Ann. & Mag. Nat. Hist. (ser. 5) viii. p. 213 (1881).

anterior legs (or chelipedes) in both specimens are very large and robust; arm or merus joint short, trigonous, with the margins unarmed; carpus or wrist large, with its inner margin produced into a broad squarely truncated lobe; both carpus and palm (as already noted) are punctulated above, the palm has its upper margin rounded, the lower margin straight, thin-edged, and entire; there is a rounded prominence on the inner surface; the fingers are black, dentated on their inner margins, with acute apices, the coloration not extending along the inner or outer surface of the palm. The ambulatory legs are slender, smooth, and nearly naked, with the penultimate and terminal joints longitudinally canaliculated, the longitudinal channels in the penultimate joints not always extending along the whole length of the joints. Length of the specimen from Ascension Island about 1 inch (25 millim.), breadth about $1\frac{1}{2}$ inch (38 millim.). This specimen is a female (preserved in spirit); it is of a flesh-coloured tint, and bears numerous ova. It was received with the collection of fishes of H.M.S. 'Challenger.' There is also a larger male specimen (preserved dry) in the British-Museum collection from St. Helena (*J. C. Melliss, Esq.*): length nearly 1 inch 5 lines ($35\frac{1}{2}$ millim.), breadth a little over 2 inches 3 lines (nearly 59 millim.). This specimen is of a more bluish pink hue.

The smooth but rather convex and very transverse carapace, which is marked neither with tubercles nor *sulci*, and the absence of the three anterior teeth of the antero-lateral margins, suffice to distinguish this species from all with which I am at present acquainted. *Xantho Bouvieri*, A. M.-Edwards*, from the Cape-Verd Islands (St. Vincent), if one may judge from the brief description, bears some slight resemblance to this species; but the carapace is much narrower, the front less deeply notched, and the antero-lateral margins have but a single obscure tooth near their posterior angles.

It *may* be identical with the small bright orange-red-coloured crab, figured on a reduced scale, but not determined, by Mr. C. S. Bate, in the work of the late Mr. J. C. Melliss on St. Helena ('Crustacea,' p. 206, pl. xxii. fig. 3, 1875). Mr. Melliss notes that it is very rare; but one specimen was brought to him from Break-neck Valley, on the leeward side of the island. The crab figured by Mr. Bate differs from the species now described in being much narrower in proportion to its length. I designate this species *P. Mellissi*, after its original discoverer†.

* Rev. et Mag. Zool. xxi. p. 377 (1869).

† Whether the Museum specimen received from Mr. Melliss is that referred to by Mr. Bate is uncertain. It was received from Mr. Melliss

In regard to the distribution of the species, I have already (*l. c.*) noted the occurrence of *X. melanodactylus* at Madeira and Cape St. Vincent, in the Cape-Verd Islands. *Pachygrapsus transversus*, Gibbes, is a very common and widely distributed form, occurring on the coast of Brazil, on the shores of the West-Indian islands, at Nicaragua, Vera Cruz, on the coast of Florida, &c.; also on the west coast of Central America (*Capt. Dow, in coll. Brit. Mus.*), California (*Kingsley*), Vancouver Island (var. *socius*, Stm., *J. K. Lord, Esq.*, *in coll. Brit. Mus.*), at Madeira (*Rev. R. B. Watson*), &c. Mr. Kingsley, in his recently published and very useful synopsis of the Grapsidæ*, mentions specimens (identified by himself) occurring at Tahiti, New Zealand, and Australia.

Leiolophus planissimus also occurs at various localities on the eastern and western coasts of America, and at Madeira, and is widely distributed throughout the Oriental region †.

MYRIOPODA.

Scolopendra Leachii, Newport.

From West and South Africa.

COLEOPTERA.

1. *Dermestes vulpinus*, Fabr.

Cosmopolitan.

2. *Dermestes felinus*, Fabr.

This species was described from Tasmania. A specimen in the Banksian collection is marked "Kerguelen I." It is a species which might be found anywhere, but is not nearly so frequently met with as *D. vulpinus*.

3. *Alphitobius piceus*, Oliv.

A warehouse insect.

4. *Anthicus floralis*, Linn.

A European species.

5. *Phlyctinus callosus*, Bohem.

From the Cape of Good Hope.

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with some specimens of *Plagusia depressa*; and no species of *Plagusia* is mentioned by Mr. Spence Bate in his report.

* Proc. Acad. Nat. Sci. Philad. p. 200 (1880).

† *Vide* Ann. & Mag. Nat. Hist. (ser. 5) i. p. 153 (1878).

6. *Naupactus longimanus*, Fabr.

Siderodactylus ornatus, Pascoe.

A Brazilian species. Mr. Pascoe, misled by the reception of this species from Ascension, described it as a new species of the old-world genus *Siderodactylus* (Ent. Mo. Mag. xv. 1879, p. 185). This insect formed the subject of a communication from the Lords of the Admiralty to the Director of the Royal Gardens, Kew. It is stated to have done much damage to grape-vines by eating the leaves, and is said also to attack the plants of kohlrabi.

7. *Orthoperus punctum*, Marsham.

A European species, described originally from England. The late Mr. T. V. Wollaston met with it in Madeira.

Hymenoptera.

Evania lævigata, L.

In the British Museum, from Mexico, Congo, Rodriguez, Ceylon, Sandwich Islands, Port Essington, &c.

Lepidoptera.

1. *Leucania Loreyi*, Dup.

Occurs in Europe, and there are in the British Museum examples from Brazil and Java.

2. *Prodenia retina*, Herrich-Schäffer.

Has been received from Crete, European Turkey, Asia Minor, Madagascar, Mauritius, Madeira, Congo, and Nepal.

3. *Laphygma caradrinoides*, Walker.

Port Natal.

4. *Cosmophila indica*, Guenée.

Received from Mauritius, Sierra Leone, Congo, Ceylon, North India, Moreton Bay, and Tasmania.

5. *Plusia aurifera*, Hübner.

Has been received also from Teneriffe.

6. *Plusia ni*, Hübner.

Europe, New York, &c.

7. *Hymenia fascialis*, Cramer.

West Indies, Venezuela, Santarem, Sierra Leone, Congo, Bagdad, Ceylon, North India, China, Australia, New Zealand.

8. *Scoparia alconalis*, Walker.

In the British Museum only from Ceylon.

Diptera.

1. *Sarcophaga hæmorrhoidalis*, Fall.

A European species.

2. *Musca cæsar*, Linn.

A European species.

Neuroptera.

1. *Oligotoma Saundersii*, Westw.

Originally described from Bengal. Mr. Conry states that it is doing much mischief in Ascension.

2. *Chrysopa vulgaris*, Schneider.

A European species.

Orthoptera.

1. *Bacteria trophinus*, Westw.

From Port Natal.

2. *Gryllus capensis*, Fabr.

Found almost everywhere.

3. *Meroncidius specularis*, Fabr.

Brazil and Mexico.

4. *Pachytes*, spp.?

Specimens of two species of this genus, which do not agree satisfactorily with any in the British Museum.

Echinodermata.

1. *Cidaris metularia*, Lamk.

Three specimens, with and without spines.

2. *Diadema setosum*, Gray.

Three specimens, with and without spines.

3. *Tripneustes angulosus*, Leske.

One specimen, without spines; abactinal area complete.

4. *Echinometra subangularis*, Leske.

One specimen, of moderate size; no spines.

This is doubtless the "small Warted Barbadoes Sea Egg" which was collected by James Cuninghame at Ascension about 1699 *.

5. *Echinoneus cyclostomus*, Leske.

Five specimens, all in good condition, and three quite richly covered with spines.

6. *Rotula dentata*, Leske.

Two specimens, without spines—one only slightly injured and still pale green in parts, the other bleached and more broken.

7. *Linckia diplax*, M. & Tr.

A large specimen, with four long and two very short arms, which I am unable to distinguish from a specimen of *L. diplax* that was determined by Prof. Perrier.

All the above specimens arrived dry; an Ophiurid in spirit is not in a condition to be certainly determined.

The species enumerated are all forms with a wide distribution; and none of them are at all specially characteristic of the eastern coast of the American continent; indeed *Diadema setosum* and *Echinometra subangularis* (with the possible, though very doubtful†, case of *Tripneustes angulosus*) are the only forms that seem as yet to have been found in that region. On the other hand, *D. setosum*, *E. subangularis*, and *Rotula dentata* have all been found on the eastern shores of the Atlantic; the last-mentioned would appear to be the only species in this collection which is confined to the western side of the African continent. The other species (*Cidaris metularia*, *Tripneustes angulosus*, *Echinoneus cyclostomus*, and *Linckia diplax*) are only to be found when we touch the Cape of Good Hope or pass from it into the great ocean on the eastern side; from this statement the island of St. Helena will probably have to be excluded.

As compared with the Mollusca, it is of interest to note

* See Phil. Trans. vol. xxi. p. 298.
† P. Z. S. 1879, p. 661.

that no Mediterranean species is represented in this collection; and the "great Agulhas current" to which Dr. Gwyn Jeffreys has directed attention is not only an efficient, but also, so far as the problem is raised by the characters of the Echinoderm-fauna, a sufficient cause for the presence of the same species on both sides of the southern peninsula of the Old World.

It may be of interest to add that *Salenia varispina* and *Echinus acutus* have been taken in deep water off Ascension.

MADREPORARIA.

Platygyra ascensionis, sp. n.

The specimen which I venture thus to designate is unfortunately but a portion of what was probably a globose colony. It is somewhat worn, the summits of many of the intercalicular walls being rather rubbed and the septa of many of the calicles considerably broken. Enough, however, remains of its characters to leave little doubt as to what they originally were. The species is decidedly fissiparous. The calicles are polygonal, generally either pentagonal or hexagonal, generally rather longer than they are broad, especially when about to divide; greatest diameter from 3 millim. to 5 millim., least diameter from 2 to 3 millim., depth about 2 millim. The calicles are absolutely united by their walls, which are barely 1 millim. thick at bottom of calicle, and end somewhat bluntly above, the septa being slightly indicated as low teeth on the summit of the wall. There are no traces of dissepiments or traverses, and seldom of lateral union between the septa. Septa in three cycles, the rudimentary third cycle frequently wanting, generally about three primaries to a millimetre; the primaries project horizontally about 1·5 millim. from the wall, and then slope gradually to the columella, to which they are intimately united; secondaries only about half as wide as the primaries; tertiaries, where present, mere ridges on the wall. Septa thin, but strongly roughened by lateral tubercles; edges of primaries decidedly dentate, those of inferior cycles slightly so. Columella distinct, normally spongy, but drawn out into a linear form in calicles about to divide. Tissue of walls and of the part subjacent to the calicles dense and non-cellular.

This species is a very interesting one, as showing a marked divergence from the ordinary type of the genus (*Platygyra*, Ehrb., = *Cœloria* + *Astroria*, M.-Edw. & Haime) to which I have assigned it; it appears to fall into the *Astroria* division of that genus, but differs from any species hitherto assigned to it in the small size and very slight depth of the calices. It differs further in its spongy columella so much from the typical forms that it is excluded from the genus as limited

Fig. 1.

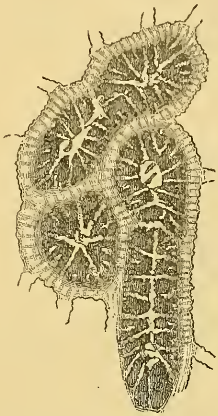

Fig. 2.

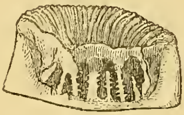

Fig. 1. *Platygyra ascensionis.* A few calicles, as seen from above, × 4.
Fig. 2. Ditto. A wide calicle in vertical section, made outside the columella, which is seen beyond line of section, × 4.

(under the appellation *Cœloria*) by Milne-Edwards & Haime (Hist. Cor. ii. p. 411); but Dr. Brüggemann has given reasons ("Corals of Rodriguez," Phil. Trans. vol. clxviii. p. 571) for considering the character, whether vertical or spongy, of this part not to be even of specific importance, having been obliged to unite under the name *Platygyra Esperi* forms which have both vertical and spongy columellæ. This species has the calicles much more individualized than is usual in that species, and in this respect appears to approach the Faviaceæ, and may perhaps mark a transition to that group; but it is very decidedly distinct in other points from the genera of that group as at present known and under their present limitations.

Of the species referred doubtfully to *Prionastræa* by Milne-Edwards & Haime (Hist. Cor. ii. pp. 522–525), I believe both *Astræa rigida* and *A. varia*, Dana, to be referable to this section of *Platygyra*: the former, coming from the East Indies, seems to be the nearest known ally of this form out of the Atlantic area; and the latter (*A. varia*), from the West Indies, the nearest from the Atlantic region. Some forms of *P. Esperi* from Rodriguez Island also approach it, but not closely.

It differs from *A. rigida* in the small proportions of the calices, from *A. varia* in the non-cellularity of the corallum and the shallowness of the calices, from *P. Esperi* in the small size of the calices and of their parts and in the slight denticulation of the mural ridge by the septa.

The only coral alluded to in the paper on Ascension in the Phil. Trans. for 1699 could hardly be this species, though some Astræid is possibly indicated by the very vague and unscientific description there given.

XLV.—*Description of a new Species of the Genus* Archaster *from St. Helena.* By F. Jeffrey Bell, M.A.

In connexion with the foregoing notes on the fauna of the island of Ascension it seems to be of interest to present an account of a magnificent species from the island of St. Helena, two specimens of which were, several years ago, presented to the Trustees of the British Museum by Mr. J. C. Melliss, but to which the donor makes no reference in his valuable work on that island *, and which have not as yet been described.

Archaster magnificus, n. sp.

Rays five. $R=207, 138$; $r=50, 37$. Breadth of arms at base 57, 36; at middle 36, 20; breadth of paxillar area at middle 17, 10·5.

Disk rather flat, the median portion of the arms elevated, and the paxillæ along the middle line arranged in longitudinal, and not, as at the sides, transverse rows. Anus obscure.

The tips of the paxillæ consist of a tuft of about fifteen cylindrical spinules, closely appressed together, and not forming any kind of fringing crown. There are, in one specimen, about seventy-four, and in the other about sixty-four, supero-marginal plates; these are covered with granular scales, which may become elongated, or converted at the lower edge into flattened spatulate spines, which do not appear to stand erect, but to lie along the side of the arm. The plates themselves are placed altogether at the margin of the arm, and are somewhat higher than broad. Near the tip of the arm the spines on these plates may disappear, while the plates themselves take a more dorsal position. The infero-marginal plates are thickly covered with stout flattened spines, which are much better developed than in *A. angulatus*. The spines are frequently cut off square at their tips, and are so closely packed as to destroy any distinct appearance of regularity of distribution; here and there, however, it is possible to detect

* J. C. Melliss, 'St. Helena' (London, 1875).

a transverse row of five spines. The adambulacral plates are convex towards the ambulacrum, and carry on their inner edge three or four spines; the other spines on these plates are stouter, with blunted ends, and would seem in younger examples to have been arranged in two or three regular longitudinal rows; such regularity, however, is considerably obscured in well-grown specimens. The rich supply of stout blunt spines which distinguishes the adambulacral region and the infero-marginal plates is a characteristic also of the intermediate plates on the ventral surface, the transverse axes of which are completely covered by them, about ten being, in the larger specimen, found to be set in one more or less regular line at the angle of the disk.

The madreporic plate is large, and, though not projecting, is very distinct; it is distant a little more than its own diameter from the edge of the disk. The abactinal surface of the larger specimen is greyish brown, and of the smaller orange-yellow; both are, unfortunately, dried.

Like *Archaster angulatus*, *A. magnificus* attains a considerable size, but, as compared with that species, has the skeletal plates of its arm distinctly not so stout; it is possibly in consequence of this that we find the spines themselves so richly and so well developed.

Indeed we have much evidence in support of the generalization that in littoral species, at any rate, the strength and number of the spines is in inverse proportion to the stoutness of the skeletal plates: when these are strong, the starfish is enabled to withstand the bite of an enemy; but when they are weaker, a defensive apparatus is provided in longer, stronger, and stouter spines.

XLVI.—*Description of two new Species of Shells.* By Edgar A. Smith.

Cypræa fallax.

Testa pyriformi-ovata, postice subumbilicata vel excavata, lutea, maculis albis parvis notata, basi marginibusque albis; labrum mediocriter crassum, postice aliquanto productum, dentibus 23 subæqualibus munitum; labium internum dentibus 23 paulo minoribus parum prominentibus instructum. Longit. 36 mill., lat. 20.

Hab. West Australia.

This shell closely resembles the common *C. cribraria*; but I venture to describe it as a new species for the following reasons. It is larger than any specimen of that species which has come under my observation, and of a pear-like shape (in which respect it resembles *C. miliaris* or *C. Cumingii*), it has more than the average number (about nineteen) of teeth on the labrum, and the white spots are smaller and not so clearly defined as in *C. cribraria.* The fawn-colour is paler than in most specimens of the latter (perhaps the result of bleaching), and on the right side towards the labrum it is somewhat deeper in tone. This darker tint (possibly an individual peculiarity) commences where the white margination ceases, and extends upwards between the white spots in the form of irregular streaks, and thus does not terminate in a defined line. An almost invariable character of *C. cribraria* is the circularity and clear definition of the white spots, which, too, are very frequently margined with a dark ring. Many specimens (I believe, even the majority) of that species in addition exhibit a few minute brown dots just above or on the white lateral ridge. On the contrary, in *C. fallax* the white spots appear to blend into the fawn-colour, and no indication of minute dotting is traceable. The locality (West Australia) may also be slight evidence in favour of its specific distinctness; for, as far as I can ascertain, *C. cribraria* is not known from that region.

Conus clarus.

Testa abbreviato-turbinata, dilute rosacea, basim versus oblique sulcata; spira breviter conica, apice acuto, lateribus leviter concavis; anfractus 8–9, plani, declives, parum gradati, striis tenuibus circiter 7 spiraliter sculpti; anfr. ultimus superne ad angulum subacuto carinatus, infra carinam vix convexus, lateribus fere rectilinearibus; apertura angusta, pallide rosacea; labrum vix arcuatum, sinu superiore inconspicuo. Longit. 27 mill., lat. max. 14.

Hab. West Australia.

This species possesses no very striking features by which it may be recognized. The uniformity of its colour (a very pale pink, or white with a blush of pink), the sharpness and carination of the angle of the body-whorl, and the fine striation of the spire are the principal characters. Only a single specimen was received by Mr. G. B. Sowerby, from whom it was purchased for the Museum, together with the *Cypræa* just described, which is likewise unique at present.

The only species at all resembling *C. clarus* is *C. cyanostoma*, A. Adams. The figure of the latter (Sowerby's Thesaurus Conch. pl. cc. fig. 304) will serve as a guide to the form of this species, which, however, is a trifle narrower.

BIBLIOGRAPHICAL NOTICE.

The Formation of Vegetable Mould through the Action of Worms, with Observations on their Habits. By CHARLES DARWIN, LL.D., F.R.S. Sm. 8vo. London: Murray, 1881.

EARTHWORMS are probably not regarded with much interest by the public in general. For the most part they are looked upon as nuisances, from their exceedingly unpleasant habit of disfiguring the lawns and gravel-walks of our gardens with their unsightly castings; and the only people who hold them in any degree of esteem (and that manifested in a way that the worms themselves can hardly be expected to appreciate very highly) are the anglers, who occasionally use worms as bait, and then, no doubt, follow the advice of the old piscatorial writer and handle them as if they loved them, always barring the insertion of the hook, which it would be hard to interpret into a sign of affection. This feeling of indifference, perhaps verging upon contempt, has been abundantly reflected in what is by courtesy styled the "comic literature" of the day, since the appearance of the book of which the title stands at the head of this article. The jokers and *soi-disant* jokers who produce that marvellous flood of words with which we are familiar in the so-called comic journals found something exquisitely funny in the notion of a grave philosopher devoting his time to the observation of earthworms, and at once gave utterance to a series of more or less jocular remarks on the subject, most of which serve chiefly to prove (what, indeed, is tolerably evident from their efforts in other directions) that the writers in question have entirely mistaken their vocation in attempting to be funny.

We can quite believe that similar sentiments were entertained by most people when, some forty-four years ago, at a time when probably most of our readers had not begun to think very much, and certainly few of them had turned their thoughts to scientific subjects, the naturalist, who now above all others fulfils the requirements involved in that title, communicated to the Geological Society a short paper, in which he maintained that earthworms have played and are still playing a very important part in the economy of this world of ours.

We do not know how the Fellows of the Society received the novel views put forward by Mr. Darwin in this paper; but they printed it in their Transactions, and the question of the influence of worms on the cultivation both of fields and gardens was for some time a subject of discussion. Many, no doubt, like the Vicomte D'Archiac, regarded Mr. Darwin's earthworm-theory as a singular one; but we fancy that, on the whole, the conclusion arrived at was, that the action of worms upon the soil was beneficial (mechanically at all events) to cultivation, although comparatively little importance was assigned to it. Mr. Darwin, however, continued his observations, and supplemented them with numerous experiments, after the persevering fashion with which he has familiarized us in his many invaluable works; and he now publishes the results in a most interesting little volume, in which he fully vindicates the claims of his humble clients to be regarded as entities of considerable importance.

Mr. Darwin claims for earthworms the performance of two most important functions. He maintains that they are, to a great extent, the actual makers of what we are accustomed to call "vegetable mould," and, secondly, that they are great workers in, and transporters of, this mould when formed.

These animals are shown to contribute to the formation of the substance called vegetable mould in several ways. They feed chiefly on vegetable substances, which may be either already mixed with the existing mould, or dragged by them into their burrows for the purpose or, in the first instance, to stop the mouth of the hole, or to line the interior of the upper part of the burrow—a practice for the discovery of which we are indebted to Mr. Darwin. These vegetable materials are torn into minute shreds and swallowed by the worms, in addition to the soil which they take for the purpose of extracting nourishment from it; and the residue of this food, passing through their bodies and getting mixed with their intestinal secretions, goes to increase the stratum of mould. They further assist in the process of mould-formation by throwing up their castings over the dead leaves lying on the surface of the ground, which are thus brought at once into the layer of soil and protected from atmospheric action until they either become slowly decomposed or are converted into food for worms, in either case adding to the thickness of mould. And they add to the quantity of mineral matter in the soil by bringing up the finer particles of the subsoil, into which they burrow to some depth, and facilitating their mixture with the other materials. The reality of this influence is proved in a striking manner by an experiment made by Von Hensen and cited by Mr. Darwin from that gentleman's admirable article on the natural history of earthworms, published in Siebold and Kölliker's 'Zeitschrift' for 1877. "Von Hensen," he says, "placed two worms in a vessel 18 inches in diameter, which was filled with sand, on which fallen leaves were strewed; and these were soon dragged into their burrows to a depth of 3 inches. After about six weeks an almost uniform layer of sand, a centimetre (·4 inch) in thickness, was converted into humus by having passed through the alimentary canals of these two worms."

As workers of the soil, their influence seems to be of equal importance. As they are constantly swallowing the mould in which they live, and reducing the organic matter contained in it to the smallest possible particles, they effect a most intimate intermixture of all the parts, acting, as Mr. Darwin points out, "just in the same way as a gardener in preparing the finest soil for his choicest plants, bringing it into a state in which it is well fitted to retain moisture and to absorb all soluble substances, as well as for the process of nitrification." Their burrows, which frequently descend to a considerable depth, give access to air and water, and also, by yielding to pressure or to atmospheric agencies, facilitate small movements of the soil, changing the position of its component particles. The author says, "The plough is one of the most ancient and most valuable of man's inventions; but long before he existed the land was in fact regularly ploughed, and still continues to be ploughed, by earth-worms."

But the most striking action of worms in working the soil consists in the transport of great quantities of mould to the surface, where it can be exposed to the action of the air, spread over the surface by rains, and thus serve as new nourishment for growing plants. This is effected by the worms coming to the mouths of their burrows with their intestines full of mould, which is then discharged upon the surface in the well-known convoluted bodies known as worm-casts or castings. It was to this characteristic of the action of worms that Mr. Darwin's first observations related; and he showed by the gradual and uniform sinking of top-dressings of various kinds (lime, cinders, burnt marl, &c.) that it was a real factor in nature. Substances unfit for the food of worms, and too large for them to swallow, if lying on the surface of the soil are slowly but continuously involved in a layer of soil brought up from below them and discharged at the surface, while at the same time and by the same process they are to an equal extent undermined. The phenomenon, in fact, consists of a transfer of the substance of the more deeply-seated layers of mould to the surface; and as such objects as bones, stones, &c. must remain in contact with the surface on which they were originally deposited, they are compelled to sink with it beneath the fresh layers of earth brought up. To show the important effects thus produced upon the general face of the land, we may cite an example adduced by Mr. Darwin from his experience in one of his fields at Down. He says that a sloping part of this field "was last ploughed in 1841, was then harrowed, and left to become pasture-land. For several years it was clothed with an extremely scant vegetation, and was so thickly covered with small and large flints (some of them half as large as a child's head) that the field was always called by my sons 'the stony field.' When they ran down the slope the stones clattered together. I remember doubting whether I should live to see these larger flints covered with vegetable mould and turf. But the smaller stones disappeared before many years had elapsed, as did every one of the larger ones after a time; so that after thirty years (1871) a horse could gallop over the compact turf from one end of the field to the other and not strike a single stone with his shoes. . . . This was certainly the work of the worms; for, though castings were not frequent for several years, yet some were thrown up month after month, and these gradually increased in numbers as the pasture improved." A trench cut in 1871 showed a thickness of $\frac{1}{2}$ an inch of turf and $2\frac{1}{2}$ inches of vegetable mould, beneath which lay clayey earth full of flints like that in the neighbouring ploughed fields. The rate of formation of the mould in this case is certainly very slow, not more on the average than an inch in twelve years; but, slow as it is, it justifies the following remarks of Mr. Darwin:—"When we behold a wide turf-covered expanse, we should remember that its smoothness, on which so much of its beauty depends, is mainly due to all the inequalities having been slowly levelled by worms. It is a marvellous reflection that the whole of the superficial mould over any such expanse has passed, and will again pass, every few years through the bodies of worms." Large stones lying on the surface of grass-land become gradually imbedded, partly by the raising of the surface and partly by the undermining action of worms; and the same influences have been at work, as the author well shows, in the covering up with a layer of mould of the remains of ancient buildings.

The quantity of earth moved in this way is enormous, and such as to surprise those whose minds are not already familiar with the vast effects that are produced in nature by the long-continued working of minute agencies. By collecting, drying, and weighing the worm-casts over a given space of ground Mr. Darwin is enabled, at least approximately, to determine the quantity of soil brought to the surface by worms; and he finds that in many parts of England this amounts to about ten tons per acre annually. Two of his calculations, however, give a much larger amount, namely 16·1 and 18·12 tons per acre. These larger quantities, when corrected, would produce a layer of about $1\frac{1}{2}$ inch spread over the whole surface in ten years. This, of course, does not represent increase of thickness, but only the rate of transfer of the underlying mould to the surface.

This notice has extended to such a length that we must bring it somewhat abruptly to a close, merely remarking in conclusion that, besides their influence upon the formation of mould, Mr. Darwin ascribes to earthworms under certain conditions an important action in aid of the phenomena of denudation, as their castings, when present on the surface, will be peculiarly liable to be washed away by heavy rains, and even in dry weather they will break up into small pellets which may easily be transported by the wind. It is hardly necessary to say further that for the better exposition of the main subject of his book Mr. Darwin thoroughly describes the structure and habits of worms, and dwells especially upon their senses and mental qualities. His book is a most interesting and attractive one, and its teaching of the importance in nature of what are apparently the most contemptible of agents will furnish an excellent lesson to many besides the reading section of the general public.

MISCELLANEOUS.

Dutch Mollusca. By J. Gwyn Jeffreys, LL.D., F.R.S.

While passing a short time in Holland, immediately after sustaining the greatest calamity which can befall a man (the death of a long-loved wife), I spent a day at Scheveningen, a favourite sea-side resort near the Hague, and I made a note of the shells that had been thrown up on the sands. The season being over, I had the beach to myself. As I am not aware that any list of the Mollusca from the Dutch coast has been published since the work of Dr. Herklots, now nearly twenty years ago, I subjoin the names of those species which I noticed during my solitary ramble. Although all of these species are common in the North Sea, one of them at least (*Montacuta bidentata*) is not mentioned in the above work on the Mollusca of the Netherlands; and the list may be useful to give the modern nomenclature.

CONCHIFERA.

Ostrea edulis, *Linné.*
Pecten varius, *L.*
Mytilus edulis, *L.*
Montacuta bidentata, *Montagu.*
Cardium edule, *L.*
Tellina balthica, *L.* Larger than British specimens, and thrice the size of those from the Baltic.
—— tenuis, *Da Costa.*
—— fabula, *Gronovius.*
Donax vittatus, *Da Costa.*
Mactra solida, *L.*, and var. truncata.
—— subtruncata, *Da Costa.*
—— stultorum, *L.* Very large.
Lutraria elliptica, *Lamarck.*
Scrobicularia alba, *W. Wood.*
—— piperata, *Bellonius.*
Solen ensis, *L.*
—— siliqua, *L.*
Mya truncata, *L.*
Pholas candida, *L.*

GASTROPODA.

Trochus zizyphinus, *Linné.*
Littorina obtusata, *L.*
—— litorea, *L.*
Scalaria communis, *Lamarck.*
Natica catena, *Da Costa.*
—— Alderi, *Forbes.*
Buccinum undatum, *L.*
Nassa reticulata, *L.*

This list gives a total of twenty-seven species, viz. nineteen bivalves and eight univalves. All of them inhabit sand except the first-named three species of univalves, which inhabit rocky places.

In the great wood between the Hague and Scheveningen I observed a few land and freshwater shells, viz.:—*Zonites purus*, Alder; *Z. radiatulus*, Ald.; *Z. crystallinus*, Müller; *Z. fulvus*, Müll.; *Helix pulchella*, Müll., and var. *costata*; *Cochlicopa lubrica*, Müll., var. *lubricoïdes*; *Carychium minimum*, Müll.; and *Unio tumidus*, Philippson.

These lists could easily be quadrupled by examining the refuse from fishermen's boats and spending more time than I had to spare.

41 Seymour Street,
7 Nov., 1881.

An Abbreviated Metamorphosis in Alpheus heterochelis. By A. S. PACKARD, Jun.

This species and *Alpheus minus*, Say, are very abundant, living in the larger excurrent orifices of the large sponges which exist from the depth of one or two feet or more to deeper water, at Key West, Florida. *A. minus*, however, is far more abundant than the larger species. I found several of *A. heterochelis* with far advanced embryos in the winter of 1869–70, and on removing the embryonic zoëa from the egg, was interested to find that the larva was of a form much more advanced than in the zoëa of other Anomura described and figured by Fritz Müller in his suggestive work entitled "Facts for Darwin." Indeed the metamorphosis appears to be abbreviated; and the larva, on hatching, closely approximates the form of the adult, as in the case of the development of the lobster, the crayfish, and of *Palæmon adspersus* and *Eriphia spinifrons* (the three latter observed by Rathke). The eyes were developed on very short peduncles, being almost sessile. The embryo was near the time of hatching, though the yolk was not entirely absorbed. The two pairs of antennæ were well developed and hung down behind the large claws; the five pairs of legs were well developed, the joints distinct, and the first pair were about twice as thick as the others, the claws rather large, but not so disproportionately so as in the adult form, but as much so as in the larva in the second stage of the lobster, figured by Prof. Smith. The eyes were large, but nearly sessile. The abdomen was broad and flat, spatulate at the end much as in the adult; there were five pairs of abdominal feet or swimmerets, each with an endopodite and exopodite, like those seen in the second larval stage of the lobster.

It thus appears that *Alpheus heterochelis* hatches in a stage more advanced than the first larval stage of the lobster. Unfortunately the specimens, though carefully preserved for several years, finally got misplaced; so that it is not possible for us to give a more detailed description of the young at the time of birth.—*Amer. Nat.*, Oct. 1881.

Observations on the Rotifera of the Genus Melicerta. By M. Joliet.

The observations here summarized were made upon two species of *Melicerta*, namely *Melicerta ringens* and an allied species distinguished by the presence of a long thread that fixes it in its sheath. With the exception of a few details, all that applies to the one applies to the other.

Nervous System.—Several authors, following Huxley, have stated that the ganglion of the Melicertina is situated near the mouth, and consequently at the surface of the body opposite to the anus. This would be the reverse of what exists in all Rotatoria. In reality, what these observers have taken for the ganglion is a gland, both in its structure and in its situation and functions. The true nervous centre is on the opposite side, on the dorsal surface of the pharynx. It consists of a group of large cells of very characteristic form, and furnished with a voluminous nucleus. Several similar cells are arranged by the side of the former, and extend in different directions. This centre a good deal resembles that described by Leydig in the genus *Lacinularia*. It is not voluminous; and I think that the comparatively enormous ganglia that have been described in several Rotatoria are glands, and that the true nervous centre is still to be sought.

In any case, we see that the anomaly created for the Melicertina must disappear, and that, as in all the Rotatoria, the central nervous system occurs in these animals on the anal or dorsal side, and consequently in the curvature of the digestive tube.

Reproduction.—During the whole summer we find three kinds of ova in the tubes inhabited by the *Melicertæ*, namely:—male summer-eggs, which are the smallest, and have not previously been indicated; female summer-eggs, of larger size; and, lastly, winter-eggs, which are still larger, and exceedingly opaque at the moment of deposition, and which afterwards become encysted in an ornamented chitinous membrane within the first chorion. These different ova are not produced by all the females indiscriminately, but each one has, so to speak, its specialty.

Formation of the Ovum.—It is to be remarked that in the ovary of the Rotatoria all the ova are of uniform aspect, and appear to be equally advanced, with the exception of a single one, which, being detached from the ovary and placed in that portion of the enveloping membrane that may be called the *sac of maturation*, is always strongly granular, and increases in size with such rapidity, that in less than twenty-four hours it attains a volume more than fifty times that which it had retained for some weeks in the ovary. This result and these appearances are explained by the fact that the stroma of the genital gland constantly secretes a great quantity of granules of deutoplasm. These granules the freed ovum agglutinates rapidly, and mixes with its own vitelline substance. In certain *Floscularicæ*, in which the sac of maturation does not exist, and in which the ovum, when detached from the ovary, falls into the general cavity, we see these granules circulate and spread everywhere in the body, even into the limb and the peduncle, and then unite with the ovum, which increases in size rapidly. I cannot help seeing in these facts a sort of sketch of what takes place in many Turbellaria and in the Trematoda, in which a supplementary vitellus furnished by special glands (vitellogene) is added to the ovum (germinal vesicle of Van Beneden) as it issues from the ovary (germigene).

Winter-Egg.—There has been much discussion as to the nature of the winter-egg. Huxley regards it, not as a true ovum, but as a portion of the ovary separated from the rest, a sort of compound of several ova. He does not suppose that these eggs undergo segmentation after deposition. I am in a position to assert that the winter-eggs are formed in the *Melicertæ* exactly like the summer-eggs, and that they are segmented after deposition absolutely like the latter. What may have deceived that eminent observer is, that the vitelline granules of the winter-eggs, being exceedingly opaque, render the stroma of the ovary which secretes them very dark.

The first phases of the segmentation of the winter-egg are identical with those of the summer-egg. It is difficult to follow the transformations in all their details, in consequence of the extreme opacity; but the general course is exactly the same. As the development progresses the ovum becomes less dark-coloured, until it finally acquires a lemon-colour, which it retains throughout the winter. It is then covered by an inner shell, ornamented and formed of parchment cells. At the end of the winter this latter shell generally alone remains; and towards the month of March or April there issues from it a small but perfectly formed *Melicerta*, which does not pass through the phase of ciliated and swimming larva, like that born from the summer-egg.

Male Summer-Egg.—The development of the male egg is similar to that of the female summer-egg, at least up the closure of the blastopore. The creature that issues from it is about half the size of the female larva. It resembles the latter in general form, but differs in the complete absence of the digestive tube, and in the presence of an organ which, from the analogy of the male of *Lacinularia*, I regard as a sperm-sac, although I have been unable to detect in it any spermatozoids, but at the utmost some mother cells. This may be because I have always observed the male soon after exclusion. I have therefore no observation upon its function. It is rare, and dies soon; I have never found it in any tube of the female. Does it fertilize all the females, or only those with winter-eggs? Does it fertilize some of them, as is the case with certain species of insects? or is the reproduction wholly parthenogenetic? I cannot decide this. At any rate, I have never observed in any female any thing resembling a spermatozoid. The ovum, from the time of its passing into the sac of maturation, becomes clothed with a thick chorion; it always begins segmentation immediately after deposition, and apparently under the influence of water; for an ovum ready for deposition which remains in a dead female is not segmented, but becomes destroyed—that is to say, unless the chitinous envelope of the mother is torn so as to allow the water to enter, in which case the ovum soon begins its development.—*Comptes Rendus*, November 7, 1881, p. 748.

Addendum to our Knowledge of the Carnosa. By H. J. Carter, F.R.S. &c.

In the number of the 'Annals' for October last I gave a tabular view of the Carnosa (pp. 252, 253), omitting *Lacinia stellifica*, Salenka (p. 249) and *Cellulophana pileata*, Schmidt (p. 258), because I could not satisfy myself that they not only were not Carnosa, but not sponges at all.

Since then my attention has been called to Dr. F. E. Schultze's observations on his family "Chondrosidæ" (Zeitschrift f. wiss. Zoologie, Bd. xxix. 1877), wherein, at pp. 35 and 37 respectively, my doubts regarding the spongeous nature of these organisms are confirmed, inasmuch as Dr. Schultze therein affirms that he has satisfied himself, through actual examination, that both *Lacinia stellifica* and *Cellulophana pileata* are compound Ascidians.

I am not sorry that these recorded facts had slipped my memory at the time the "Contribution" to which I have alluded was compiled, because the observations therein made lead independently to the decisions of an unquestionable authority.

On the Circulatory System of Spatangus purpureus.
By M. R. Kœhler.

The buccal aperture of *Spatangus purpureus* is surrounded by two vascular rings—an outer one, belonging to the blood-vascular system, and an inner one, belonging to the ambulacral system. The same arrangement recurs in the ambulacra.

Hoffmann's branch of communication, which connects the intestinal vessel with the only peribuccal ring described by that author, really divides at the level of the mouth into two branches, one of which opens into the sanguiferous ring, and the other into the ambulacral ring.

In the same way the sand-canal is double in that part of it included between the opening of the mouth and the extremity of the œsophagus; it is formed of two canals placed close together, each of which opens into the corresponding peribuccal ring. At the level of the extremity of the œsophagus (first curvature) these two canals unite in one, which continues simple as far as the point where the second convolution of the digestive tube joins the third. Beyond this region it becomes partitioned off again into several secondary cavities, four or five in number, at the moment of its arrival at the organ commonly called the heart, in which it loses itself. It becomes reconstructed after having traversed this organ, and reaches the madreporic plate in the form of a slender canal of peculiar structure.

The supposed heart is a spongy organ, the interstices of which become completely filled when the sand-canal is injected. It is composed of connective tissue supporting numerous nuclei and elements like those of the blood and of the general cavity. Are we to regard this organ as a sort of blood-vascular gland? or simply as an organ of secretion? The so-called membrane which surrounds the extremity of the sand-canal and unites it with the madreporic plate also appears rather to be a gland in connexion with that canal. It presents a structure analogous to that of the heart.

The digestive tube receives the blood from the inner and outer marginal vessels. It only possesses vessels in the region included between the first orifice of the siphon and the origin of the third convolution; the œsophagus, the third convolution, and the rectum do not receive a single one. Moreover, where the vessels exist, their distribution is far from being so regular as figured by Hoffmann. The ventral surface of the second convolution receives no vessel, except in the neighbourhood of the orifice of the diverticulum and on each side of that organ; it is the dorsal surface that receives the greater part of the vessels. The intestinal vessel of Hoffmann, which, according to him, furnishes vessels to the stomach, the third convolution, and the rectum, really dies out a little beyond the origin of the branch of communication without reaching the stomach, the vessels of which present the following arrangement:—The two marginal vessels of the second convolution form a very close plexus around the orifice of the diverticulum; and from this originate two other vessels, which are continued on each side of the stomach as far as the siphon, and are united here and there by transverse anastomoses, on both the dorsal and ventral surfaces. Moreover the vessel which skirts the right border of the stomach * furnishes several small vessels which ramify over the mesenteric lamella extending from the diverticulum to the digestive tube. All these vessels afterwards unite in one trunk, which follows the diverticulum to the heart, between the sand-canal and the marginal vessel of the diverticulum, giving off to the right and left transverse branches, which place it in communication at once with the sand-canal and this marginal vessel.—*Comptes Rendus,* October 24, 1881, p. 651.

Jurassic Birds and their Allies. By Prof. O. C. MARSH†.

About twenty years ago, two fossil animals of great interest were found in the lithographic slates of Bavaria. One was the skeleton of *Archæopteryx*, now in the British Museum; and the other was the *Compsognathus* preserved in the Royal Museum at Munich. A single feather, to which the name *Archæopteryx* was first applied by Von Meyer, had previously been discovered at the same locality. More recently, another skeleton has been brought to light in the same beds, and is now in the Museum of Berlin. These three specimens of *Archæopteryx* are the only remains of this genus known, while of *Compsognathus* the original skeleton is, up to the present time, the only representative.

When these two animals were first discovered, they were both considered to be reptiles by Wagner, who described *Compsognathus*; and this view has been held by various authors down to the present time. The best authorities, however, now agree with Owen that *Archæopteryx* is a bird, and that *Compsognathus*, as Gegenbaur and Huxley have shown, is a Dinosaurian reptile.

Having been engaged for several years in the investigation of American Mesozoic birds, it became important for me to study the European forms; and I have recently examined with some care the three known specimens of *Archæopteryx*. I have also studied in the continental museums various fossil reptiles, including *Compsognathus*, which promised to throw light on the early forms of birds.

During my investigation of *Archæopteryx*, I observed several characters of importance not previously determined; and I have thought it might be appropriate to present them here. The more important of these characters are as follows:—

1. The presence of true teeth, in position, in the skull.
2. Vertebræ biconcave.
3. A well-ossified, broad sternum.
4. Three digits only in the manus, all with claws.
5. Pelvic bones separate.
6. The distal end of fibula in front of tibia.

* The animal supposed to be placed on the ventral surface.

† Read before Section D, British Association for the Advancement of Science, at York, Sept. 2, 1881.

7. Metatarsals separate or imperfectly united.

These characters, taken in connexion with the free metacarpals and long tails, previously described, show clearly that we have in *Archæopteryx* a most remarkable form, which, if a bird (as I believe), is certainly the most reptilian of birds.

If now we examine these various characters in detail, their importance will be apparent.

The teeth actually in position in the skull appear to be in the premaxillary, as they are below or in front of the nasal aperture. The form of the teeth, both crown and root, is very similar to that of the teeth of *Hesperornis*. The fact that some teeth are scattered about near the jaw would suggest that they were implanted in a groove. No teeth are known from the lower jaw; but they were probably present.

The presacral vertebræ are all, or nearly all, biconcave, resembling those of *Ichthyornis* in general form, but without the large lateral foramina. There appear to be twenty-one presacral vertebræ, and the same, or nearly the same, number of caudals. The sacral vertebræ are fewer in number than in any known bird, those united together not exceeding five, and probably less.

The scapular arch strongly resembles that of modern birds. The articulation of the scapula and coracoid, and of the latter with the sternum, is characteristic; and the furcula is distinctly avian. The sternum is a single broad plate, well ossified. It probably supported a keel; but this is not exposed in the known specimens.

In the wing itself the main interest centres in the manus and its free metacarpals. In form and position these three bones are just what may be seen in some young birds of today. This is an important point, as it has been claimed that the hand of *Archæopteryx* is not at all avian, but reptilian. The bones of the reptile are indeed there; but they have already received the stamp of the bird.

One of the most interesting points determined during my investigation of *Archæopteryx* was the separate condition of the pelvic bones. In all other known adult birds, recent and extinct, the three pelvic elements, ilium, ischium, and pubis, are firmly ankylosed. In young birds these bones are separate; and in all known Dinosaurian reptiles they are also distinct. This point may perhaps be made clearer by referring to the two diagrams before you, which I owe to the kindness of my friend Dr. Woodward, of the British Museum, who also gave me excellent facilities for examining the *Archæopteryx* under his care. In the first diagram we have represented the pelvis of an American Jurassic Dinosaur allied to *Iguanodon*; and here the pelvic bones are distinct. The second diagram is an enlarged view of the pelvis of the *Archæopteryx* in the British Museum; and here too the ilium is seen separate from the ischium and pubis.

In birds the fibula is usually incomplete below; but it may be coossified with the side of the tibia. In the typical Dinosaurs (*Iguanodon*, for example) the fibula at its distal end stands in front of the tibia; and this is exactly its position in *Archæopteryx*, an interesting point not before seen in birds.

The metatarsal bones of *Archæopteryx* show, on the outer face at least, deep grooves between the three elements, which imply that the latter are distinct, or unite late together. The free metacarpal and separate pelvic bones would also suggest distinct metatarsals, although they naturally would be placed closely together, so as to appear connate.

Among other points of interest in *Archæopteryx* may be mentioned the brain-cast, which shows that the brain, although comparatively small, was like that of a bird, and not that of a Dinosaurian reptile. It resembles in form the brain-cast of *Laopteryx*, an American Jurassic bird, which I have recently described. The brain in both these birds appears to have been of a somewhat higher grade than that of *Hesperornis*; but this may have been due to the fact that the latter was an aquatic form, while the Jurassic species were land birds.

As the Dinosauria are now generally considered the nearest allies to birds, it was interesting to find in those investigated many points of resemblance to the latter class. *Compsognathus*, for example, shows in its extremities a striking similarity to *Archæopteryx*. The three-clawed digits of the manus correspond closely with those of that genus, although the bones are of different proportions. The hind feet also have essentially the same structure in both. The vertebræ, however, and the pelvic bones of *Compsognathus* differ materially from those of *Archæopteryx*; and the two forms are in reality widely separated. While examining the *Compsognathus* skeleton, I detected in the abdominal cavity the remains of a small reptile which had not been previously observed. The size and position of this enclosed skeleton would imply that it was a fœtus; but it may possibly have been the young of the same species, or an allied form that had been swallowed. No similar instance is known among the Dinosaurs.

A point of resemblance of some importance between birds and Dinosaurs is the clavicle. All birds have those bones; but they have been considered wanting in Dinosaurs. Two specimens of *Iguanodon* in the British Museum, however, show that these elements of the pectoral arch are present in that genus. Some other Dinosauria possess clavicles; but in several families of this subclass, as I regard it, they appear to be wanting.

The nearest approach to birds now known would seem to be in the very small Dinosaurs from the American Jurassic. In some of these the separate bones of the skeleton cannot be distinguished with certainty from those of Jurassic birds, if the skull is wanting; and even in this part the resemblance is striking. Some of these diminutive Dinosaurs were perhaps arboreal in habit; and the difference between them and the birds that lived with them may have been at first mainly one of feathers, as I have shown in my memoir on the Odontornithes, published during the past year.

It is an interesting fact that all the Jurassic birds known, both from Europe and America, are land birds, while all from the Cretaceous are aquatic forms. The four oldest known birds, moreover, differ more widely from each other than do any two recent birds. These facts show that we may hope for most important discoveries in the future, especially from the Triassic, which has as yet furnished no authentic trace of birds. For the primitive forms of this class we must evidently look to the Palæozoic.—*Amer. Journ. Science,* Nov. 1881, pp. 337–340.

Contributions to the Natural History of the Compound Ascidia of the Bay of Naples. By Dr. A. Della Valle.

The author in the first place carefully describes his genus *Distaplia*. In this genus the colony is pedunculate or sessile; the individuals, arranged in branched cœnobia, have the form of Didemnidæ with an ectodermic process. The branchial sac is furnished with four series of fissures; the stomach has smooth walls; the heart is placed at the level of the intestinal loop; the sexual glands are situated on the right side and rather above the heart. The testis is developed before the ovary, and in all the individuals of the colony at the same time, so that the colonies are always formed entirely of male or of female individuals. The mature ova are collected in the cloaca, whence they fall into a peculiar diverticulum, which is developed for this purpose and afterwards separates from the animal. The larvæ are gigantic, and already produce buds. The formation of a new bud commences by eversion of the parietal lamella of the peritoneal sac at a short distance from the end of the endostyle. The bud very soon separates from the maternal individual, and migrates towards the peripheral parts, dividing by scission, and thus giving origin to new individuals, which increase the colony.

In connexion with the structure of the tail of this large larva the author gives an account of the observations of other writers on the axial cord which is seen in the tail of these larvæ, and shows, by means of transverse sections, that this cord, considered by Kowalevsky, Kupffer, &c. to be formed of solid gelatinous material, is, instead, merely a cylindrical canal full of a transparent and colourless liquid, which is perhaps the same liquid that bathes the surrounding cellular elements.

The author then proceeds to the exposition of his anatomical researches. He has observed that in the living ectoderm amœboid cells move about in the common mantle, thus confirming a previous observation of Hertwig's. He describes very carefully the general structure of an ascidiozooid, which he finds to be formed of an internal endodermic sac and of a bilobed peritoneal sac, interposed between the two primary sacs. The peritoneal sac communicates on the one hand with the endoderm by means of the branchial fissures, and on the other with the exterior by the cloacal siphon. The muscular fibres are situated between the parietal lamella of the peritoneum and the ectoderm. The heart and the sexual glands are similarly situated; and the products of the latter are poured directly into the body-cavity. The existence of a mesentery and the mode of development of the buds and of the embryo in the ovum demonstrate very clearly the Enterocœlous type of the Ascidia. The author confirms the opinion that the endostyle is a gland, and states that the circulation of the blood takes place exclusively by lacunæ.

The reproductive apparatus of the Ascidia was almost entirely unknown. The author has paid particular attention to it, and has obtained truly important results from his careful observations. Particularly noteworthy are the formation of a special oviduct in the Botryllidæ analogous to that of the Salpæ, and the peculiar form of the testis in the Aplidia, which induced Milne-Edwards and Giard to regard the postabdomen of those animals as a true ovary. He also gives a very exact description of the structure of the postabdomen, in which are recognized all the elements of the fundamental lamellæ of the animal, namely ectoderm, endoderm, and peritoneal sacs.

In a young Botryllid the author has seen the nervous ganglion in direct continuity with the prolongation of the vibratile fossa. The muscular system is composed of smooth fibres situated beneath the ectoderm, between this and the parietal lamella of the peritoneum.

Finally, the author confirms the discovery of Metschnikoff of the origin of the buds of the Botryllidæ from the parietal lamella to the right and left, and describes minutely their various stages, and especially the formation of the enterocele. In connexion with this he refers to the memoir of Kowalevsky upon the development of the simple Ascidia, and demonstrates that in these also the peritoneal sacs are not developed from the ectoderm, as maintained by the Russian naturalist, but are rather derived directly from the intestine. Hence he draws the final conclusion that the Ascidia certainly belong to the Enterocœlous type.—*Atti R. Accad. dei Lincei, Transunti*, vol. vi., 1881, p. 14.

On the Vitality of the Germs of Artemia salina *and* Blepharisma lateritia. By M. A. Certes.

After inundations or heavy rains the sudden appearance of certain lower Crustaceans (*Apus*, *Branchipus*) has frequently been noticed; and it has been justly concluded that the ova of these Crustaceans had the property of remaining uninjured under very different conditions of medium. An experiment that I have recently made upon *Artemia salina* leaves no doubt upon this point, and proves that the alternations of desiccation and moisture to which the ova of this Crustacean are subjected may be prolonged with impunity during several years.

In March 1878 I collected salt water from the Chott Timrit, near Boutinelli (Province of Constantine, Algeria). A rapid examination (all that was possible at the moment) enabled me to ascertain the existence of Algæ, Infusoria, and even larvæ of which I could not then determine the species. I evaporated the water in the sun, and carefully collected the sediments, with the view of making experiments in revivification, which it seemed to me would be of more validity in the case of water having a quite peculiar chemical composition, than with fresh or simply brackish water.

On the 9th of April, 1881 (that is to say, after more than three years of complete desiccation), these sediments were placed in boiled and filtered rain-water, which quickly became strongly saline. The next day, although every precaution had been taken to protect this infusion from germs, I ascertained the presence in it of Flagellata, and soon afterwards of ciliated Infusoria, which, I must say, from the species recognized, did not give any special character to the fauna. It was only at the beginning of June that I perceived the presence of Nauplian larvæ, which were at first microscopic. The number of these larvæ has since greatly increased. They grew larger, and became transformed into a little animal about 0·01 metre in length, provided with a tail, and moving very actively by means of its branchial feet. I still (October 31) possess many living specimens.

M. Vayssière, who has kindly determined the species of these animals, recognized them as *Artemia salina*. As long since as 1875 Schmankevitsch indicated the curious modifications undergone by the organization of this little Crustacean according to the degree of saltness of the water in which it lives. For my part, even before I had ascertained the species with which I had to do, I had transferred a certain number of *Artemiæ* into sea-water; and they are still living in it. Up to the present time I have not observed any modification except their extreme transparency, due, no doubt, to a change of food.

According to Claus the existence of *Artemia salina* has already been ascertained in the salt-marshes in the neighbourhood of Montpellier, Cagliari, Lymington, and in the Crimea. M. Vayssière has found it near Marseilles. It had not previously been noticed in the Chotts of Algeria, where the periods of desiccation are certainly hotter, of longer duration, and more frequent than in the localities just mentioned.

Whether we have to do with germs, eggs, or animals said to be reviviscent, the phenomena of latent life are fundamentally the same. In the different cases death is only apparent. The phenomena of organic combustion and the nutritive exchanges never cease completely in the living creature, egg, seed, or animal. I therefore do not wander much from my subject in recording another fact which I had the opportunity of observing in Algeria in *Blepharisma lateritia*, a rather rare ciliated Infusorian.

The Sahel of Algeria is commanded by a small mountain, the Bouzaréah, on the summit of which exist the ditches of an ancient Turkish fort. In 1877 the drought was exceptional, even in the Sahel. As soon as the first rains came I ascended to the Bouzaréah; and in the same ditch where I had collected them eight months before I found abundant specimens of *Blepharisma*, very distinctly characterized by their form and their rose-colour. Here again, and during a torrid heat, there had been life latent for several months, whether of animalcules, or of their germs, or of their cysts. —*Comptes Rendus*, November 7, 1881, p. 750.

The Tertiary Lake-basin of Florissant, Colorado.
By S. H. Scudder*.

Mr. Scudder describes in this paper the position, characters, palæontology, and age of the remarkable lacustrine deposits of Florissant, Colorado, and illustrates the subject with a map. His observations in the region were made in 1877, along with Mr. A. Lakes, whose geological notes are incorporated, and also Mr. F. C. Bowditch. The lake-basin, nearly nine miles long, according to the map, occupies a low depression among the mountains at the southern extremity of the Front Range of Colorado, "at no great distance from Pike's Peak," and sends its arms up the valleys on either side. The beds are whitish, drab, and brownish shales below, with fine and coarse sandstone above; and, besides, trachyte occurs in the adjoining promontories and along the margin of the basin. The material of the coarser beds directly above the shales, from a locality visited by Mr. Scudder (south of the house of Mr. A. Hill), according to microscopic investigations by Mr. M. E. Wadsworth, is tufaceous; and the shales are "simply the finer material of the tufas laid down in laminæ of various thickness and coarseness." The shales at this place are about 22¼ feet thick. The fossils from the Florissant shales include:—of Hymenopterous insects, several species of Apidæ and Andrenidæ, about 30 of Vespidæ or wasp-like Hymenoptera, 50 species or more of ants (mostly Formicidæ, with some Myrmicidæ and Poneridæ) represented by about 4000 specimens, about 80 species of Ichneumonidæ, over 100 other species of Hymenopters; of Lepidopters perhaps a dozen species; of Dipters, some thousands of specimens and a large number of species, among them 1000 specimens of Bibionidæ, and "a vast host of Muscidæ and allied kinds;" of Coleopters, over 300 species of the normal series, and about 120 of the Rhynchophorous section; of Hemipters, more than 100 species of the Heteroptera and 65 of Homoptera; of Orthopters, many species; of Neuropters, largely the Phryganidæ, of which there are 15 or 20 species, 6 species of the Termites family, and others; of spiders, 30 species, all Araneæ; one Myriopod, an *Iulus*; of mollusks, only one species, that a *Planorbis*; of fishes, 8 species, all described by Cope, except one by Osborn, Scott, and Speir; of birds, several feathers, a single tolerably perfect Passerine bird, described by J. A. Allen, under the name *Palæospiza bella*, and a plover, *Charedinus Sheppardianus*, described by Cope.

* Pp. 279–300 of the Bulletin, vol. vi. no. 2, of the U.S. Geol. and Geogr. Survey, under Dr. F. V. Hayden (Dept. of the Interior).

The fossil plants include large silicified trunks of trees, probably Sequoias, and many species, 90 to 100 in all, about 40 of which have already been described by Lesquereux, besides some flowers with long stamens. The assemblage of plants indicates, according to Lesquereux, a climate like that of the northern shores of the Gulf of Mexico; of fishes, according to Cope, of latitude 35°; of insects, according to Scudder, a still warmer climate.

The age of the deposits is referred by the most recent and best authorities to the later Eocene or early Miocene.

The insects are soon to be described by Mr. Scudder in a quarto volume and illustrated by a large number of plates.—*Amer. Journ. Sci.* Nov. 1881, p. 409.

On the Nature of Cyathophycus. By C. D. Walcott.

This genus was originally described by me under the impression that the form was an alga of a peculiar appearance *. On reading the observations of Prof. R. P. Whitfield on the nature of *Dictyophyton* and its affinities to certain sponges †, it was instantly suggested that *Cyathophycus* was probably a member of the same group. A special effort was made to obtain perfectly preserved specimens of the genus, and with such success that the reticulate structure mentioned in the original description was found to be formed of a horizontal and perpendicular series of narrow bands crossing each other at right angles so as to form a network with rectangular interspaces, the narrow bands being formed of thread-like spicula resting on, or one against the other. The spicula differ in size; some are filiform, while others are stronger and more prominent; and all appear to be replaced by pyrite, as in the Devonian specimens studied by Principal Dawson and Professor Whitfield. Through the kindness of Professor Whitfield I have had the opportunity of examining the specimens referred to by him, and now have little doubt that the Utica slate form belongs to the same class, although probably differing generically from the Devonian species, and is an earlier representative of this interesting group of sponges.

Cyathophycus reticulatus presents a beautiful appearance when a large number of specimens are flattened out on a slab of the dark slate. Each individual lies free from its associates; and the striking resemblance to *Euplectella* is seen at a glance, although the convex summit of the latter genus is absent, and the margin curves over and downward on the inside to a considerable distance at least; how far is yet unknown. The cylindrical forms vary in length from 10 to 350 millim., and the spheroidal species, *C. subsphæricus,* from 3 to 60 millim. in diameter, each species preserving the rounded rim of the circular aperture at the summit.—*Amer. Journ. Sci.* Nov. 1881, p. 394.

* Trans. Albany Institute, vol. x. 1879.

† Amer. Journ. Science, xxii. July & Aug. 1881; and pp. 167, 237 of the present volume of the 'Annals.'

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END OF THE EIGHTH VOLUME.

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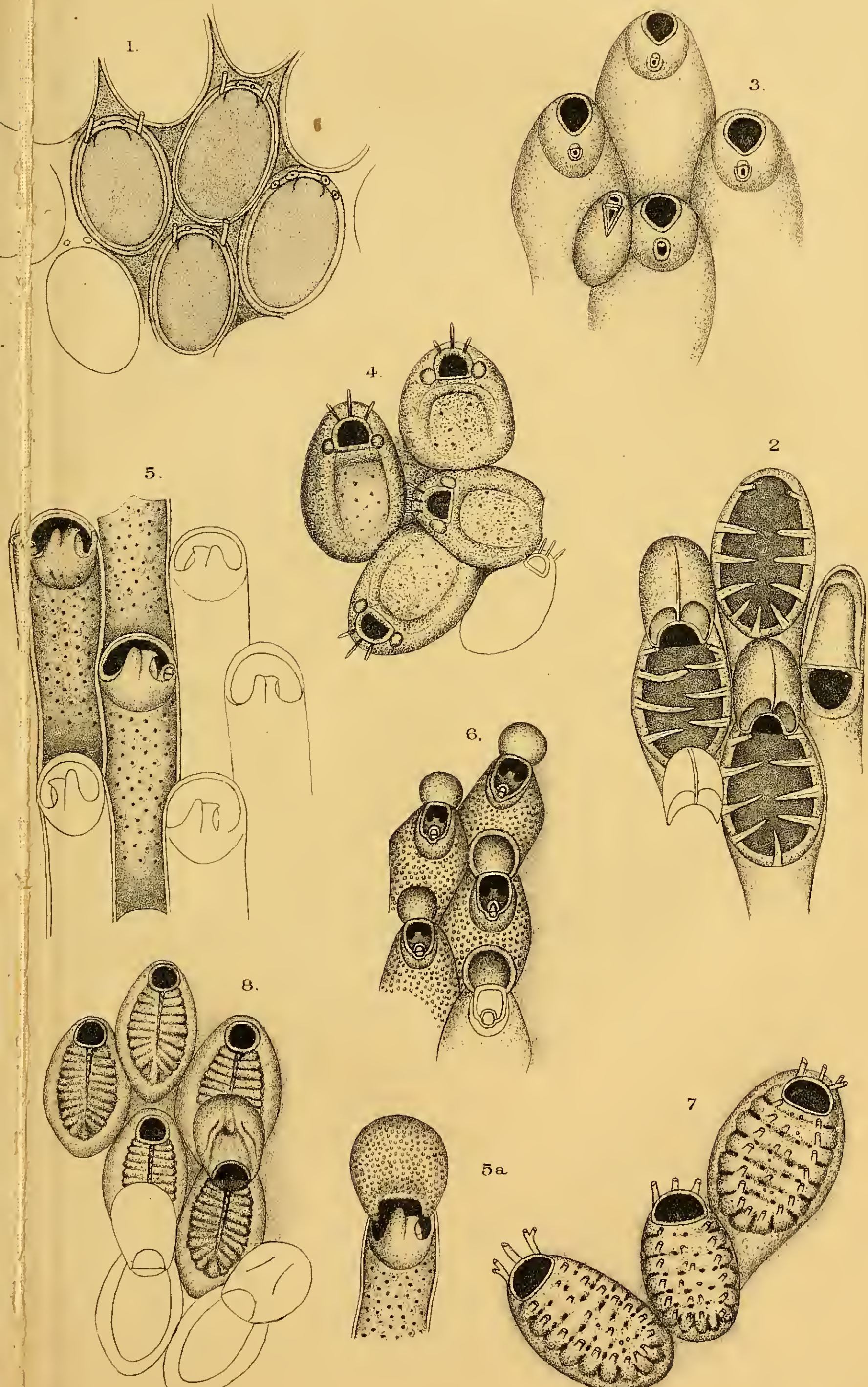

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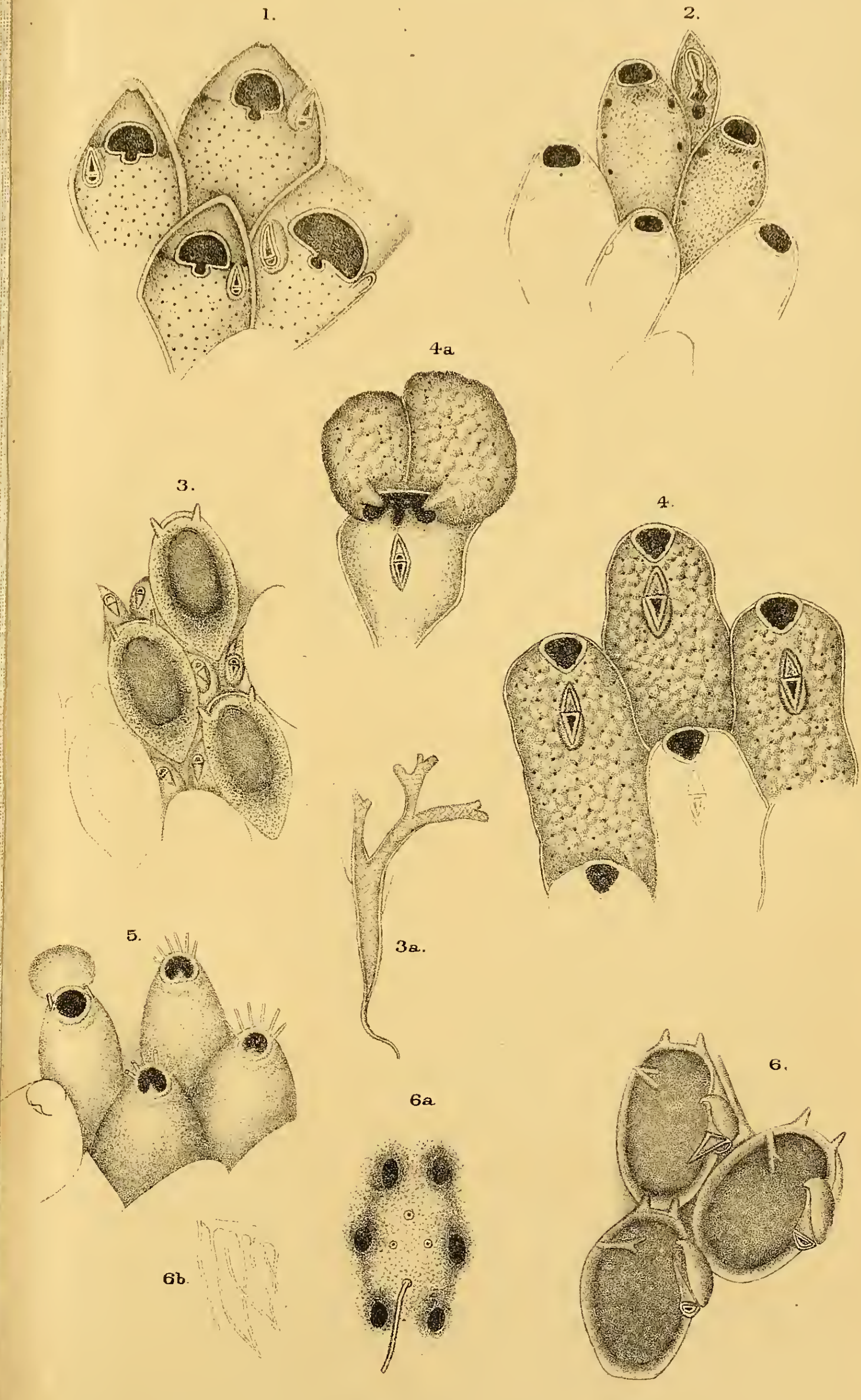

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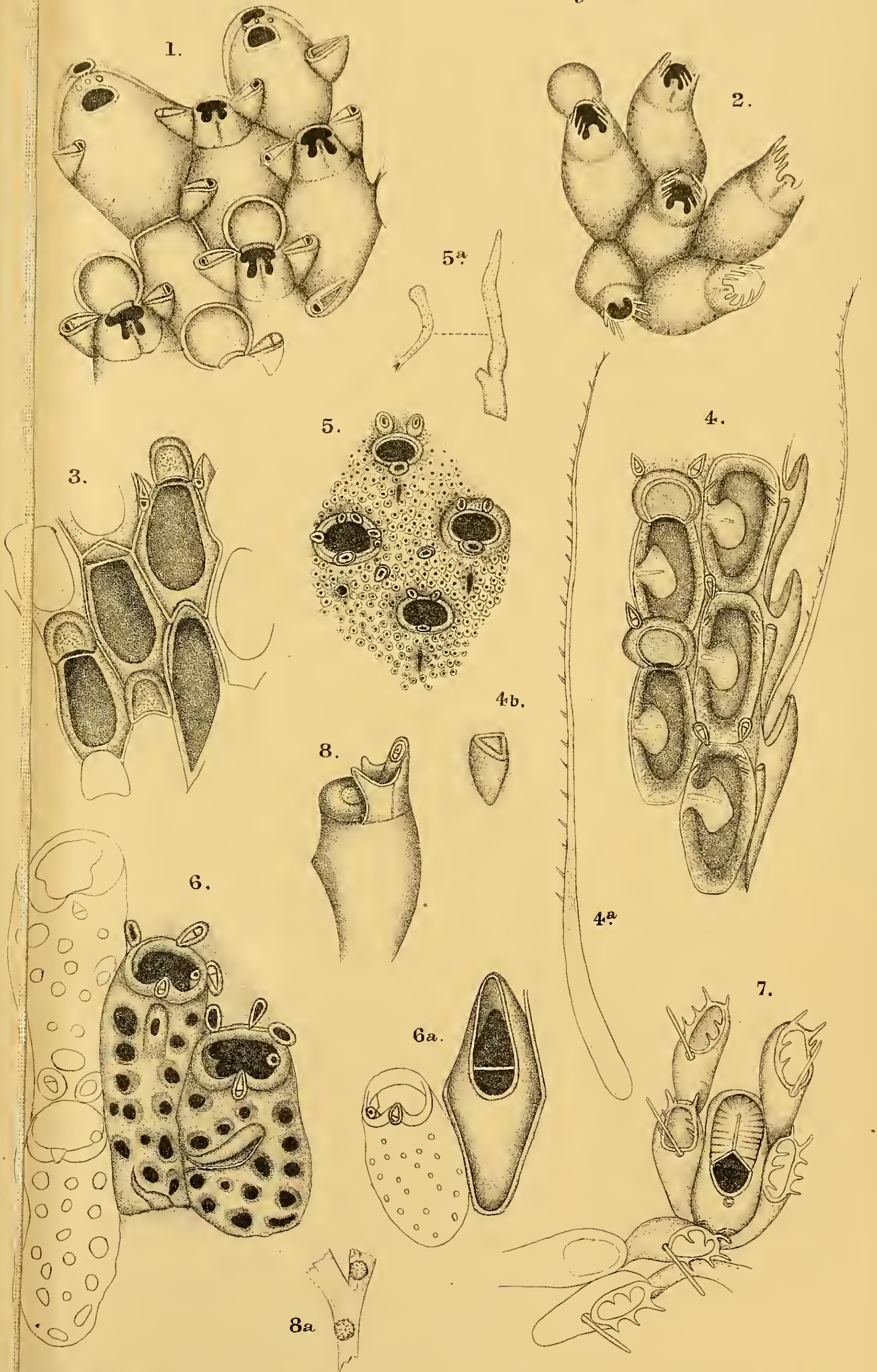

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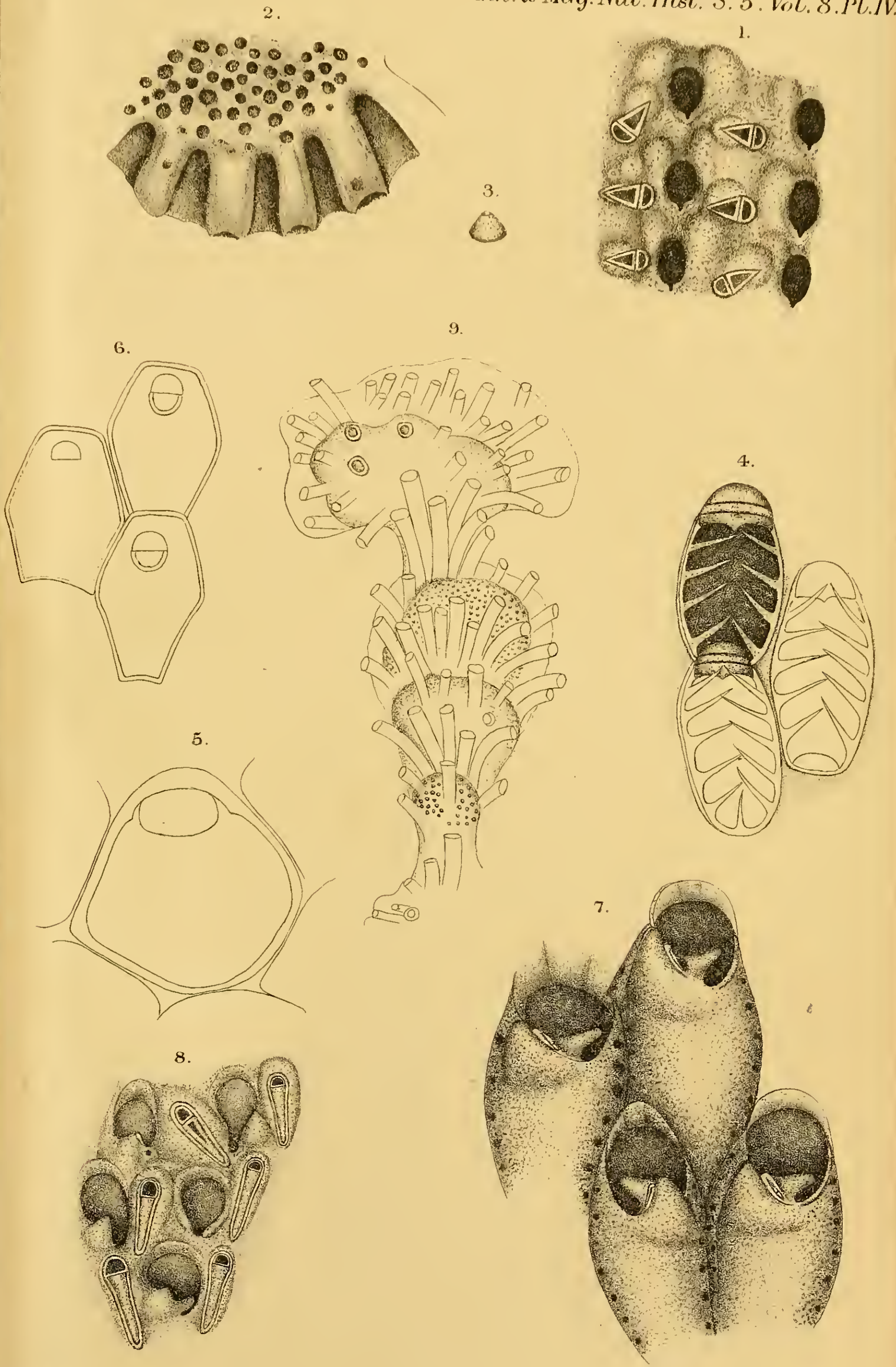

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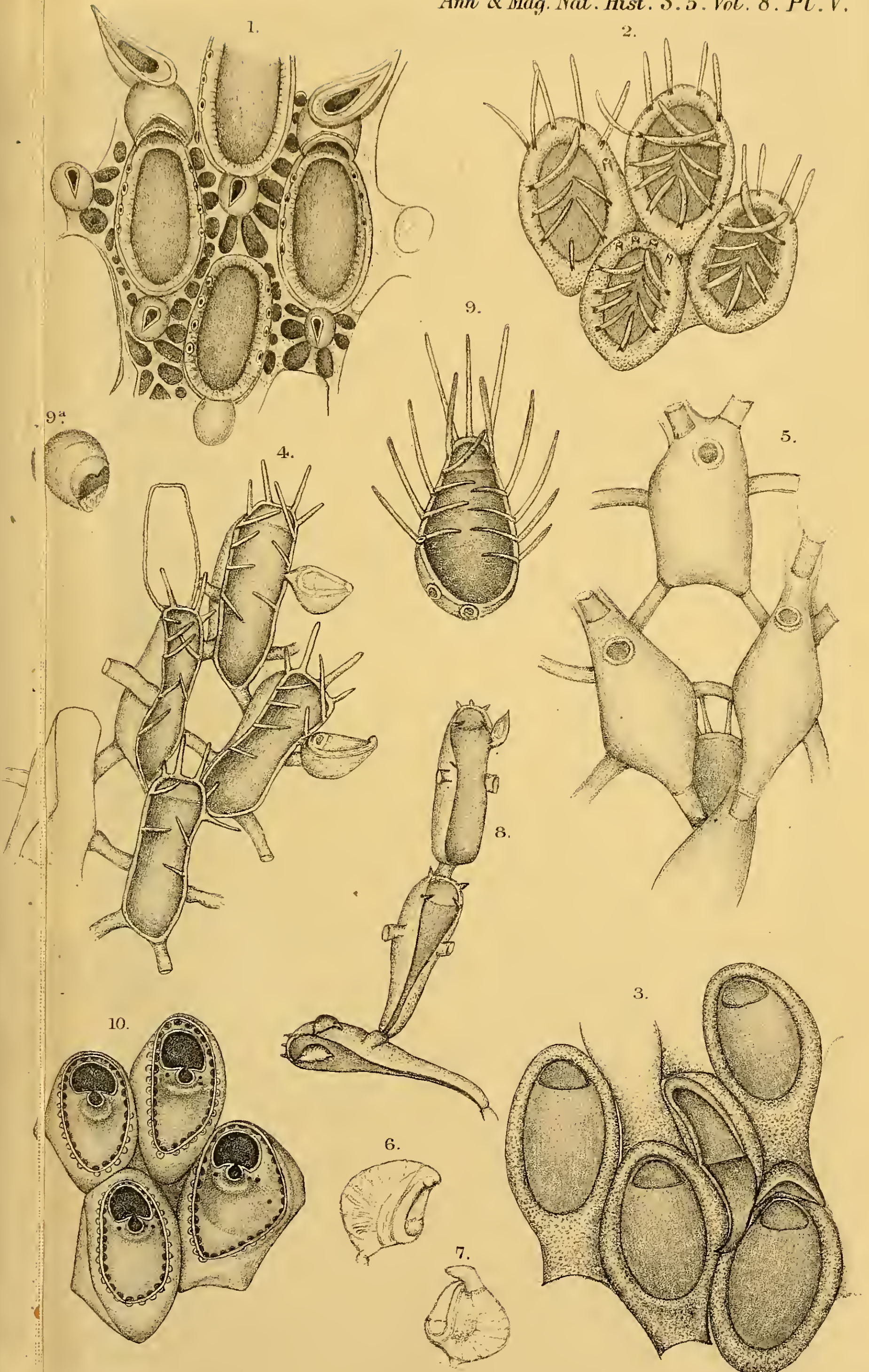

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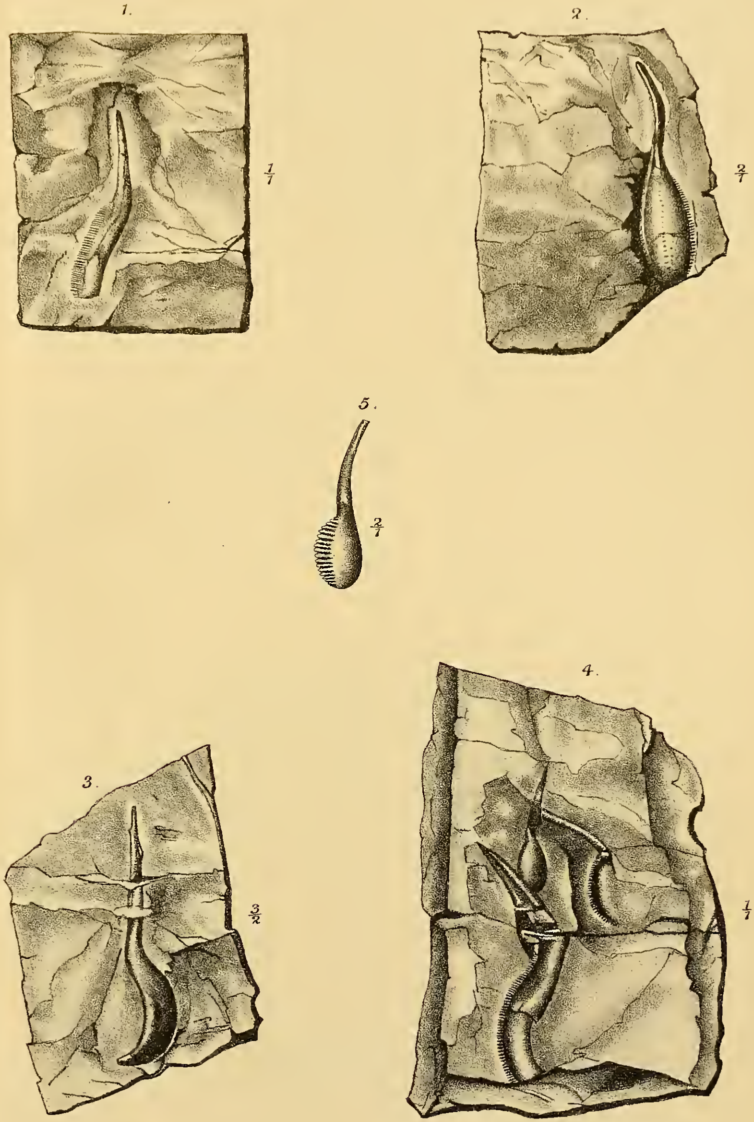

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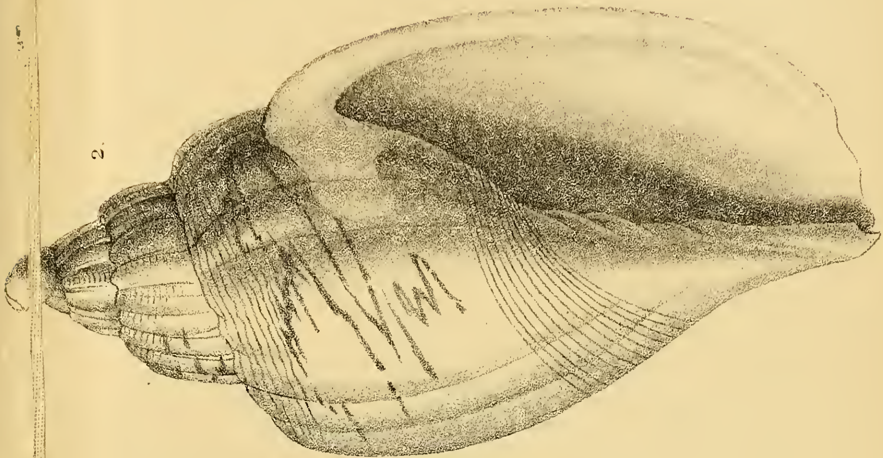

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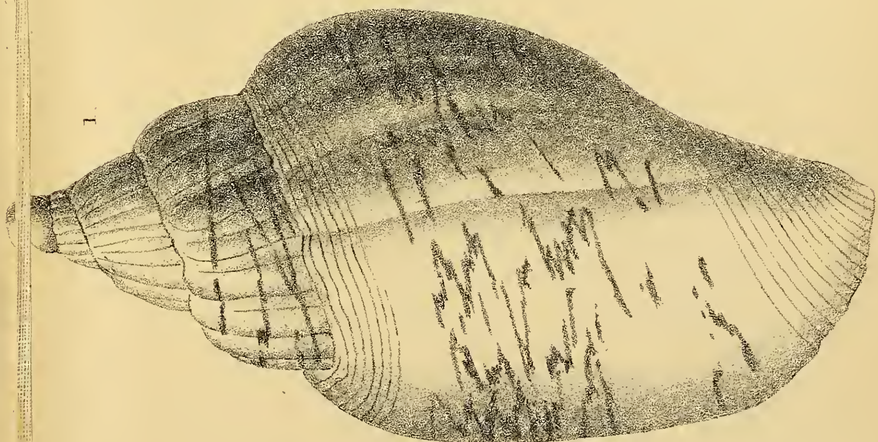

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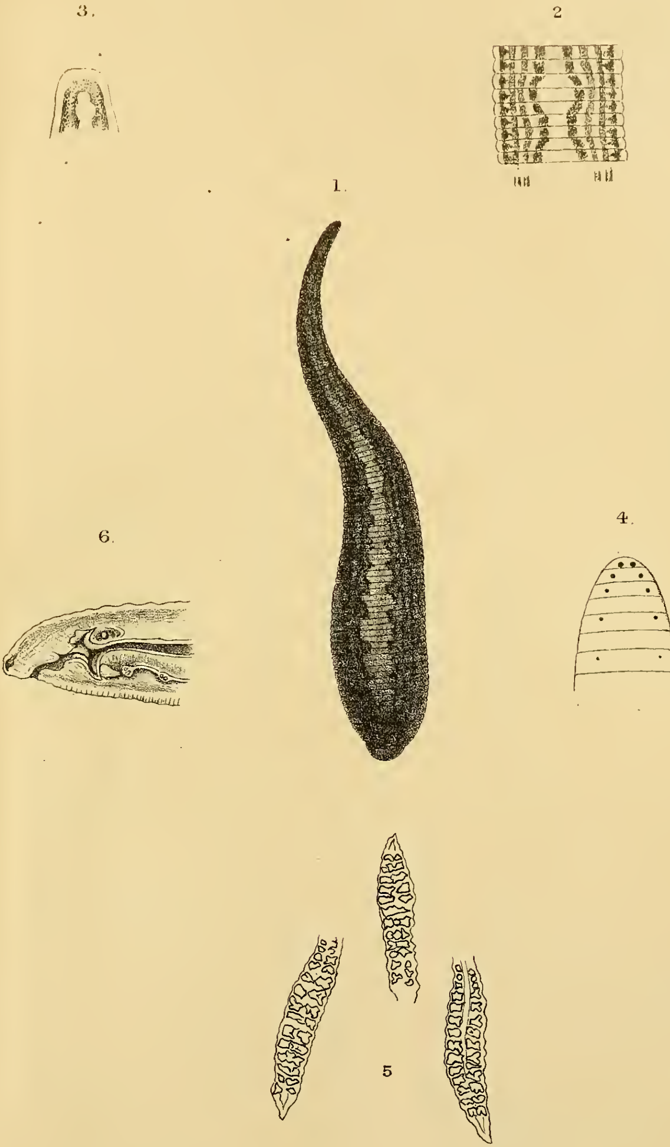

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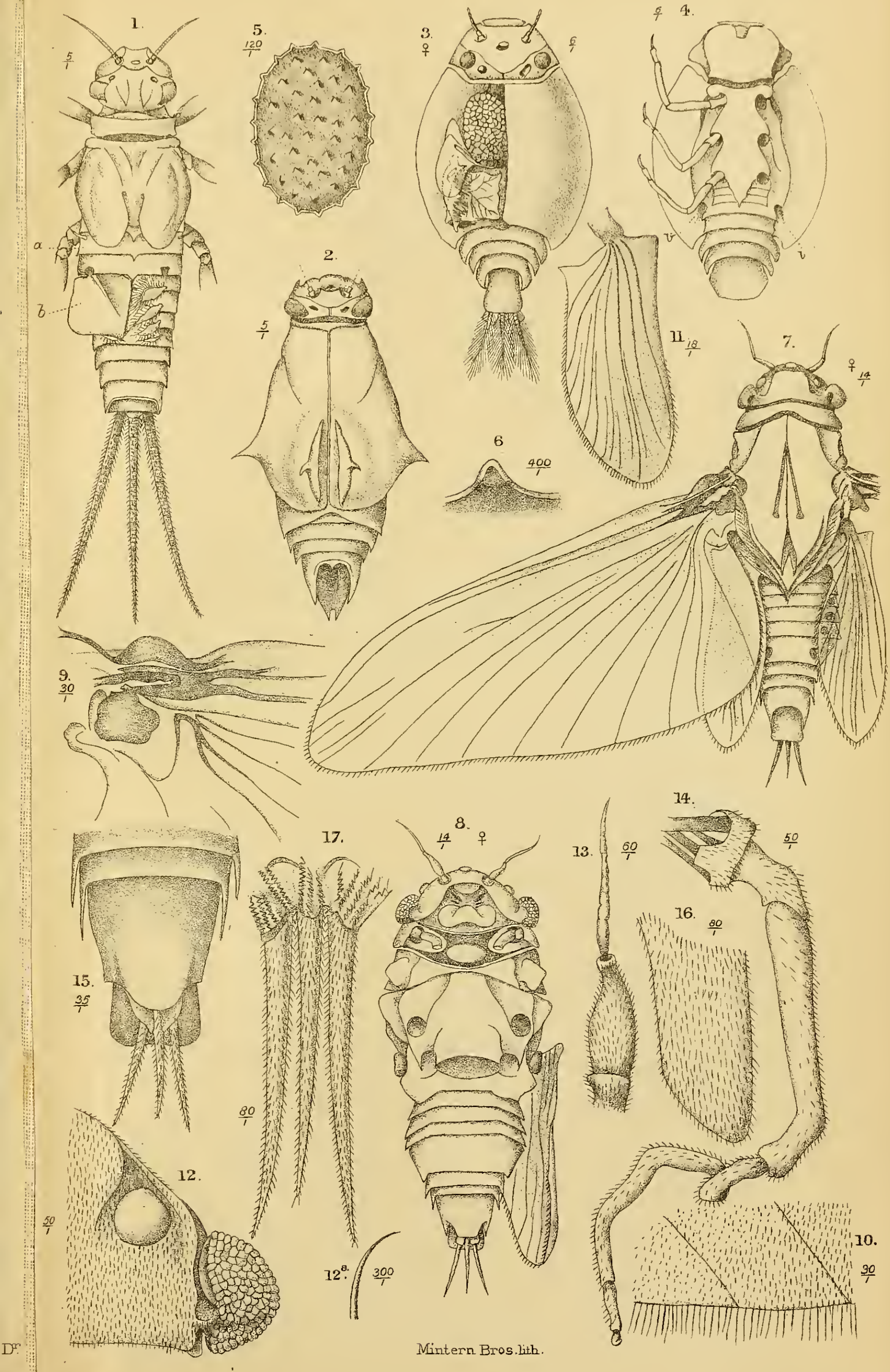

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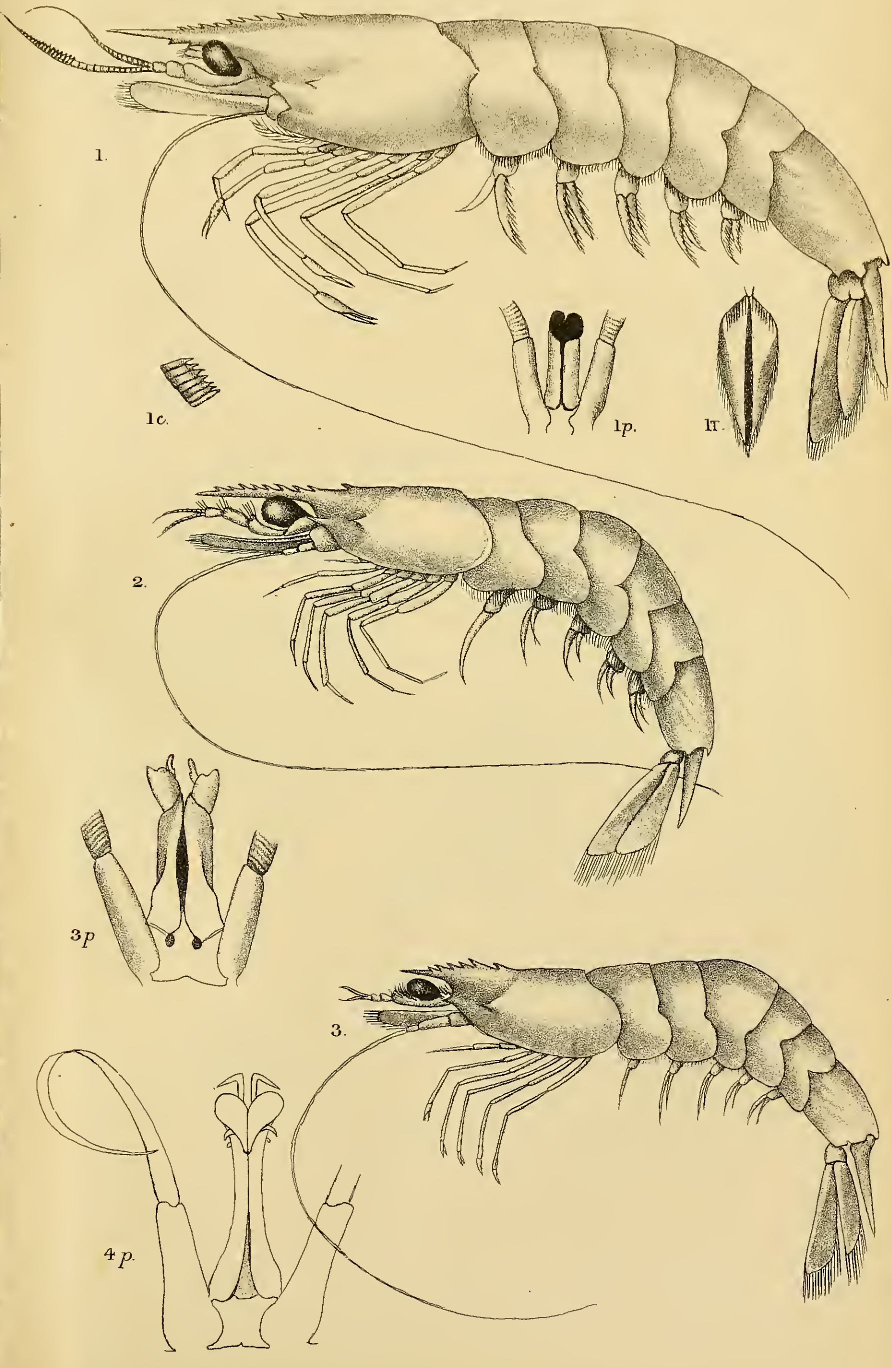

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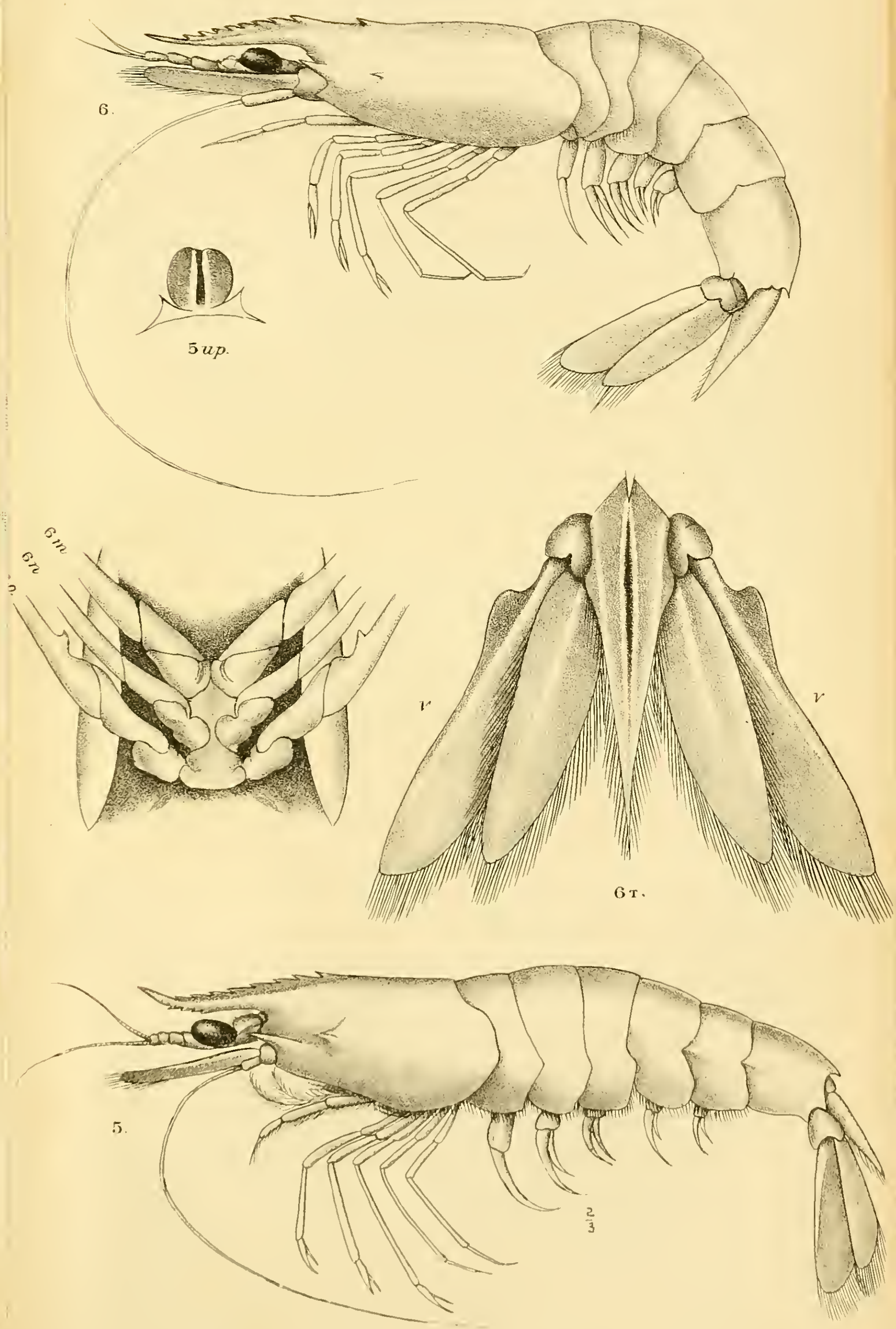

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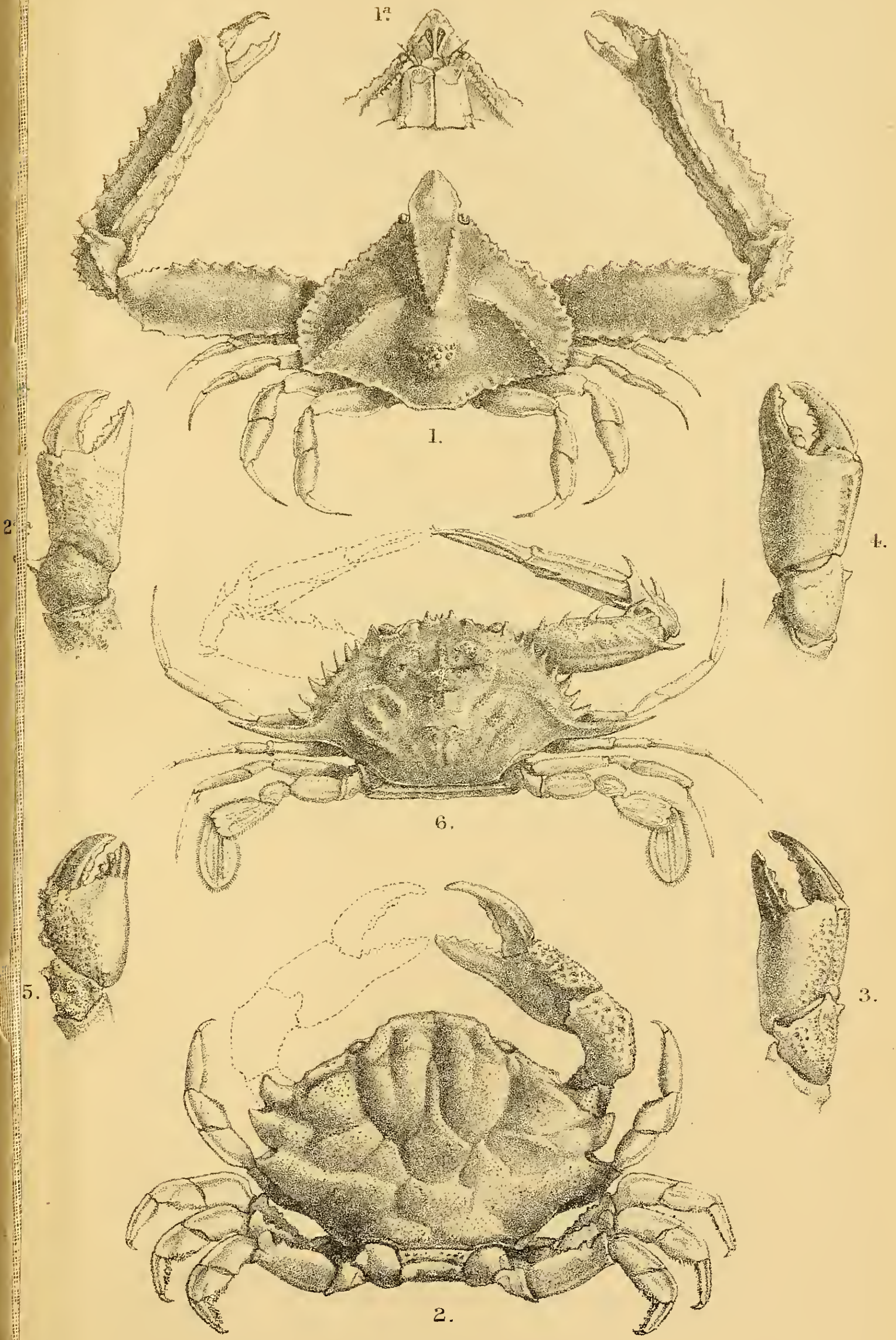

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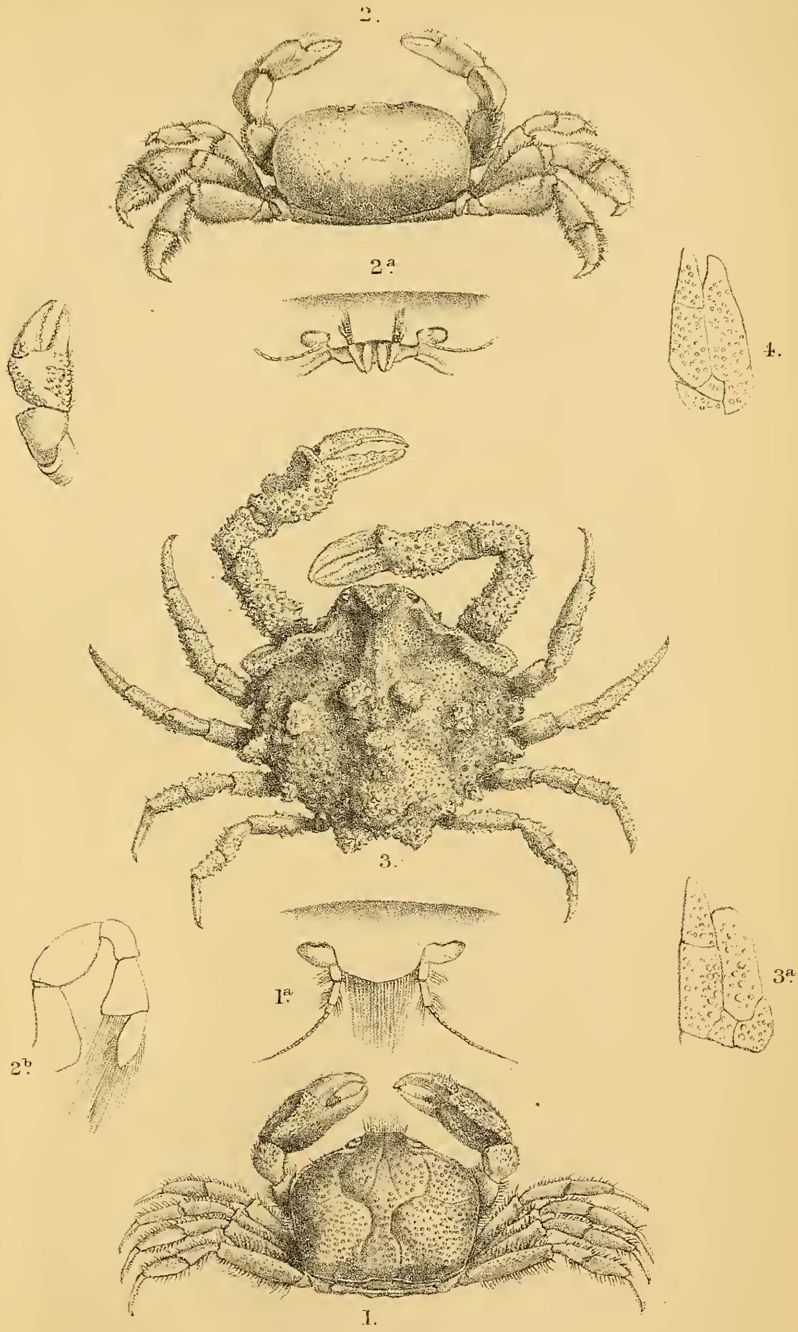

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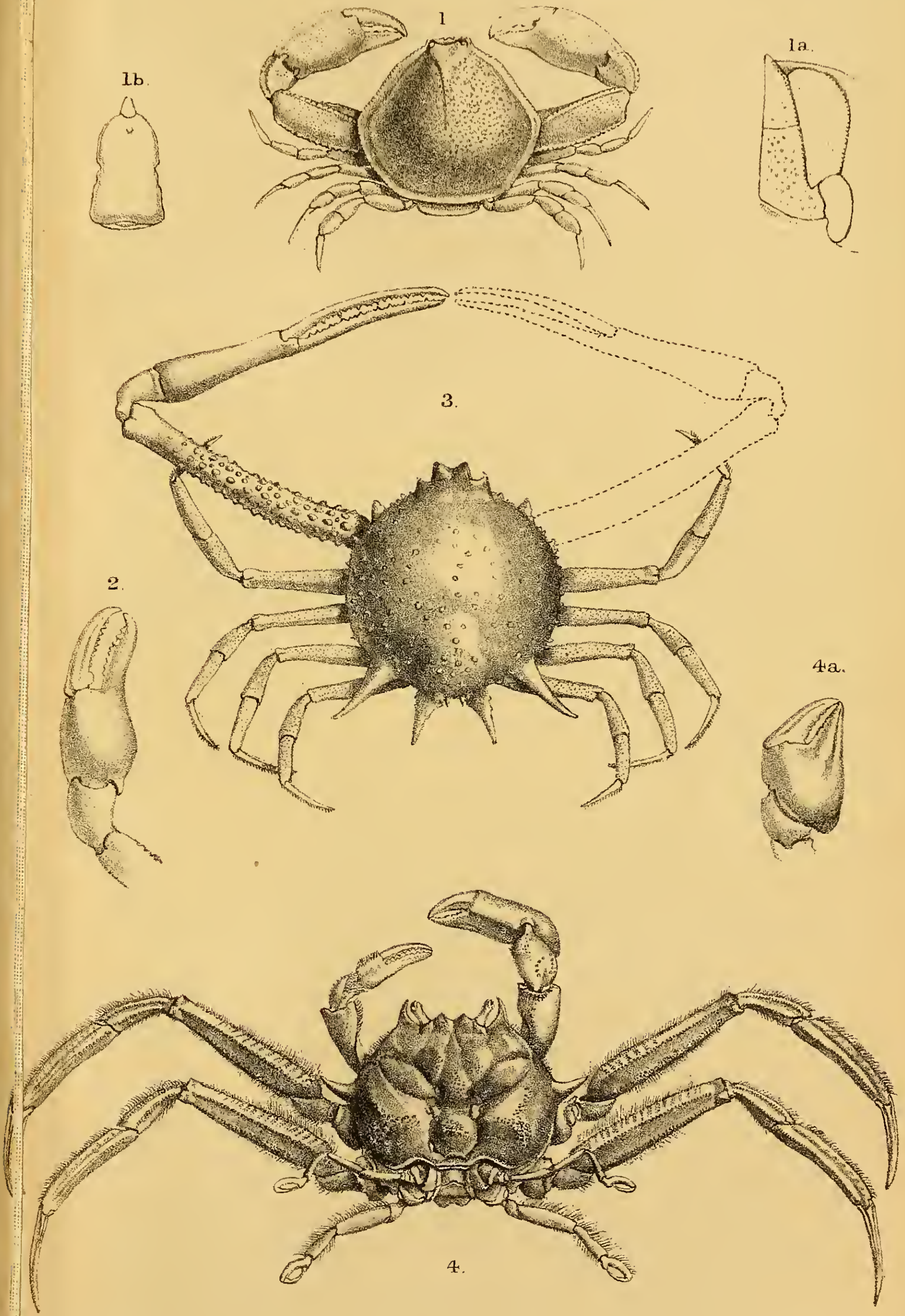

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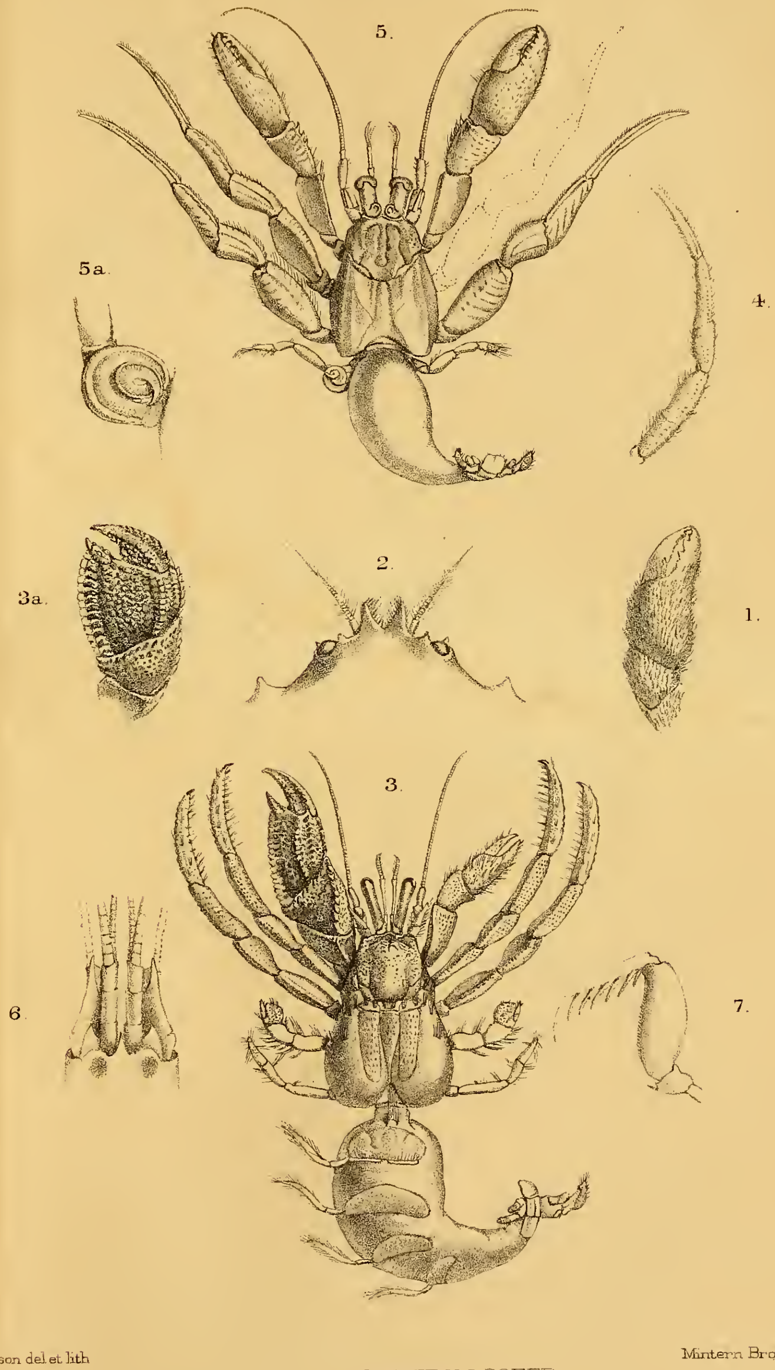

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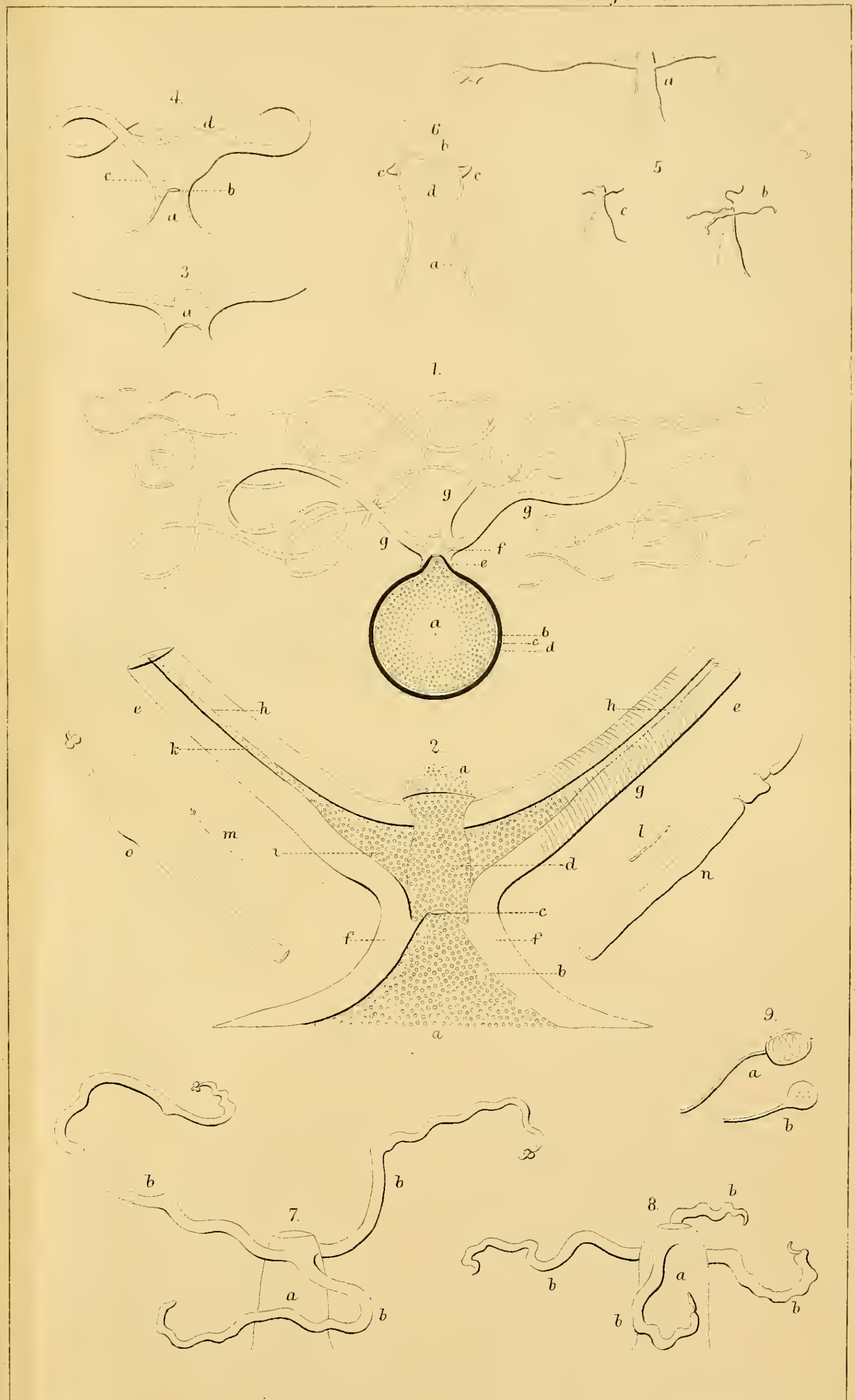

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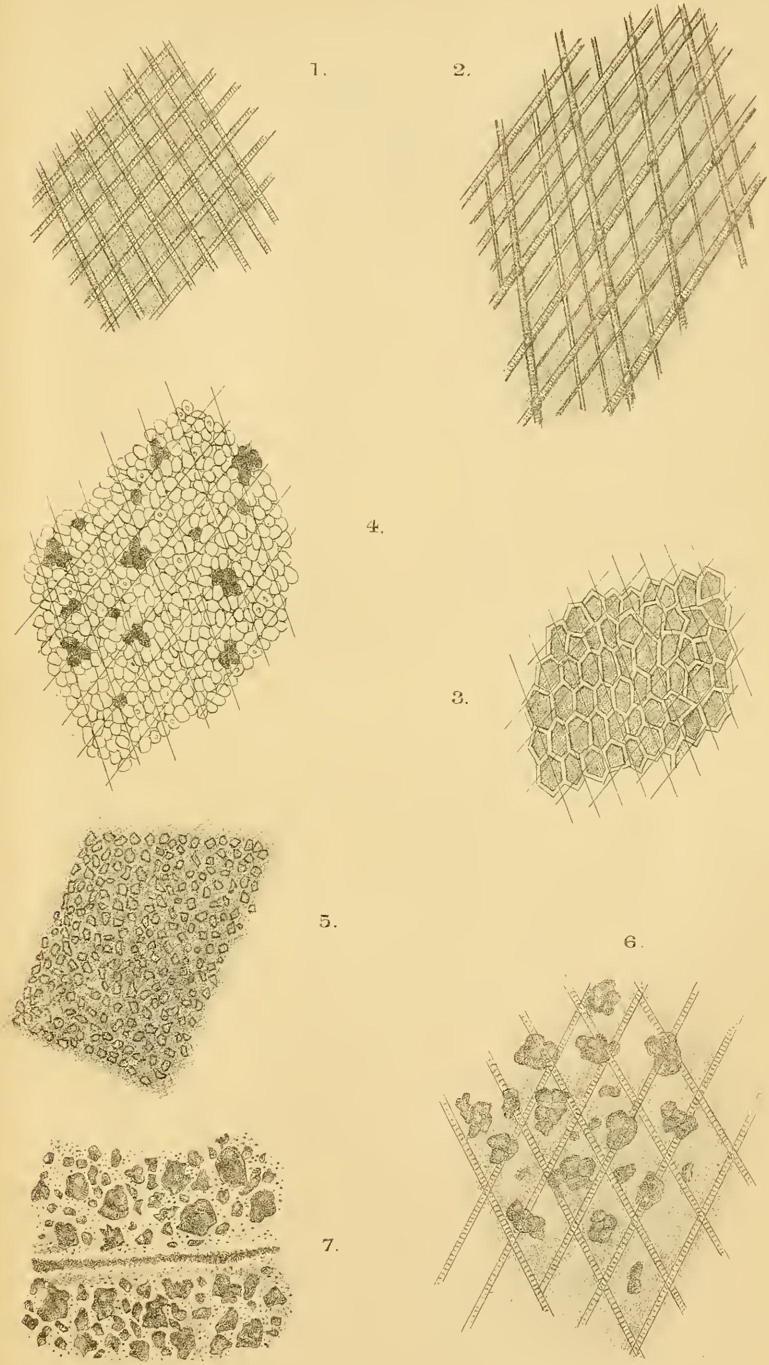

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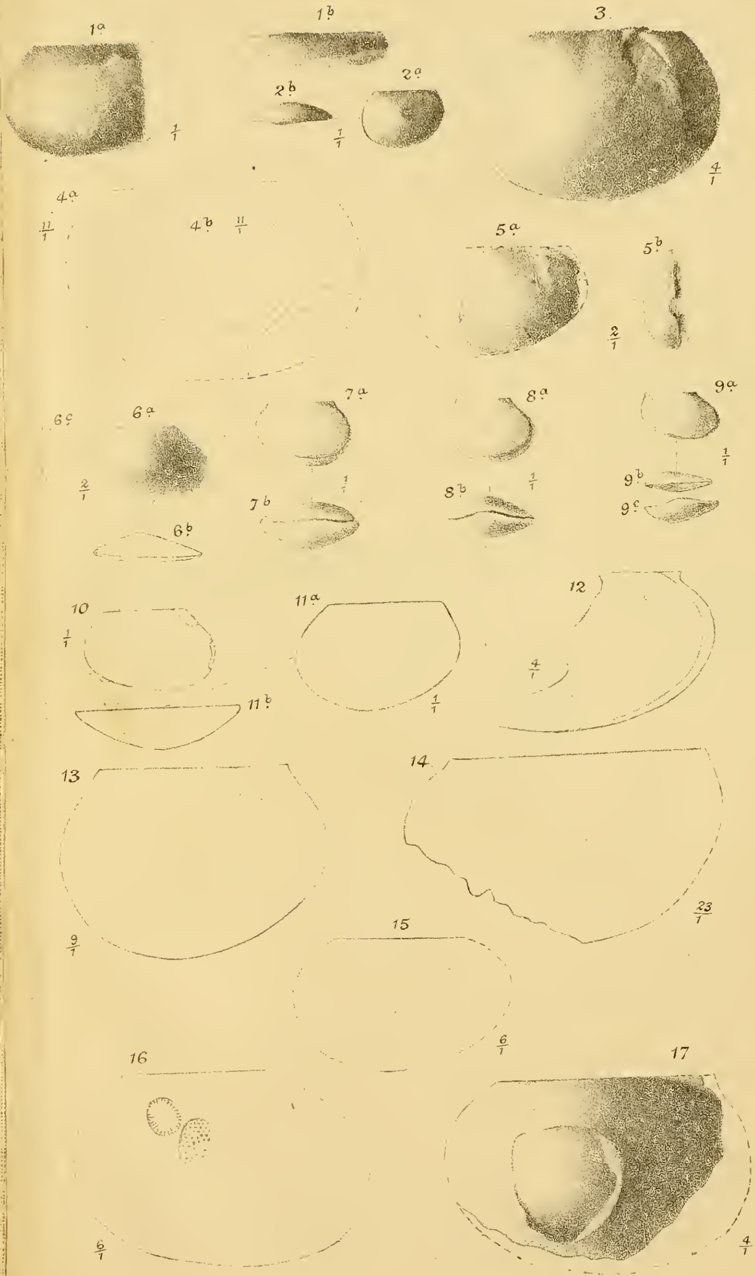

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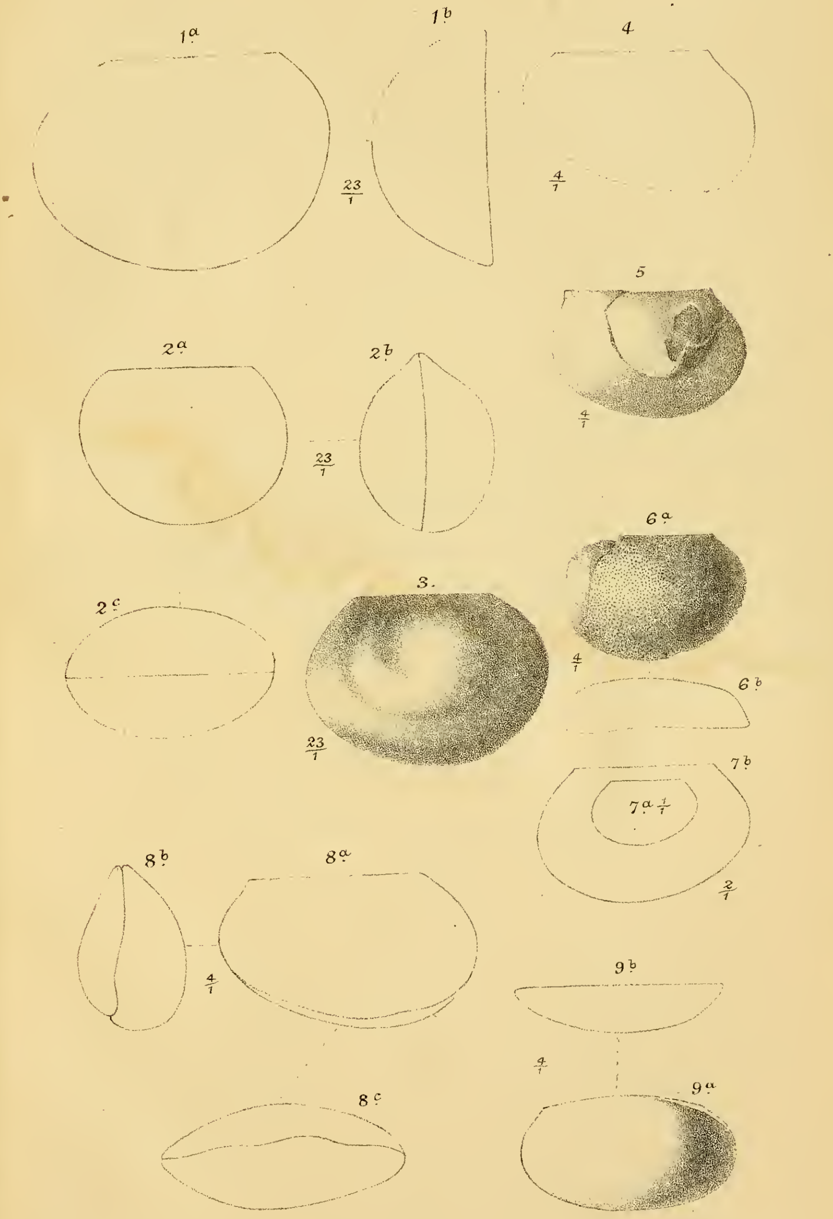

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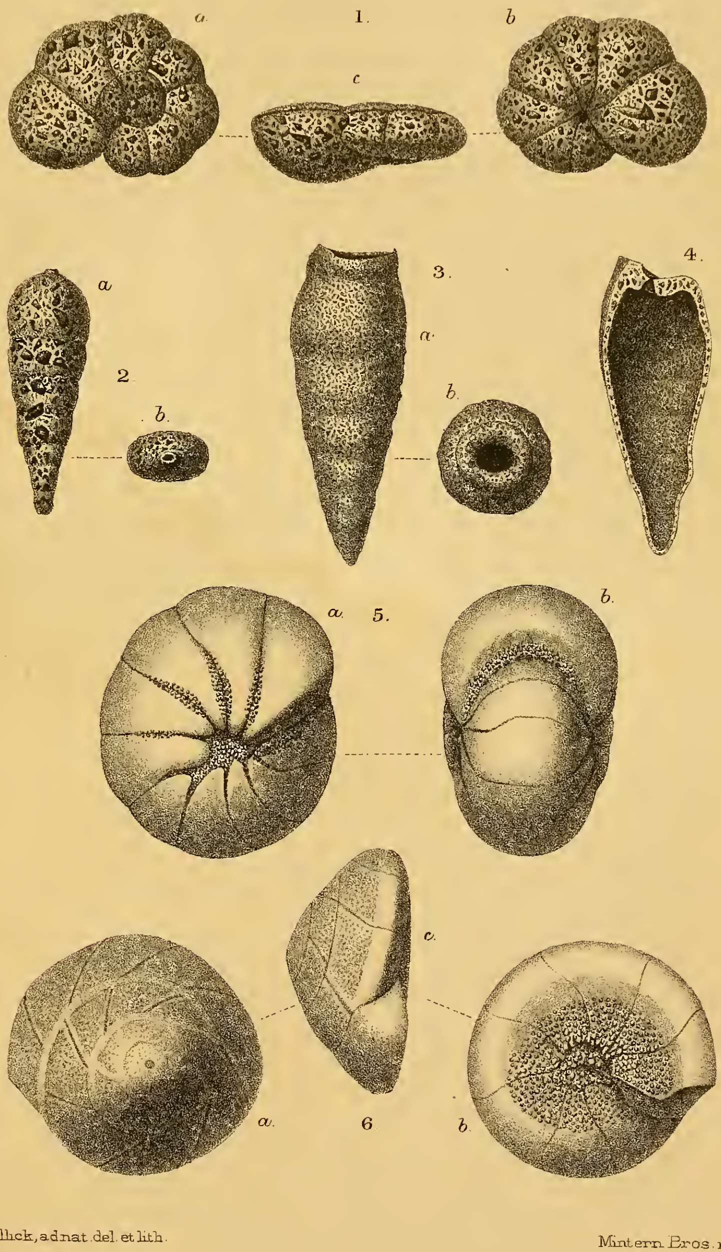

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