THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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

CONDUCTED BY

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

VOL. II.—SIXTH SERIES.

LONDON:

PRINTED AND PUBLISHED BY TAYLOR AND FRANCIS.

SOLD BY LONGMANS, GREEN, AND CO.; SIMPKIN, MARSHALL, AND CO.; KENT AND CO.; WHITTAKER AND CO.: BAILLIÈRE, PARIS: MACLACHLAN AND STEWART, EDINBURGH: HODGES, FOSTER, AND CO., DUBLIN: AND ASHER, BERLIN.

1888.

"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.

CONTENTS OF VOL. II.

[SIXTH SERIES.]

NUMBER VII.

NUMBER IX.

NUMBER X.

NUMBER XI.

NUMBER XII.

PLATES IN VOL. II.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

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

No. 7. JULY 1888.

I.—*On some new Species of* Uruguaya, *Carter, with Remarks on the Genus.* By GEORGE JENNINGS HINDE, Ph.D.

[Plate IV.]

I AM indebted to the kindness of my friend Dr. H. Woodward, F.R.S., for the opportunity of studying a specimen of a freshwater sponge from the River Uruguay, brought to this country by Alex. R. Mackinnon, Esq. The specimen proves to be a new species of the genus *Uruguaya*, Carter, and it is more particularly interesting from the fact of possessing well-developed gemmules, which have not hitherto been discovered in examples of this genus. In comparing the new species with specimens of *U. corallioides*, Bowbk., sp., in the British Museum and elsewhere, I have ascertained that gemmules are likewise present in a specimen referred by Mr. H. J. Carter, F.R.S., to Bowerbank's species, but which appears to me to be distinct from it; and I have further met with some minute forms which appear to be yet undescribed. I propose in the present paper to refer to all the forms of the genus from South America, and to discuss the validity of the genus in view of the fact that some of the sponges included in it are gemmuliferous.

Uruguaya repens, n. sp. (Pl. IV. figs. 1–6.)

Sponge incrusting, growing evenly over a continuous surface of a fragment of wood. Colour in the dry state of a light lead-brown, both on the surface and in the interior of the sponge. Skeleton very hard and resistant. Surface smooth and even, with numerous minute irregular apertures, scarcely visible without a lens. Neither canals nor oscules are shown in the skeleton. This is built up of large, slightly arcuate, smooth, cylindrical spicules, evenly rounded at both ends, which are so disposed as to form an open meshwork with loop-like interspaces. The spicules of the surface-layer are much more closely arranged than those of the interior. The gemmules occur either singly or in small groups or monticules, which are attached to the surface of the wood overgrown by the sponge and enclosed by a spicular envelope or layer, the spicules of which are of the same form, but usually smaller than those of the skeleton. The gemmules are subglobate in form and covered by a single layer of amphidisc-spicules with smooth incurved complete margins and stout shafts, which slightly project beyond the rotules at both ends.

The specimen partially covers an irregularly-shaped fractured fragment of decaying wood with a smooth crust, about 1 millim. in thickness, which is nearly of the same tint in its dried state as the wood itself. Evidently the sponge originally incrusted nearly the entire piece, for here and there small monticules of gemmules yet remain on the exposed surfaces, which must have been formed when these were covered by the sponge. The smooth even surface of the sponge has a punctate appearance, produced by minute rounded or subpolygonal apertures, varying from ·13 to ·4 millim. in width, which open into the interior of the mesh. The skeleton-spicules are all curved to a slightly varying degree and uniformly cylindrical; they are smooth, but under high powers of the microscope a slight micropunctation is apparent near the rounded ends. They vary from ·15 to ·24 millim. in length and from ·02 to ·03 millim. in thickness. The spicules are grouped as it were in fascicles, to form the mesh; those of the same fascicle are nearly parallel with each other, and project from a common centre. The surface-layer in some patches is completely felted over with spicules.

The gemmules are invariably attached to the surface of the wood on which the sponge is growing, and in no instance do they appear to be imbedded in the skeleton tissue of the sponge. On lifting up a portion of the sponge from the surface of the wood they always remain behind, fixed to the wood, and they appear as minute, brownish, wart-like bodies from ·5 to 2 millim. in width. These may consist of a single gemmule or there may be a number, varying from two to five, aggregated together in a single heap. Both the single gemmules and the aggregated masses are enclosed by a layer of spicules forming a kind of envelope or nidus, which completely invests them and conceals them from view. The spicules of this investing layer are smooth and of the same character as those of the sponge-skeleton, but distinctly smaller, averaging ·14 millim. in length by ·018 millim. in thickness. There does not seem to be any distinct arrangement in the spicules of this layer; in some cases, however, they are side by side, in others crossing over each other irregularly, and there is no aperture at its summit. Very frequently this envelope is partially worn off, and the upper portion of the gemmules is then exposed. The individual gemmules are about ·5 millim. in average diameter, very small forms are only ·1 millim., and a large example measures ·6 millim. across. Most of them are now partially collapsed through desiccation; but they appear originally to have been subglobate in form. Their outer surfaces are smooth, and in most of them no indications of an aperture can be seen; in a few there are one or more slightly raised spots in a lateral position, which may represent apertures. The gemmule is furnished with a single layer of amphidisc-spicules, very regularly and closely arranged, so that the outer surface has the appearance of being studded over with microscopic nail-heads. These amphidiscs are very regular in size, averaging ·016 millim. in height and the same in the width of the rotules. The shafts are cylindrical, and they project beyond the rotules at both ends in the form of bluntly rounded processes. The rotules are approximately circular in outline, with smooth, complete, curved, saucer-like margins, which are invariably turned in the same direction.

This species differs from *U. corallioides*, Bowbk., sp., in its incrusting mode of growth, in the absence of definite oscules, in the smaller dimensions of the skeleton-spicules, and in the presence of gemmules. From the incrusting species of *Uruguaya* or *Potamolepis*, described by Dr. W. Marshall * from the Congo, the present form differs in the absence of definite oscules and in the slighter proportions of the skeleton-spicules, likewise in the presence of gemmules, which have not yet been met with in any of the Congo forms of the genus.

* Zeitschrift für Naturwissenschaften, N. F. Bd. ix. pp. 553–577. See also a translation of this paper in Ann. & Mag. Nat. Hist. ser. 5, vol. xii. (1883), pp. 391–412.

A remarkable feature in connexion with *U. repens* is the close agreement in details of form of the amphidisc-spicules with those of other freshwater sponges of the genus *Meyenia*, Carter, which occur in widely separated geographical areas. Thus, for example, the amphidisc-spicules of *Meyenia Leidyi*, Bowbk., sp. *, from the Schuylkill River, near Philadelphia, of *Meyenia gregaria*, Bowbk., sp. †, from the River Amazons, and of *Meyenia erinaceus*, Ehr., sp. ‡, from the River Elbe, alike possess circular, complete, curved margins, and their shafts are similarly prolonged into small bosses at both ends of the spicules, so that there are, in fact, only unimportant differences in the size of the amphidiscs in these species of *Meyenia* and in *Uruguaya repens*. But with this similarity in the form of the amphidisc-spicules there are notable differences in the characters of the skeleton in the above-named species of *Meyenia* which distinguish them from each other and from *Uruguaya*.

Distribution. River Uruguay, South America. Only a single specimen has at present been discovered, and the exact locality whence it comes is unknown to me.

Uruguaya Macandrewi, n. sp. (Pl. IV. figs. 11–14.)

1881. *Uruguaya corallioides*, Carter (in part), Ann. & Mag. Nat. Hist. ser. 5, vol. vii. p. 100.

Sponge with an incrusting base, from which numerous thickly-set palmate stems or branches arise, which partially coalesce and give off digitiform processes with truncated summits. The exterior surface is very dark, almost black in appearance, but the interior is of a much lighter tint and approaches silver-grey. The surface is smooth and even and in the lower portion compact. The skeleton is very hard and resistant to pressure. The oscules are circular, elliptical, or trifoliate in outline; they have no regular arrangement, but are scattered indiscriminately over the surface of the branches. There is usually a small cavity immediately beneath the oscular aperture. The canals in the interior of the skeleton can scarcely be distinguished from the interspaces of the mesh. The skeleton-spicules are moderately robust, decidedly arcuate, cylindrical, evenly rounded at the ends. There are also a few slender acerate spicules and transitional forms between these and the cylindrical spicules. The surface of

* Proc. Zool. Soc. 1863, p. 7, pl. xxxviii. fig. 2 *b*.

† *Ibid.* p. 14, pl. xxxviii. fig. 7 *d*, *e*.

‡ See Vejdovsky, "Die Süsswasser-Schwämme Böhmens," Abh. königl. Gesellsch. Wiss. (Prag), 1883, p. 31, pl. iii. figs. 11–13.

the spicules is distinctly micropunctate, but this is scarcely visible unless they are magnified about 300 diameters.

Gemmules are present in the lower portion of the sponge attached to the surface on which the sponge grows; as in *U. repens* they are aggregated together into small monticules, from two to five in each. The monticule is enclosed by a common outer envelope of curved cylindrical spicules of far smaller proportions than those of the skeleton. The gemmules are subglobular and furnished with a coating of amphidisc-spicules of a similar form to those of *U. repens*, but of slightly different proportions.

This species is based on a large bushy specimen, nearly entire, which is now preserved in the British Museum. It was presented by Mr. MacAndrew, and is labelled as coming from Paraguay. The specimen has been studied by Mr. H. J. Carter, F.R.S., who regarded it as identical with *U. corallioides*, Bowbk., and, in fact, Mr. Carter's own description of this last-named species appears to have been mainly derived from the characters of this specimen. There are, however, distinct differences between this and the type of Bowerbank's species which seem to me to be of specific value.

The Paraguay specimen is attached to a large pebble, which it almost entirely covers with a firm thin crust, from which the stems and branches rise to form a rigid bushy mass, which is about 200 millim. in height, the same in width, and 90 millim. in thickness. The branches, when simple, are nearly circular in cross section and about 5 millim. in thickness; they have a tendency to coalesce laterally to form semipalmate expansions. Occasionally small patches of a smooth dermal membrane are preserved. The spicules of the surface of the lower portions of the sponge are so closely arranged as to form a crust in which no apertures can be recognized; in the upper portions there are irregular interspaces in the surface-layer leading into the interior, as in *U. repens*.

The oscules are, as a rule, nearly level with the general surface of the sponge, sometimes they have slightly elevated margins; they are from 1 to 2 millim. in width, a few simple oscules are, however, only ·5 millim. across. The skeleton-spicules are from ·25 to ·34 millim. in length and from ·03 to ·04 millim. in thickness. The acerate spicules are about half as thick as the cylindrical forms; they are very few in comparison with these latter.

The gemmules appear to be few in number, and, as in *U. repens*, they are attached to the substance on which the sponge is growing and are overgrown by the base of the sponge.

They appear to be entirely restricted to the basal portion, for I failed to find any gemmules in the broken stems and branches. In this specimen they were entirely hidden from view, and it was only by removing a small portion of the incrusting base that they were found attached directly to the pebble beneath.

The spicules of the monticular envelope are not more than 11 millim. in length by ·015 millim. in thickness, thus contrasting greatly in size with the spicules of the skeletal mesh. The spicules are very closely arranged and apparently united together in a distinct membranous layer. As far as can be ascertained the gemmules are subglobular in form; I could not see any apertures in the few specimens examined. An average example measured ·6 millim. in width. The amphidisc-spicules have short and very thick shafts; they are ·014 millim. in height, and the rotules ·017 millim. in width.

This species is closely allied to *U. corallioides*, Bowbk., sp., in its mode of growth, but is distinguished by the irregular distribution of the oscules and their generally compound character; the skeleton-spicules are also less robust. It likewise possesses gemmules which have not yet been definitely recognized in Bowerbank's type form. From *U. repens* it is distinguished by its mode of growth, the presence of oscules, the larger forms and the micropunctation of the skeleton-spicules, whilst the spicules of the monticular envelope are smaller and the amphidisc-spicules are shorter and stouter. From the Congo species of *Uruguaya* (*Potamolepis*) it is marked off by its bushy mode of growth and the smaller dimensions of the skeleton-spicules.

Distribution. Paraguay. No further information as to its precise locality can be obtained.

Uruguaya corallioides, Bowbk., sp. (Pl. IV. figs. 15, 16.)

1863. *Spongilla corallioides*, Bowerbank, Proc. Zool. Soc. 1863, p. 22, pl. xxxviii. fig. 13.
1877. *Spongilla corallioides*, T. Higgin, Proc. Lit. and Phil. Soc. Liverpool, 1877–78.
1881. *Uruguaya corallioides*, Carter (in part), Ann. & Mag. Nat. Hist. ser. 5, vol. vii. p. 100.
1884. *Uruguaya corallioides*, Carter, *ibid.* ser. 5, vol. xiii. p. 271.
1887. *Uruguaya corallioides*, Vosmaer, Bronn's Klassen u. Ordn. des Thierreichs, Bd. ii. p. 347.
1887. *Uruguaya corallioides*, Potts, Proc. Acad. Nat. Sci. Philad. p. 268.

Sponge growing in bushy rigid masses from an incrusting base. The surface in the dry state is of a lead-grey tint with a smooth shiny aspect, the interior is of a lighter tint. It is very hard and resistant in texture. The branches are compressed; they frequently coalesce into semipalmate expansions. The oscules are for the most part simple, circular, or elliptical, scarcely if at all elevated above the general surface; they are usually ranged in vertical rows along the thin compressed edges of the branches. The general surface shows the minute irregular apertures between the spicular mesh as in the species already described. The spicules are cylindrical with rounded extremities, unusually robust; their surfaces are faintly micropunctate. No gemmules have as yet been met with in this species.

The type specimen, on which Dr. Bowerbank based his excellent description of this species, is about 225 millim. in height, 175 millim. in width, and from 50 to 75 millim. in thickness. The basal portion has been broken from the surface to which it was attached; but there are smooth patches on its underside covered by membrane, where the sponge apparently rested on a rock or pebbly surface. The oscules are from 1 to 2 millim. apart and about ·75 millim. in diameter; they have a well-defined border of closely arranged spicules. As in *U. Macandrewi*, the spicules of the surface are much more closely arranged than in the interior and form a definite crust to the sponge.

The skeleton-spicules average ·28 millim. in length by ·052 millim. in thickness. A few acerate spicules are mingled with the cylindrical forms; they are evidently, as Dr. Bowerbank has remarked, only immature forms, and this is further proved by the fact that within some of the cylindrical spicules the outlines of acerate spicules can still be distinguished. The micropunctation of the spicules can be seen only under high powers of the microscope.

I have made a careful search for gemmules in the type specimen of this species now preserved in the museum of the Royal College of Surgeons, but failed to find any. In some of the membranous patches on the underside of the sponge, where it had been resting on the pebbly or rocky floor of the stream, there were enclosed a few small capsular bodies composed of minute cylindrical spicules, not dissimilar to those of the monticular envelope of *U. Macandrewi*. There were, however, no traces of gemmules within them, and I therefore conclude that they may have been young individuals of *U. pygmæa*, described below, which had been overgrown by the larger sponge.

At my request Mr. T. Higgin, F.L.S., examined the fine example of *U. corallioides* presented to the Liverpool Free Museum by his brother, Mr. George Higgin, C.E., but could not discover gemmules in it.

This species is closely related to *U. Macandrewi* in its mode of growth, but differs therefrom in the simple form and linear arrangement of the oscules, in its compressed branches, and in the more robust proportions of the skeletal spicules. From the Congo forms of *Uruguaya* it is distinguished by its mode of growth and by the simple character of the oscules; the spicules, moreover, are not so long as in the African forms, but they are equally robust.

Distribution. River Uruguay, near Salto, Banda Oriental, South America. Mr. Carter has already pointed out Dr. Bowerbank's error in stating that this Salto was on a branch of the Amazons. The type form is in the museum of the Royal College of Surgeons; a branch from it, which belonged to the Bowerbank collection, is in the British (Natural History) Museum.

Uruguaya pygmæa, sp. n. (Pl. IV. figs. 7–10.)

Sponges minute, simple or compound, subconical in form, with a slightly expanded base, of a light brown or silvery-white tint in the dried state, with one or occasionally two simple oscules. The sponge is built up of minute, smooth, arcuate, cylindrical spicules with rounded ends, which form a smooth outer crust with microscopic interspaces. Gemmules subglobular in form, furnished with spool-like amphidiscs, with incurved margins, like those of the other species of the genus.

This species is founded on some very small sponges growing at the base of the type specimen of *U. Macandrewi*, described above. In most instances the sponges are partially attached to the outer surface of the larger form, in others they grow entirely separate from it on the surface of the pebble on which the larger form likewise grows. In the cases where the minute sponges grow partially on the surface of *U. Macandrewi* they are attached to the surface-membrane of this form and thus evidently exterior to it. The sponges are nearly circular in outline at the base, from 2 to 5 millim. in width, and from ·75 to 1·5 millim. in height. They are generally simple, with a single well-defined oscule from ·2 to ·5 millim. in width at the summit; in some examples two oscules are present. The sponge apparently consists of a crust-like wall, enclosing an interior spicular mesh. The spicules are very uniform in size, measuring ·11 millim. in length by

·017 millim. in thickness. They are disposed in fascicles so as to form a meshwork precisely of the same character as in the larger forms of the genus, but of much smaller proportions. In one of the two specimens of which I examined the interior there was a single gemmule of about the same size as those of the larger sponges, and furnished with similar amphidisc-spicules, varying only in size. The amphidiscs are ·014 millim. in height and the rotules ·017 millim. in width.

The close resemblance of the skeletal spicules of these small sponges to those of the envelope enclosing the gemmules of *U. Macandrewi*, their position of growth at the base of the larger species, and the similarity in the form of the gemmules in both, very naturally raise a suspicion whether the pigmy sponges may not be merely peculiarly modified stages of development of the larger, and not independent sponges. On the other hand, they have every appearance of being complete sponges. Their spicules are uniformly cylindrical, and are evidently full-sized, and not young forms of the larger spicules of *U. Macandrewi*; their arrangement in the wall is the same as in the wall of the larger species, whilst it is distinct from the irregular disposition of the spicules of the monticular envelope in *U. Macandrewi*; the oscules at their summits are perfectly distinct, and the presence of full-sized gemmules within the cavity of the sponge indicates that it had reached maturity.

Distribution. Paraguay. Attached to the base of the type specimen of *Uruguaya Macandrewi*, now in the British (Natural History) Museum. I have also one specimen growing on a fragment of *U. corallioides*, Bowbk., sp.

The genus *Uruguaya* was provisionally constituted by Mr. Carter on the supposition that gemmules were not developed in the sponges placed in it; but now that it has been shown that these bodies are present in some, if not in all, the species, it is necessary to consider whether it can be retained, or whether the forms placed therein should be removed to the genus *Meyenia*, Carter, which includes sponges with gemmules furnished with amphidisc- or birotulate spicules like those in *Uruguaya*. The classification of the freshwater sponges generally adopted at the present time is that proposed by Mr. Carter in his paper on the "History and Classification of the known Species of *Spongilla*" *. This is admittedly "based chiefly on the spicules of the statoblast," since "the form of the skeleton-spicule is not only always acerate, but almost always more or less alike in all." But

* Ann. & Mag. Nat. Hist. ser. 5, vol. vii. (1881), pp. 77–107.

whilst the classificatory value of the gemmule-spicules is generally recognized, it is an undoubted disadvantage to rely wholly upon this single feature for generic distinction, and may lead to uniting sponges in the same genus which in other important features than those of the gemmule-spicules are markedly different from each other.

This is well exemplified in the case of the present genus *Uruguaya* and certain species of *Meyenia* in which, as mentioned above, the gemmule-spicules are strikingly similar, even in minute structural details, to those of *Uruguaya*, whilst the skeleton-spicules and the characters of the skeleton are so extremely different that they would fully justify retaining these sponges in distinct genera. In these forms the converse of Mr. Carter's statement occurs, since the gemmule-spicule is more or less alike in all, and the skeleton-spicule and the skeleton have undergone modification. Taking into account, therefore, the cylindrical form of the skeleton-spicules in *Uruguaya*, their peculiar fascicular arrangement in the skeleton, and its firm rigid structure, this genus possesses characters, independent of the gemmules, sufficiently distinct to mark it off from other * freshwater sponges, and may properly be retained.

There can hardly be a doubt that such large branching sponges as *U. corallioides* and *U. Macandrewi* result from an uninterrupted growth of several years' duration, and that consequently they must have lived in positions where they were not exposed to those influences of heat, drought, or cold which limit the existence of most freshwater sponges to a single season. Their conditions of existence must in fact have approximated closely to those of marine forms, and it is probably owing to these favourable circumstances that in one of these species no gemmules have as yet been found, whilst in another they are very sparsely developed. A further feature in connexion with the gemmules is that they only occur in the basal layer of the sponge, no trace of them appearing in the branches and palmate extensions which grow from the base and constitute the larger part of the sponge. In most freshwater sponges the gemmules likewise occur in the basal layer; but where there is a series of layers marking the growth of successive years there is frequently, if not always,

* I include under *Uruguaya* the sponges from the River Congo described by Dr. W. Marshall under the genus *Potamolepis* (Zeitschrift für Naturwissenschaften, N. F. Bd. ix. p. 553). The author acknowledges the generic identity of the Congo forms with *Uruguaya*, Carter, but declines to adopt the name on account of its distinctive geographical origin.

a fresh development of gemmules at the base of each, indicating that there has been a break in the life of the sponge and that the fresh growth, though immediately overlying that of the previous season, is quite distinct from it *. The restriction of the gemmules in *U. Macandrewi* to the base of the sponge, therefore, confirms the idea of its perennial growth.

It also seems probable that gemmules are not produced after the first year of the life of the sponge, and that when the conditions are sufficiently favourable to allow of its continued growth for longer periods there is no repetition of this mode of reproduction. It might also well happen that under these circumstances gemmules would cease to be produced, and this may be the case in *U. corallioides.*

The presence of gemmules in some forms of *Uruguaya* and the minute structural resemblance between their amphidisc-spicules and those of certain species of *Meyenia* indicate that these sponges are genetically related to some common gemmuliferous ancestor, and thus tend to negative the supposition of Dr. W. Marshall that the sponges of the former genus may have been derived independently from marine forms which have become adapted to fresh water. The suggestion of Dr. Marshall that freshwater sponges may be of polyphyletic origin seems very probable, more especially as regards those occurring in Lake Baikal; but the facts brought forward in the present paper point to the desirability of renewed careful search before speculating with confidence on the absence of gemmules either in *Lubomirskia* or in he Congo forms of *Uruguaya.*

In conclusion, I wish to express my thanks for the kind assistance in the preparation of this paper which I have received from my friend Mr H. J. Carter, F.R.S., from Mr. T. Higgin, F.L.S., of Liverpool, Dr. C. Stewart, F.L.S., of the Royal College of Surgeons, Mr. E. Howarth, of the Sheffield Public Museum, and from the authorities of the British Museum of Natural History.

EXPLANATION OF PLATE IV.

Uruguaya repens, n. sp.

Fig. 1. A fragment of the skeletal mesh, showing the arrangement of the spicules. Enlarged 60 diameters.

Fig. 2. Detached spicules of the skeleton. Enlarged 100 diameters.

---

* This is well shown in a specimen of *Meyenia Leidyi,* Bowbk., sp., which has been kindly sent to me by Mr. Edward Potts, of Philadelphia. In this there are several skeletal layers overlying each other, and there is a platform of gemmules at the base of each.

Fig. 3. Detached spicules of the envelope enclosing the gemmules. Enlarged 100 diameters.
Fig. 4. One of the monticules of gemmules, showing the irregularly arranged cylindrical spicules of the outer layer; these are partially weathered off at one end, and the surface of one of the gemmules is exposed. Enlarged 20 diameters.
Fig. 5. A portion of the exterior surface of a gemmule, showing the natural arrangement of the amphidisc-spicules. Enlarged 200 diameters.
Fig. 6. Detached amphidisc-spicules. Enlarged 660 diameters.

Uruguaya pygmæa, n. sp.

Fig. 7. A complete specimen, in which two oscules are developed. It is growing at the base of *U. Macandrewi*. Enlarged 8 diameters.
Fig. 8. A portion of the exterior surface, showing the arrangement of the spicules. Enlarged 60 diameters.
Fig. 9. Detached skeleton-spicules. Enlarged 100 diameters.
Fig. 10. Detached amphidisc-spicules. Enlarged 660 diameters.

Uruguaya Macandrewi, n. sp.

Fig. 11. A fragment of the type specimen, showing its mode of growth and the character of the oscules. Natural size.
Fig. 12. Cylindrical and immature acerate spicules of the skeleton. Enlarged 100 diameters.
Fig. 13. Detached spicules of the monticular envelope. Enlarged 100 diameters.
Fig. 14. Detached amphidisc-spicules. Enlarged 660 diameters.

Uruguaya corallioides, Bowbk., sp.

Fig. 15. A fragment of the type specimen, showing the mode of growth and the arrangement of the oscules. Natural size.
Fig. 16. Detached skeleton-spicules. Enlarged 100 diameters.

[The originals of all the figures are in the British (Natural History) Museum.]

II.—*Polyzoa from Port Phillip.* By R. Kirkpatrick, British Museum (Natural History).

[Plate II.]

A collection of Polyzoa dredged in the neighbourhood of Port Phillip by Mr. J. Bracebridge Wilson was sent by him to the Natural-History Museum.

The collection contains representatives of ninety-five species, of which six appear to have been undescribed, and fifteen have not been recorded from the locality. The genera *Amathia* and *Catenicella* were most largely represented.

In this paper the new species are described, those new to the locality recorded, and remarks made on points of interest in the known species.

Group *ECTOPROCTA.*

Suborder Cheilostomata.

Family **Flustridæ.**

Genus Flustra.

Flustra reticulum, Hincks.

Flustra reticulum, Hincks, Ann. & Mag. Nat. Hist. [5] x. p. 163, pl. vii. fig. 4.

There are two specimens of *F. reticulum* in this collection, one answering in every particular the description given by Hincks, the other presenting certain curious differences. In the latter the marginal radical (?) fibres have become greatly developed, bending backwards on each side and branching copiously in a dichotomous manner. The horny spines from each side meet and interlace across the middle of the posterior surface of the branches.

The colour of the variety differs from that of the typical form, being pale yellow in place of dark brown. If it is necessary to make a new variety of this form, a name descriptive of the curious modification of the marginal spines is suggested in var. "*dorsitecta*."

Family **Cribrilinidæ.**

Genus Cribrilina, Gray.

Cribrilina philomela, Busk.

Cribrilina philomela, Busk, Chall. Rep. p. 132, pl. xvii. fig. 6.

The specimen incrusts *Idmonea marionensis*, Busk. The zoœcia differ in no respect from those of the Hemescharan form described by Busk. There are no vicarious avicularia present; hence the Port-Phillip specimen, although incrusting, is not identical with var. *adnata*, Busk.

Family **Escharidæ.**

Genus Lepralia, Johnston.

Lepralia Pallasiana.

The specimen from Port Phillip Heads has a finely developed funnel-shaped peristome. The peristome resembles milk-white porcelain; the inner surface is marked with longitudinal striæ, and the upper border is rolled out and thickened. Surface of zooœcia punctured in young cells; in old cells the punctures are obliterated and their place taken by small round knobs, as in *L. canthariformis*, Busk; but in many cells the horseshoe shape of orifice and straight lower border are apparent.

Hab. Growing on pebbles.

Lepralia Poissonii, Aud.

In the specimen from Port Phillip the vibraculoid mandibles cross each other on the front of the zooœcia, in some cases even being directed upwards. In Mediterranean and Mauritius specimens these organs are directed downwards parallel to each other.

Hab. Incrusting Algæ.

Genus Haswellia, Busk.

Haswellia victoriensis, n. sp. (Pl. II. figs. 1, 1 *a*.)

Zoarium branching, subdichotomous, branches 1 millim. in diameter. Zoœcia irregularly verticillate, in whorls of from eight to twelve; zooœcia ovate, walls thick, obscurely punctured round margins; without special pore; orifice pyriform, the notch occupying the whole proximal margin; peristome forming a pointed triangular elevation on each side, deficient in front and behind. No oral avicularia; scattered over zoarium avicularia with broad, thick, semicircular or spatulate mandibles. Oœcia depressed, marked in front with semicircular area with radiating ridges and bounded by a ridge. Operculum ·1 × ·07 millim.

The species described above is most nearly related to *H. auriculata*, Busk, but differs in the following particulars:—The branches of *H. victoriensis* are double the thickness of those of *H. auriculata*; there are no oral avicularia and no trace of special pore in *H. victoriensis*.

Genus Porella, Gray.

Porella lævis, var. *subcompressa.*

Porella lævis, Hincks, Brit. Mar. Pol. p. 334, pl. xlvii. figs. 10, 11.
Porella lævis, var. *subcompressa*, Busk, Chall. Rep. p. 149, pl. xx. fig. 3.

Geographical distribution of P. lævis.—Norway, 30-300 fath.; Greenland; Nova Zembla; Kara Sea.

Geographical distribution of P. lævis, *var.* subcompressa. —Porto Praya, St. Iago, Cape Verd, 100-150 fath. ('*Challenger*'); Port Phillip.

It will be seen from the above list of localities that the range of this species extends over a very wide area.

Suborder CYCLOSTOMATA.

Family **Tubuliporidæ**.

Genus IDMONEA, Lamouroux.

Idmonea marionensis, Busk.

For references and localities see Busk, Chall. Rep., Polyzoa, pt. ii. p. 11.

Family **Horneridæ**.

Genus HORNERA.

Hornera lichenoides, Linn.

For geographical distribution see Busk, Chall. Rep., Polyzoa, pt. ii. p. 16.

Family **Tubuliporidæ**.

Genus ENTALOPHORA, Lamouroux.

Entalophora parasitica, Busk.

The Port Phillip specimen presents one trifling difference from Busk's description. The surface of the zoœcia is whitish and marked with brown spots, instead of being brown and marked with white spots.

Hab. Attached to horny fibres of *Catenicella.*

Loc. New Zealand (*Busk*); Port Phillip.

Genus BIDIASTOPORA, d'Orbigny.

Bidiastopora torquata, n. sp. (Pl. II. figs. 2, 2 *a*, 2 *b*, 2 *c*.)

? *Bidiastopora compressa*, d'Orb.

Zoarium erect, dichotomously branched, the branches compressed, bilaminate, twisted on their long axes, diameter 1–1·3 millim. Zoœcia arranged in oblique half-spiral series, from five to nine in each series; zoœcia slightly projecting, surface obscurely granular in old cells, punctured in young cells; section of branches showing a transverse thin double lamina, which projects beyond the ends of the branches. Oœcia oval, ·8 millim. long by ·6 broad, with four to six zoœcial openings on surface.

The genus *Bidiastopora* was founded by d'Orbigny for the reception of forms with compressed branches, the cells on each side having a quincuncial arrangement, and with a lamina in the middle of the branches. The main difference between *Entalophora* (Lamouroux) and *Bidiastopora* lay in the fact that in the former the branches are compressed, in the latter rounded. In some parts of the zoarium the lamina may be obscure or even absent; but its occurrence in any part would indicate that the species should not be classed in the genus *Entalophora*.

In arranging the Cyclostomata systematically great importance is necessarily attached to the structure of the zoarium, since the individual zoœcia present such slight differences. The presence of the median double lamina is a sufficiently important structural characteristic to warrant the reintroduction of d'Orbigny's genus. In *Entalophora* (*Pustulopora*) the rounded branches are formed of fascicles of zoœcia, and a transverse section is porous throughout.

Family **Heteroporidæ?**

Genus HETEROPORA, Blainville.

Heteropora mæandrina, n. sp. (Pl. II. figs. 8, 8 *a*, 8 *b*, 8 *c*.)

Zoarium forming a thick crust, loosely encircling stems of *Amathia*; the surface marked with irregularly arranged ridges and depressions; the crests of ridges smooth and generally bare of zoœcial pores; zoœcial orifices circular, with thickened tuberculated border; zoœcia surrounded by five or six cancelli.

The specimen above described differs considerably from d'Orbigny's *Plethopora cervicornis* ('Paléontologie Française,' tom. v. p. 1045, pl. 799. figs. 4, 5), but resembles a specimen described and figured as *Heteropora cervicornis*, d'Orb., by Mr. Waters (Journ. Roy. Micr. Soc. vol. ii. p. 390, pl. xv.). MacGillivray's *Densipora corrugata* (J. R. S. V. 1880) appears to resemble very closely *Heteropora cervicornis*, d'Orb. The specimen from Port Phillip measures 10 × 7 millim.

A fully developed specimen of *H. mæandrina* would perhaps form a dendritic growth. D'Orbigny describes the branches of *Heteropora cervicornis* as being provided with large transverse tubercles, forming crests, with the cellules arranged along the middle, the base and intervals of these groups being pierced by a number of intermediate pores. In *H. mœandrina* the pores are deficient along the crests and fill up the floor of the depressions.

Along the length of the zoœcial tubes the pores and so-called septa can be seen as in other species of *Heteropora.*

Suborder Ctenostomata.

Family **Alcyonidiidæ.**

Genus Alcyonidium, Lamouroux.

Alcyonidium mytili, Dalyell. (Pl. II. figs. 6, 6 *a.*)

The cells are hexagonal and the septa between the cells distinctly visible.

Hab. Incrusting the stems and branches of *Amathiæ.*

The incrusting growth is probably not parasitic on the *Amathia*, since the contents of the biserial groups of cells of the latter are not absorbed, but the *Amathia* forms an efficient axial support. In Great Britain *A. mytili* incrusts shells, stones, and Algæ.

Geographical distribution. Great Britain, Cattegat, Baltic.

Family **Vesiculariidæ.**

Genus Amathia.

The following species of *Amathia* were represented in this collection :—

Amathia australis, Tenison-Woods.
—— *bicornis*, Tenison-Woods.
—— *biseriata*, Krauss.
—— *connexa*, Busk.
—— *lendigera*, Linn.
—— *Wilsoni*, n. sp.
—— *pinnata*, n. sp.
—— *Brongniartii*, Desmarest & Lesueur.

Amathia biseriata, Krauss.

Amathia biseriata, Krauss, Corallineen und Zoophyten der Südsee, p. 23, fig. 1, *a, b, c.*
? *Amathia inarmata*, MacGillivray, Trans. Roy. Soc. Vict. vol. xxiii. p. 183.

Excellent figures of this species are given in Krauss's memoir. The characteristic "ramis falcatis" mentioned by Krauss are a well-marked feature of the species, and enable the distinction to be made from *A. lendigera* and from *A. Brongniartii*, Desm. & Les.

Krauss mentions that the internodes are much shorter than in *A. lendigera.*

Amathia Wilsoni, n. sp. (Pl. II. figs. 4, 4 *a*.)

Zoarium formed of delicate, feathery, subcylindrical bunches or festoons. Branching of main branches tripartite, three branches given off at each node, two laterally and one posteriorly; internodes partly occupied on anterior surface only by from five to eight pairs of zoœcia; lateral and posterior branches (*i. e.* those given off at the nodes) branching pinnately, with the biserial groups of zoœcia on the upper surface, the last two or three internodes unoccupied by zoœcia (thus giving the plumose appearance to the zoarium); one of the anterior branches of each lateral branch much hypertrophied and with that of the opposite side forming an arch across the anterior surface of a main branch (thus giving the festoons a somewhat cylindrical appearance). Dimensions of zoœcia ·5 by ·14 millim. Stems whitish, thick, ·4 to ·5 millim. in diameter.

The system of branching of this beautiful species is highly characteristic. In the collection of the Natural-History Museum there is a specimen from Port Jackson.

Amathia Brongniartii, Desm. & Les. (Pl. II. figs. 3, 3 *a*.)

Zoarium reddish brown, branched dichotomously; internodes long, straight, occupied for nearly the whole length (except ·1 millim. at the lower end) by from ten to twelve pairs of rather broad zoœcia, ·5 × ·2 millim. Diameter of stems ·1 to ·15 millim.

A. Brongniartii differs from *A. biseriata*, Krauss, the branching of which is also dichotomous, in the internodes being straight, not curved ("ramis falcatis," Krauss), and in the greater length of the internodes. The posterior aspect of *A. Brongniartii* shows the zoœcia bulging beyond the stem on each side.

Through the kindness of Mr. Waters I have had the opportunity of looking through certain unpublished plates, engraved by Lesueur in 1829, in which are figured "polypiers flexibles" collected in Australia.

The manuscript by Desmarest and Lesueur explaining the plates was found by M. Pergens in the Paris Museum. In the 'Bulletin des séances de la Société royale Malacologique de Belgique,' tome xxii. (1887), M. Pergens gives a list of the names of species given by Desmarest and Lesueur, and appends thereto a list of names given by later authors. The greater part of the collection is preserved in the Havre Museum, the remainder having been lost. In the figures of Lesueur several well-known species can be recognized.

The following names of species of *Amathia* are copied from the list of M. Pergens:—

Desmarest and Lesueur.	*M. Pergens.*
Sirinx Archimedi.	Amathia spiralis, telle que Busk (Chall. Rep. Polyzoa, ii. p. 34, pl. vi. fig. 2) figure. Je doute si c'est réellement l'espèce de Lamouroux.
—— spinosa.	—— bicornis, *Tenison-Woods.*
—— cruciformis.	—— connexa, *Busk.*
—— circumplicata.	—— crispa, *Lamarck.*
Amathia Brongniartii.	——, sp.
—— Lemanii.	—— cornuta, *Lamarck.*

The specimen described and figured by Busk as *Amathia spiralis*, Lamouroux, is probably *A. convoluta*, Lamouroux. The zoœcia of the spiral are exsert, and not adnate to the stem along their inner surfaces.

Amathia pinnata, n. sp. (Pl. II. figs. 5, 5 *a*.)

Zoarium pinnately branched; internodes long, occupied for five sixths of their length by from twelve to sixteen pairs of zoœcia; zoœcia on the same face of the stem. Dimensions of zoœcia about ·5 × ·11 millim.; breadth of stems ·25 millim.

The characteristic feature of this species is the regular pinnate branching. Where the zoœcia do not present any special characteristic, the arrangement of the zoœcia on the stems and branches and the mode of branching are almost the sole means for classifying the species of this genus.

Family **Cylindrœciidæ.**

Genus Cylindrœcium, Hincks.

Cylindrœcium altum, n. sp. (Pl. II. figs. 7, 7 *a*.)

Zoarium forming a slender, creeping, network stolon, dilating at the nodes of the network into expansions, whence arise erect, tubular, branching (?) zoœcia. Zoœcia very tall, opaque, contracted at base, where they joined the expansions of stolon. Height of fully developed zoœcia 4·6 millim.; breadth from ·16 to ·2 millim.; breadth of stolon ·02 millim.

C. altum is closely allied to *C. giganteum*, Busk (Quart. Journ. Micr. Sci. vol. iv. p. 93, pl. v. figs. 1, 2). In *C. altum* the zoœcia are higher and narrower than those of *C. giganteum* and are contracted at the base. *C. altum* more nearly resembles *C. dilatatum* as regards the characters of the stolon.

The respective dimensions of the zoœcia of these three species are as follows:—

	Length.	Breadth.
C. giganteum	3·5	0·20–0·25
C. dilatatum	0·9	0·13
C. altum	4·6	0·16–0·2

In the absence of more specimens it would be rash to assume that the "branching" in *C. altum* is a normal and constant condition of that species, and not a mere sport. The reasons for caution are, firstly, that several cells of the solitary specimen of *C. altum* are not branched, and secondly, that branched cells are occasionally met with in other species of *Cylindrœcium*. The "branched" condition of zoœcia might be accounted for in three ways:—

1. The main zoœcium may bifurcate or may produce a secondary zoœcium by budding, the polypide of the bud later remaining in organic connexion with that of the primary cell. *Anguinella palmata*, Van Beneden, presents the nearest resemblance to a *Cylindrœcium* with branching zoœcia.

2. Embryos may settle down on the zoœcial tubes and there develop; such a condition is well seen in the Hydroid *Tubularia indivisa*.

3. Portions of stolon may become fixed to the walls of a zoœcium, and a zoœcium develop at that point.

Judging from the specimen, any one or all of these events may have taken place, for zoœcia can be seen growing from the walls of primary zoœcia and unconnected with stolon; others again have a portion of stolon-tube growing from the attached base; and, lastly, one cell has bifurcated.

Cylindrœcium papuense, Busk.

Hab. Growing on *Amathiœ*.

Loc. Station 188, lat. 9° 59′ S., long. 139° 42′ E., 28 fath. ('*Challenger*').

Group *ENTOPROCTA*.

Family **Pedicellinidæ**.

Genus PEDICELLINA.

Pedicellina cernua, Pallas.

The Port-Phillip specimen differs from those found in European waters in having the stalks shorter and thicker in comparison with the heads of the polypides. The stalks are covered with spines and much contracted at the point of junction with the polypides.

Hab. Creeping on Algæ.

Genus ASCOPODARIA, Busk.

Ascopodaria gracilis, Sars.

Hab. The jointed reticulate stolon creeps on Algæ. Five or six stolon-shoots radiate out from the base of each polypide-stalk and join with those from other polypides to form an almost regular reticulum. The upper end of the chitinous portion of the polypide-stalks is pointed on one side as in *A. fruticosa*, Hincks.

EXPLANATION OF PLATE II.

Fig. 1. *Haswellia victoriensis*, n. sp. 1 *a*. Portion of branch, magnified (the zoœcia are seldom arranged so regularly as in figure). 1 *b*. Operculum.

Fig. 2. *Bidiastopora torquata*, n. sp. 2 *a*. Portion of branch, magnified. 2 *b*. Section, showing double lamina. 2 *c*. Section of an *Entalophora*.

Figs. 3, 3 *a*. *Amathia Brongniartii*, Desm. & Les. (the zoœcia should be longer).

Fig. 4. *Amathia Wilsoni*, n. sp., posterior aspect. 4 *a*. The same, magnified, posterior aspect; the zoœcia of anterior aspect are just visible to the left of main branch.

Figs. 5, 5 *a*. *Amathia pinnata*, n. sp.

Figs. 6, 6 *a*. *Alcyonidium mytili*, Dalyell.

Fig. 7. *Cylindrœcium altum*, n. sp. 7 *a*. Piece of stolon-tube at base of attached zoœcium.

Fig. 8. *Heteropora mæandrina*, n. sp. 8 *a*. Magnified. 8 *b*. Zoœcium surrounded by cancelli. 8 *c*. Longitudinal section, showing pores.

III.—*On the Fructification of two Coal-measure Ferns.* By ROBERT KIDSTON, F.R.S.E., F.G.S.*

[Plate I.]

CROSSOTHECA, Zeiller, 1883.

Crossotheca, Zeiller, Ann. d. Sc. Nat. 6e sér. Bot. vol. xvi. p. 180; id. Flore foss. d. bassin houil. d. Valenciennes, p. 33, fig. 21.
Sorotheca, Stur, Zur Morph. u. Syst. d. Culm- u. Carbon-Farne, p. 175; id. Carbon-Flora, i. p. 273.
Sorocladus, Lesquereux (in part), Coal Flora, vol. i. p. 327.

Description.—Fertile and barren pinnules dissimilar, the fertile pinnules having the limb much reduced. Sporangia exannulate, tapering to a point at the apex, contiguous, more or less united among themselves, and suspended like a fringe from the margin of the fertile pinnule.

Remarks.—This genus has been described and illustrated by Zeiller in the Ann. d. Sc. Nat. (*l. c.*) and in his 'Flore foss. d. bassin houil. d. Valenciennes.' In this latter work he gives additional and fuller figures of *Crossotheca Crepini*, Zeiller †, the type of the genus, and also figures a second species, *Crossotheca Boulayi*, Zeiller ‡.

The name of *Sorotheca* has been applied to the same plants by Stur; but his paper containing the description of his genus did not appear till some months after the issue of that in which Zeiller's genus *Crossotheca* was defined.

Probably *Sorocladus sagittatus*, Lesqx. §, is referable to *Crossotheca*; but *Sorocladus*, Lesquereux, has been employed by him merely as a genus in which to place "fructifications of ferns in separate branches and of unknown attribution" without any attempt at a definition, and, in fact, it embraces fructifications belonging to ferns of very different generic affinity.

The sporangia of *Crossotheca* are linear, the base being slightly broader than the tapered apex. They are unprovided with an annulus, and the walls are composed of cells elongated in the direction of their axis. The sporangia are placed close together, and it is difficult to determine whether they are free or united to each other. According to Zeiller

* Communicated by the Author, having been read before the Royal Physical Society of Edinburgh, April 18, 1888.

† *Loc. cit.* p. 112, pl. xiii. figs. 1–3.

‡ *Loc. cit.* p. 115, pl. iv. fig. 4.

§ Coal Flora, vol. i. p. 329, pl. xlviii. figs. 10 and 10 *b*, vol. iii. p. 762, pl. C. figs. 4–5.

they appear to be united in pairs or perhaps in fours at the extremities of veins which are given off from a swelling of the pedicel that terminates in a thickening in the centre of the fertile pinnule.

It should be mentioned that what are here treated as exannulate sporangia are regarded by Stur as portions of an indusium which has burst at maturity into valves. This view, however, appears to be entirely at variance with the structure of the organs under consideration.

Among fossil genera *Crossotheca* approaches most closely to *Calymmatotheca*; but in the latter genus the sporangia are not attached around the margin of a prominent disk, nor are they so fully united to each other. In *Calymmatotheca* the branches bearing them are also entirely deprived of foliage-pinnules, and ramify by a series of dichotomies; and, as far as observation has shown, the fruiting pinnæ are only borne at the base of the frond.

Crossotheca fimbriata, Kidston, n. s.
(Pl. I. figs. 1–8.)

Description.—Frond tripinnate, pinnæ deltoid, subalternate. Fertile and barren pinnæ dissimilar. Fertile pinnules simple, with the limb much modified; sporangia exannulate, linear, numerous, united to each other and suspended from a central disk, which is borne at the summit of a slender pedicel. Barren pinnules divided into from two to seven single-veined, simple or bifid, linear segments, according to their position on the pinna.

Remarks.—The specimens of *Crossotheca fimbriata* which I have the pleasure of describing were communicated to me by Mr. William Hemingway, to whom my thanks are due for the opportunity of examining this interesting addition to the Coal-measure flora of Britain.

Figs. 1–3 show portions of what are probably primary pinnæ; at the right of the pinna in fig. 1 is a small fragment of a rachis, to which probably the fruiting pinna was attached.

The sporangia are borne as a fringe at the margin of what appears to have been an oval disk. This disk and, more particularly, the sporangia appear to have possessed a considerable thickness of tissue, which contrasts markedly with the delicate structure of the barren pinnules. The sporangia are converted into a bright, brittle, carbonaceous substance, so that in splitting the stone in almost all cases they are more or less fractured; and, further, in no case where they are at all well preserved have I been able to discover a complete fruiting pinnule, one half of each pinnule having apparently adhered to each side of the matrix when the stone was split. Thus there is only one half of the disk with its surrounding fringe of sporangia shown respectively on the fossils and their counterparts.

Figs. 4 and 5 represent each two fruiting pinnules, magnified six and a half times. These figures are drawn under the microscope with the camera lucida, and every endeavour has been taken to avoid any "restoration;" so that those who cannot see the originals may form their own conclusions from the drawings.

Fig. 4 is an enlargement of the two fruiting pinnules marked *a* in fig. 1. Both these pinnules, as already mentioned, are split through the middle, so that only half the disk and its fringe of sporangia are shown. The sporangia appear to have depended almost at right angles from the margin of the supporting disk. In no case did I see any trace of a thickened vein in the disk-like portion of the pinnule like that figured and described by Zeiller (see fig. 9).

Owing to the fruiting pinnules being split in two—and this arises evidently from the comparatively thick mass of coaly matter into which they have been converted—the pinnules have the appearance of being attached to the pedicels by their centre, within the fringe of sporangia; but in reality I believe the pedicels are attached to the outside edge of the fruiting pinnules, like a leaf to its stalk, and that the pedicel is bent into a knee, which causes the pinnule to assume a horizontal position. The apparent *peltate* attachment of the fruiting pinnules to the pedicels is therefore probably caused by the pinnule *lying upon* the pedicel and concealing the upper part of it.

Fig. 5 exhibits very much the same characters as fig. 4.

Fig. 6 shows four sporangia, enlarged eighteen times. The form of the sporangia is better shown here than in the previous figures. This figure is part of the fruiting pinnule marked *b* in fig. 1. The sporangia are linear and apparently blunt-pointed, as shown by that to the left; the other three are probably broken over at their apices. They all show, especially those to the left, an apparent basal contraction which ends in a short pedicel. The sporangia are clearly united to each other and only free at the apex. For the purpose of comparison I have given a copy of a fruiting pinnule of *Crossotheca Crepini*, as figured by Zeiller (fig. 9).

The barren pinnules of *Crossotheca fimbriata* are of very delicate texture, and though they frequently occur on the same slabs as the fruiting specimens they are seldom well preserved. Two fragments are shown in figs. 7 and 8. Barren pinnæ have been observed attached to the same rachis as the fruiting pinnæ, and in one case one of these fruiting pinnæ has a few barren pinnules interspersed with the fruiting ones.

Crossotheca fimbriata in the barren condition seems undistinguishable from *Calymmatotheca schatzlarensis*, Stur *. The figures given by Stur are somewhat indistinct, especially that showing the fruit of his fern (fig. 2), from which really nothing can be learnt of the form and structure of the fructification. In his description he refers to the imperfect preservation of the fruit of his specimen, but among other remarks mentions that the fruit contains four or five sporangia (valves (Klappen) of an indusium according to Stur), which are directed downwards and only free at their upper part, that the upward directed portion of the fructification to which the supporting stalk is attached is convex, and that the fruit is 2–3 millim. long and 1·2–1·4 millim. broad. Notwithstanding the somewhat imperfect condition in which the fruit is said to be, a very distinct woodcut of the same is given on p. 238, fig. 40. Accepting, then, this figure and description as correct, *Crossotheca fimbriata* is essentially distinct from *Calymmatotheca schatzlarensis*, Stur. In *Crossotheca fimbriata* the *synangia* are broader than long, having a breadth of from 3–4 millim. and a length of about 2 millim. in the compressed condition. Again, in *Crossotheca fimbriata* the sporangia are numerous, narrow, oblong, or linear, and are united to each other throughout almost the whole of their length. The fructification of the two species is therefore altogether dissimilar. It is possible that the specimens examined by Dr. Stur were not so fully developed as those figured by me, for on some of the small slabs from Yorkshire, on which the fruit appears to be younger and scarcely so well preserved as in the specimens I have figured, the entire synangium is oval and but little broader than long, and in this condition it has a much closer approach in general appearance to fig. 40 given by Stur on p. 238 of his ‘Carbon-Flora’ than to those given on my plate.

The affinities of *Crossotheca fimbriata* are clearly *Marattiaceous*. In the union of the sporangia to each other, their attachment to an oval (or circular) disk, and in their forming a cup-like synangium, they have a considerable similarity to the synangia of *Kaulfussia*, Blume; but in *Kaulfussia* the synangia are scattered on the back of the frond, not on portions of the frond specially metamorphosed for fructification.

* Carbon-Flora, i. p. 265, pl. xxxviii. figs. 1, 2 (1885).

Localities.—Monkton Colliery, near Barnsley, and East Gawber Colliery, Barnsley, Yorkshire.

Horizon.—Middle Coal-measures; Shale over "Barnsley Thick Coal."

CYCLOTHECA, Kidston, n. g.

Description.—Sporangia small, free, sessile, circular, exannulate, and arranged in two parallel rows.

Remarks.—In structure the individual sporangia approach closely to those of *Myriotheca*, Zeiller *, but in *Myriotheca* the sporangia are oval and cover the whole of the lower surface of the pinnules.

In *Renaultia*, to which *Cyclotheca* has also some affinity in the structure of the sporangia, the sporangia are situated at the extremities of the veins either singly or in groups of from two to five. *Cyclotheca* differs from both these genera in the sporangia being circular and arranged in two parallel rows—probably one row was situated on each side of the midrib of the fruiting pinnule.

Cyclotheca belongs to the Marattiaceæ, and is more closely related by the structure of its sporangia to *Angiopteris* than to any other recent genus.

Cyclotheca biseriata, Kidston, n. s.
(Pl. I. figs. 10–12.)

Description.—Characters of genus. The sporangia measure ·50 millim. in diameter, and their walls are composed of small cells not elongated more in one direction than the other.

Remarks.—This species is founded on a single specimen which was collected by Mr. P. Jack near Baillieston. Fig. 10 shows the fossil, natural size. It consists of several pinnæ lying on each side of the rachis, of which a small fragment is shown towards the centre of the figure. With the exception of this fragment of rachis there is nothing preserved in the fossil but the parallel rows of sporangia. These are well preserved and shown at fig. 11, magnified six and a half times. At fig. 12 are given four sporangia, magnified twenty times. Although no trace of a midrib is shown, one probably lay between the parallel rows of sporangia.

The small specimens originally figured by Lesquereux as *Staphylopteris asteroides* † probably belong to the genus *Cyclotheca*.

* Ann. d. Sc. Nat. 6e sér. vol. xvi. Bot. p. 186, pl. ix. figs. 18–20; also Flore foss. du bassin houil. d. Valenciennes, p. 32, fig. 19.

† Rep. Geol. Survey of Illin. vol. iv. pl. xiv. figs. 8–10.

It is impossible to say to which fern the Baillieston fructification belongs. As the fruiting portion of ferns often assumes an outline so entirely different from that of the barren condition, I refrain from any suggestion upon this point.

Locality.—Ellismuir, Baillieston, Lanarkshire.

Horizon.—Lower Coal-measures: shales above the "Killongue" Coal.

Note.—Since this paper was put into type I have been favoured by my friend, M. Crépin, Director of the State Botanical Gardens, Brussels, with two fruiting specimens of *Calymmatotheca schatzlarensis*, Stur, from one of the original localities—Charbonnage de l'Agrappe, Framerier (Fosse Grand Trait), Belgium. With these I have compared the Yorkshire examples, and find that the plant I had named *Crossotheca fimbriata* is the *Calymmatotheca schatzlarensis*, Stur. The woodcut given by Stur of the fruit of his fern (*l. c.* p. 238, fig. 40) is therefore quite misleading, and does not at all represent the fruit of the plant from the same locality which has been forwarded to me by Mons. Crépin under Stur's name. In fact the description Stur gives of his admittedly badly preserved fruit leads one to inquire whence the evidence has come for the creation of his fig. 40.

The fossil remains, however, in the genus *Crossotheca*, but under the name of *Crossotheca schatzlarensis*, Stur, sp.

Stirling,
June 6, 1888.

EXPLANATION OF PLATE I.

Crossotheca fimbriata, Kidston.

Figs. 1–3. Fruiting pinnæ.
Figs. 4 & 5. Synangia, enlarged $6\frac{1}{2}$ times.
Fig. 6. Portion of a synangium, enlarged 18 times.
Figs. 7 & 8. Fragments of barren pinnæ.

Crossotheca Crepini, Zeiller.

Fig. 9. Fruiting pinnule, enlarged 5 times (after Zeiller).

Cyclotheca biseriata, Kidston.

Fig. 10. Specimen, natural size.
Fig. 11. Sporangia, enlarged $6\frac{1}{2}$ times.
Fig. 12. Sporangia, enlarged 20 times.

IV.—*Monographic Note on the Rotifera of the Family* Asplanchnidæ. By M. Jules de Guerne *.

As previously indicated, one of the most remarkable types of the pelagic fauna of the Lagoa Grande is a new Rotifer of the genus *Asplanchna.* I give the description of it below, and follow it with a summary investigation of the family Asplanchnidæ. Having been struck long since with the fact that its representatives exist in almost all lacustrine faunas, I had collected numerous documents upon most species of the group. The present work furnishes a very natural opportunity to coordinate these.

Asplanchna Imhofi, sp. nov. (Fig. 1.)

Diagnosis.—Femina. Corpus ovato-globosum, pellucidum; maxillæ duobus tantum ramis compositæ, robustæ, elongatæ, apice paululum incurvato, bifido; rami in medio unco valido interno armati; ramorum basis triangularis, solida, hamulo externo superne instructa.

Mas ignotus.

Long. mill. 0·45–0·50, lat. mill. 0·30–0·35.

The dimensions, taken from specimens fixed by osmic acid or plunged while alive into alcohol, are certainly below the reality. The animals have undergone a violent contraction and must be much larger when alive.

The body is globular and extremely transparent, with the exception of the stomach, as in all the species of the genus. I have seen no oculiform point. The masticatory apparatus, composed only of two pieces, is very characteristic; it differs from that of all known *Asplanchnæ* (fig. 1); its form is constant, and I have observed it in a great number of specimens.

Locality.—This species is exceedingly abundant in the produce of pelagic fishings made in the Lagoa Grande at

* Extracted from a volume published at the cost of His Highness Prince Albert of Monaco, who has been kind enough to permit us to translate this chapter. The work is entitled 'Excursions Zoologiques dans les îles de Fayal et de San Miguel (Açores),' and the materials for it were collected by the author during the third scientific expedition into the North Atlantic, made in 1887 by His Highness Prince Albert of Monaco in his yacht 'l'Hirondelle,' the Prince having invited M. Jules de Guerne to accompany him as zoologist.

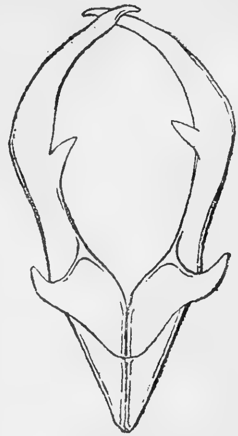
Sete Cidades. It is found in comparatively small numbers in the surface-fishings, but swarms at a certain depth.

No doubt this Rotifer feeds by preference at night; the stomachs of the numerous individuals which have passed under my eyes, and which I examined carefully in order to detect Protozoa in them, were absolutely empty.

I have seen no males, and it is probable that at the period of my investigations (July 9) they are still very rare. The winter eggs, however, had not made their appearance.

I beg Dr. O. E. Imhof, of the University of Zurich, to accept the dedication of this new species of *Asplanchna*. This homage is due to him for the series of interesting memoirs in which he has been the first to show the considerable part taken by the Rotifera in the constitution of the lacustrine pelagic faunas.

Fig. 1.



Masticatory apparatus of *Asplanchna Imhofi*, × 700.

The figure does not sufficiently show the bifid character of the extremities of the jaws.

The *Asplanchnæ* are not rare animals, as seems to be thought by various English authors, as, for example, by Hudson, with reference to *A. Ebbesbornei* (Hudson and Gosse, 'Rotifera,' vol. i. p. 122). We have only to seek them where they are to be found and with suitable apparatus; they are then taken in enormous quantities. This is so true that, notwithstanding their extreme transparency, certain observers have detected them as it were in spite of themselves. This has been the case especially with Herrick when collecting the Entomostraca of Minnesota. The American author, however, does not seem to have appreciated at its full value the importance of a discovery which has just furnished a new and remarkable example of the singular homogeneity of the lacustrine pelagic faunas and the vast geographical distribution of the types which constitute it. Nevertheless Herrick has figured one of the *Asplanchnæ* which he collected so clearly to enable us to recognize in it an undescribed species and to describe it, at least briefly.

Asplanchna Herricki, sp. n. (Fig. 2.)

Herrick, "Final Report on the Crustacea of Minnesota, included in the Orders Cladocera and Copepoda," pl. v. figs. 8, 9 (in the Twelfth Annual Report Geol. Nat. Hist. Surv. of Minnesota, 1884), and "Notes on American Rotifers," Bull. Sci. Labor. Denison Univ. vol. i. p. 61 (1885).

Diagnosis.—Femina. Corpus lageniforme; maxillæ duobus tantum ramis compositæ, validæ, margine interno fere recto, unco robusto terminatæ, apice interne haud denticulato.

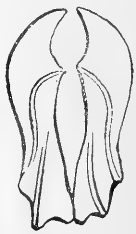
Mas ignotus.

Long. ?

In the explanation of his plate v. Herrick asserts that his *Asplanchna* is hermaphrodite; but this is not probable. As to the resemblance between the present species and *A. Brightwelli*, indicated by the author in his second memoir, this simply shows that the comparison was not carefully made. We have only to glance at the masticatory apparatus of the two types to see how different they are.

Locality. Minnesota, United States.

Fig. 2.



Masticatory apparatus of *Asplanchna Herricki* (after Herrick).

Before Herrick, a German entomologist, Kramer, well known for his works on the Acarina, had the opportunity (probably in seeking after the freshwater Acarina) of meeting with a species of *Asplanchna.* Examined and figured by Kramer, although imperfectly, this Rotifer has not received a name. The form of its maxillæ appears, however, to distinguish it from all its congeners.

Asplanchna Krameri, sp. n. (Fig. 3.)

Kramer, "Eine Bemerkung über ein Räderthier aus der Familie der Asplanchneen," in Archiv für Naturg. Jahrg. 1876, vol. i. pl. viii. figs. 1–4.

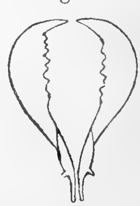
Diagnosis. — Femina. Corpus globosum; maxillæ duobus tantum ramis compositæ, curvatæ, ad basin graciles, extremitate valida, cultriformi, margine interiore denticulato.

Mas ignotus.

Long. 0·5 mill.

Locality. Schleusingen?

Fig. 3.



Masticatory apparatus of *Asplanchna Krameri* (after Kramer).

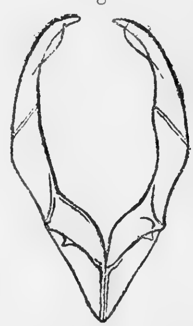
Lastly, the following is the description of a species which has been communicated to me by M. Jules Richard, and which I cannot refer to any known form.

Asplanchna Girodi, sp. n. (Fig. 4.)

Diagnosis.—Femina. Corpus globosum; maxillæ duobus tantum ramis compositæ, elongatæ, validæ; rami apice bidentati, dente uno curvato, subobtuso, altero compresso, lamelloso.
Mas ignotus.
Long. 0·85, lat. 0·55 mill.

This *Asplanchna*, which must certainly attain a length of 1 millim. (the above measurements are taken from specimens contracted in alcohol), is distinguished among all its congeners by the lamellar tooth of its masticatory apparatus (fig. 4).

Fig. 4.



Masticatory apparatus of *Asplanchna Girodi,* × 500.

Locality. Found first of all in small quantities by M. J. Richard in the neighbourhood of Vichy (Allier) in the pond of Cognet, on 16th September, 1886, this Rotifer has since been collected by the same zoologist in Lake Chambon (Puy-de-Dôme) at an elevation of 880 metres, on 15th August, 1887. I proposed at first to dedicate this species to the young and zealous naturalist who discovered it; but M. Richard, by a sentiment which does him honour, has begged me to attach to it the name of Dr. Girod, Professor in the Faculty of Sciences of Clermont, under whose guidance his first work was performed *.

In the following table I have summarized, in an artificial manner (which, however, I have endeavoured to render clear and practical), the principal characters of the known species of the genus *Asplanchna.* It seemed to me that the distinctions should as far as possible be derived from the masticatory

* It is to the initiation of Dr. Girod that we owe the investigations at present in progress upon the fauna of the Auvergne, investigations in the course of which M. J. Richard has not only met with the *Asplanchna* above described, but with many other interesting types, the lists of which he will soon publish.

apparatus, which seems to vary very little in the same species. Moreover the mastax, which resists the digestion of certain fishes to such an extent that it may be recognized in their intestine, may serve to determine the types obtained by distant fishings and mounted on the spot. It will often happen, however, especially in the case of pelagic faunas, that the *Asplanchnæ* will occur in great numbers and that it will be easy to break up many specimens for the purpose of study.

The dichotomic table will have to be kept up with the progress of science. It is possible that future discoveries will compel us to transfer from the first division into the second the species of which the male is unknown. At present, I assume, until there is evidence to the contrary, that all the forms of which the female alone is described have globular males destitute of appendages.

It will be observed that I have not introduced into the table either *Asplanchna intermedia*, Hudson, and *A. triophthalma*, Daday *, which are not well defined, or *A. myrmeleo*, Ehrenb. This last, it seems to me, must be taken as the type of a new generic group, which I will name *Asplanchnopus*. This name, like the separation of the genus, is founded upon the remarkable peculiarity presented by *A. myrmeleo* of the possession of a foot. The presence of this rudimentary organ seems to indicate in this Rotifer a less advanced degree of adaptation to a pelagic life than in the true *Asplanchnæ*. From this point of view it would present some analogy with *Notops*. The male has not yet been met with. It would be the more interesting to ascertain whether, like the other sex, it has retained a vestige of the foot, because all the males of the class are singularly atrophied.

* Hudson, "On some Male Rotifers," in Monthly Micr. Journ., February 1875, p. 53, pl. xci. fig. 7, and Hudson & Gosse, *loc. cit.* vol. i. p. 122, note. Von Daday, "Neue Beiträge zur Kenntniss der Räderthiere," in Math. u. naturwiss. Berichte aus Ungarn, vol. i. p. 263 (1883). The following is the diagnosis of *A. triophthalma* :—"Corpus truncato-ovatum ; ocellis tribus, duobus marginalibus, una majore collari ; organo rotatorio simplice, parum undulato ; fronte organis tentaculatis ; pede anoque caret. Longit. corp. $0^{mm}{\cdot}8$–$1^{mm}{\cdot}2$."

According to the author this Rotifer, one of the largest known, would closely resemble *A. Sieboldi*, Leyd. ; the male, however, is globular. Von Daday gives no particulars as to the mastax. Its locality is Mezö-Zäh (Hungary ?).

It will also be remarked that no mention is made of *A. Bowesi*, Gosse. Even according to the naturalist who has described it, this species does not differ from *A. Brightwelli* (Gosse, "A Catalogue of Rotifera found in Britain," in Ann. & Mag. Nat. Hist. ser. 2, vol. viii. p. 200).

Table of the Species of the Genus Asplanchna.

Body	globular in both sexes; masticatory apparatus	formed of four pieces; median piece	wide, with the inner margin straight, extremity denticulated; denticulations	six in number, outer piece strongly arcuate	*A. helvetica*, Imhof.
				more numerous, the terminal tooth very long; outer piece scarcely arcuate	*A. priodonta*, Gosse.
			narrow, arched, with a strong tooth on its inner margin		*A. Brightwelli*, Gosse.
		formed of two pieces	wide, robust, not denticulated on the inner margin		*A. Herricki**, De Guerne.
			rather wide, denticulated on inner margin, base slender		*A. Krameri**, De Guerne.
			narrow, inner margin arcuate, distant from each other; extremity bidentate;	a faintly marked tooth towards the middle of the inner margin	*A. syrinx**, Ehrenb.
				a strong tooth towards the middle of the inner margin ..	*A. Imhofi**, De Guerne.
				no tooth on inner margin; one of the terminal teeth lamellar	*A. Girodi**, De Guerne.
	furnished with appendages	in the two sexes; masticatory apparatus formed of two pieces			*A. Ebbesbornei*, Hudson.
		only in the male; masticatory apparatus formed of four pieces			*A. Sieboldi*, Leydig.

* Male unknown.

Asplanchnopus, gen. nov.

(Etymology: *Asplanchna* and ποῦς, foot.)

Diagnosis.—Femina. Corpus ovato-globosum, pellucidum, pede bifido minimo ventrali instructum; maxillæ duobus tantum ramis compositæ; rami incurvati, validi, apice acuto simplici.
Asplanchnopus generi *Asplanchna* dicto ceterum valde affinis.
Mas ignotus.

This Rotifer must also resume the specific name *multiceps*, which was given to it by Schrank as long ago as 1793, and which Ehrenberg changed in opposition to the rules of nomenclature.

Asplanchnopus multiceps, Schrank (sp.).

1793. *Brachionus multiceps*, Schrank, "Mikroskopische Wahrnehmungen," in Naturforscher, vol. xxvii. p. 30, pl. iii. figs. 16–19.
1803. *Brachionus multiceps*, Schrank, Fauna Boica, vol. iii. pt. 2, p. 139.
1835. *Notommata myrmeleo*, Ehrenberg, "Dritter Beitrag &c.," in Abhandl. Akad. Wiss. zu Berlin, 1833, pp. 214, 215.
1838. *Notommata myrmeleo*, Ehrenberg, Die Infusionsthierchen, p. 425, pl. xlix. fig. I, 1-3.
1854. *Notommata myrmeleo*, Leydig, "Ueber den Bau &c. der Räderthiere," in Zeitschr. f. wiss. Zool. Bd. vi. pp. 20–24, pl. iv. fig. 36.
1884. "Deadly enemy to *Chydorus*," Herrick, "Final Report &c." in Twelfth Ann. Rep. Geol. and Nat. Hist. Survey of Minnesota, pl. v. figs. 10, 11.
1885. *Asplanchna myrmeleo*, Plate, "Beiträge zur Naturg. der Rotatorien," in Jenaische Zeitschrift, Bd. xix. pp. 73–83, pl. iii. figs. 31–33, 35, 36.
1885. *Asplanchna magnificus*?, Herrick, "Notes on American Rotifers," in Bull. Sci. Labor. of Denison University, vol. i. p. 60, pl. ii. fig. 2.

Considering the instruments which he had at his disposal, Schrank very well investigated *Asplanchnopus multiceps*. The name that he gave it, however, has its origin in an error of observation, which was likewise committed by Ehrenberg. These naturalists mistook for so many rotatory organs the groups of cilia which better means of investigation have enabled us to study more completely. Further, both of them regarded the rudiment of the foot as lateral, whilst it is in reality ventral, as Leydig was the first to indicate *.

At any rate the "vielköpfiges Kapselthier" furnished Schrank with the subject of interesting observations. He says that it is met with frequently in stagnant but clear

* Leydig, *loc. cit.* p. 20, pl. iv. fig. 36. See also Plate, *loc. cit.* pl. iii. fig. 31.

water. Although it is one of the largest known Rotifera, its extreme transparency has concealed it from observation. It would remain invisible if its viscera were not generally filled with yellowish matter. Yet it is very difficult to distinguish in a somewhat strong light *.

Schrank gave four figures of this animal, and from these it appears that he had grasped the general features of its organization. Nevertheless many details are wanting, and the mastax, among other things, was not observed; but there is no doubt as to the identity of the species, as Ehrenberg has already recognized, although, as I have stated, he changed the name †.

It is to be remarked that *Asplanchnopus multiceps* is the only type of the family which possesses maxillæ terminating in a simple acute point ‡.

Gosse seems to think § that this Rotifer is destitute of a contractile vesicle; but this is very improbable, considering the contrary and concordant observations of Ehrenberg, Leydig, and Plate.

I think that we must identify with *A. multiceps* the species recently described by Herrick under the name of *Asplanchna magnificus*, and previously figured by him with no other indication than this:—"Deadly enemy to *Chydorus.*" Truth, however, compels me to add that the figures of the American author surpass in mediocrity anything that it is possible to imagine. The little engravings given by Schrank in 1793 are indisputably better than these quite recent figures.

Asplanchnopus multiceps, which was discovered by Schrank at Ingolstadt in Bavaria, was found at Berlin by Ehrenberg, in the neighbourhood of Wurzburg by Leydig, and more recently at Bonn and at Bremen by Plate. Lastly, it has

* Schrank, 'Naturforscher,' xxvii. pp. 30–32. It is certain that the transparency of the Rotifera of the family Asplanchnidæ renders their capture very difficult in the vessels in which they are kept alive. I have had to seek in vain for a long time for one of these animals in water which I knew to be full of it. No doubt this circumstance, coupled with the minuteness of their size, has hitherto prevented the discovery of the males of several species.

† In 1838. Ehrenberg does not appear to have been acquainted with Schrank's work when he first described *Notommata myrmeleo*.

‡ From the description ("rami with singly pointed ends") and fig. 32 in the text of Gosse and Hudson (*loc. cit.* vol. i. pp. 29 and 120) it might be thought that this is also the case in *Asplanchna Ebbesbornei*; but fig. 3 *e* in pl. xi. bears an indication of a small tooth, much more marked still in fig. 15 of pl. x. of the previous memoir by Hudson (Journ. Roy. Micr. Soc. ser. 2, vol. iii., 1883).

§ Hudson and Gosse, *loc. cit.* vol. ii. p. 134.

been met with in Scotland, at Dundee (according to Gosse, in Hudson and Gosse, *loc. cit.* vol. ii. p. 134), and, if the identification above proposed be accepted, at Minnesota in the United States.

As regards the numerous forms of the genus *Asplanchna* their geographical distribution is scarcely known. First studied in Germany and in England, for a long time they were noticed only in those countries; but more recently, as investigations have become more numerous, and especially as the work relating to the pelagic faunas has been greatly extended, these Rotifera, formerly reputed rare, have seemed to become more and more common. Thus, *A. helvetica*, discovered in Switzerland by Imhof, exists in a great number of lakes of Northern Italy, Austria, and North * and South Germany. It is probable that the *Asplanchnæ* indicated by Imhof † first in Alsace and then in the harbours of Lubeck and Stockholm, and by Nordqvist ‡ in Russia and in Finland, also belong to this species.

M. J. Richard informs me that he has taken it in great numbers in several lakes of the Auvergne (Bourdouze, elevation 800 m.?, and Montcineyre, 1170 m., in the department of the Puy-de-Dôme). I have collected it in abundance in the Lac d'Enghien, near Paris; lastly, Prof. Moniez sends me an *Asplanchna* captured at Lille, which also closely approaches *A. helvetica*. It will be seen that since its discovery in France by Imhof, in the lakes of Annecy and Bourget §, this Rotifer has been met with at various points very distant from each other. The same will certainly be the case in different regions.

I am now, thanks to the scientific zeal of my friend Charles

* Dr. Zacharias who first met with *A. helvetica* in North Germany, and who discovered the males of the species, appears inclined to identify it with *A. priodonta*, Gosse. There is room for further investigations upon this subject. To refer only to the mastax, none of those which I have examined in the supposed *A. helvetica* seems to me to agree with the figures and descriptions of the same part in *A. priodonta*.

† Imhof, "Pelagische Thiere aus Süsswasserbecken in Elsass-Lothringen," in Zool. Anz. 1885, p. 720 (see Annals, ser. 5, vol. xvii. p. 297), and "Ueber mikroskopische pelagische Thiere aus der Ostsee," *ibid.* 1886, p. 612.

‡ Nordqvist, "Die pelagische und Tiefsee-Fauna der grösserern finnischen Seen," in Zool. Anz. 1887, pp. 339 and 358.

§ Imhof "Die pelagische Fauna und die Tiefsee-Fauna der zwei Savoyerseen; Lac du Bourget und Lac d'Annecy," in Zool. Anz. 1883, p. 655.

Rabot, able to indicate the existence of *A. helvetica* under the Arctic circle, at a higher latitude than that of the lakes investigated by Nordqvist. It abounds in the Imandra and in the Kolozero (Russian Lapland, 68° N. lat.), where M. Rabot has taken it in considerable quantities, especially in the second locality, on the 16th August, 1885, between 8 and 9 o'clock in the evening, at the surface. These sheets of water, probably the remains of an ancient strait, are about 100 metres above the level of the sea, under the isotherm of 0° C. *

In this connexion it is of interest to remember that *A. helvetica* was collected by Imhof in Switzerland up to an elevation of about 1800 metres in the lake of Campfèr †; sooner or later it will certainly be met with close to the limit of perpetual snow.

The chorological data are much less numerous for the other species. *A. Brightwelli* and *A. priodonta*, long known in England, were met with, twenty years ago, at Brunswick by Eyferth, and more recently by Plate in the neighbourhood of Bonn and Bremen. *A. Sieboldi* is cited at Wurzburg (Leydig) and at Prague (Stein).

But the most interesting of the *Asplanchnæ* from the point of view of geographical distribution is, unquestionably, *A. syrinx*. Described by Ehrenberg from specimens collected at Berlin, it has been indicated at St. Petersburg (Weisse), in Egypt, and at the summit of Adam's Peak (2260 metres) in Ceylon (Schmarda).

One may, perhaps, be tempted to doubt the accuracy of the determinations of this species, of which, so far as I know, there still exists only the figure published by Ehrenberg in 1838. I may remark, however, that Weisse and Schmarda, who were both very well acquainted with the Rotifera, no doubt had Ehrenberg's work before them‡.

* Some zoologists regard light as the principal cause of the daily vertical migrations of the pelagic fauna. In connexion with this I would remark that, in the northern lakes in which this fauna seems to attain its maximum development, the supposed nocturnal or crepuscular animals which constitute it are condemned throughout the summer to the persistent brightness of the long polar days. From the small depth of many of the lakes it is even impossible for them to descend sufficiently to avoid the luminous rays.

† Imhof, "Ueber die mikroskopische Thierwelt hochalpiner Seen" (600–2780 M. ü. M.)," in Zool. Anz. 1887, pp. 13 and 33. (Translated in 'Annals,' ser. 5, vol. xix. p. 276.)

‡ In noticing the discovery of *Hydatina senta* in the neighbourhood of Auckland, New Zealand, Schmarda states that he was able to compare the living Rotifera on the spot with the figures of Ehrenberg, whose voluminous Atlas in folio he had taken with him on his voyage. See "Neue wirbellose Thiere beobachtet und gesammelt auf einer Reise um die Erde, 1853 bis 1857" (1859), vol. i. p. 50.

There is, however, nothing astonishing in finding distributed over the whole surface of the globe animals which are easily diffused, and which, on the one hand, either on mountains or in high latitudes, support a very intense cold, and, on the other, live in water at a high temperature, as especially in Egypt.

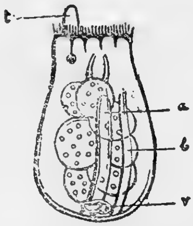
It is probable that future investigations will lead to the discovery in very different localities of the new species above described, as well as of *A. Ebbesbornei*, at present noted only at a single point in England. The example of *A. helvetica* (described in 1883) suffices to show with what rapidity data may be brought together upon the geographical distribution of an animal when special researches lead to its being collected by suitable processes.

On the Genus Ascomorpha.—Before concluding this chapter I will say a few words on the *Ascomorphæ*, which are usually classed, although wrongly, in the family Asplanchnidæ. The very small Rotifera which belong to this genus are very difficult to study, and still appear not to be satisfactorily known. The absence of an anal aperture, which has led to their being approximated to *Asplanchna*, is not a character of prime importance, for it almost certainly results from an adaptation to a particular mode of life. To unite the forms which present this peculiarity without taking into account other details of structure is to fall into an error like that which would consist, for example, in establishing a family for all the Rotifera which are destitute of a foot.

However imperfectly investigated, it is evident that the feeble mastax of the *Ascomorphæ* in no degree resembles the powerful maxillæ of *Asplanchna*. The same observation applies to the stomach, the singular diverticula of which have been noticed by Gosse and Bartsch in two different species. The latter zoologist, to whom, indeed, we are indebted for the fullest information upon these animals, has described, in *Ascomorpha saltans*, a sort of resistant envelope bearing projecting and symmetrical ridges. Seen from the dorsal surface, with its four ridges converging towards the bottom, this envelope presents some analogy, always excepting the denticulation of the aperture, with the test of certain species of *Anuræa* (*A. striata*, Ehr., among others). Lastly, the Hungarian author indicates in the same type the existence of a sort of stout tentacle, quite unknown in the *Asplanchnæ*. I have thought it desirable to reproduce here (fig. 5) the figure published by Bartsch in a very interesting work which is not sufficiently known*.

In this the genus *Ascomorpha* is placed at the head of the group Loricata, in which it immediately precedes the genus *Salpina*. This course appears to me better than that which consists in combining the *Ascomorphæ* and the *Asplanchnæ* in the same family. At any rate, until we have fuller information, it is preferable to leave these Rotifera amongst the forms *incertæ sedis*.

Fig. 5.



Ascomorpha saltans, Bartsch, seen in profile; right side.

a and *b*, ridges or ribs of the envelope; *t*, tentacle; *v*, contractile vesicle (after Bartsch).

The following gives, in a few lines, the complete synonymy of the genus *Ascomorpha*, which denomination must be adopted as the earliest in date, as well as the specific name of *ecaudis*, first employed by Perty for *A. helvetica*. I do not think that there is any reason for uniting the three species at present known, after the example of Hudson and Gosse; in any case, *A. saltans*, Bartsch, appears to me to be a very distinct type.

Ascomorpha, Perty.

Ascomorpha, Perty, Neue Räderthiere der Schweiz, in Mitth. Bern. Gesellsch. 1850, p. 18.

Sacculus, Gosse, Cat. Rotifera, Ann. & Mag. N. H. 1851, ser. 2, vol. viii. p. 198.

1. *Ascomorpha ecaudis*, Perty.

Ascomorpha ecaudis, Perty, *loc. cit.* p. 18.

Sacculus viridis, Gosse, *loc. cit.* p. 198; Phil. Trans. vol. cxlvii. p. 320, pl. xv. figs. 24–26 (1858); Hudson and Gosse, Rotifera, p. 124, pl. xi. fig. 2 (1886).

Ascomorpha helvetica, Perty, Zur Kenntniss kleinster Lebensformen &c. (1852), p. 39, pl. ii. fig. 1.

Switzerland (*Perty*); England (*Gosse* and *Hudson*).

* 'Rotatoria Hungariæ,' pl. ii. fig. 17 (1877). I have been enabled to take cognizance of Bartsch's memoir by the extreme kindness of Dr. Maurice Vellentszéy, to whom I offer my sincere thanks.

Several distinguished Hungarian zoologists, Toth, Bartsch, Vejdovsky, and, more recently, Von Daday, have successfully studied the Rotifera. It is to be regretted that these naturalists have thought fit to publish most of their works in Hungarian. By this means they remain beyond the reach of the scientific public. To act in this way out of patriotism is certainly an error, the consequence of which is to narrow greatly the renown of the national *savants*.

2. *Ascomorpha germanica*, Leydig.

Ascomorpha germanica, Leydig, Zeitschr. f. wiss. Zool. vol. vi. p. 45, pl. iii. fig. 34 (1854).

Wurzburg (*Leydig*).

3. *Ascomorpha saltans*, Bartsch.

Ascomorpha saltans, Bartsch, Württ. Jahresb. 1870, p. 363; Rotatoria Hungariæ, p. 42, pl. ii. fig. 17 (1877).

Tübingen, Buda Pesth (*Bartsch*).

V.—*On some Reptiles and Batrachians from Iguarasse, Pernambuco.* By G. A. Boulenger.

[Plate III.]

The Natural-History Museum has received a small collection of Reptiles and Batrachians made at Iguarasse, Pernambuco, by Mr. G. A. Ramage. Small as it is the collection is one of the greatest interest, such as would hardly have been expected from a part of Brazil which is regarded as one of the best explored. Four species are new, two being of particular interest from a geographical point of view—the *Phyllodactylus* as the first-known Brazilian representative of a genus quartered in the West Indies, Central America, and Venezuela; the *Nototrema* (marsupial tree-frog) as extending the range of a genus otherwise restricted to the Andes, from Central America to Peru. The following known species were obtained:—

Hemidactylus mabouia, Mor.; *Enyalius catenatus*, Wied; *Strobilurus torquatus*, Wiegm.; *Microblepharus Maximiliani*, R. & L.; *Amphisbæna subocularis*, Ptrs.; *Xenodon rhabdocephalus*, Wied; *Rana palmipes*, Spix (larvæ, body as large as a pigeon's egg, with the anal opening on the right side); *Paludicola biligonigera*, Cope; and *Hyla rubra*, Daud.*

New species:—

Sphærodactylus meridionalis.

Snout pointed, as long as the distance between the eye

* To this list may be added the names of two reptiles previously obtained by Mr. H. N. Ridley at Iguarasse, viz. *Anolis fusco-auratus*, D'Orb., and *Stenolepis Ridleyi*, Blgr.

and the ear-opening, which is very small, oval, vertical. Rostral large, cleft above; nostril pierced between the rostral, the first labial, and two small scales; five upper labials, first very long; mental large, rounded posteriorly; no chin-shields; no supraciliary spine. Body covered with rhomboidal, imbricate, smooth scales, which are a little larger on the belly than on the back; forty-six scales round the middle of the body. Uniform brown above, whitish inferiorly; one of the specimens has a large whitish spot on the forehead and a pair of small ones on the occiput.

From snout to vent 24 millim.

Three specimens, without tail.

Hylodes plicifera.

Tongue oval, slightly nicked behind. Vomerine teeth in two oblique series behind the choanæ. Snout subacuminate, scarcely prominent, with angular canthus rostralis and concave loreal region; nostril much nearer the tip of the snout than the eye; interorbital space slightly broader than the upper eyelid; tympanum distinct, one third the diameter of the eye. Fingers and toes moderate; disks small; subarticular tubercles strong; first finger much longer than second; toes not fringed, with a very slight rudiment of web; two small metatarsal tubercles. The tibio-tarsal articulation reaches the eye. Head and back with several symmetrical linear folds, viz. a median straight one from between the nostrils to above the vent, and five undulous others on each side, beginning from the supraciliary edge and crossing obliquely the upper eyelid; sides with small warts; lower parts smooth. Pinkish grey above, with blackish markings; a blackish cross band between the eyes and three radiating blackish streaks on each side from the eye to the mouth; limbs with crimson cross bars; hinder side of thighs and lower surface of tarsus blackish; lower parts uniform whitish.

From snout to vent 17 millim.

A single specimen.

Hylodes Ramagii.

Tongue oval, slightly nicked behind. Vomerine teeth in two minute groups behind the choanæ. Snout subacuminate, scarcely prominent, as long as the diameter of the orbit, with angular canthus rostralis and concave loreal region; nostril much nearer the tip of the snout than the eye; interorbital space slightly broader than the upper eyelid; tympanum distinct, two thirds the diameter of the eye. Digits rather elongate, with well-developed disks and strong subarticular tubercles; first finger longer than second; toes quite free; two metatarsal tubercles, outer extremely small. The tibio-tarsal articulation reaches the nostril. Upper surfaces with small warts; belly and lower surface of thighs with granules of unequal size. Grey-brown, with symmetrical darker markings, viz. a cross bar on the interorbital region, a Λ on the scapulary, a ⅄ in front of the sacral, an oblique bar on each side in front of the groin, and oblique bands across the limbs; sides of head blackish; lower parts whitish, throat marbled with brown.

From snout to vent 22 millim.

A single specimen.

Nototrema fissipes. (Plate III.)

Tongue subcircular, slightly nicked and free behind. Vomerine teeth in two short slightly oblique series between the choanæ. Head rather large, considerably broader than long, rugose, the skin of the temple alone being free from the cranial ossification; posterior border of casque sinuous; snout very short; canthus rostralis angular; loreal region concave; nostrils near the end of the snout; interorbital space concave, twice as broad as the upper eyelid; tympanum vertically oval, nearly as large as the eye. Fingers free, first longest and opposable to the others; toes short, with a very slight rudiment of web; disks well developed, hardly half as large as the tympanum; subarticular tubercles strong; no tarsal fold. The tibio-tarsal articulation reaches between the tympanum and the eye. Skin finely granulate above, coarsely on the belly and under the thighs; throat smooth; lower surface of tarsi warty. Purplish brown above, with a curved dark band, concavity forwards, on the interorbital region and a semicircular dark spot on the scapulary; a blackish-brown band, sharply defined above, along each side, from the eye to the groin, involving the tympanum and sending a subocular process to the edge of the mouth; a series of yellow spots on each side of the body, below the dark lateral band; groin with irregular yellow spots separated by a blackish network; limbs with dark brown cross bands, of which there are five on the thigh and three on the leg; ground-colour of the thigh above yellow, with a narrow brown longitudinal band; lower surfaces purplish brown, the abdominal and femoral granules lighter.

From snout to vent 80 millim.

A single female specimen. The pouch is filled with a single layer of very large ova (10 millim. in diameter), sixteen in number. From the size and small number of the ova it may be safely predicted that the young undergo the whole of the metamorphoses within the pouch, as in *N. oviferum*, which is the nearest ally of *N. fissipes.*

VI.—*Description of two new Snakes from Hongkong, and Note on the Dentition of* Hydrophis viperina. By G. A. BOULENGER.

THE snakes described below were obtained, through the kind mediation of Dr. J. Anderson, F.R.S., from the Directors of the City Hall Museum, Hongkong. They were labelled as from Hongkong, presented to the City Hall Museum by C. Ford, Esq.

Achalinus rufescens.

Head narrow, elongate. Suture between the internasals twice as long as that between the præfrontals; frontal broader than long, half as long as the parietals; only the upper anterior temporal in contact with the eye; three shields bordering the parietals on each side, the third very large and separated from its fellow by a small azygos occipital; five upper labials, third and fourth entering the eye, fifth much elongate; five lower labials, third much elongate, first in contact with its fellow behind the mental; three pairs of large chin-shields, succeeded by the ventrals, first and second longer than broad, third as long as broad. Scales strongly keeled, some distinctly tricarinate, in twenty-five longitudinal series; on the anterior half of the body each ventral scute is in contact with the second series of scales. Ventrals 136; anal single; subcaudals 82. Uniform pale reddish brown above; upper labials and a spot on the temple yellow; uniform yellowish beneath.

Total length 290 millim.; tail 80.

CALAMOHYDRUS, g. n. (*Homalopsinarum*).

Teeth in jaws and palate small, equal. Head rather elongate, slightly distinct from neck; eyes very small, with round pupil, separated from the labials by suboculars; nostrils superior, pierced in the upper part of the nasal; a pair of internasals; a single præfrontal; rostral small, not prominent; loreal, præ- and postocular present. Scales finely striated and feebly keeled (in seventeen rows). Tail moderate, tapering to a fine point. Anal and subcaudals divided.

An annectant form between the Calamarinæ and the Homalopsinæ.

Calamohydrus Andersonii.

Præfrontal more than twice as broad as long, in contact with the posterior border of the nasals and wedged in between the tear-shaped internasals, which form a suture anteriorly; frontal pentagonal, a little longer than broad, and a little shorter than the suture between the parietals; eye surrounded by a small supraocular, which is more than twice as long as broad, a præocular, two suboculars, and a postocular; loreal elongate, more than twice as long as deep, in contact with the third and fourth labials; temporals 1 + 2; eight upper labials, fifth below the eye; nine lower labials, five anterior in contact with the chin-shields, first in contact with its fellow behind the mental; two pairs of chin-shields, anterior large, posterior small and separated by three scales. Scales in seventeen rows, without apical grooves; the keel very feeble, absent on the hinder third of the scale. Ventrals 161; subcaudals 58. Blackish above, each scale edged with whitish; lower parts whitish; chin and lower labials brown.

Total length 240 millim.; tail 45.

The same collection contained an adult specimen of a rare sea-snake, *Hydrophis viperina*, Schmidt (*Disteira præscutata*, D. & B.), which reveals a new type of dentition. The maxillary of the *Hydrophides* is armed, as is well known, with a pair of grooved fangs, followed after an interval by a series of much smaller solid teeth. In *H. viperina* we have instead a series of four equidistant, subequal, grooved fangs. The *Calamaria*-like *Ogmodon vitianus*, Peters, was the only snake known to possess a series of grooved fangs; but the number and proportions of these fangs are very different from what is shown by *Hydrophis viperina*.

Schmidt, the original describer of this species, notices that the teeth are small and show no trace of a groove, and regards the snake as non-poisonous. I find, however, a large poison-gland; and the author's mistake is probably due to the similarity between the maxillary teeth, which is in striking contrast to the abruptly enlarged anterior fangs of ordinary *Hydrophides.*

Although I am unable to find any external characters by which to separate *H. viperina* from its allies, I should have proposed a new generic name were it not that *Disteira*, Lacép., specimens of the type species of which I have unfortunately no means of investigating, may possibly possess a dentition similar to that of *H. viperina.*

VII.—*On the Organic and Inorganic Changes of* Parkeria, *together with Further Observations on the Nature of the Opaque Scarlet Spherules in Foraminifera.* By H. J. Carter, F.R.S.*

[Plate V.]

In the 'Annals' for March and April last (vol. i., 1888) I described in separate communications "Two new Genera allied to *Loftusia*," viz. *Stoliczkiella Theobaldi* and *Millarella cantabrigiensis*, and the "Nature of the Opaque Scarlet Spherules found in the Chambers and Canals of many Fossilized Foraminifera," the former accompanied by a footnote (p. 180) in which allusion is made to other specimens of *Parkeria* in which *Millarella* appeared to be present in the condition of a "foreign nucleus" over which the *Parkeria* had grown; but it now seems to me (after examination of more specimens of the same kind) that this "nucleus" must have been a subsequent instead of a primary formation, from which the *Millarella* might have spread itself throughout the whole of the *Parkeria*, until the structure of the latter had become obliterated—of course in a living or unfossilized state.

The structure of *Millarella* (for the term here must be used in a generic sense) may be stated to present itself under the form of a minutely reticulated rhizopodous mycelium of a brown colour (Pl. V. fig. 9, *a a*), accompanied more or less

* In this communication it should be remembered that I am treating of "Transformations" only, and not of the natural structure of *Parkeria*, which should be learnt from Prof. Nicholson's illustrated description of this fossil in the 'Annals' for January 1888, vol. i. p. 1, pl. iii.

by equally minute, sparsely branched filaments (fig. 9, *b b*), which may have extended itself throughout the *Parkeria*, so as to destroy by transformation the whole of the structure of the latter and replace it by one which is totally different.

That there are globular rhizopodous organisms similar in outward form and equal in size to any *Parkeria* existing at the present day may be learnt from what Mr. H. B. Brady, F.R.S., &c., has stated in the description of his *Syringammina fragillissima*, which was dredged by Mr. J. Murray in the Faroë Channel during the cruise of H.M.S. 'Triton' ('Challenger' Reports, vol. ix. "Text," p. 242), viz.:—"Two specimens were secured, but owing to the excessively fragile nature of the test both were much broken. The largest fragment is represented in [his woodcut] figs. *a*, *b*, drawn to the natural size. This specimen is about an inch and a half (38 millim.) in diameter, and about eight tenths of an inch (20 millim.) in thickness; but it is probable that the latter dimension may not be much more than half that of the entire organism; indeed, it is evident that the test, when complete, was a rounded mass which, if developed with any degree of symmetry, must have been a sphere about an inch and a half in diameter." The structure revealed by the fractured surfaces is that of a congeries of branching and inosculating tubes radiating from a common centre, "the walls of which are composed of 'fine sand,' among which is a very large number of minute foraminifera."

To return to *Parkeria*. It is impossible to conceive that a foreign nucleus could get into the centre and destroy its structure in a fossilized state; but not so when it is remembered that the *Parkeria* when fresh was probably as penetrable as Mr. Brady's *Syringammina fragillissima*; further, that the embryo of *Millarella* might have previously existed in that of the *Parkeria*, as in Prof. F. E. Schulze's specimen of *Spongelia pallescens* which was infested with an *Oscillaria*, wherein the larva or ciliated ovum of the sponge already contained several minute reproductive bits of the filament of this Alga, of which, in 1878, he kindly sent me a mounted specimen (Zeitschrift f. wiss. Zool. Bd. xxxii. Taf. v. fig. 7).

However, I had better describe a typical instance of this kind of foreign nucleus in a specimen of *Parkeria* first, and then leave the reader to form his own views as to how it got there. Here the nucleus, which is in a specimen of *Parkeria* about one inch and a half in diameter, passes through its centre, so as to reach the circumference of the *Parkeria* at opposite ends (Pl. V. fig. 1, *a*). In form it is a conical solid cylinder, whose greatest thickness, viz. 9-24ths inch, is just below the centre, so that it is somewhat swollen here, while the upper end is conical and free and the lower one obtuse and fractured, indicative of previous fixation at this point to some submarine body. In composition it consists of a whitish-yellow, minutely granular substance like "chalk" intermixed with small tracts that are pure white, while the whole is charged with foraminiferal detritus in which the tests are not only fragmentary but very minute, and for the most part globular in form, of different sizes, like *Orbulina* and *Globigerina*, together with numerous grains of glauconite (fig. 1, *a*). All around the circumference of this whitish cylindrical nucleus the structure of the *Parkeria* is more or less obscured by the growth outwards of the dark brown mycelium and filamentous structure of *Millarella*, of which the former (which should be viewed by reflected light) requires a high power to be distinguished in detail, while the latter is easily seen with a much lower one, when it appears as a glistening white thread more or less branched—the glistening white appearance arising from the minute crystalline matter of which it is now composed. This thread or filament is about 1-900th of an inch in diameter, tortuous, and more or less branched; but what its state was when fresh I am not prepared to say. Such filaments often form part of a Saprolegnious Alga; but I could see no appearance of fructification about them.

The white chalk-like part represents the oldest and the darker (fig. 1, *c*) stains (like rot to the naked eye) the youngest parts of the *Millarella*. Nevertheless the chalk-like substance also is pervaded by the reticulated mycelium, which imparts to it the "whitish-brown" colour before mentioned, but which can only be seen with a high power, when the presence of the minute fragments of the Foraminifera in it indicates its originally plastic nature.

It must not be inferred that this kind of nucleus always presents the same shape, for I have several specimens of *Parkeria* in which it is present, wherein both in form and size it is quite different. For instance, in one of these (fig. 2, *a*) it is globular, about half an inch in diameter, surrounded by a dark jagged edge, composed of the brown substance or young structure of *Millarella*, which, on account of the light colour of the specimen of *Parkeria* itself, contrasts strongly with it in this respect, so that the definition of the nucleus is very marked, while it is by no means situated in the centre of the *Parkeria*, but, on the contrary, towards the circumference, where it communicates with the exterior by a small contracted neck (fig. 2, *b*)—the centre of the *Parkeria* (which is about $1\frac{1}{2}$ inch in diameter) being thus not only at some distance from it, but itself presenting no appearance of any kind of nucleus beyond a confused mass of cellular structure (fig. 2, *d*).

In all instances, however, this kind of nucleus is connected at some point with the exterior or circumference of the *Parkeria* (figs. 1, *b*, and 2, *b*), although in many specimens dark, apparently isolated spots of the brown substance like "rot" may show themselves in different parts of it (fig. 1, *c*).

It is therefore possible that when the *Parkeria* was in a *fresh* state and the *Millarella* in a *plastic* one the latter might, after having destroyed part of the substance of the former and thus having made room for itself, have drawn in the foraminiferal detritus of which the white or chalky portion of the nucleus is composed in the fossilized body, if not the originating particles of the glauconite too, seeing that this mineral may commence in the chamber of a foraminiferal test, as I have already explained ('Annals,' *l. c.* p. 181), although the former, at least, could not have got into it afterwards.

The nucleus of *Parkeria*, as Prof. Nicholson has lately stated (*l. c.* p. 9), is probably always some foreign body, such as the "fragment of a shell," and when otherwise it is probably like that of *Millarella* above described (figs. 1 and 2). Again, when it is the "fragment of a shell," this may be that of a multilocular one, viz. Cephalopodous, which is generally the case, or a flat, turbinated one of a small Gasteropod, which seems to be not so frequent, judging from the small collection of *Parkeriæ* in my possession, which does not amount to more than a dozen specimens, although many more than this have passed through my hands; still, even when the nucleus is a "fragment of a shell," it may be remarked that the *Millarella*, although present in other parts of the *Parkeria*, does not emanate from it, but that, on the contrary, the confines of the "shell-fragment" remain so clearly defined that the commencement of the Parkerian structure (that is, its cœnenchyma) may be seen to rest upon it all round, while it is frequently so small that, in this way, the cœnenchymal structure may be traced up to nearly the centre of the specimen. Indeed, although the *Parkeria* seems to have generally sought some foreign body as a nucleus to begin upon, it is only when the nucleus is a *Millarella* that it is in connexion with the *circumference* of the organism. On the other hand, the centre of the *Parkeria* may present no distinguishable nucleus whatever, and the spot of *Millarella* be situated at some distance from it towards the circumference, as in the case mentioned, which strongly supports the inference that the latter was an intruder either before or after death, that is, while the *Parkeria* was still fresh or unfossilized.

We have now to turn our attention for a few minutes to an *in*organic or mineralogical change which may take place in *Parkeria*; and for this purpose it is necessary to premise its natural state, so far as my specimens will allow.

In the *purest* form, then, that I possess the tubular structure or cœnenchyma (cœnosteum of Nicholson) is so thin and delicate in appearance and the ultimate structure of its walls so minute that all that I can see in them, under a very high power by reflected light, is an amorphous, pulverulent, translucent substance which, it is worthy of remark, closely resembles that of the "shell-fragment" upon which the *Parkeria* had grown; and thus I am led to infer, with Prof. Nicholson (*op. cit.* p. 5), that both originally were of the same nature, that is "calcareous."

On the other hand, in a less pure condition the lamina or wall thus composed may be more or less covered on each side by a layer of crystalline granular calcite, when, of course, the tubular structure having become thickened becomes more evident, and in this way the greater part of the interior of *Parkeria* may present no trace of the original cœnenchyma whatever *except under section*, when the lamina or wall of the tubular structure is brought into view (figs. 5 and 6).

Where this has been the case the external or circumferential part of the fossil has for some distance inwards been transformed into a hard, compact, petrous shell, composed of a dark black-brown (by transmitted light), waxy-looking mineral, in which the remains of the cœnenchyma may be faintly traced together with filaments of the *Millarella* (fig. 3, *a*). In short, the whole looks like fossilized *Millarella-structure*; but however this may be, on the inner side of this petrous portion little holes begin to destroy its continuity, which soon transforms it into the calcitized cœnenchyma above mentioned (fig. 3, *b*, *c*, and figs. 4, 5, 6). In this case the latter, whose interstices are empty, may occupy one third or more of the interior of the *Parkeria*, so that when the external or more compact part of the specimen is cracked off the inner part of the calcitized portion (fig. 3, *c*) falls out, like the kernel of a nut under similar circumstances, when, from the interstices being *empty*, it presents itself under the form of a spherical ball of tubular reticulated thread-structure of a light brown colour, identically representing a cast of the cœnenchyma. It was under this condition that I formerly made the mistake of describing the skeletal structure of *Parkeria* as being composed of "granular calcspar," which has very properly been considered by Prof. Nicholson (*op. cit.* p. 5) to be a "secondary change."

Of this mineral transformation I possess two instances; and here I would digress for a moment to remark that in *one* the cœnenchyma thus altered is richly charged with another kind of, and much larger, crystal than the calcite, of a dark brown colour by reflected, but amber by transmitted light, which is chiefly situated on the surface of the cavities in the calcitized cœnenchyma, where it contrasts strongly with the light brown calcite not only in size and colour, but in its "regular" tetrahedral summit, which for the most part projects into the empty interstices of the cœnenchyma thus transformed (fig. 4, *d d*).

To examine these crystals more particularly a fragment of each specimen of the transformed cœnenchyma like fig. 4 was treated with *nitric acid*, when the whole of the calcite in each was dissolved with strong effervescence, leaving in one instance nothing at all and in the other a great number of the dark brown crystals mentioned, most of which presented beautifully defined tetrahedral summits, and many the corresponding part also, thus forming "regular octahedrons" about 1-450th inch in diameter. These, although numerous, were too small for *me* to subject to the reducing-flame of a blowpipe (for I should have blown them away), otherwise the residue would probably have been attracted by the magnet, and thus, as in the case of glauconite, of which they appeared to me to be but another form, as will presently appear, they would have been proved to have in like manner been composed of iron.

I was led to this view, first by finding crystalline grains of the same colour mixed with those of glauconite side by side in *Millarella*; secondly, because in the so-called "black grains" *now* forming part of the sea-bed between the north of Scotland and the Faroë Islands, to which I have already alluded ('Annals,' *l. c.* p. 181), the transition of the brown colour of some of the casts of the *Globigerinæ* &c. into green glauconite indicates a preliminary stage only to the latter; thirdly, by the presence among the dissolved-out crystals of the calcitized cœnenchyma of the cast of a *Globigerina* composed of the same kind of mineral; and fourthly, because where these crystals have become disintegrated in this transformed cœnenchyma they have left an *iron-rust* stain. My inference therefore is that they are of the same composition as that of glauconite, only of a different colour. Further than this I cannot go, and therefore must leave the question for mineralogists to decide, merely adding that, as these crystals appear in *one* of the only two instances of this transformation that I possess, it is not improbable that their presence, which is too striking to be overlooked, is not uncommon.

Let us now return to the evidences of the *organic* changes in the tubular structure or cœnenchyma of *Parkeria* caused by the presence of *Millarella*, and having described the most striking parts of the latter, viz. the brown mycelium and the white filament, it is only necessary for me to add that in one of the specimens in my collection (which unfortunately is only a thick slice between the centre and the circumference of the *Parkeria*) where this transformation is most evident, spots of it may be seen like dark "rot" throughout this slice, intermixed with the white cœnenchyma in its natural state, which presents every gradation, from the dull white *continuous* structure to that which is broken up and finally lost amidst the brown mycelium and glistening mineralized filaments of the *Millarella*. Indeed in some parts the filament appears to have crept along the side of the "*lamina*" forming the wall of the tubulation, while in others the "lamina" itself appears to be yielding to its influence so as itself to become a "glistening" white filament. At all events, the destructive character of the *Millarella* is evidenced by the gradual disappearance of the cœnenchymal structure and the presence of that of *Millarella* (fig. 10, *a*, *h*).

However, I have got another specimen wherein the transformation has extended a little further and the *whole* of the central part of the *Parkeria* has passed into *Millarella*, while the external part has become hard and petrous, like that observed in the "calcite" transformation of the cœnenchyma. This specimen, which was about 1¼ inch in diameter, has been cut into halves, of which the petrous portion forms a kind of shell about 3-12ths inch thick, while the rest consists of a solid spherical mass of *Millarella* 9-12ths inch in diameter, but of which unfortunately I have only a tangential section (fig. 7) whose greatest thickness is 3-12ths inch; therefore it is only the *outside* third of the spherical mass that I possess, which is amply sufficient for structural description, although I would rather have had the whole or a section through the centre, that I might also have seen the latter.

Of the external or petrous portion I need only state that in composition and colour it is precisely like that which surrounds the "calcitic" or inorganic transformation above described, while the spherical mass presents through the tangential section all that is to be found in the "nucleus of *Millarella*" first described—that is, the brown mycelium (fig. 9, *a a*), the filaments (fig. 9, *b b*), and the chalky substance charged with foraminiferal detritus and grains of glauconite (fig. 9, *c*), only arranged in a peculiar manner; thus the internal or plane surface of the tangential section (fig. 7) presents a massive veno-reticulated structure of a light brown colour (fig. 8 *a*), with an equal amount of interstices which are filled with the chalky substance just mentioned (fig. 8, *b*), thus indicating that the whole sphere was composed of this reticulated structure &c.; while in some parts the chalky substance under a high power by reflected light may be seen to be pervaded by the myceliated structure also, in the interstices of which, as well as in its substance generally, the smallest as well as the largest particles of the foraminiferal detritus and grains of glauconite are imbedded. On the other hand, the massive veno-reticulated structure appears to have been chiefly composed of the filamentous part of the *Millarella* (fig. 9, *b b*), which, where the filaments are situated horizontally, are easily recognized, that is *laterally*, although this of course is not the case where the section has passed through them transversely, so that they are more or less represented "end on" (fig. 9, *a a*). In this way the central portion of the *Parkeria* has become a solid mass, in which I could discover no traces of its cœnenchyma. Thus, although analogous in general form to the "calcitic" transformation, it is in other respects perfectly different, inasmuch as the "calcitic" one indicates a mineral or *in*organic change, while the imbedded fragments of foreign matter in the *Millarella* are a decided evidence of an organic one.

Of the nature of *Millarella* when fresh I can only repeat what has been before stated, viz. that it appears to have belonged to some Saprolegnious Alga both in its plastic character and destructive agency—the former indicated by the imbedding in its mycelium of *foreign* material whose animal forms are perfectly evident, and the latter evidenced by the entire transformation of the cœnenchyma of the *Parkeria* into *Millarella*; while the latter in its independent existence has been described under the name of "*Millarella cantabrigiensis*" in this periodical (*l. c.* p. 178)*.

Further Observations on the "Opaque Scarlet Spherules."

When I was engaged in describing the "opaque scarlet spherules" which are confined to the chambers and canals of

* It now seems to me that the forms of *Loftusia persica* and *Stoliczkiella Theobaldi* are so unlike any that would be produced by *Millarella* alone that it is not impossible that these organisms respectively might, like *Parkeria*, have become invaded by a *Millarella*.

certain fossilized Foraminifera (*op. et l. c.*) I had not observed that similar spherules were equally abundant in the interstices of the cœnenchyma of *Parkeria*, and that they evidently passed from the "scarlet" state into that of "pyrites;" while the apparently "granular" composition which they presented both here and in the Foraminifera could not be ascribed to any previous organic, but to some subsequent mineralogic structure, wherein the granular appearance on the surface had in all probability been produced by the facets of the ends of the radiating pillar-structure of which spherical pyrites is composed.

Still, although the "opaque scarlet spherule" may be of general occurrence and merely a mineralogical form of iron (for I think I have seen such in trap-agates which certainly cannot possess any fossilized *organic* structure), yet the fact of these bodies in fossilized Foraminifera being *confined* to the "chambers and canals"—as a colourless or white fossilization of another species of Foraminifera, viz. *Orbitolites* (*Orbitoides*, D'Orbigny) *Mantelli*, Carter, just ground down for the purpose, has still further confirmed—indicates that there must be a connexion between the "scarlet spherules" and something in the sarcodiferous cavities which led to their formation. Then certainly follows the question, What was the form of that "something," and did it lead to the spherical form of the "scarlet spherule," or is this only a natural consequence of the increase in size of a particle of iron destined in its growth to assume this form?

Such reflections are engendered by further research into the nature of the "scarlet spherules," for, however great the connexion may appear to be between certain contents of the sarcode in the chambers of living Foraminifera—which in this state is generally charged with spherical cells of a similar form that have been *proved* by M. Schultze ('Annals,' *l. c.* p. 177) to be *reproductive bodies*—and these "scarlet spherules" in a fossilized one, it is impossible in the present state of our knowledge to disregard the fact without being influenced by its contingencies in the opinion that should be formed of the nature of these "spherules."

Of course "brown hæmatite," of which, under another colour, these spherules are composed, is extremely common in all kinds of fossils; but the question here is, Why should it be *confined* in the Foraminifera to their sarcodal cavities, and there look so much like the "reproductive bodies" which are found in the same position in the living animal?

EXPLANATION OF PLATE V.

N.B.—All the illustrations are more or less diagrammatic, as it would be impossible in the small space of an octavo page to give them otherwise; hence this must be left for a future occasion, when it may be thought desirable to draw the representations to scale in which all their parts would be relatively magnified.

Fig. 1. *Millarella* in the form of a cylindrical nucleus passing through the centre of a *Parkeria.* Section through the centre, nat. size. *a,* chalk-like portion charged with foraminiferal detritus and grains of glauconite, the latter represented by the dark puncta; *b,* point of communication with the exterior; *c,* dark shades intended to represent spots of *Millarella* scattered throughout the fossil; *d,* radiated structure of the *Parkeria.*

Fig. 2. The same, but with the *Millarella* of a globular form, confined to the circumference of the *Parkeria,* and thus separated from the centre, which, in this instance, does not appear to possess any nucleus whatever. *a, Millarella*; *b,* its communication with the exterior; *c,* radiate structure of the *Parkeria*; *d,* centre of the same.

Fig. 3. *Parkeria* in which the central portion of the cœnenchyma has become calcitized. Section through the centre, magnified two diameters. *a,* external or petrous portion; *b* and *c,* transformation of the same into calcitized tissue; *d,* imaginary line of separation between *b* and *c,* to point out the part where the division between *b* and *c* is supposed to take place when, on the cracking off of the petrous portion, *c* falls out in a spherical form.

Fig. 4. The same. Fragment of the calcitized cœnenchyma much magnified, to show *a a a,* the "concentric lamellæ," *b b,* the "radiating columns," *c c,* the intervals between them, *d d,* the "tetrahedral" crystals of supposed silicate of iron.

Fig. 5. The same. Two portions of the tubulation of the calcitized cœnenchyma cut across to show their structure, greatly magnified. *a,* cavity of the tubule; *b,* wall of the same entire; *c,* external layer of the granular calcite; *d,* internal layer; *e e e,* the same, showing the remains *only* of the tubular wall; *f,* calcitized tubule, in which there are no remains of the "wall" whatever.

Fig. 6. The same. Lateral view of a fragment of a tubule, magnified upon the same scale. *a,* wall of the tubule; *b,* its cavity; *c,* external layer of granular calcite; *d,* internal layer of the same.

Fig. 7. Tangential section of the central portion of a *Parkeria wholly* transformed into *Millarella,* viewed from the interior or the plane side. Nat. size.

Fig. 8. The same. Fragment of the surface greatly magnified, to show its reticulated structure and chalky intervals. *a,* veno-reticulation, indicated by the darker shade; *b,* chalk-like material in which the grains of glauconite are indicated by the dark puncta.

Fig. 9. Fragment of the latter very much more magnified, to show the composition of the two structures, viz.:—*a a,* structure of the veno-reticulation in the tangential section where seen "end on;" *b b,* filamentous parts where seen laterally; *c,* chalky intervals charged with foraminiferal detritus and grains of glauconite.

Fig. 10. Diagram to show the replacement of the cœnenchymal structure of *Parkeria* by *Millarella.* *a*, cœnenchyma *continuous*; *b*, "zooidal tube;" *c*, cœnenchymal structure breaking up and disappearing; *d*, dark shade in the tubules of the cœnenchymal structure, indicating the presence of *Millarella* in its minute form, of a brown colour; *e*, filamentous form; *f*, chalk-like portion; *g*, fragments of foraminiferal detritus; *h*, grains of glauconite.

Budleigh Salterton, Devon,
June 1, 1888.

VIII.—*Descriptions of new Land-Shells from the Andaman and Nicobar group of Islands in the Bay of Bengal.* By Lieut.-Col. H. H. Godwin-Austen, F.R.S., F.Z.S., &c.

My old conchological colleague and friend Geoffrey Nevill a few months before his early death sent me his revised and interleaved copy of the Catalogue or Hand-list of the Mollusca in the Indian Museum, Calcutta, of which it was intended to be the second edition; and this I hope the trustees of that museum will sooner or later have put into type. It contains a mass of new material, references to original descriptions, and a large number of species added to the museum since 1878, and a great number of MS. names given to undescribed forms. Of many of these new Indian species he had sent me typical shells, some of which I have figured and described in 'Land and Freshwater Mollusca of India,' and many I still have by me. From Mr. F. A. de Roepstorff I had received many Andamanese and Nicobar shells, and after that officer's melancholy death by the hands of a sepoy at Camorta, Mrs. de Roepstorff very kindly sent me his large collection of land-shells. With this material I am able to complete the good work begun by Geoffrey Nevill and identify the shells bearing his MS. names and describe the same. MS. names, unless thus quickly dealt with, become a terrible source of vexation and worry to future naturalists; they wander away into collections all over the world, are very frequently never published, while some species rejoice in two or more such titles. I therefore in this paper propose to clear off as many undescribed shells as I can from the islands of the Bay of Bengal, trusting to be able to figure them in the second volume of my work on Indian Mollusca, and in some cases give some further account of those I have in spirit.

Machrochlamys? bathycharax, Benson, MS.

Helix bathycharax, Theob. Cat. Supp. p. 17.

Loc. South Andaman Island.

Shell discoid, narrowly umbilicated; sculpture polished to the eye, under lens some fine indistinct longitudinal striæ; colour pale sienna-brown; spire very low, flat above, apex flat; suture canaliculate; whorls $5\frac{1}{2}$, specimen young; aperture and peristome not fully developed.

Size: maj. diam. 10·75, alt. axis 5·0 millim.

This is no. 69 of G. Nevill's Hand-list, p. 27, as *Nanina*.

It is a very near ally of *H. convallata*, Benson (Ann. & Mag. Nat. Hist. 1856, vol. xviii. p. 250). I have not compared them. Nevill puts it on one label in De Roepstorff's collection as a variety of it.

In a revised catalogue of Nevill's Hand-list, which he sent to me a few weeks previous to his death, he has:—

"No. 123. *Nanina subconvallata.* 2 sp. Nicobars. Coll. F. A. de Roepstorff, Esq.

"No. 120. *Nanina bathycharax*, Bs. MS. S. Andamans. 14 sp. Collected by Wood-Mason, Nevill, Stoliczka, and De Roepstorff.

"No. 124. *convallata*, var.? n. sp. *Euomphalus.* More openly umbilicated. 10 sp. Andamans. F. A. de Roepstorff."

Macrochlamys Fordiana, n. sp. (Nevill, MS.).

Loc. South Andaman.

Shell subcarinate, subglobosely conoid, narrowly umbilicated; sculpture close, regular, wavy, transverse ribbing, no longitudinal striation; colour pale horny; spire subconoid, apex rounded; suture shallow; whorls 5, regularly increasing, subconvex; aperture ovate; peristome thin, columellar margin reflected abruptly over the umbilicus.

Size: maj. diam. 18·7, min. 16·3, alt. axis 8·2, body-whorl 7·8 millim.

This form differs from its nearest ally in these islands, *M. choinix*, in its sculpture; the latter is smooth and polished, with fine longitudinal striation; in *M. choinix* the body-whorl is more inflated and the whorls and apex flatter and closer wound near the apex. *M. exul*, another near form, is a closer-whorled shell and with different sculpture.

Macrochlamys stephus, Benson.

"Animal throughout yellow, except the tentacles, which are black; sole of foot also yellow" (*Nevill*).

Macrochlamys choinix, Benson.

"Animal very active, throughout black, except the sole of foot, which is white" (*Nevill*).

Macrochlamys? pseudaulopis, n. sp. (Nevill, MS.).

Loc. South Andaman.

Shell depressedly conoid, subcarinate, umbilicated, polished; sculpture well-defined, parallel continuous striation, crossed by transverse lines, in some specimens having an indistinct ribbing; colour rich umber-brown; spire subconical, apex bluntly rounded; suture impressed; whorls 5, very gradually increasing; aperture quadrately oval, oblique; peristome thin, columellar margin subvertical.

Size: maj. diam. 10·0, min. 9·2, alt. axis 4·2 millim.

Animal from the dried specimens after soaking has a long right shell-lobe.

The shell of this species differs from *M. aulopis*, for which it might be mistaken on a casual examination, in the whorls being quite convex; also in the sculpture, *M. aulopis* being almost decussate.

In Nevill's copy of his Hand-list I find the following note under this MS. name to no. 103:—"Closely allied to *N. aulopis*, with which it is usually confounded; the animal is quite different, being of a black hue throughout instead of light grey mottled with a darker shade, as is the true *N. aulopis* of Benson. Common on Mt. Harriet."

Macrochlamys perinconspicua, n. sp. (Nevill, MS.).

Loc. Little Brother Andaman (*De Roepstorff*).

Shell subglobosely conoid, well umbilicated, rather solid for its size, surface polished; sculpture very fine parallel longitudinal striæ under lens; colour umber-brown; spire moderately high, apex rounded; suture shallow; whorls 5, adpressed, increasing evenly; aperture ovate; peristome thin, well rounded below, columellar margin perpendicular, scarcely reflected.

Largest sp.:	maj. diam. 7·5,	min. 7·0,	alt. axis	3·5 inches.
Generally:	„ 6·5,	„ 6·0,	„	3·25 „

This is no. 184 of Nevill's revised Hand-list of shells in the Indian Museum, Calcutta.

Microcystina Hochstetteri, n. sp.

Loc. Nicobars, precise island not indicated (*De Roepstorff*).

Shell subglobosely conoid, imperforate ; sculpture, the longitudinal striæ are only to be traced in places, the surface very polished ; colour dark sienna-brown ; spire subconoid, apex blunt ; suture very shallow ; whorls 5, regularly increasing ; aperture lunate ; peristome thin, columellar margin thickened and curved as in the genus.

Size : maj. diam. 7·9, min. 7·1, alt. axis 4·0 millim.

This is a very distinct species and much larger than any yet recorded from these islands. I have named it after Professor Hochstetter, who gave the first account of the geological and physical features of the Nicobars in the 'Reise der Novara.'

Macrochlamys battimalvensis, n. sp. (Nevill, MS.)

Loc. Battemalve Island.

Shell very depressedly conoid, sharply carinate, umbilicated; sculpture regular, distant, fine longitudinal striæ, crossed by irregular transverse lines; colour pale horny ; spire flatly pyramidal, apex rounded ; suture shallow ; whorls 4 (incomplete), flat ; aperture quadrate, oblique ; peristome thin, columellar margin perpendicular.

Size : maj. diam. 9·5, min. 8·5, body-whorl 4·0 millim.

Helix (*Microcystis*) *subpatuloidea*, n. sp. (Nevill, MS.).

Loc. South Andamans (*De Roepstorff*).

Shell depressedly pyramidal, openly umbilicated, carinate, not polished ; sculpture fine, close, rough, transverse ribbing, crossed by obscure, longitudinal, rather distant striæ ; colour dull umber-brown ; spire subconoid, apex rounded ; suture shallow ; whorls 4½, flat above, convex below ; aperture quadrate, oblique ; peristome thin, columellar margin suboblique.

Size : maj. diam. 5·2, min. 4·8, alt. axis 2·8 millim.

This is no. 89 of Nevill's revised Hand-list, facing p. 41.

Georissa Roepstorffi, n. sp. (Nevill, MS.).

Loc. South Andamans (*De Roepstorff*).

Shell globosely conical, imperforate, rather solid ; sculpture well-marked spiral ribbing, about fifteen on the last whorl in front, the apical whorl smooth ; colour pale ruddy brown ; spire moderately high, apex blunt, mammillate ; suture deep ; whorls 4, convex, the last full and rounded ; aperture oval ; peristome simple, columellar margin oblique and straight.

Size: maj. diam. 1·5, alt. axis 2·0 millim.

Operculum smooth, semicircular in form, and straight on the columellar or inner side.

This species is nearest to *G. laratula*, from near Moulmein, described and figured by Stoliczka in J. A. S. B. 1871, p. 157, pl. vi. fig. 5; but the ribbing is not so coarse and strong as in *G. laratula*.

IX.—*On new Longicorn Coleoptera from China.* By C. J. Gahan, M.A., Assistant, Zoological Department, British Museum.

Most of the species described in this paper have been represented for some time in the British-Museum collection, but only by single or poor specimens. The addition of fresh specimens, presented by Mr. J. H. Leech, and the access which I have had to the collection of this gentleman, have enabled me now for the first time to describe them. Some of the species, duplicates of which have been presented by Mr. Leech, are quite new.

Trachylophus, n. g.

Head slightly projecting; the front vertical, impressed; the antennal tubercles somewhat depressed, separated by only a narrow groove; the vertex with a short median sulcus. Antennæ a little longer than the body in the male, about equal in length to the body in the female, with the third and fourth joints cylindrical, scarcely thickened at the apex, the fourth much shorter than the third, the fifth joint appreciably longer than the third, cylindrical at the base, compressed and angulate on its inner side at the apex; joints sixth to tenth subequal, compressed, and each angulate on its inner side at the apex; eleventh joint in the male a little longer, in the female scarcely longer than the tenth. Prothorax broader than long, narrow in front, dilated, but not armed at the sides in the middle, strongly rugose above. Elytra elongate, subparallel in their anterior four fifths. Legs long, femora linear, the posterior scarcely surpassing the third abdominal segment in the male, somewhat shorter in the female. Prosternum vertical and with a median keel or tubercle behind.

The position of this genus is between *Mallambyx*, Bates, and *Xoanodera*, Pascoe. With the head of the former, it has antennæ more like those of the latter genus.

Trachylophus sinensis, n. sp.

Fuscus, pubescentia grisea subsericea omnino indutus; capite supra sulco brevi impresso; prothorace antice angustato, lateribus in medio paulo dilatato, supra fortiter rugoso, rugis prominulis, intricatis; elytris minutissime et dense punctulatis, apicibus sub-oblique truncatis, angulis internis breviter spinosis; antennis (♂) corpore paulo longioribus, (♀) corpore subæqualibus, articulo quinto quam tertio longiore.
Long. 25–38 mm. ♂ ♀.

Hab. China.

Dark brown, the whole body with the legs and antennæ clothed with a uniform, greyish, somewhat silky pubescence. The vertex of the head between the eyes with a short longitudinal sulcus. The thorax very rough above, the convolutions of the ridges forming an intricate pattern. Two of the ridges, separated posteriorly by a median longitudinal furrow, run up to the middle, where they are widest apart, and then, running together, meet a little in front of the middle, and again separate anteriorly; the ridges next on the outside of these are also more or less regular, and have a somewhat longitudinal course; the other ridges are very irregular. Elytra very minutely and thickly punctured, with their apices slightly obliquely truncate and their sutural angles each armed with a very short spine. The prosternum moderately broad, with a faint median carina, which ends behind in a more or less prominent posteriorly directed tubercle.

There is a second species from Java which is closely allied to this, and which can only be distinguished from it by the broader and more distinct sulcus on the vertex of the head, by the different pattern of the sculpturing on the thorax, and by its narrower prosternum. As this species is undescribed, I give a short Latin diagnosis of its characters in a footnote*.

Callichroma? bimaculatum, White.

The series of this species from Kiu Kiang in Mr. Leech's

* *Trachylophus approximator*, n. sp.

T. sinensi valde affinis, sed differt prosterno paulo angustiore; prothorace rugis medio disco nec longitudinaliter dispositis.
Long. 30–37 mm., ♂ ♀.

Hab. Java. Brit. Mus. Collection.

collection shows every change from those specimens in which there is a simple spot on each elytron to those in which the elytra are completely banded. The latter form, described by Deyrolle as *Callichroma? Davidis*, cannot therefore be regarded as even a local variety, much less a distinct species.

Sympiezocera sinensis, n. sp.

S. japonicæ affinis, nigra, hirsuta; prothorace dorso calloso; elytris punctatis, fulvo-testaceis, macula magna transversa singulo ad medium et tertio apicali, nigris; antennis corpore (♂), vel corporis dimidio (♀), paulo longioribus.

Long. 20 mm., lat. 6 mm.

Hab. China.

Black, with fine and sparse greyish-fulvous hairs everywhere, very sparse on the elytra. Prothorax broadest a little before the middle, narrowest at the base, less expanded at the sides in the female, with five smooth callosities on the disk. The elytra fulvous testaceous, and having an incomplete fascia across the middle, made up of two large, black, transverse spots, which extend, one on each side, from the margin almost up to the suture. The apical third of the elytra is also black. Antennæ in the male black, a little longer than the body, in the female dark brown and reaching about the middle of the elytra. Posterior thighs in the male a little shorter than the elytra, in the female much shorter.

A single female in the British-Museum collection; two males in Mr. Leech's collection.

Purpuricenus Pratti, n. sp.

Niger; prothorace sanguineo, dorso maculis quinque nigris—duabus antice et tribus postice, lateribus medio spinosis; elytris sanguineis, maculis tribus nigris, duabus ante medium, tertia communis, maxima, rotundata, pone medium; antennis (♀) corpori æqualibus, (♂) duplo longioribus.

Long. 18–20 mm.

Hab. China.

Black, excepting the prothorax and elytra, which are red; the former is sometimes almost wholly red on the underside, sometimes the intercoxal process and the parts surrounding the coxal cavities are black. There are five black spots on the disk of the thorax, two anterior and three posterior, of which the median one marks the position of a small tubercle. The lateral spines are in the middle, and the thorax is slightly narrower behind than in front of them. The elytra are marked with three black spots, one on each near the base, the third, very large and round, common to both and extending from a little in front of the middle to near the apex. The prosternum and mesosternum are both slightly tubercled. The antennæ of the female are about as long as the body, those of the male twice as long.

In a good series of specimens, nearly all of which, however, are from Kiu Kiang, the markings of the elytra are subject to very little variation, and this only in the size of the basal spots.

In a variety of this species represented in the British-Museum collection by a single female example from Chowsan, the basal spots of the elytra are absent and the large post-median spot is replaced by four spots—two oblong, sutural, and two smaller, external to them.

Monohammus albisparsus, n. sp.

Omnino pubescens, infra griseus, supra griseo-brunneus; scutello et macula media ad marginem posticam thoracis fulvis; elytris maculis albis irregulariter dispersis; antennis scapo fusco, ceteris articulis griseis, apicibus fuscis; mesosterno tuberculato.

Long. 15–18 mm.

Hab. China (Kiu Kiang).

A species which may be recognized by the fulvous scutellum with a spot of the same colour at the base of the thorax, by the elytra with a close pubescence of a dark greyish or brownish colour, with a large, very irregular, broken, dirty white spot on the middle of each, and smaller spots of the same colour scattered over their surface.

The antennæ with the scape narrowly but completely cicatrized at the apex, with this joint dark brown in colour, the remaining joints grey at their base and more or less fuscous towards their apex. The mesosternum conically tubercled in the middle.

Haplohammus contemptus, n. sp.

Fuscus, viridi-griseo pubescens; capite punctato; prothorace supra convexo, æquali, dense punctato; elytris punctatis, brunneo-griseis, pallide griseo mixtis; scapo antennarum vix cicatricoso.

Long. 10–14 mm.

Hab. China.

A small obscure-looking species, with the head punctate, only slightly concave between the antennal tubercles, the latter not at all prominent.

The prothorax is almost or entirely without transverse grooves, is somewhat convex on the disk, and is very closely punctured both above and at the sides. The scutellum is pale grey. The elytra are punctate, of a brownish grey mixed with a paler grey, the latter appearing mostly as a very indefinite broken band on each elytron extending from the shoulders obliquely towards the suture and thence along to the apex. The cicatrice of the scape is scarcely apparent in fresh specimens, in which it is covered by the pubescence; it is incomplete. The joints of the antennæ from the third are testaceous and pale grey pubescent at their bases.

Melanauster Leechi, n. sp.

Niger, nitidus; capite inter tuberculos antenniferos valde concavo; prothorace impunctato, nitidissimo, dorso inæquali, lobo mediano postice emarginato; elytris nigris, minutissime exsculptis, sine granulis et fere impunctatis; antennis articulo secundo griseo-cæruleo, ceteris nigris; tarsis supra griseo-cæruleis.

Long. 30–40 mm.

Hab. China (Kiu Kiang).

Head minutely and sparsely punctured, deeply and triangularly concave between the antennal tubercles, with the front somewhat depressed in the middle. Prothorax impunctate, very shiny, somewhat constricted in front of and behind the lateral tubercles; these with a slightly posteriorly-directed curvature and sharply pointed at their ends. The disk somewhat obtusely tubercled or raised across the middle, the median lobe or tubercle projecting a little on the posterior transverse groove and triangularly notched behind. Elytra black, very finely and minutely sculptured, so as to have a coriaceous appearance, with a few minute scattered punctures behind the shoulders. Body black and glossy below; the legs with a faint greyish pile; the tarsi with a pale greyish-blue pubescence above. Antennæ with the second joint and the extreme base of the third joint bluish grey, the remaining joints black.

I have named this fine species after Mr. J. H. Leech, to whom the British Museum is indebted for its specimens of this and other species described in the present paper.

Uræcha punctata, n. sp.

U. angustæ, Pasc., affinis, sed latior; capite, articulis antennarum basalibus, pedibus et corpore subtus cupreo-brunneo pubescentibus; prothorace supra griseo, ferrugineo-maculato et minute granuloso; scutello ferrugineo; elytris, antice fortiter punctatis, fuscis, sparse ferrugineo-pubescentibus, singulo apice subrotundato, lateraliter plagiato, parte plagæ ante medium majore, alba, minus dense punctata, parte pone medium minore, brunneo-nigra, valde et dense punctata.

Long. 14–20 mm., lat. 4–6 mm.

Hab. China.

The underside of the body, the legs, head, and antennæ at the base of a somewhat dull bronze colour. The apices of the third to the last antennal joints fuscous; the last few joints almost completely so. Two distinct ferruginous spots on the disk of the thorax near its anterior margin, and one or two spots of the same colour on each side. The large patch on the side of each elytron touches the margin, but does not reach the suture; it is white and closely pubescent in its anterior two thirds, and dark brown, almost black, in its posterior third. The elytra are strongly and thickly punctured at the base and along the suture between the lateral plagæ, as well as on the black parts of the latter; on the white parts the punctures appear smaller and more distant, but this is doubtless due to the closer pubescence which covers them; towards the apex the punctures are smaller and fewer.

This species is broader than *Uræcha* (*Monohammus*) *angusta*, Pascoe; the elytra also are more punctate, but in other respects (the colour excepted) it agrees so well with that species that it must be placed close to it. There are three female specimens in the British-Museum collection.

Saperda simulans, n. sp.

S. carchariæ simillima, sed angustior; antennis gracilioribus, unicoloribus.

Long. (♂) 21 mm., (♀) 24–26 mm.; lat. (♂) 6 mm., (♀) 8 mm.

Hab. China.

In colour and punctuation this species has a very close resemblance to the well-known *S. carcharias*, but may be easily distinguished by its smaller and narrower form, and by its antennæ, which are slenderer and covered throughout with a tawny pubescence like that of the body. The elytra are less attenuated posteriorly than in *carcharias*, and each ends in a very short but distinct tooth. The antennæ are about equal in length to the body in the male, and somewhat shorter in the female.

The measurements given above are taken from a limited number of specimens, of which one only is a male; this male specimen is in Mr. Leech's collection.

Saperda brunnipes, n. sp.

Capitis lateribus et fronte, prothoracis lateribus et corpore subtus sulphureo-pubescentibus; capitis vertice, lata vitta longitudinali in medio thoracis, elytrisque nigris, leviter griseo-pubescentibus; antennis, pedibus tarsisque brunneis, leviter pubescentibus.
Long. 14 mm., lat. 4 mm.

Hab. China (Kiu Kiang).

Head with the front and sides yellowish pubescent, the vertex black, with a faint greyish pile. The thorax yellow at the sides and beneath, with a broad longitudinal band on the middle of the disk, the band (with the exception of a faint median carina) covered with a greyish pile. There are two very faint tubercles, one each side of the thorax, and each marked out by a small black spot. The elytra are black, punctate throughout, and clothed with a greyish pile. The legs and antennæ are light brown and faintly pubescent, the latter are somewhat fuscous towards the tip.

GLENIDA, n. g.

Head flat or nearly so between the antennal tubercles. The lower lobes of the eyes rather large and reaching about two thirds of the way to the base in the male, distinctly smaller in the female, and reaching scarcely halfway to the base. The cheeks in the female prominent, so that the head is broadest across the base; in the male the cheeks are not at all prominent. The antennæ nearly as long as the body in the male, shorter in the female; the third joint longest, the first and fourth subequal, the others gradually decreasing in length. Thorax obtusely conically tubercled at the sides. Elytra moderately long, sharply carinate for two thirds their length at the sides, somewhat oblique at the shoulders, slightly narrowed posteriorly, with the apex broadly rounded. Intermediate tibiæ entire, the claws of the tarsi simple and divaricate.

This new genus of the Saperditæ is created for two pretty species from China. It is closely allied to *Neoxantha*, Pascoe, from which it is distinguished by its more elongated form, by the less parallel elytra, as well as by the more prominent cheeks and larger mandibles in the female. It approaches the genus *Glenea* in appearance, but differs by its broader form, tubercled thorax, and entire median tibiæ.

Glenida suffusa, n. sp.

Capite punctato, cæruleo-griseo squamoso pubescente; prothorace lateribus ante medium obtuse tuberculato, ochraceo-pubescente, dorso medio macula nigra griseo marginata, postice carina mediana dorsali; scutello griseo-albo; elytris nigro-velutinis, cæruleo suffusis, ad basin ochraceis; corpore subtus pedibusque fulvo-ochraceis; tarsis et tibiarum apicibus nigris; antennis fuscis, articulis tertio et quarto pallidis.
Long. 17–21 mm., lat. $6\frac{3}{4}$–$8\frac{3}{4}$ mm. ♂ ♀.

Hab. China (Kiu Kiang).

Head punctate, black, with a squamous pubescence, which is pale blue on the front and round the eyes and yellowish on the cheeks. Prothorax obtusely tubercled at the sides in front of the middle; an oblique groove separates each of the lateral tubercles from a tubercular swelling in front of and below it, close to the anterior margin. The thorax is of a reddish ochraceous colour, with a black spot margined with grey on the middle of the disk, and with a faint grey spot on each side just behind the lateral tubercles. A short longitudinal keel extends from the posterior margin about halfway along the middle of the thorax. Elytra very slightly projecting on each side of the scutellum, with a triangular basal area reddish ochraceous, like the thorax, the rest of a deep black suffused with pale blue, punctured near the base and along the lateral carinæ. The underside of the body and the legs fulvous, covered with a yellowish pubescence. The tarsi and apices of the tibiæ black, slightly mixed with grey. Antennæ with the third and fourth joints testaceous, the scape black, and the remaining joints dark brown.

Glenida cyaneipennis, n. sp.

Capite, articulis antennarum basalibus, thorace (tuberculis lateralibus et maculis duabus medio disco, fuscis, exceptis), pedibus et corpore subtus ochraceo-fulvis; elytris glabris, cyaneis, punctatis; tarsis apicibusque tibiarum nigro-fuscis.
Long. $19\frac{1}{2}$ mm., lat. $7\frac{1}{2}$ mm. ♀.

Hab. China.

A very pretty species, which I believe to be congeneric with the last. The head is of a rich fulvous colour, the front impunctate, with a median longitudinal groove which extends on to the vertex. The prothorax is ochraceously pubescent, with a distinct conical tubercle on each side very little in front of the middle; these tubercles and two triangular spots on the middle of the disk are of a dark brown colour. The scutellum is ochraceous. The elytra, glabrous and punctate throughout nearly their whole extent, are of a fine metallic blue. The lateral carinæ are sharp and distinct and extend about two thirds the length of the elytra. The whole underside of the body, the femora, and bases of the tibiæ are of a bright ochraceous colour. The tarsi and apices of the tibiæ are of a very dark brown.

Two females of this species only are known to me; they are in the British-Museum collection.

Thyestes funebris, n. sp.

Niger, pubescens; capite punctato, nigro pubescente, fronte ad basin obscure griseo; prothorace supra dense punctato, omnino nigro; elytris antice punctatis, omnino nigris, pubescentibus; antennis nigris, articulis quarto ad octavum, ad basin et subtus griseis.

Long. $11\frac{1}{2}$–13 mm.

Hab. China (Kiu Kiang).

Of the size and form of *T. Gebleri*, Falderm., the only other described species of the genus, but very distinct by the absence of any white stripes. It is wholly black with the exception of an obscure greyish patch on the front of the head at its base, and of some of the joints of the antennæ, which are greyish at their base and underside.

X.—*The Adhesive Disk of* Echeneis. By R. Storms, Brussels.

The singular disk covering the head of *Echeneis* has, since ancient times, attracted the attention of naturalists, and more recently its structure and morphological interpretation have been several times investigated. Notwithstanding this, there still remains a certain amount of divergence of opinion and uncertainty as to the nature of the organ as a whole or of its constituent parts. In the present paper an endeavour will be made to solve the different questions pertaining to this subject.

I.

Morphological Value of the Disk as a whole.

Two interpretations of the morphological value of the disk have been given.

1. The first, generally adopted, explains it as a modified dorsal fin. Voigt, according to Dr. Günther *, was the first to give this interpretation, which was also put forth by Blainville †, Agassiz ‡, and most writers.

2. The second interpretation, much less known, was suggested by Kner §. He compares the organ of *Echeneis* to the scutes and spines of *Gastrosteus*, and explains them all as modified dermal ossifications.

There can be little doubt as to the first interpretation being the true one, because

1. The disk occupies the position of a spinous dorsal fin; and as *Echeneis* by its other characters can be proved to belong to the Acanthopterygians, it is natural to think that the missing spinous dorsal has served to form the disk.

2. Some parts of the disk, *i. e.* the interneural spines, are so little transformed that they are easily recognizable.

3. As will be shown further on, it is not only the interneural spines, but also the other elements composing the disk, that can be compared to those which enter into the structure of a normal spinous dorsal fin.

As for the other opinion, it does not satisfy any of the foregoing conditions.

II.

Morphological Value of the Elements of the Disk.

If most authors agree in regarding the disk as a modified dorsal fin, there is much greater uncertainty as to the interpretation of the different bony elements which enter into its composition, and also as to the way in which these have been modified.

1. Voigt ‖, Blainville ¶, and the older authors regard the buckler as formed of a fin, the rays of which have been bent downwards on both sides.

2. Dr. Günther** explains each pair of lamellæ of the disk as formed out of one spine, each half of which is bent down towards the right and left.

* A. Günther, "On the History of *Echeneis*," Ann. & Mag. Nat. Hist. [3] 1860, vol. v. p. 389.

† A. Günther, *loc. cit.* I have not been able to consult the original papers of Voigt and Blainville.

‡ L. Agassiz, Recherch. Poiss. Foss. vol. v. p. 117.

§ Dr. Rudolf Kner, "Ueber den Flossenbau der Fische," Sitzungsb. kais. Akad. Wiss. Bd. xliv. 1861, p. 62.

‖ Dr. Günther, *loc. cit.* p. 389.

¶ *Id. ibid.*

** Dr. Günther, 'The Study of Fishes,' p. 460.

3. G. Beck *, after describing and naming the different elements of the disk, considers the pectinated lamellæ to be enlarged spinous rays and ascribes the two other elements to the interneural bones (*Flossentrager*).

4. Finally, M. Niemiec † finds it impossible to explain the homologies of the lamellæ composing the disk.

In order to arrive at a satisfactory solution of these questions it will be necessary:

1. First, to examine attentively the different elements of the disk;
2. Secondly, to study the structure of a normal spinous dorsal fin;
3. Lastly, to compare both organs together.

I. *Description of the Elements of the Disk.*

Two kinds of structures may be regarded as entering into the composition of the hard parts of the disk:—

1st. Structures which have a dermal origin;

2nd. The skeleton properly so-called of the disk.

1. To the first category belong the rows of small teeth which cover the posterior margins of the lamellæ. That they are not formed by outgrowths of the bony substance of the lamellæ is proved by the facility with which they fall off by prolonged maceration or ebullition. The presence of these rows of teeth on the posterior margin of the lamellæ was one of the reasons which prevented Dr. Kner ‡ from adopting the usual interpretation of the disk of *Echeneis*.

2. The properly so-called bony skeleton of the disk.

A. *A typical segment* of the disk is composed of three elements:—

α. The interneural ray;

β. The intercalary bone (*Fussplatt*, G. Beck; *Os trabéculaire*, Niemiec);

γ. The pectinated lamellæ (*Zähnplatten* of G. Beck; *Lames pectinées* of Niemiec).

α. *Interneural ray.*—This bone is rather small and has pretty much the usual form, the principal difference being that the upper part, which expands to carry the ray, is in the same plane as the lower blade; this is caused by the direction

* G. Beck, "Ueber die Haftscheibe der *Echeneis remora*," Inaugural Dissertation, 1879, p. 31.

† Niemiec, "Les ventouses dans le règne animal," Recueil zoologique suisse, tome ii. 1885, p. 117.

‡ Dr. R. Kner, "Ueber den Flossenbau der Fische," Sitzungsb. kais. Akad. Wiss. Wien, Bd. xlii. p. 768.

of the latter being opposite to what it is in other fishes, the lower extremities of the interneurals pointing backwards instead of forwards. The upper expanded portions of the interneural spine each carry a pair of lamellæ at their junction.

β. *Intercalary bone.*—This is a lamellar bone formed of wing-like plates, with a narrow connecting part which expands in its middle and rests partly on the interneural spines. The wing-like anterior parts of the consecutive intercalary bones overlap one another, like the tiles of a roof.

γ. *Pectinated lamellæ.*—These are paired bones, joining two by two in the median line and occupying the whole surface of the disk. They have an elongated shape. Their posterior margin carries the bands of small teeth mentioned above. One of these teeth, placed at the junction of the two lamellæ, is much longer than the others and is situated on a lower plane. It has a curved shape, and suggests the idea of a spinous ray; but it does not form a continuous part of the pectinated lamellæ. Each lamella carries at its anterior margin, nearer to the median line, a strong process. It is directed forwards and passes downwards through the interspaces left between the intercalary bones.

B. *The anterior extremity* of the disk ends in a segment rounded anteriorly and formed by the fusion of the different kinds of elements already mentioned—the pectinated lamellæ, an intercalary and an interneural spine. Although it is difficult to make out all the bones which enter into the composition of the anterior extremity of this segment, it is curious to remark the presence of a small spine which appears to represent the longest of the small teeth, all the others being quite absent.

C. *The posterior extremity* finishes by a notch partly containing a curious round ossification, which may possibly be a modified interneural.

II. *Description of a normal Spinous Dorsal Fin.*

We shall take the spinous dorsal of *Scomber*, as this fish belongs to the same division as *Echeneis*.

Here we also find three elements:—

1. The interneural spine;
2. An intercalary bone;
3. A spinous ray.

1. *The interneural spine* (*axonost* of E. D. Cope* and Ryder) may be divided into two parts:—

* E. Cope, 'American Naturalist,' vol. xxi. no. 11, 1887, p. 1015.

A. An expanded and horizontal upper part, transversely enlarged in two places, which gives it the form of an X. The first enlargement carries the spinous ray.

B. The lower part, forming the shaft of the bone, directed downwards and forwards between the lateral muscles.

2. *The upper interneural spine*, which can be proved to be the *baseost* (Cope and Ryder), has the shape of two wings. At their junction these carry a process directed backwards, which enters into a cavity at the base of the spine.

3. *The spinous ray* has a transversely much enlarged base, in the middle of which there is a small hole. The base carries on its posterior side two processes directed backwards when the ray is erected. A groove is seen on the spine itself, showing the two halves which formed the ray.

III. *Comparison between the Elements of the Disk and those of a Spinous Dorsal Fin.*

1. *Interneural spine.*—There can be no difficulty as to the homology of the interneural spines in the disk and spinous dorsal fin, as admitted by MM. Beck *, Niemiec †, &c.

2. *Intercalary bone* (*Fussplatt*, Beck; *Os trabéculaire*, Niemiec).—This bone corresponds by its position on the interneural spine (it rests not on the anterior widened surface of the interneural spine, but more backwards and connects each interneural with the following), and especially by its winged shape, to the upper interneural (or baseost) of *Scomber*.

3. *Pectinated lamellæ* (*Zähnplatten*, Beck; *Lames pectinées*, Niemiec).—These bony lamellæ have been considered by most authors to be transformed spinous rays. They correspond to spinous rays by their position on the interneural spines (each pair of lamellæ rests at their junction on the enlarged upper surface of the interneural spine), by their position with regard to the intercalary lamellæ, and by the strong processes which they carry underneath. To this interpretation M. Niemiec ‡ objects that it is very difficult to explain the transformation of a median bone into two lateral symmetrical bones differing completely from the primitive one. But it ought first to be borne in mind that spinous rays, like the articulated rays, are formed of two halves § (traces of this can still be seen in the spinous rays of *Scomber*) more or less completely joined. It is easy to conceive that these can remain separated by arrest in development.

* G. Beck, *loc. cit.* p. 31. † Niemiec, *loc. cit.* p. 116.

‡ Niemiec, *loc. cit.* p. 117.

§ Wiedersheim, 'Lehrbuch der vergleichenden Anatomie,' p. 168.

This homology of the pectinated plates and spinous rays being admitted, there still remains to explain the way in which a spinous ray has been transformed.

Three methods have been suggested :—

I. The fin-rays have been bent downwards on both sides (Voigt *, Blainville †, according to Dr. Günther).

II. Each pair of lamellæ is formed out of one spine, each half of which is bent down towards the right and left (Dr. Günther ‡).

III. Each pair of lamellæ represents a transversely enlarged spine (G. Beck §).

I. The *first* hypothesis must be rejected, because the pectinated lamellæ are in pairs which correspond to each other and are supported by a single interneural.

II. The *second* notion seems very improbable. 1. Supposing such a splitting and bending down of the two halves of a spinous ray to have taken place at first accidentally (teratologically), how could such an accidental structure have been immediately seized upon and adapted to a new habit? 2. A dorsal fin split in half does not by itself form an adhesive disk. 3. Then how could the exterior extremities of the lamellæ, which in this supposition represent the points of the spines, be as firmly united to the connective tissue of the integuments of the head, as they appear to be, according to M. Niemiec ‖? 4. And finally, if we take two corresponding pectinated lamellæ, and if we replace them in their supposed primitive position, it can be seen immediately that the processes corresponding to those of a normal spinous ray are then situated on diametrically opposite sides, in the spinous ray and in the pectinated lamella.

III. The *third* supposition, which maintains that the pectinated lamellæ are transversely enlarged spines, avoids the former difficulties; but there remains still to be explained in what way the enlargement took place. To suppose that the spine proper of the spinous ray took part in the enlargement would be very difficult to understand and quite unjustifiable by observation. There is no trace on any of the lamellæ of what might represent such an enlarged spine. It is much more natural to think that the bases of the spinous rays alone have formed the lamellæ and that the spine proper was gradually reduced in size until it has nearly disappeared. Such a reduc-

* Günther, Ann. & Mag. Nat. Hist. [3] 1860, vol. v. p. 389.

† *Id. ibid.*

‡ Günther, 'The Study of Fishes,' p. 460.

§ Beck, *loc. cit.* p. 31.

‖ Niemiec, *loc. cit.* p. 119.

tion of the spines is frequently observed among fishes, *i. e.* *Naucrates*, *Elacate*, &c.

A comparison between a pair of pectinated lamellæ and the base of a spinous ray confirms this opinion. In both analogous processes situated on the same side (if we suppose the spinous ray bent down) can be seen, and between the two lamellæ, when they are joined, a hole or notch is observed corresponding to that in the base of the spinous ray.

III.

Where was the Disk formed?

This question, although it has not, so far as I know, been discussed by naturalists, is not devoid of interest. Three suppositions are possible:—

1. The disk was formed *in situ* from a primitive fin;
2. Spinous rays migrated to the extremity of the snout, there to be transformed into a disk;
3. The disk was formed on the dorsal region, and then migrated gradually to its actual position.

1. The *first* supposition is very improbable, for in all Teleosteans, and especially the Acanthopterygians, when the dorsal extends to the extremity of the head it does so in a secondary way (Pediculati, Pleuronectidæ). Moreover all the nerves and blood-vessels for the disk come from the cervical region *.

2. The *second* hypothesis also seems improbable, for it supposes that a dorsal fin, more or less normally constituted, migrated to the extremity of the head, a secondary position for a dorsal fin rarely observed among fishes, and that this migration had another cause than that of the transformation of the fin into an adhesive disk.

3. Therefore the *third* supposition appears to be the most likely, *i. e.* that the disk was formed on the anterior dorsal region and migrated, after it was used as a disk, towards the extremity of the head.

IV.

Echeneis glaronensis.

The recent discovery of a well-preserved fossil *Echeneis* in the schists of Glaris † is of special interest for our present

* G. Beck, *loc. cit.* p. 27.

† Dr. A. Wettstein, "Ueber die Fischfauna des tertiären Glarnerschiefers," Abhandlungen der schweizerischen paläontologischen Gesellschaft, vol. xiii. (1886).

purpose, as it most probably shows us an ancestral form of the living types. We shall examine in this section whether a study of this fossil throws any light on the three questions treated of above, *i. e.*:—

I. The morphological value of the disk as a whole.

II. The morphological value of the elements of the disk.

III. Where was the disk formed?

I. As to the *first* question, the disk of the fossil confirms the opinion that it was formed of a dorsal fin, because

1. It has a position more similar to that of a normal dorsal. The disk of *Echeneis glaronensis* is placed on the cervical region, extending only onto the posterior part of the head, instead of covering its whole surface up to the extremity of the snout.

But it might be objected that in the Glaris fossil

a. The disk has been displaced backwards during fossilization; or

β. That the disk has lost all its anterior segments and extended really as far forwards in the fossil as in the living forms.

a. To the *first* objection it may be replied that all the other elements of the skeleton of the fossil have been kept in their real anatomical connexions, that they are even united together by traces of skin, and therefore it is improbable that the disk alone has changed its position.

It is true that the roof of the skull has been displaced by compression; but even in this case it has not moved backwards or forwards, but has opened like the lid of a box, one side of it being still in connexion with the other bones of the head and shoulder-girdle.

β. To the *second* objection, as well as to the first, may be replied that the frontal bones, by their pitted and striated appearance, show that they were not buried under a layer of muscles, but were near to the surface. Bones covered by muscles, like those of the roof of the skull of the living *Echeneis*, for instance, are smooth and have quite a different appearance.

2. By its narrowness it is also more like a normal dorsal if, as has been shown above, the lamellæ represent the enlarged bases of the spinous rays and the superior interneurals (baseost).

II. Regarding the *second* question, the morphological value of the elements of the disk, attentive examination of the fine figure in Dr. Wettstein's work does not furnish conclusive evidence. It is even rather difficult to make out in it the elements of the disk of a living *Echeneis*. Perhaps the study of the fossil itself would yield better results. At any rate, its narrowness is what would be expected if the view is adopted that the lamellæ were formed by a gradual transversal enlargement of the bases of the spinous rays and wing-shaped bones accompanied by a reduction of the spines themselves. Moreover Dr. Wettstein * speaks of short spines directed backwards which are observed on the disk of *Echeneis glaronensis*. If these spines are really spinous rays, and not the interneurals, as they may be (if, for instance, the disk is seen from its under surface), then we should have here a strong confirmation of the views I have adopted.

III. Finally, in regard to the *third* question, as to where the disk was formed, evidently the Glaris *Echeneis*, showing us the disk still partly on the dorsal region, proves that it was first formed on the back and migrated afterwards towards the extremity of the head.

It might be objected that, if the disk of *Echeneis glaronensis* does not extend to the extremity of the snout, it is because it is formed of but a small number of lamellæ. However, a living species of *Echeneis* (*E. lineata*) has probably the same number of lamellæ, notwithstanding which the disk goes to the end of the snout.

Before leaving this subject I should like to make a few remarks suggested by *Echeneis glaronensis*—

1. As to the position in classification of the genus *Echeneis*;
2. As to the general form of the body of *Echeneis glaronensis* compared with that of living species.

1. Authors have classed this genus in various families of Acanthopterygians. Joh. Müller makes of it a group of the Gobiidæ †; L. Agassiz ‡ and, after him, most authors class them with the Scombridæ.

Certainly none of the characters of *Echeneis glaronensis* point towards the Gobiidæ; on the contrary, in the shape of the head, the structure of the ventrals, the size of the pectorals, the shape of the caudal fin, &c., it differs more from the Gobiidæ than the living forms do. On the other hand, by all these characters and others *Echeneis glaronensis* ought to be classed among the Cotto-Scombriform Acanthopterygians. But here the difficulty begins. If we adhere strictly to the characters of the families given by Dr. Günther, *Echeneis*

* Dr. Wettstein, *loc. cit.* p. 82.

† Johannes Müller, Abhandl. d. k. Ak. d. Wissensch. Berlin, 1844, p. 158.

‡ L. Agassiz, Rech. poiss. foss. vol. v. p. 117.

glaronensis, on account of the number of its vertebræ (10/13 according to Dr. Wettstein *), should be classed among the Carangidæ, whilst all the living forms having more than 10/14 vertebræ ought to be put with the Scombridæ. The other characters of *E. glaronensis* do not decide in which of these two families it ought to be placed.

2. A careful comparison of the proportions of all the parts of the skeleton of the fossil *Echeneis* with those of the living forms, such as *E. naucrates* or *E. remora*, shows that the fossil differs nearly equally from both and that it was a more normally shaped fish than either of these forms. The head was narrower and less flattened, the preoperculum wider, the two jaws had nearly the same length. The ribs, as also the neural and hæmal spines, were longer, the tail more forked, and the soft dorsal fin much longer. In fact it was a more compressed type, probably a far better swimmer than its living congeners, as might be expected if the smallness of the adhesive disk is taken into account.

XI.—*On the Family* Rhysodidæ.
By George Lewis, F.L.S.

The primary object of this paper is to record the species at present known from Japan; but as I found it impossible to work out the Japanese species without investigating the general literature of the group, and finding then that most of the species described are subsequent to the publication of the 'Munich Catalogue,' I have thought it well to give as an appendix a list of all the species known to date. I have also described a new species from the Caucasus, and suggested a new genus, *Epiglymmius*, to receive *Rhysodes sulcatus*, Fab., and a similar species from Japan, on the characters given below.

The Japanese species are:—

Epiglymmius comes.	Rhysodes rostratus.
Rhysodes crassiusculus.	—— niponensis.
—— sulcicollis.	Clinidium veneficum.

Dr. L. von Heyden has not included any species of this family in his 'Catalogue of Siberian Coleoptera,' so it may

* Dr. Wettstein, *loc. cit.* p. 83.

be assumed that collectors in that region have either overlooked these insects or that the captures have not been recorded; and no Chinese species is known.

Lacordaire and others have noticed that some of the characters of the Rhysodidæ are similar to some possessed by the Brenthidæ; yet while likening them to *Trachelizus* and *Hephebocerus* Lacordaire says, "quoique cette ressemblance soit fortifiée par des habitudes pareilles, ce n'est là, comme on le pense bien, qu'une analogie lointaine." And if *Rhysodes crassiusculus* is examined sideways the cheeks, or cephalic lobes as I have termed them in this paper, will be seen to project over the neck, somewhat like those of *Higonius cilo*, Lewis, figured in the Journ. Linn. Soc., Zool. vol. xvii. pl. xii. fig. 10. Erichson has pointed out their similitude in some respects to the Carabidæ, and Crotch placed them in the Adephaga. Imhoff, in 1856, placed *Cupes* and *Rhysodes* in a family he called Baculicornes; and Leconte says that "Latreille, who first proposed the genus *Rhysodes*, though he did not describe it, had a clearer recognition of the true affinities when he associated it with *Cupes*. This approximation has not received the approval of other investigators, though I hope to demonstrate its correctness" (North-American Col. vol. v. 1875, p. 165). The Cupesidæ as a family has many characteristics similar to those of the Ptinidæ, and for convenience in classification they should, I think, be placed next to each other in our catalogues. Leconte says this is an "error which has hitherto obscured the perception of the affinity" of *Cupes* and *Rhysodes*. But Leconte's view will not be entertained by students at this time, for excepting the cephalic lobes they have nothing in common. *Cupes* in the imago-state has the habits of a *Ptinus* and occurs in similar situations; both are usually nocturnal or crepuscular in their wanderings; but on one occasion, in August, near Hakodate, I found *Cupes* running about on some old railings at four o'clock in the afternoon. The larvæ of *Cupes* and *Rhysodes* are, I believe, unknown; but it is not in the least likely they correspond with each other in habit. The imagos of the Rhysodidæ are well known as inhabiting the interiors of large trees when in the later stages of decay, and seldom stray far from their habitat. The Rhysodidæ have five-jointed tarsi which are nearly equal in length, and the posterior coxæ are remarkably wide apart. *Clinidium* is an apterous genus, and this want of wings perhaps accounts for the great depression in the region of the scutellum, which is one of its most notable characters. *Epiglymmius* and *Rhysodes* are alate, and as the humeral angles of the elytra in the former are not projecting, we may assume that the singular humeral projections in *Clinidium* and *Rhysodes* are not connected with the membranous organs of flight, because they are equally prominent in the apterous genus *Clinidium* as in the alate *Rhysodes*.

By my journal I find that I captured a large number of Rhysodidæ on the 19th April and again on the 23rd December, 1880, in the touchwood of old beeches and firs, and the beetles associated with them were *Stomonaxus*, *Leptochirus*, *Osorius*, *Hypulus* (two species), *Platydema*, *Scaphidema* (four or five species of the last two genera, some unicolorous, others maculate after the manner of the Erotylidæ), *Hypophlœus*, and some Cossonidæ. Of these *Stomonaxus læviventris*, Bates, a Carabideous insect which always lives in rotten trees, corresponds best with *Rhysodes* in colour, and its front tibiæ also are notched somewhat in the same way; but it is difficult to connect any of these species together excepting in the fact of their congregating in a common habitat. The Rhysodidæ are apparently less numerous in the tropical parts of Asia than in the more temperate regions where deciduous trees are more abundant, as I found but one species in Ceylon, *R. taprobanæ*, Fairm., whereas by the methods I employed there for the capture of insects certainly three would have been taken in Japan.

Out of eighty-seven specimens found in Japan twenty-three only are males, and I cannot believe that this proportion of the sexes is accidental, as the males are comparatively few in all the species. Of thirty taken in Ceylon eleven are males.

In habits the Brenthidæ do not correspond with the Rhysodidæ; but amongst the Cucujidæ *Prostomis* appears to do so, though I have never found specimens of the two families in one tree. *Prostomis* resides in the centre of rotten trees and possesses the same moniliform antennæ, with which character also *Leptochirus* and *Osorius*, which live in similar places, approximately correspond. A trunk of a tree thrown across a stream to form a bridge for the Tamils on a coffee-estate at Dickoya, in Ceylon, was submerged for five months during the wet season, and on the water lowering in April the trunk was discovered and broken up, and several hundred specimens of *Prostomis Schlegelii*, Olliff, were taken from it. The specimens were collected by a coolie and brought to me in an old meat-tin, and the destructive propensities towards each other awakened in the insects by this unnatural situation left very few perfect examples.

The few species of cylindrical Cucujidæ of the genus *Ancistria* I brought from Japan were captured fortuitously, and whether they follow the insects which pierce the timber diametrically or those that work in the layers of the bark I cannot say; but their habits are doubtless in no way analogous to those of *Prostomis* or *Rhysodes*. The least artificial position for the Rhysodidæ seems to me to be next to the Cucujidæ, and this is the position in which they are placed on page 867 of the 'Munich Catalogue.'

I have given the name of *Rhysodes Brouni* to *Rhysodes aterrimus*, Broun, as the latter name has been used by Chevrolat; and in uniting *eminens*, Broun, with *orbitosus*, Broun, as the sexes of one species, I have allowed the name of the female precedence; and this I have no doubt the gallant describer will cordially endorse.

The six following species have the eyes more or less circular at their edge and visibly reticulate; wings ample.

Epiglymmius, n. g., 1888.

I restrict this genus to two species, *sulcatus*, Fabr., and *comes*, Lewis; both these insects have the terminal joint of the antenna conical, the median elevation on the upper surface of the head not abbreviated, and the humeral angles of the elytra are round.

Epiglymmius comes, sp. n.

E. sulcato simillimus; thorace trisulcato, sulcis lateralibus haud abbreviatis.

L. $7\frac{1}{2}$ mill.

This species is narrower than *sulcatus*, Fabr., and rather smaller. The head is less transverse behind the eyes, the two lateral thoracic sulci are complete, the thorax is narrower and more parallel at the sides, and the legs are less robust. Erichson says of *sulcatus*, Fabr. (Nat. Ins. iii. p. 300), "prothorace trisulcato, sulcis lateribus antice abbreviatis," and there is an excellent figure of it in Duval's Gen. Col. d'Europe, p. 47, fig. 234.

I obtained two specimens of *comes* at Nikko and two at Sapporo.

Rhysodes, Westwood, 1835.

The name of this genus was suggested by Dalman in 1823, but it was first characterized by Westwood in 1829, and published by him six years later in the Zool. Journ. vol. v. p. 215 (1835). The type of the genus is figured with dissections, t. xlvi. fig. 1; and as Professor Westwood has very kindly sent me the type for examination, I am able to say positively that his type is an American insect and the same as *R. americanus* of the list at the end of this paper. For many years confusion existed in the nomenclature of this species owing to an impression in the minds of the earlier entomologists that *exaratus*, Illiger, from America, and *exaratus*, Serv., from Europe, were specifically the same. The characters on which I rely to separate *Rhysodes* from *Epiglymmius* are the truncate (or nearly so) terminal joint of the antennæ, the median raised surface of the head abbreviated, and the prominent and reflexed humeral angles of the elytra; but in the list at the end of the paper I have included in it some species which perhaps may not eventually be left in the genus. I allude more especially to *Rhysodes arcuatus*, Chevrolat, from New Zealand, which has the last joint of the antenna distinctly conical; and perhaps this insect is nearer to *Clinidium*, or may finally be placed in a new genus. Captain Broun (owing I suppose to the great rareness of the New-Zealand species) has not yet distinguished the sexual from the specific characters. For the proper working out of insects of this class a long series is very desirable, but unfortunately rarely obtainable.

Rhysodes crassiusculus.

R. americano simillimus at latior, tibiis anticis ♂ in medio spinosis, posticis valde dilatatis.

L. $6\frac{1}{2}$–7 mill.

This species is very similar to the well-known *R. americanus* of North America. It is, however, broader, the head has the hind angles below the eyes a little prominent, the cephalic lobes viewed sideways will be seen to project in a marked manner over the neck, and the thoracic elevations are sparsely but distinctly punctate. The male has a strong tooth in the middle of the interior edge of the fore tibiæ (the only species known to me with it) and a second on the anterior femur; the apex of the middle tibia has two claw-shaped spines and the hind tibia is robust, bent inwards from the middle, and from the point of the bend conspicuously dilated. The dilatation is three times the extent of that in *R. americanus*. The female is wanting in these characters, except in the femoral tooth, which is, however, much less conspicuous; it has the middle segment of the abdomen largely excavated at the sides.

Found rather commonly at Nikko and in the Hakone district; and one example was captured near Sapporo. Inhabits beech trees.

Rhysodes sulcicollis, sp. n.

♀. Elongatus, brunneus, subnitidus, thorace profunde trisulcato.
L. $5\frac{3}{4}$ mill.

Elongate, rather robust, brown, rather shining; head not rounded behind the eyes, with the cephalic lobes meeting in an angle in front of the neck; thorax narrowed anteriorly but parallel at the sides, which leaves three quarters of the posterior area nearly quadrate; the four raised portions between the sulci are broad, parallel, and all nearly of the same width; the elytra are rather coarsely punctate-striate, with the second and third interstices slightly elevated. The first joint of the antenna is opaque and more than double the size of the second; the head or rostrum in front of the insertion of the antennæ measures nearly the length of the basal antennal joint. The back part of the head behind the eye is excavated. This description is drawn from a female example, but it is a very distinct species, and I think the male characters in the legs will be very remarkable.

One example from Oyayama, in Higo, May 1881.

Rhysodes rostratus, sp. n.

♂. Præcedenti simillimus at paulo angustior; rostro producto, capite vix transverso.
L. $5\frac{1}{2}$ mill.

Elongate, brown, shining; head with lateral outline semicircular in the region of the eyes, cephalic lobes approach in front of the neck obtusely. Rostrum or head in front of antennæ the length of the first two joints of the antennæ, very parallel and of corresponding width behind the antennæ until the enlargement of the head for the cephalic lobes. The thorax has three deep and complete sulci, is rather narrow, and gradually rounded off behind the head. The elytral punctures are much smaller than those of the preceding species and the interstices less raised. There is a distinct tooth on the anterior femur, and the base of the hind tibiæ is slightly enlarged, as in *R. niponensis*. The last segment of the abdomen is rather coarsely and thickly punctured, and the cephalic lobes are a little prominent over the neck.

Two examples from Oyayama, found with the preceding, but they are evidently not the sexes of one species.

Rhysodes niponensis, sp. n.

Elongatus, piceus, nitidus; thorace trisulcato, sulcis externis brevibus.

L. $5\frac{1}{2}$–6 mill.

Elongate, pitchy brown, shining; head with cephalic lobes nearly touching before the neck, but separated anteriorly by a deep fovea, the frontal raised portion somewhat triangular and terminating before the fovea mentioned in the centre of the head; thorax above with lateral margin rather elevated, a deep median sulcus and two lateral sulci, which extend from a basal fovea over rather more than half the length of the thorax; elytra strongly punctate-striate, interstices smooth and a little raised, but in this region there are no important characters. The anterior femora are toothed in the middle on the lower edge, strongly in the male, and scarcely less so in the female. The posterior tibiæ are swollen before the apices and a little enlarged at the base in the male, simple in both cases in the female. The female also has a large and deep fovea on each side of one abdominal segment, and *this character seems common to the genus*. This species differs from the other Japanese ones in the shortened outer thoracic sulci, and in this character it is somewhat similar to a species of *Clinidium*.

Common in the Hakone district and in Higo. It occurs only under bark of firs (*Pinus*).

Rhysodes Lederi, sp. n.

♀. Niger, nitidus, elongatus, robustus. *R. exarato* similis at multo major et differt colore, capite, lobo in medio approximato; pronoto profunde trisulcato, interstitiis parce punctatis.

L. $8\frac{1}{2}$ mill.

Hab. Caucasus.

This species may be placed in the same section of the genus to which *R. exaratus* belongs; but at the same time it is a very different insect. The large size, black colour, and punctate thoracic interstices are simple differential characters, but the head is shaped very differently from that of any other known species. The head is largely swollen posteriorly below the level of the eyes, the cephalic lobes almost touch each other in the centre of the head (not near the neck, as in *R. exaratus*, Serv.), and the raised portion between the antennæ is not constricted in the middle, but is of an elongate diamond-shape.. The elytral striæ also are very deeply punctate and the interstices clearly convex. On the under surface I have not observed any very important characters; but the cheeks under the eyes are convex and give a striking appearance as compared with *R. exaratus*. When the male is discovered it will probably be found to present remarkable sexual differences.

I have named this species after Herr Hans Leder (to whose researches on the eastern confines of Southern Europe scientists are indebted for many rare species) with the latent hope that he may discover the male.

Clinidium, Kirby, 1835.

Eyes narrow, somewhat elliptical, and obscurely granulate. The region of the scutellum is profoundly depressed, and the species are apterous.

Clinidium veneficum, sp. n.

Elongatum, brunneum, nitidum. *C. Guildingi* proxime affinis at angustior.

L. 7–7¼ mill.

Elongate, brown, shining; head with cephalic lobes oblong, rather widely separated, but sometimes approaching each other between the eyes, frontal elevation somewhat cordate; thorax with two parallel lateral sulci and a median sulcus, which is narrowest in the middle and deepest in front and behind; the intermediate sulci are short and broadest at the base, which gives an appearance of obliqueness. The elytral striæ are narrow, the third being the widest and deepest, and in the female this stria is widened out behind the legs. The male has an obsolete tooth on the fore femur and a conspicuous incurved spine at the bases of the middle and hind tibiæ. The female has the hind tibiæ a little swollen at their bases and the last segment of the abdomen is largely excavated, with two large rather acute tubercles on each side. In the male the tubercles are small and the abdomen is not excavated, but merely impressed.

This species is more elongate than *C. Guildingi*, Kirby, and in the male the middle and hind tibiæ are more slender and the apical spines longer. The singular abdominal characters are worthy of notice.

I found it at Hakone in old beeches, and under like conditions in several places in the province of Higo, in Kiushiu.

List of Species, arranged generically.

Epiglymmius, Lewis, 1888. (Type *sulcatus*, Fabr.)		
—— comes, Lewis, sp. n.		Japan.
—— sulcatus (Cucujus), Fabr. Mant. I. p. 165	1787	Europe.
europæus (Rhysodes), Ahrens, Faun. Ins. Eur. vi. p. 1	1814	
exaratus (Rhysodes), Dalman, Analect. ent. p. 93	1823	
exaratus (Rhysodes), Newman, Mon. Mag. Nat. Hist. 2 ser. ii. p. 665	1838	
Rhysodes, Westwood, 1835. (Type *americanus*, Lap.)		
—— americanus, Lap., Silb. Rev. Ent. iv. p. 58, 1836 (Lec. Tr. Am. Ent. Soc. v. p. 162, 1874)	1836	America.
exaratus, Illiger (Crotch's Cat. no. 2657)..	1873	
exaratus, Westwood, Zool. Journ. v. p. 215, t. xlvi. fig. 1	1835	
aratus, Newman, Mon. *l. c.* p. 664	1838	
—— aterrimus, Chevrolat, Ann. Soc. Ent. Fr. 5, iii. p. 209	1873	Malacca.
—— Brouni, Lewis		New Zealand.
aterrimus, Broun, Man. N. Z. Col. p. 214	1880	
—— canaliculatus, Castelnau	1836	Madagascar.
tubericeps, Fairm. Ann. Soc. Fr. 4 sér. viii. p. 782	1868	
—— crassiusculus, Lewis, sp. n.		Japan.
—— eminens, Broun, ♀, Man. N. Z. Col. p. 215 ..	1880	New Zealand.
orbitosus, Broun, ♂, Man. N. Z. Col. p. 215	1880	
—— exaratus, Serv. Enc. Méth. x. p. 308	1825	Europe.
var. *piceus*, Germ.	1840	
—— figuratus, Germ. Zeitschr. ii. p. 352..........	1840	Cape of Good Hope.
capensis, Dej. Cat. 3rd ed. p. 128	1837	
—— hamatus, Leconte, Tr. Am. Ent. Soc. v. p. 163	1875	California.
—— Lederi, Lewis, sp. n.		Europe.
—— lignarius, Olliff, Proc. Linn. Soc. N. S. W. p. 471	1885	Australia.
—— luscus, Chevrolat, Bull. Soc. Ent. Fr. 5, v. p. 183	1875	New Zealand.
—— maderiensis, Chevrolat, Ann. Soc. Ent. Fr. 5, iii. p. 211	1873	Madeira.
—— Montrouzieri, Chevrolat, Bull. Soc. Ent. Fr. 5, v. p. 182	1875	New Caledonia.
—— niponensis, Lewis, sp. n.		Japan.
—— parumcostatus, Fairm. Ann. Soc. Ent. Fr. 4 sér. viii. p. 782	1868	Madagascar.
—— philippensis (*sic*), Chevrolat, Bull. Soc. Ent. Fr. 5, v. p. 183	1875	Philippines.
—— probrius, Broun, Man. N. Z. Col. p. 215......	1880	New Zealand.
—— quadristriatus, Chevrolat, Ann. Soc. Ent. Fr. 5, iii. p. 211	1873	Cayenne.
—— rostratus, Lewis, sp. n.		Japan.
—— strabus, Newman, Mon. *l. c.* p. 663..........	1838	Java.
strobus, Munich Catalogue..............	1868	
—— sulcicollis, Lewis, sp. n.		Japan.

Rhysodes taprobanæ, Fairm. Ann. Soc. Ent. Fr. 5, iii. p. 389	1873	Ceylon.
Clinidium, Kirby, 1835. (Type *Guildingi*, Kirby.)		
—— apertum, Reitter, Verh. Ver. Brünn, xviii. p. 29	1880	India.
—— arcuatum (Rhysodes), Chevrolat, Ann. Soc. Ent. Fr. 5, iii. p. 216	1873	New Zealand.
pensus (Rhysodes), Broun, Man. N. Z. Col. p. 215	1880	
—— calcaratum, Leconte, Tr. Am. Ent. Soc. v. p. 164	1875	America.
—— cavicolle, Chevrolat, Ann. Soc. Ent. Fr. 5, iii. p. 388	1873	Brazil.
—— Chevrolati, Reitter, Verh. Ver. Brünn, xviii. p. 30	1880	Columbia.
—— canaliculatum, Costa, Att. Acc. Napol. iv.	1839	
trisulcatus (Rhysodes), Germ. Zeitschr. ii. p. 441	1840	Europe.
sulcipennis (Rhysodes), Muls. Opusc. ent. ii. p. 6	1853	
—— costatum, Guérin (Rhysodes), Ic. Règn. anim. Ins. p. 58, t. xvi. fig. 12	1829	
liratus (Rhysodes), Newman, Mon. *l. c.* p. 665	1838	Brazil.
brasiliensis, Dej. Cat. 3rd ed. p. 128	1837	
—— curvicosta, Chevrolat, Ann. Soc. Ent. Fr. 5, iii. p. 215	1873	Cuba.
—— granatensis (*sic*), Chevrolat, Ann. Soc. Ent. Fr. 5, iii. p. 216	1873	New Granada.
—— Guildingi, Kirby, Zool. Journ. v. p. 8, t. ii. figs. 1–4	1835	Antilles.
planum, Chevrolat, Ic. Règn. Anim. Ins. p. 58	1829	
—— humeridens, Chevrolat, Ann. Soc. Ent. Fr. 5, iii. p. 215	1873	Cuba.
—— mexicanum, Chevrolat, Ann. Soc. Ent. Fr. 5, iii. p. 214	1873	Mexico.
conjungens, St.	1843	
—— Rojasi, Chevrolat, Ann. Soc. Ent. Fr. 5, iii. p. 214	1873	Venezuela.
—— sculptile (Rhysodes), Newman, Mon. *l. c.* p. 666	1838	
conjungens, Germ. Zeitschr. ii. p. 351	1840	
—— simplex, Chevrolat, Ann. Soc. Ent. Fr. 5, iii. p. 388	1873	New Granada.
—— veneficum, Lewis, sp. n.		Japan.

Note.—*Stemmoderus*, Spinola, 1842 (*Stemmatoderus*, Harold, 1868), is not a genus rightly placed in this family, nor is *Ips monilis*, Olivier (*Rhysodes monilis*, Newman), or the genus *Rhyzodina*. French entomologists spell the genus *Rhysodes* "*Rhyzodes*," Redtenbacher and Agassiz spelt it "*Rhyssodes*;" both these modes are incorrect.

XII.—*On some Ectoparasitic Rotatoria of the Bay of Naples.* By Ludwig Plate *.

[Plate VI.]

There are referred to the Rotatoria certain forms which depart widely from the ordinary type of this class and which have this in common in their mode of life, that they live as ectoparasites upon the marine Phyllopodiform genus *Nebalia*. Hitherto two different genera of these animalcules have been known, one of which was discovered by Grube † and introduced into science under the name of *Seison*. Subsequently Claus ‡ recognized two distinct species (*S. Grubii* and *S. annulatus*) in the animals described by the above-named naturalist, and subjected these to a very thorough investigation. The second genus which must be referred to the group of the Seisonidæ was first described by P. J. Van Beneden § and C. E. Hesse under the name of *Saccobdella*. One of the species discovered by these naturalists, *Saccobdella nebaliæ*, was erroneously placed by them with the Hirudineæ, and Claus first referred it to its proper place in the neighbourhood of the genus *Seison*. As, however, the two representatives of the latter differ considerably in the form of the body from *Saccobdella nebaliæ*, their generic distinctness must be maintained, and it seems to me incorrect to cite the animal described by the Belgian naturalists as a distinct species of the genus *Seison*. How far the internal organization of *S. nebaliæ* agrees with that of the true Seisonidæ cannot at present be decided, as our knowledge of that Rotatorian is still imperfect and in many points pressingly requires confirmation. The genus *Seison* also needs further investigation, because with regard to the sexual and excretory apparatus many questions still wait for a definitive solution. This circumstance induced me to devote a short sojourn at the Zoological Station at Naples in the spring of 1886 to the study of this interesting group of animals.

* Translated from the 'Mittheilungen aus der zoologischen Station zu Neapel,' Bd. vii. pp. 234–263.

† E. Grube, 'Ein Ausflug nach Triest und dem Quarnero,' Berlin, 1861, pp. 19 and 109–115.

‡ C. Claus, "Ueber die Organisation und die systematische Stellung der Gattung *Seison*, Gr.," in the Festschrift zur Feier des 25-jährigen Bestehen der k. k. zool.-bot. Ges. in Wien, 1876; and "Zur Kenntniss der Organisation von *Seison*," in 'Zool. Anzeiger,' 1880, no. 68.

§ Van Beneden and Hesse, 'Recherches sur les Bdellodes ou Hirudinées, et les Trematodes marins,' Brussels, 1863, pp. 48 *et seqq.*

To my astonishment I found upon the *Nebaliæ* of the Bay of Naples, with which I was most abundantly provided, not the same genus which Claus met with on the Phyllopods of Trieste, but another one, differing from it in many respects; but as it agrees in most of its characters of organization with *Seison annulatus* and *Grubii*, it may in future bear the name of *Paraseison*. Its description forms the subject of the following pages.

In all I have seen four species of *Paraseison*, of which, however, only one was to be met with in comparative abundance on *Nebaliæ* from the middle of March to the middle of April; the other three, on the contrary, were so rare that, with all my efforts, I was only able to study one or two living females of any of them. I will commence with the common species:—

1. *Paraseison asplanchnus*, sp. n.

Even this species was not particularly plentiful during my residence in Naples; on the average only each fourth or fifth *Nebalia* was infested by parasites, and it was seldom that more than two or three adult individuals occurred together on the same host. I have no doubt, however, that at a more advanced season of the year these Rotatoria become more numerous, as their abundance was slowly increasing during the time that I was able to observe them. Reproduction seems to be reduced to a very small amount during the winter months, for at the commencement I found only old adult individuals, while later on ova and newly hatched examples were frequently observed. Female animals were always present in greater number than males, but the proportional abundance of the two sexes was by no means so extreme as in the freshwater Rotatoria; generally there was one male to six females. The animalcules attach themselves, like the true Seisonidæ, by preference to the branchial laminæ; but they also creep about upon all the other regions of the body. They attach themselves by means of an adhesive mucus, which is secreted from a number of pedal glands, by the posterior pole of the body to their point of support; and as we not unfrequently see, near the point of attachment of a female, several ova lying together in different stages of development (in one case I observed eleven in one mass), it seems to me probable that the adult animals often remain seated for a long time in the same place, or at least that they limit their locomotion within very small distances.

The most essential distinction which exists between the genera *Seison* and *Paraseison* on the one hand, and the numerous genera which I have classed together as "Ductifera" in a recently published memoir * on the other, is this, that only in the latter does a marked sexual dimorphism occur, while it is wanting in the former. In the Seisonidæ males and females are approximately of the same size, and the difference of the two sexes finds expression only in the sexual apparatus and, in connexion therewith, also slightly in the secretory organ and muscular system; all the other organs are of the same nature in both.

A glance at Pl. VI. fig. 1 shows us the external habit of the animal. The body is divided into four distinctly marked sections, which, as in the genus *Seison*, may be characterized as head, neck, middle-body or trunk, and abdomen or tail. The neck and tail have a cylindrical form, while in the two other sections the sides of the body are considerably broader than the dorsal and ventral surfaces. The females in the adult and fully extended state are of an average length of 0·9–1·1 millim.; the males are rather smaller, attaining only 0·4–0·7 millim. As, however, both the neck and the tail are composed of apparent segments which can be invaginated one within the other, and, further, the whole neck is frequently retracted within the trunk, the *Paraseison* may acquire a much smaller length of body. When an adult individual is completely extended the abdomen is the largest section of the body; the trunk and neck are rather shorter, but nearly equal to one another. The foremost section is two thirds of the length of these. For systematic purposes such relative sizes may be of importance, and therefore the measurements of an old female example are here given in millim.:—

Total length 1·1; tail 0·34; trunk 0·27; neck 0·28; head 0·19.
Width of neck at anterior end 0·016.
" " posterior end 0·04.
Greatest breadth of trunk seen from the side 0·104.
Breadth of tail at the base 0·06.
" " posterior extremity 0·02.

* L. Plate, "Untersuchung einiger an den Kiemenblättern des *Gammarus pulex* lebenden Ectoparasiten," in Zeitschr. f. wiss. Zool. Bd. xliii. p. 229 (1886).

Before proceeding to the detailed description of the different organs, we may, for the purpose of orientation, in the first place glance at the general organization of *Paraseison.*

The *head* agrees very little with the image which the typical Rotatoria present of this part of the body, as it displays no trace of a wheel-apparatus composed of motile cilia. Looked at from the side it has a lenticular form; broadest in the middle, it tapers off before and behind, bears the small buccal aperture (fig. 1, *o*) at its anterior pole, and contains in its interior a complicated masticatory apparatus (*ma*), a slender œsophagus (*œ*) opening dorsally into this, and a large ganglion (*g*), which may be regarded as the brain. The *neck* consists of three segments separated by annular grooves in the cuticle, of which the anterior can each be invaginated within that behind it, and which is traversed throughout its whole length by the œsophagus. Its width gradually increases from before backwards. The *middle-body* (*trunk*) is by far the broadest section of the whole body. In it we find the stomach (*st.*), which is closed cæcally, and consequently possesses no intestine and anus; dorsally or laterally to this are placed the paired sexual organs, the unpaired aperture of which is very differently placed in the two sexes. It is always situated on the dorsal surface, in the male at the point where the neck and trunk meet, in the female at that where the trunk passes into the tail (*a*). The *abdomen*, which follows, gradually becomes narrower posteriorly; it is composed of several apparent segments which can be pushed forward telescopically into one another, and which enclose a number of pyriform mucous glands (*f*), whose long efferent ducts open at the hinder pole of the body, and the secretion from which attaches the animal to its surface of support.

From a passing examination of the object it may seem doubtful which side is to be characterized as the back and which as the belly, especially if we start from the organization of the freshwater Rotatoria whose sexual organs are always placed ventrally. But from the position of the masticatory apparatus, the ganglion, and the sexual orifice it appears at once that the surface of the body regarded by me as the *back* really merits that name. In favour of this we have also the method adopted by *Paraseison* in locomotion. It creeps about after the fashion of a geometric caterpillar, attaching itself to its support by the head, curving the neck and trunk into a circle, and then attaching the caudal extremity quite close to the head. Then the head detaches itself again from the surface of support, the animal stretches itself to its full length, and repeats the same movement again and again. Fig. 1 represents an individual engaged in wandering, and it shows at the same time that the side turned towards the support must be regarded as the *belly*.

The limitation of the four sections of the body distinguished in the preceding description cannot be followed out quite sharply, as they gradually pass one into the other. This applies especially to the two posterior divisions; it seems therefore advisable to reckon the foot as extending as far as the adhesive glands which give it its function extend forward (*f*). The female genital orifice then indeed falls within the region of the tail, which moreover is marked by a peculiar habit of the *Paraseison* during life. Thus, when the animal is disturbed or finds itself in an uncomfortable position, *e. g.* on the object-slide, the body almost invariably forms an angle, usually representing nearly a right angle, one limb of which is formed by the tail alone; its apex, as shown in fig. 1, is situated a little above the sexual aperture (*a*). This singular position is explained anatomically by the fact that the principal muscles of the trunk and abdomen meet in the region of this apical point, and it is further evidently connected with the absence of a rotatory apparatus, which compels the animal to seek its nourishment by feeling about with its head upon the support; it presents a peculiar spectacle to see the disproportioned animalcule in a bent posture stretching its long swan-like neck in all directions, and every moment retracting it completely into the trunk.

After this introductory glance at the structure of *Paraseison asplanchnus* we may pass to a more detailed description of the different organs. I commence with the general covering of the body.

The Skin.—This possesses all the properties characteristic of the body-wall of the freshwater Rotatoria. It consists of a thin hyaline cuticle, which is coated internally with a delicate protoplasmic matrix-layer, in which small nuclei with a large nucleolus are scattered here and there. This *hypodermis* is in parts so extraordinarily thin that we can only detect it with very high powers. Nevertheless it could be demonstrated everywhere, and probably therefore the species of *Seison* also present the same character, although Claus observes that "subcuticular traces are retained only in a few places in the form of granular pads." At the extreme apex of the head, close to the buccal aperture, the matrix of *Paraseison* becomes thickened into pads, evidently the rudimentary homologues of the cephalic pads bearing the rotatory apparatus in the freshwater forms. Special *cutaneous glands*, such as are said to occur in *Seison*, are quite absent in our animal, unless we are to interpret as such a pyriform thickening of the hypodermis situated in the tail in the median dorsal line. The *cuticle* is not of homogeneous constitution throughout, but presents some remarkable conditions of structure. In the segments of the neck we find a very delicate longitudinal striation (fig. 2) formed by many parallel lines, and which, spreading out like a brush, also extends upon the posterior part of the head. Instead of this there is, upon the posterior parts of the trunk, an apparent granulation, which also covers the whole of the foot. As we see by considering an ideal transverse section at the margin of the body (fig. 3), this is produced by small rounded or elongated hollow spaces which are placed close together, and frequently, arranged in longitudinal rows, traverse the inner part of the cuticle. If the punctuation of the tail be carefully examined, it is seen that on the two hindmost apparent segments it suddenly becomes much weaker than on the preceding ones. Further, the skin of the penultimate caudal ring is distinguished by the possession of a striation which is very noticeable. Four sharply marked lines run parallel to each other and not far apart from the dorsal towards the ventral surface and obliquely from before backward (figs. 1 and 7). Those of the right and left sides do not meet in the median dorsal line, but leave between them a narrow band of the ordinary texture. The ventral surface of the same segment bears the aperture of a peculiar organ, which also occurs in *Seison*, but for which I cannot with certainty indicate a homologue in the other Rotatoria. Claus says of it (*l. c.* p. 82):—" A pretty strong efferent duct opens in front of the adherent disk, on the convexly curved ventral surface of the terminal piece, upon a small conical tubercle." It is a small roundish vesicle, composed (it seems to me) of a structureless membrane, and it opens by a short duct projecting a little beyond the rest of the skin (figs. 4 and 7, *x*). Frequently it was tensely filled with a limpid fluid, whilst at other times the walls lay loosely in contact. With all my efforts I have never been able to observe any contractions of it, and therefore believe that none take place. In the freshwater genera *Monocerca* and *Diurella** the adhesive glands of the foot are converted into vesicles with contractile walls, which can suddenly evacuate their secretion. Possibly we have here to do with a corresponding arrangement which has become *rudimentary*, and then this organ would have to be regarded as a modified pedal gland,

* L. Plate, "Beiträge zur Naturgeschichte der Rotatorien," in Jenaische Zeitschr. f. Naturw. Bd. xix. N. F. xii. pp. 50, 51.

a view which acquires the more probability because we not unfrequently see a viscid drop adhering to the orifice of the efferent duct.

The description of the *adhesive glands* of the foot may perhaps be best appended to that of the skin, as they undoubtedly represent particularly strongly developed portions of the subcuticular matrix. There are about six to eight glands, each possessing a very long efferent duct traversing the abdomen (figs. 1 and 7, *f*). The further the cell producing the viscous slime is moved from the posterior pole of the body the longer is its efferent duct, which contains a great number of granules. The foremost viscous glands, which are placed at the level of the female sexual aperture or even still further forward, have several nuclei which belong to separate cells; those situated further back, on the contrary, are uninuclear. The efferent ducts of the different glands run, without uniting, to the caudal extremity, the peculiar construction of which may be seen from fig. 4. It forms a rounded tubercle, the periphery of which is beset with a number of small denticles placed in a row, and thus resembles the cog-wheel of a machine. The mucus secreted by the glands is pressed out through these prongs, by which means it frequently acquires the form of short threads lying side by side. It is not always easy to convince one's self of the construction of the posterior extremity of the body, as, like the posterior apparent segment itself, it can be introverted. When this is the case an adherent disk with thickened margins seems to close the caudal extremity, which, according to Claus, is actually the case in *Seison*.

The *alimentary organs* consist of three sections—the buccal cavity with the masticatory apparatus, the œsophagus, and the stomach. The anterior extremity of the head may be somewhat drawn in, and the small *buccal aperture*, situated at its extreme apex, is therefore not always equally visible. When we look down upon it from above, which, indeed, we seldom have the opportunity of doing, we observe that around it stand four tufts (fig. 5, *t*) of small rigid setæ, which are never moved, and evidently serve only for tactile purposes. We shall perhaps not be mistaken if we regard these as the last rudiments of the *rotatory apparatus*, which is retained in a more distinct form in *Seison* and in *Paraseison ciliatus*, hereafter to be described. From the side, of course, we see only two [bundles of] tactile setæ (fig. 6, *t*), and even these become inaccessible to observation, when the fore part of the head is more or less introverted. The buccal aperture itself has a rounded form only when the masticatory apparatus is at rest; at each movement of the maxillæ it is, on the contrary, more or less elongated transversely. It leads into a short, canaliform, buccal cavity, into the bottom of which project the denticles of the mastax, which, dorsally, enclose between them the orifice of the œsophagus (fig. 6). At the first glance it seems as if the masticatory apparatus in *Seison* and *Paraseison* lay in a special appendage of the œsophagus, and thus differed from the condition in the freshwater Rotatoria; but as, in the latter, the œsophagus likewise always opens dorsally into the masticatory apparatus, although usually towards the middle or the hinder end of it, there is, in these genera, only a considerable displacement forwards of the œsophageal aperture.

The *masticatory apparatus* forms two divisions—the teeth, which project forward into the buccal cavity, of which two pairs are present (fig. 9, I. and II.), and a supporting apparatus, bearing these, and placed further back (figs. 8, 9, a, β, γ). The latter consists of three pairs of rather large chitinous ossicles, of which the middle one (a) far exceeds the others in length, and therefore at once catches the eye. It forms two thin spatuliform laminæ, much narrowed in their anterior half, where they unite to form a single pointed rod, as is best seen by examination from below (fig. 9). At the posterior extremity the two laminæ certainly lie very close together, but by a fine median line they show the original double nature of the whole structure. The broad surfaces of the laminæ bear about nine longitudinal costæ, which are strongly marked posteriorly, but terminate in front in extremely delicate lines. To the right and left of this median piece (a) of the supporting apparatus lie two ossicles, one of which (β) bends somewhat outwards and downwards, and the other (γ) in a large curve upwards; this latter dorsal member does not extend quite so far backwards as the ventral one, of which it must further be mentioned that its posterior extremity is widened like the bowl of a spoon, while the anterior end curves slightly outwards and is directly applied to one of the teeth. At the point where the chitinous pieces γ and β meet there is also a small rib directed backwards (fig. 9, δ). The two pairs of teeth, which are firmly united with the above-described supporting pieces and are moved by them, are of different forms. Two teeth form little rods, which fork into two short points at the anterior end (fig. 9, I.). They are supported by the pieces indicated by γ. The two other teeth are stout, elongate, ovate structures, which abruptly become narrower in front. The reciprocal movement of these teeth is effected by stout muscles, which spring from the costæ of the spatuliform median laminæ and are inserted upon β and γ. In the individual represented in fig. 9 these muscles were contracted, by which means the anterior extremities of β and γ, and therefore also the denticles, were drawn apart, whereas in the resting state of the muscles they are very closely approximated. Between the ossicles of the supporting apparatus the efferent ducts of the ventral *salivary glands* (fig. 9, *dr′*) may be traced to the denticles, the action of which they assist with their secretion.

A little in front of the masticatory apparatus there lies upon the dorsal surface of the buccal cavity a small rounded body (figs. 5, 6, *y*), which, in the living animal, is always remarkable by its yellowish-green colour. On closer examination this proves to be composed of several (probably four) small bacilli, which are only slowly destroyed by solution of potash and dilute sulphuric acid, and therefore appear to be of a chitinous nature. Two of these bacilli are rather longer than the others (0·016 millim.) and terminate at one end in a fine, somewhat bent point. As to the significance of these structures I have been unable to arrive at any conclusion. As two pyriform unicellular glands, furnished with a very long efferent duct (fig. 6, dr^2), which lie dorsally to the œsophagus and right and left of the cerebrum, open between them, they are probably functionally related to these. I regard these organs, which likewise occur in the same way in *Seison*, as *viscous glands* of the head, fulfilling the same office as the pyriform cells of the foot. In fact, whenever a *Paraseison* creeps about upon the object-slide, attaching itself alternately by the anterior and posterior poles of the body, we find at the spots where the head was fixed a shining jelly, which has evidently served for the attachment of the animal, and is very probably secreted by the glands above described. On the other hand, two other glands (fig. 6, *dr′*) must be interpreted as *salivary glands*; these, which are of the same structure as those just referred to, lie ventrally to the mouth and open immediately between its teeth.

The *œsophagus* (figs. 1, 2, 6, *œ*) forms a narrow tube, of equal width throughout, which traverses the entire length of the head and neck and on approaching the dorsal surface of the stomach passes into it. It is formed of a delicate membrane, in which I could recognize fine muscular fibres but no nuclei. In opposition to most Rotatoria we find its inner wall not lined with cilia, and the food taken will therefore certainly be conveyed backward by a sort of peristaltic movement, as is also the case, for example, in the *Synchætæ* and *Asplanchnæ*. The anterior extremity of the œsophagus very often shows an undulately denticulate inner wall, a peculiarity which is probably to be ascribed to the muscles there situated. Soon after its entrance into the neck the œsophagus receives on each side the efferent duct of an elongate-pyriform unicellular *gland* (fig. 6, dr^3), which extends into the head and evidently represents the "5–6 flask-shaped cells" which are said to occupy the same position in *Seison*. To the third segment of the neck belong two (or more?) small glands (fig. 2, dr^4), which likewise discharge into the œsophagus and by their secretion facilitate the downward passage of the food.

The *stomach* (figs. 1, 2, 13, *st*) forms an elongated sac, cæcally closed behind, which is formed of large polygonal cells. The latter are arranged in irregular longitudinal series, and, in a well-nourished individual, densely packed with brown pigment-particles. If the animals be allowed to starve for a time, these disappear, and in an individual just escaped from the egg they are not yet developed. It is remarkable that the cells bear no cilia on the inner surface, a condition which, so far as I know, has not hitherto been observed in any other Rotatorian. It is, indeed, often difficult to detect the delicate cilia in the stomach of the Rotatoria; but I have definitely convinced myself of their absence in many very favourable animals. Indirectly the correctness of this statement is confirmed by another observation. Thus, in the lumen of the stomach there are frequently a great number of oil-globules of different sizes, and these, when the stomach is perfectly quiescent, remain quite motionless, even when they lie close to the wall, which would be impossible if motile cilia were present. Claus also noticed no vibratile movement in *Seison*. At the anterior end of the stomach, above the point of entrance of the œsophagus, two *glands* come in, which do not deviate from the ordinary structure of these organs. In the hinder wall the cellular coat of the stomach is somewhat thicker than elsewhere, but it does not allow the smallest trace of even a rudimentary intestine to be recognized. By the absence of this, *Paraseison* may easily be distinguished from *Seison*, as the latter, according to the last published observations of the Viennese naturalist, possesses, in both sexes, a rectum opening with the sexual apparatus. The *food* of *Paraseison* appears to me to consist chiefly of vegetable detritus and of particles of the eggs of *Nebalia* which have become decomposed; at least I often saw the stomach densely filled with a mass permeated by numerous fat-drops, which I regard as yolk. Probably the loss of the cilia of the stomach is to be ascribed to a readily absorbable form of food of this kind, standing in need of no further division. I have never seen in our animal fæcal matter of any kind.

The *female sexual organs* are situated, unlike those of all other Rotatoria, dorsally with regard to the stomach. They are two elongated sacs (fig. 1, *ov*), which, in adult animals, traverse the whole trunk, and open, about the level of the hinder extremity of the stomach, into a common efferent duct (fig. 1, *du*), which opens somewhat further back (*a*). This last point strikes one very easily as a transverse slit in examining the dorsal surface of the animal. When the sexual organs have grown to a certain size, they very frequently extend upon the sides of the body to the right and left of the stomach, and in rare cases I have seen an ovary, or both of them, by displacement, occupy the position characteristic of the other Rotatoria, ventral to the stomach.

Although the structure of the female sexual apparatus appears to be rather simple, I have not been able to arrive at perfect certainty about all its characters, which may be due to the fact that it is subject to different alterations, according to the maturity of the ova. In the condition which I have most frequently met with, a considerable number of ova are arranged behind one another and irregularly side by side to form a sac-like organ, and each of them is provided with a nucleus, which is distinguished by the possession of a very large nucleolus. The size of the ova by no means increases from before backwards, but large and small ova follow one another indiscriminately. At the anterior extremity of the whole organ there is, however, frequently a special aggregation of smaller ova, which are distinguished from the others by a much clearer vitellus, *i. e.* containing fewer fat-granules. We shall probably not be far wrong in ascribing these clearer ova to an early stage of development. All the ova of an ovarium are separated from each other by a distinct wall, and even on very careful examination show nothing in the shape of a membrane enveloping the whole ovary and continued into the efferent duct (fig. 1, *du*) ; nevertheless something of the kind must probably be present, and only escape observation by the fact of its clinging very closely to the ova, for how else should these ova, which are not firmly attached to each other, but change their relative positions and are frequently separated by gaps, be united into a special organ ?

A somewhat different picture from that just described is presented by some individuals, in which the anterior parts of the right and left ovaries of the same female differ considerably. The apex of the left organ may be formed by a rounded body filled with a homogeneous mass of plasma, in which numerous solid nuclei of different sizes are scattered. The three nuclei situated in the following section approach the ordinary form, which we see in the next section, by the possession of a nucleolus, although this is but small. The only remarkable deviation presented by the third section is that its plasma is not yet segregated around all the nuclei into separate ova. The ovary placed on the other side of the body in the same individual, on the contrary, showed nothing but distinct ova with nuclei of the usual form. One cell containing a remarkably large nucleus, appeared to be in process of division, at least the form of the nucleus and an annular constriction of the plasma led to this conclusion. The first section of the left ovary seems to indicate that the ova at first are not sharply separated from each other, but owe their origin to a germinal layer, and that a transformation of the nuclei goes on side by side with the development of separate ova. Perhaps, however, such a *germinal layer* does not occur in all individuals, but only in such as have left the egg comparatively early; at least, I have met with many young females in the ovaries of which all the ova were distinctly separated from each other. It must remain for future investigations to clear up completely the genesis of the female sexual products. In the developed ovary we do not always observe the contrast above-mentioned between aggregations of ova rich and poor in vitellus, but frequently all the cells are of the same structure.

The *extruded ova* are of very considerable size in proportion to the mother, and have an oval form pointed at one end (fig. 10). Their length is about 0·187 millim., with a maximum breadth of 0·06 millim. It is remarkable that the true ovum, the vitelline mass, only fills a little more than half of the cavity enclosed by the structureless egg-capsule, the rest of the space being occupied by a limpid fluid. In this I always found one or two rounded polar corpuscles of 0·007–0·015 millim. in diameter; these break up very slowly, so that we still find them with fully developed embryos. As a rule, only one polar corpuscle with a distinct nucleus was present, and this always lay in the fluid of the pointed half of the ovum; if a second had been formed it was always of smaller size. Only when the embryo approaches the end of its period of development it becomes so voluminous that it nearly fills the egg-capsule, even when, as appears to be always the case, the head and tail are folded up against the trunk. Owing to the abundance of yolk in the egg, it was impossible for me to ascertain the details of the development. The newly-hatched animals are about 0·39 millim. long and fully developed, but the stomach only acquires its brown pigment by the inception of food. The ova lying in one mass are not all of the same sex, but among the preponderant number of female ova we find here and there a male one. As I often found only one female near such a breeding-spot, and indeed upon the *Nebalia* infested, it follows that the same animal may deposit ova of different sexes; and this merits notice because among the freshwater Rotatoria the individual produces ova only of one sex, either male or female *.

The *male sexual organs* of *Paraseison* are of very peculiar structure, and differ considerably in the corresponding organs not only from the species of *Seison*, but also from the other Rotatoria. Like the female sexual organs they are paired and placed dorsally with respect to the stomach. The testes form two pyriform organs (fig. 13, *te*), which traverse the greater part of the length of the trunk, and turn their wider end forward. Posteriorly they gradually narrow into an efferent duct, which is curved towards the back. They do not, however, always retain their position above the stomach, but frequently slip down on the two sides of it. They open into a rounded body (x), with regard to which, unfortunately, I was unable to ascertain much. It appeared to me to be paired, or at least divided by a groove into two lobes, and to stand in connexion with a large pyriform organ (*d. ej.*), which at once catches the eye. This sacciform structure becomes considerably narrowed and then opens upon the dorsal surface at the point where the neck and trunk pass into one another (a), and in this terminal portion it shows a delicate ciliation, which, however, lines the inner wall only for a short distance. The broad posterior end of this peculiar organ, which seemed to me to be formed of a structureless membrane, consists of a homogeneous mass which is traversed by two contorted ducts (*v. d.*) furnished with a ciliation striking backward; the latter open by two separate apertures into the cavity which lies before them. As to their exact course and their connexion with the body (x) which lies immediately behind them, I could arrive at no definite opinion, as in the living animal the investigation is rendered very difficult by its constant movements, and dead specimens are always so contracted that the parts in question are concealed.

The male generative organs of *Seison* do not differ from those of *Paraseison* just described so considerably as not to be comparable with them, and in accordance with this we have to regard that structure (x) in our animal which receives the efferent ducts of the testes as a *seminal vesicle* and the tor-

* See my previous memoir, *l. c.* p. 106.

tuous ducts (*v.d.*) as *vasa deferentia* which conduct the semen into the great cavity of the *ductus ejaculatorius* (*d. ej.*). Perhaps, indeed, there is only one *vas deferens* which possesses two anterior apertures.

The *testes* are often very difficult to find, especially when they lie immediately above the brown stomach. They are clothed with a delicate membrane, which contains in its interior many small cells, and in the mature state numerous active and very small *spermatozoa*. In each of the latter a head and a caudal thread may be easily recognized. In the testes of the freshwater Rotatoria, as is well known, besides the true spermatozoa, which resemble those just described, we find motionless bacilli, pointed at the two ends, of which the nature is doubtful. I have generally missed these in *Paraseison*, and only once observed an aggregation of bacilli (*y*) which might represent those just described. The *seminal vesicle* is filled with a finely granular mass, probably consisting of densely-packed spermatozoa.

The contents of the other parts of the generative apparatus are very remarkable. The *ductus ejaculatorius* contains a great number of flask-shaped corpuscles (figs. 11, 12, 13), averaging 0·014 millim. in length and 0·005 millim. in breadth, which are themselves incapable of motion, but of which some are not unfrequently driven by ciliary action into the *vasa deferentia*. In each flask we can distinguish three divisions, namely an anterior hemispherical cap (fig. 12, *a*), a somewhat narrower neck (*b*), and an ovate hinder portion (*c*), which is two or three times the breadth of the neck. The anterior and middle parts are clothed with a thin chitinous membrane, whilst the capsule of the last division is thick and firm. These conditions are best recognized by allowing a drop of solution of potash to act for a short time (fig. 11). We then see that the dark shining rod, which traverses the whole length of the neck, is not a canal, but a solid structure, which projects somewhat into the anterior and posterior pieces. The remainder of the neck is either without contents or occupied by a limpid fluid. In the anterior division of the structure under consideration there is a granular protoplasmatic substance, which looks as if it consisted of a dense accumulation of spermatozoa. It is wanting in the immediate vicinity of the anterior end of the neck-axis, so that, as shown in fig. 12, it arches over this central rod like a hood; only a fine streaking is to be recognized in the clear space between the neck and the plasma. Whether the latter really consists, as I believe, of a closely entwined coil of seminal filaments I could not decide with certainty; no movements could be observed in it. The posterior division also contains a finely granular mass, which, in general, does not completely fill the space assigned to it, and also frequently shows vacuoliform clear spaces. It is certainly different in its structure and nature from the substance of the head-piece.

So long as we have not succeeded in observing the action of the flasklets above described in the act of copulation we can only form suppositions as to their nature. I regard them as *spermatophores* which, under certain circumstances, set free the portion of semen contained in their anterior division. This opinion is supported by the following observation. Not unfrequently we find in the hinder termination of the *vasa deferentia* sperm-flasklets which have the anterior division still empty, but which are placed in the immediate vicinity of a mass of living spermatozoa, and therefore produce exactly the impression that they are about to take in a number of the latter. Unfortunately I did not notice whether such sperm-flasklets are or are not furnished with substance in their posterior cavity; but in my preserved material I found a young male with a spermatophore having no semen in the anterior, but with contents in the posterior division. Probably, therefore, this is formed by a turgescible mass, which, when in the body of the female, bursts the walls of the flasklet, and so renders it possible for the spermatozoa to amalgamate with the ova. The position which the spermatophores take up in the male animal is worthy of note. They are all, both in the *ductus ejaculatorius* and in the *vasa deferentia*, arranged more or less parallel to the longitudinal axis of the male, and always turn the head-end towards the posterior pole of the body of the latter (fig. 13). Where and how they are produced I was unable to ascertain, but they are certainly formed very early, as perfectly developed sperm-flasklets are to be met with in the interior of embryos still unhatched.

No spermatophores or structures which can be compared with these have hitherto been observed in the Rotatoria; even in *Seison* they do not appear to occur,—or are the small bacilli which also show a clear middle part and dark anterior and posterior divisions, and which, according to Claus, densely fill the *ductus ejaculatorius* and the terminal portion of the *vas deferens*, homologous although less perfect structures? The male sexual apparatus of *Seison*, however, differs considerably from that above described. Thus its *ductus ejaculatorius*, as stated by the Viennese zoologist, possesses two appendicular organs, a diverticulum on the right-hand side and opposite this a multipartite glandular body; further, the same organ presents a wall furnished with strong musculаture, while in *Paraseison* this is either entirely deficient or very feebly developed; lastly, the testicular tubes in the species of *Seison* are placed ventrally to the stomach, in *Paraseison* beside or over it.

The *copulation* I have, unfortunately, been unable to observe; it would be interesting to find out something about it, as from the mere knowledge of the male genitalia we can scarcely form any idea of the process. That the *ductus ejaculatorius* is everted through its narrow aperture of exit is quite inconceivable, considering the entire absence of any musculature which could effect this. It therefore hardly merits this designation in *Paraseison*, whilst in *Seison* it may bear it with propriety. Several times, indeed, I had occasion to see how the sperm-flasklets were driven outwards into the anterior peduncular portion of the *ductus* by the cilia. From the absence of any organ having the function of a penis, copulation can only be effected by the juxtaposition of the sexual apertures, the different position of which in the two sexes must compel the copulating individuals to take up an unusual position with regard to each other. It is very remarkable that, notwithstanding the great number of animals that I have seen, I have never found spermatophores or spermatozoa in the female individuals.

The *water-vascular system* of *Paraseison* presents nearly the same constitution in both sexes, small differences only being produced by its union with the efferent ducts of the reproductive materials; from the typical structure of the same organ in the freshwater Rotatoria it differs by the possession of a long lateral canal with a cæcal termination. With the exception of the tail it traverses all the divisions of the body in the form of two tubes, which, however, are comparatively easy to find only in the trunk, whilst in the neck and head they are very liable to escape the notice of the observer, owing to their small calibre and transparent texture. In favourable specimens we see on each side, about the middle of the head (fig. 6, z^1), a faint undulatory movement, which is caused by a small cylindrical flicker-organ ("*Zitter-organ*"). This is seated upon a slender canal, which at this particular point forms some loops, and which may also be traced forward for some distance, although I could not succeed in discovering its anterior termination in the head. The continuation of this tube backwards traverses the whole neck and bears a second flicker-organ (fig. 6, z^2) at the transition-point of the head and neck. Throughout this space the lumen of the canal continues of equal width. When the vessel has passed into the trunk it approaches the ventral surface and here forms a second coiled portion, which is furnished with a third flicker-organ (fig. 13, z^3). From this point it acquires a more considerable diameter, about five times as great as before, and in the male runs obliquely backwards and upwards to the posterior end of the sexual apparatus. As to the mode in which it unites with the latter organ, I have unfortunately no precise information. The aquiferous vessel seemed to me to open into the seminal vesicle, or a little before this into the testicular duct (fig. 13). In the female the secretion-canal only rises a little towards the back, and then runs backwards close and parallel to the stomach, opening into the efferent duct, which is common to both ovaries. Soon after this wide aquiferous vessel on each side has quitted the coiled-up portion situated at the commencement of the trunk, it emits, in both sexes, a slender lateral branch which runs backward along the ventral side of the animal (fig. 13, $w.g^1$), the lumen of which is not wider than that of the canal in the neck. At the point of passage of the trunk into the tail this branch forms a third coil lying close to the ventral side and connected with two further flicker-organs (fig. 13, z^4, z^5). In some *Asplanchnæ*, the aquiferous vessels of which also fork, the branches unite again before opening into the contractile vesicle, and thus form a loop. I therefore supposed that in *Paraseison* also there might be present a tubercle issuing from the hindmost looping and returning to the main canal; but this was not to be found, and consequently the canal $w.g^1$ seems to terminate cæcally here. The five flicker-organs on the right and left sides which appear to be proper to *Paraseison* show no remarkable peculiarities in their structure. They are small, cylindrical, posteriorly closed tubules, with a cilium vibrating within them; a broad, superficial, and narrow edge-view, such as we meet with in so many other Rotatoria, is not distinguishable here. The wide main canal of the trunk has only a narrow lumen, but a thick wall charged with many granules and vacuoles. Frequently the fluid-vesicles lie close behind one another, like the beads in a necklace. The same finely granular, gland-like constitution occurs also in the coiled parts; while the narrow canals in the head, neck, and trunk are clothed with a delicate almost structureless membrane.

The structure of the secretory apparatus described above is interesting, because it deviates from the typical construction of this organ by the want of a contractile vesicle and by the development of particular parts into mere conveying-ducts and of others into secretory divisions; at least it appears to me that the differentiation into nearly smooth and thin, and into finely granular thick vessels, certainly indicates such a division of labour. The water-vascular system of *Seison*, so far as one can judge from the extant investigations, is not quite so developed as in our animal. There is said to be only one flicker-organ, which represents that indicated by me as z^3, and in the trunk only one wide canal, which latter, "ascending to the intestine," passes into "a delicately membranous saccule lying upon this."

The *connective tissue* is represented in *Paraseison* by a few thin threads, which extend between the organs and the skin. Of the animal organs,

The *nervous system* has become very little known to me. Above the anterior extremity of the œsophagus there is in the head an elongated organ, somewhat pointed in front and terminating broadly behind, the *brain* (fig. 6, *g*), in which, by means of reagents, the presence of numerous nuclei with comparatively large nucleoli may be demonstrated. This is connected posteriorly with a dorsal feeler (fig. 6, *d.t*), the setæ of which arise from a circular aperture in the skin. Their size is very variable in different individuals; frequently they are very long and easily recognizable, while in other individuals they are remarkable for their smallness. To the nervous system, no doubt, belong also the four groups of tactile setæ (figs. 5, 6, *t*) which surround the buccal aperture; but I was unable to ascertain their connexion with the brain. Lateral feelers, which are so characteristic of the freshwater Rotatoria with the exception of the Philodinæa, are wanting in *Paraseison*. No eye-spots were seen.

The *muscular system* is difficult to observe in its details, owing to the constant mobility of the living animal. The longitudinal musculature is especially developed; whilst of the scantily developed transverse bands we need mention only three tolerably broad muscles, which lie at equal distances apart below the dorsal surface of the trunk and extend over the dorsal half of the sides of this division. The system o thin transverse muscles covering the whole ventral side of the trunk, which is so characteristic of *Seison*, is entirely deficient in *Paraseison asplanchnus*.

Of the *longitudinal muscles* those are of course the most important which, on the one hand, retract the neck into the trunk and, on the other, the hindmost segments into the basal part of the tail. During invagination the neck always comes to lie near the ventral surface, below the stomach, as the muscles which act in this operation are nearer to the lower surface of the body than to the back. These are two strong bands (fig. 1, m^4), smooth (like all the muscles), which traverse the trunk on each side and can be traced into the third segment of the neck. They originate somewhat behind the middle of the trunk, and are continued backwards in it on each side by two closely approximated muscles (fig. 1, m^5). If we examine *Paraseison* from the ventral surface we see, outside of the contractile bands just described, on each side another one of smaller size, which, however, traverses only the anterior half of the trunk. Within the neck-retractors, marked m^4, there are further two thin muscles, which commence at the base of the neck and penetrate deeply into the tail near the median line. Of the *retractors of the caudal segments* there are two on each side especially developed, the course of which may be seen in fig. 1, m^8 and m^6. How far they extend posteriorly I have omitted examining. Dorsally from these, two bands are extended on each side, of which one (m^7) is delicate and short, while the other (m^9) consists essentially of two muscles, which meet together at an angle, and of which the anterior one is distinguished by its shortness and breadth. Besides those mentioned above, the tail contains some other muscles, which serve to introvert the hindmost segments. Thus we have the band indicated by m^{13} in figs. 4 and 7 (which possibly forms a continuation of m^8 or m^6), as also m^{14} and m^{15}. The great muscle traversing the trunk (m^4), which is inserted in the middle of the third ring of the neck, is followed anteriorly by m^2 (fig. 2), the anterior point of attachment of which is at the base of the head. This muscle draws back the first two neck-segments, and is assisted therein by the smaller bands (fig. 2, m^1 and m^3), the position and arrangement of which is shown in the figure. All the longitudinal muscles just described are in pairs, and symmetrically arranged to right and left. This applies also to the three short adductors which introvert the most anterior part of the head. Two of these (fig. 6, m^{10} and m^{11}) lie above the masticatory apparatus, the third pair (m^{12}) below it.

Having described as accurately as possible the organization of *Paraseison asplanchnus*, the description of the other three species of the same genus which occur on the *Nebaliæ* of the Bay of Naples may be managed with few words, as, except in a few particulars, they perfectly agree with the above species.

2. *Paraseison nudus*, sp. n.

This form is distinguished especially, so far as I could see, by the entire absence of the four groups of tactile setæ which, in the ordinary species, surround the mouth ; consequently, in this species no trace of the rotatory organ has been retained—a phenomenon which is one of the greatest rarities in the class Rotatoria. Further, the head is somewhat different in form from that of *P. asplanchnus*, inasmuch as it is much attenuated in front, so that the buccal aperture is situated at the apex of a small cone. This species is much scarcer than *P. asplanchnus*, and I have seen only two female examples of it. The measurements of one of these were as follows:—Head 0·12, neck (almost extended) 0·12, trunk 0·18, tail 0·2.

3. *Paraseison proboscideus*, sp. n.

Also, like the preceding species, possesses no buccal feelers, but, on the other hand, the head is characterized by the presence of a small naked proboscis, which is situated above the buccal aperture and appears to act as a tactile organ. I think I have observed that this proboscis was connected by a delicate cord (canal?) with the yellowish-green body which I have already mentioned in *Paraseison asplanchnus*. The masticatory apparatus differs somewhat in form from that of the common species. In the musculature surrounding it we observe some bands, arranged transversely and parallel to each other, which never caught my attention in *P. asplanchnus*. When fully extended, the single female that I have observed measured about 0·76 millim.

4. *Paraseison ciliatus*, sp. n.

This species I have only twice seen living, but have often been able to examine in preserved material. In some points it greatly resembles *Seison Grubii*, Claus, so that at first I was in doubt whether it might not be identical with that form. Like the species in question it has, on each side, to the right and left of the buccal aperture, a strong tuft of cilia, by the rapid movement of which the animal's food is swept in. There are, however, no tactile setæ in the vicinity of the mouth. A further agreement with the true Seisonidæ is to be found in the fact that the matrix of the cuticle shows two streaks of changed constitution on the two sides of the ventral surface of the trunk. Each of these longitudinal bands is about 0·017 millim. in width, and bears a great number of transverse, parallel, and very delicate fibrils, between which comparatively numerous nuclei are placed. These transversely striated parts extend in the species of *Seison* over the whole ventral surface of the trunk, while in our animal they enclose between them the greater part of it unaltered in structure. In all other peculiarities of organization, however, there prevails a complete agreement with the above-described species of *Paraseison*; there is no intestine, the water-vascular system forks in the trunk into a broad and a narrow branch, in the hinder part of the head there are only two pyriform glands, which open into the œsophagus at the commencement of the neck, and in the so-called *ductus ejaculatorius*, the wall of which shows no musculature, there are a number of the flask-shaped structures which have been regarded as spermatophores. The masticatory apparatus and the dimensions of different divisions of the body are also as in *P. asplanchnus*.

5. *On the Systematic Position of the Seisonidæ, and the Natural Groups of the Rotatoria.*

The new genus *Paraseison* described in this memoir certainly differs from the previously known genus *Seison* in many particulars; but these are of so slight a nature that no doubt can exist as to the close relationship of the two forms. A fresh investigation of the ectoparasites occurring on *Nebaliæ* near Trieste will probably also furnish evidence of some things hitherto found only in *Paraseison*, such as the dorsal feeler, a greater number of flicker-organs, and a ventral branch of the part of the water-vascular system situated in the trunk. As to the position which the genus *Saccobdella* occupies with regard to these two genera further investigations must decide, as our knowledge of this animal-form is at present very imperfect, and we can only unite it provisionally and hypothetically with *Seison* and *Paraseison*, in the family Seisonidæ. The relations of this group to the other Rotatoria will be elucidated in what follows.

In my recently published memoir on some ectoparasites of *Gammarus pulex* I have attempted to show that the known freshwater Rotatoria fall under two natural subdivisions, which differ from each other in the general form of the body and in many peculiarities of organization. The most important contrast is manifested in the structure of the female generative organs. In one group, that of the *Aductifera*, or Philodinææ, these are paired, possess no efferent ducts, and are composed of a homogeneous plasma-mass permeated by nuclei*, definite portions of which are gradually constricted off, and fall, as ova, into the body-cavity. In the other group, the sexual organs are unpaired, but are formed of two sections having different functions, one of which (ovary) contains the cells

* See the supplementary note at the close of this Memoir.

which are in process of growth into ova, while the second (vitelligene) merely furnishes the nutritive material necessary for development. This family of the *Ductifera*, to which by far the greater number of genera belong, possesses a special duct for the reproductive materials opening in the back. The nervous system presents a further decided distinction between the two divisions. The Ductifera always* present two lateral and one or two dorsal tufts of tactile setæ, while in the Philodinææ only the latter occur. The *marine* Rotatoria also, upon which, however, we have no recent investigations, enter without violence into these natural groups, so far as I can judge from the examination of certain genera (*Brachionus*, *Pterodina*, *Colurus*, *Synchæta*, *Furcularia*, and *Philodinææ*), as they only differ very slightly from their allies in the fresh water. But the three genera parasitic on *Nebalia* differ so much from all other Rotatoria that in opposition to these they must be united into a third family. Undoubtedly, however, the Seisonidæ come nearer to the Philodinææ than to the Ductifera. With the former they share the elongate worm-like form, and the faculty of pushing the foremost and hindmost apparent segments into one another in telescope fashion. The adhesive organ of the tail is formed in both sections by a considerable number of glands, while the Ductifera only possess two, or have lost them altogether; and further, in the nervous system, the absence of the lateral feelers is common to them. As the primitive construction of the rotatory apparatus of the Philodinææ renders it probable that this family has retained comparatively many of the characteristic peculiarities of the original form of the entire class, we may also assume that the Seisonidæ branched off comparatively early from the genealogical tree of the Rotatoria. A further conclusion arising from this (which, however, like all such phylogenetic speculations, must, of course, be taken with the necessary reserve) would then be that the female sexual organs of the Rotatoria were originally paired, and consequently the unpaired sexual apparatus of most members of the class is to be regarded as something acquired secondarily. This view is supported by the structure of the sexual organs in *Pterodina patina*, Ehr., a species whose genus (as I have previously indicated) is one of the few Ductifera in which several primitive peculiarities of organization have been preserved; the *Pterodinæ* have the simple two-rowed rotatory apparatus of the Philodinææ, their water-vascular system has not yet developed any contractile vesicle, and the long tail terminates with the same tuft of cilia which characterizes the young forms of the

* To this *Conochilus* is an exception.

Ductifera which are sessile when adult (*Lacinularia*, *Melicerta*, and their allies). They have further a horseshoe-shaped vitelligene, each limb of which bears an ovary of the usual construction at its posterior end, that of the left side of the body being feebly, and that of the right side more strongly developed, and the latter alone seeming to function. This doubling of the ovary renders it very probable that the two limbs of the vitelligene were also originally separate, and only became united subsequently. A vitelligene so constructed, indeed, still occurs in some species of the genus *Asplanchna*, which in other respects differs greatly from *Pterodina*. Here the limbs of the organ are so long in proportion to the part uniting them, that one is involuntarily driven to the assumption of their original duplex nature, although the ovary, which is placed at the apical point of the two limbs, is unpaired. The two genera just named, therefore, as regards the structure of the female sexual organs, facilitate the passage from the two older families of the Philodinææ and Seisonidæ to the more modified younger family of the Ductifera.

This view as to the phylogenetic development of the natural groups of the Rotatoria meets only with one difficulty. The masticatory apparatus of the Seisonidæ closely approaches the typical structure of this organ in the Ductifera, but differs considerably from that of the Philodinææ. According to Gosse*, one can distinguish in the mastax of the majority of the Rotatoria a central "incus" composed of two "rami" and two lateral "mallei," parts which may also be recognized at once in *Paraseison*. In the Philodinææ, on the contrary, these ossicles are fused together into two ribbed masticatory plates, which also reappear in exactly similar development in many Melicertidæ. These facts admit two hypotheses for their explanation; either the biting-organs of the *Archirotator* were like those now presented by the Philodinææ, and developed themselves therefrom, independently of each other, in two different sections; or, and I regard this as more probable, they showed from the beginning the structure still existing in the majority of the Rotatoria, from which, then, the two masticatory plates which we now find in the Philodinææ and some Ductifera were produced by the growing together of the chitinous bands belonging to each half of the body.

In conclusion, a condensed summary of the most important anatomical points for the distinction of known genera and species of the family Seisonidæ may here follow: as a matter of course it represents only the present standpoint of our

* Gosse, "Manducatory Organs of Rotifera," in Phil. Trans. 1856.

knowledge, and will, perhaps, very soon have to submit to alterations.

Characters of the Family Seisonidæ.

Elongate, vermiform animals, $\frac{1}{2}$–3 millim. in length, of similar form in both sexes, so that the sexual dimorphism is expressed prominently only in the sexual apparatus. The males are somewhat smaller than the females and not quite so abundant. The *body* is divided into four sections composed of apparent segments, which are distinguished from before backwards as head, neck, middle body (trunk), and tail, and, with the exception of the last two, are sharply separated from each other. The neck can be retracted in its whole length into the trunk, to the ventral surface of which it is then applied. The *rotatory apparatus* is either present only in a rudimentary form, or altogether wanting. The long, narrow *œsophagus* opens into the anterior end of the masticatory apparatus, so that the latter forms a sacciform, ventral appendage of the œsophagus. In the *head* two dorsal and two ventrally situated, long-stalked, pyriform *glands,* which empty their secretion before the mastax or into it. Muciparous cells of the same kind exist also in the hind head and neck. *Stomach* elongated, with two glands at the anterior end, formed of large polygonal cells which bear no cilia within. *Sexual organs* paired, but with a common dorsal evacuator, which opens in the male at the point of passage of the neck and trunk, in the female at the posterior extremity of the trunk. The ovaries consist of numerous, distinctly separated ova, and are therefore not differentiated into ovary and vitelligene. The male sexual apparatus is of complicated structure, in which various parts, which are regarded as seminal vesicle, *vas deferens,* and *ductus ejaculatorius,* may be distinguished. Two *aquiferous vessels,* furnished with "flicker-organs" traverse head, neck, and trunk, and discharge themselves externally with the sexual organs. Characteristic of these is (1) The development of some parts into thin-walled and of others into thick-walled canals; and (2) the absence of a contractile vesicle. To the nervous system belongs a ganglion placed dorsally in the head, and bearing a dorsal feeler. There are no lateral feelers. The *longitudinal musculature* is strongly, and that running transversely feebly developed; it is smooth throughout. The tail contains a number of long-stalked, pyriform, *viscous glands,* which open at the hindmost pole of the body. At the same point there is towards the ventral surface a vesicle opening by a short projecting canal, the signification of which is doubtful. The animals live ectoparasitically upon the species of *Nebalia* of the Mediterranean and North Sea, especially on their branchial laminæ. They creep about after the fashion of geometric caterpillars, and deposit their ova in groups. At the commencement of development one or two polar corpuscles appear; all its stages are passed in the egg. Special persistent (winter) eggs do not occur.

Genus I. Seison, Grube.

With an intestine, which discharges itself with the excretory organ, and therefore places the anal aperture in different parts of the body in the two sexes. Rotatory apparatus rudimentary, formed by two tufts of cilia placed at the foremost pole of the body. In the posterior half of the head 5–6 flask-shaped cells, the efferent duct of which passes into the fore part of the neck. The sexual organs of the female are placed ventrally to the stomach. The aquiferous vessels do not fork in the trunk. The *ductus ejaculatorius* of the male possesses a well-developed musculature in its walls, and performs undulatory movements. On the right side it forms a lobiform diverticulum, and opposite to this on the left side a multipartite glandular body. No spermatophores. The tail terminates posteriorly in an adhesive disc. The whole ventral surface of the trunk is covered with a great number of transverse muscular fibres, and thereby acquires a striated appearance. In the Adriatic near Trieste.

1. *Seison Grubii*, Claus.—Trunk not annulated; neck formed of three segments.

2. *Seison annulatus*, Claus.—Trunk divided into a large portion, and, following this, four short joints; the neck shows more than three rings.

Genus II. Paraseison, gen. nov.

In both sexes *without intestine*. Rotatory apparatus either as in *Seison*, or reduced to a few tactile setæ, or entirely wanting. In the hind-head only two flask-shaped glands, which open into the œsophagus in the commencement of the neck. Sexual organs in male and female placed laterally or dorsally to the stomach, only exceptionally displaced below it. Each aquiferous vessel with five flicker-organs, and giving off a thin-walled, cæcally terminating lateral branch in the anterior part of the trunk. The *ductus ejaculatorius* of the male with smooth walls, with no movements or lateral organs, with numerous flask-shaped spermatophores. The tail does not terminate with an adhesive disc, but the posterior pole of the body has the form of a hemisphere, which is beset with a row of small denticles, between which the viscous glands discharge themselves. In the Bay of Naples.

1. *Paraseison asplanchnus*, sp. n.—Average size of the adult female 1 millim. Without true rotatory apparatus, but with four tufts of tactile setæ standing round the buccal aperture.

2. *Paraseison nudus*, sp. n.—Size 0·6 millim. Head without any trace whatever of a rotatory apparatus, and also without buccal tactile setæ. It also becomes attenuated in front, so that the buccal aperture comes to be situated at the apex of a small cone.

3. *Paraseison proboscideus*, sp. n. Size 0·75 millim. Head without any trace of rotatory apparatus, without tactile setæ at the mouth, but with a small proboscidiform eversion of the skin, situated above the buccal aperture, which serves as a tactile organ. Rare.

4. *Paraseison ciliatus*, sp. n. Size about 1 millim. Assists in the transition to the genus *Seison*, inasmuch as the rotatory apparatus is developed as in that genus, and further there are, on the ventral surface of the trunk, two longitudinal streaks composed of numerous parallel muscular fibres. Not uncommon.

With these two better-known genera is to be arranged the still insufficiently investigated

Genus III. Saccobdella, Van Beneden & Hesse.

Saccobdella nebaliæ, Van Ben. & Hesse. Length 2–3 millim. The abdomen terminates in two pedunculate sucking-discs. Neck composed of five segments of about equal length, tail of four rings. Buccal aperture on the lower surface of the head, not far from the anterior margin. The intestine is said to traverse the whole body in the median line. Colour of the body a very light blue. The ova possess a small stalk, and several of them may be united to form a bush-like group. In the North Sea.

Postscript.—The assertion formerly made by me (Zeitschr. f. wiss. Zool. Bd. xliii. pp. 230 *et seqq.*), and to which I have referred in the preceding memoir, that the sexual organs of the female Philodinææ are not divided into a germigene and a vitelligene, has recently proved to be a mistake. Soon after the completion of the manuscript of this memoir, I found the germigene in some Philodinææ which were better suited to the study of this organ than the *Callidina parasitica*, Gigl., previously investigated by me. I can now, therefore, in this point fully confirm the descriptions of the germi-vitelligene since given by Tessin (Zeitschr. f. wiss. Zool. Bd. xliv. pp. 273 *et seqq.*) and Zelinka (*ibid.* pp. 396 *et seqq.*).

EXPLANATION OF PLATE VI.

All the figures relate to *Paraseison asplanchnus*, and the letters have the following signification:—

a. Aperture of the sexual organs.
d. ej. *Ductus ejaculatorius.*
dr. Glands of the head and neck.
dt. Dorsal feeler.
du. Efferent duct of the female sexual organs.
f. Pedal glands.
g. Brain.
m. Muscle.
ma. Masticatory apparatus.
o. Buccal aperture.
œ. Œsophagus.
ov. Ovary.
st. Stomach.
t. Buccal feelers.
te. Testes.
v.d. *Vas deferens.*
wg. Aquiferous vessel.
x., *y.* Doubtful organs.
z. Flicker-organs.

Fig. 1. Female animal, × 230.
Fig. 2. Neck, × 275.
Fig. 3.* Section through the cuticle of the trunk.
Fig. 4.* Hinder extremity of the tail.
Fig. 5.* Anterior end of the head, seen in front.
Fig. 6. Head, × 550.
Fig. 7.* Tail.
Fig. 8.* Masticatory apparatus seen from the side.
Fig. 9.* Masticatory apparatus seen from below.
Fig. 10. Deposited ova, × 120.
Fig. 11. Spermatophore after treatment with solution of potash.
Fig. 12. Spermatophore in the natural state.
Fig. 13. Trunk of the male, × 275.

The figures marked with an asterisk have no indication of the amount of enlargement.

BIBLIOGRAPHICAL NOTICES.

A Flora of Hertfordshire. By the late A. R. Pryor, B.A., F.L.S. Edited for the Hertfordshire Natural History Society by Benjamin Daydon Jackson, Sec. L. S. *With an Introduction on the Geology, Climate, Botanical History, &c. of the County*, by John Hopkinson, F.L.S., F.G.S., and the Editor. London: Gurney and Jackson, 1887. 8vo, pp. viii & 588.

To edit a botanical work by one like the late Mr. Pryor, whose work we have been led to expect would at least equal, if not surpass, some of the latest of our County Floras, was no light task; and probably Mr. Jackson has acted wisely in not materially interfering with the MS. of the author, as he distinctly states he has not in the preface. The inference from this will be that, so far as the actual Flora itself is concerned, Mr. Jackson's work has to a great extent been mechanical, hence he can hardly be held responsible for any opinions it may express.

One small matter is to be heartily approved of—that is, the full references given under the generic and specific names; anyone who has worked at local botany will for this be most thankful.

The work consists of a Map of the county showing the Botanical divisions arranged under the river-basins. An Introduction, treating of the Stratigraphical Geology, with two Maps, Hydro-geology, Climate, Botanical districts, Botanical History, and list of Contributors. Following this comes the list of the Flowering Plants and higher Cryptogams, occupying 496 pages; an appendix of "Additional published stations"; "Cryptogamia," with 12 pages; a "Tabular Statement of Plant-distribution in Hertfordshire and neighbouring counties," of 31 pages; a Summary of this; "Additions and Corrections," and Index.

Looking through the Flora itself, which it should be stated is arranged according to Nyman's 'Conspectus Floræ Europææ,' there are a few things that call for notice. No time of flowering is given for any plants in the body of the work, which, Mr. Jackson rightly says, "to be of any use should be drawn from actual local observation." The *Thalictrum* from Royston is given as *T. Jacquinium* (following Nyman). If this is the same as the Cambridgeshire Gogmagogs plant, the writer of this doubts it; he has vainly tried to get that determined by continental experts, having grown it for several years past. In the Violets, *V. sepincola* and *permixta* of Jordan are placed under *odorata* (following Babington); they may technically be so placed, but naturally they are *hirta* forms, and so show themselves under cultivation. The locality for *Silene nutans*, "Garden wall one or two plants for last 22 years," followed by "Native," is not following in the footsteps of our great topographical authority, Mr. H. C. Watson. Webb and Coleman, in their 'Flora Hertfordiensis,' very rightly place the mark of non-nativity to the plant. It might be contended that it follows (in the flora) the words "English-Germanic" and applies to them; if so, it at once loses its local signification, and that alone can be accepted in a County Flora. In the same genus another species, *S. conica*, is recorded as native, the record running thus:—"Three plants in the middle of a fifty-acre field near High Down," with a reference to the 'Journal of Botany.' Whether we are to accept the ! given after this locality as a record of a specimen received, or of actually seeing the plant *in situ*, is not plain; the note in the 'Journal of Botany' would seem to say the former. Anyhow the record is a most unjustifiable one (as a native), and one can hardly tell how Mr. Pryor could have accepted it as such. It is only perhaps to be explained on the supposition that here "field" may really mean

"Field"—*i. e.* an open sheep-walk, its meaning in some of the eastern counties. If so, the plant might possibly be native though extremely doubtful. It is one of those species that appear some years in profusion and in the next can hardly be found; at least such is the experience of the writer in E. and W. Norfolk on the "Breck" lands and sea-cliffs. Here and there the British botanist will find "forms" the names of which he is not familiar with, as under *Silene Cucubulus*, p. 61, at p. 112 &c.

The Rubi seem to have been better worked out than the Roses; surely there are more forms of *canina* in Herts than those given. Is not the reference under *Hieracium vulgatum* v. *maculatum* (p. 254) a slip? Smith's plant was hardly the same as this. On page 269 *Pyrola rotundifolia* is accepted as a Herts species: surely this (at least) should have been queried; there is no intimation that Mr. Pryor had seen a specimen, and it is a rare southern plant, although it does occur in Kent! The query after "Cambs" under *Eriophorum latifoliun* may be expunged; there are specimens in Smith's herbarium at the Linnean Society "from Parson Holme."

It seems somewhat remarkable that Herts should possess *Carex lepidocarpa*, Tausch., *and no other form* of C. flava, *L.*; yet elsewhere in Britain *lepidocarpa* is a rare form. On page 440 Mr. Pryor substitutes *Carex gracilis*, Curtis, for *C. acuta*, L. (1753), yet writes *C. vulgaris*, F., for *C. Goodenovii*, Gay.

The species of the county are those mostly representing the flora of the Thames basin, with some rarities, and a few absences that are rather remarkable.

Of the first may be named *Lythrum Hyssopifolia*, *Libanotis montana*, *Bulbocastanum Linnæa*, *Melampyrum cristatum*, *Orchis militaris*, *Aceras Herminium*, *Carex paradoxa*, *Phleum phalaroides*, &c. Of the latter may be mentioned *Corydalis claviculata* and *Viola palustris*.

Thesium humifusum is very rare in the county on the chalk. There seems something about this species in its distribution in our country that is peculiar; why is it not a Kent plant? Yet within a few miles of the Kentish border in Surrey it abounds in exactly the same ground as occurs in Kent, without apparently any special physical conditions. *Alchemilla vulgaris* is a species that is tolerably common in Herts; yet in Surrey, Middlesex, and Kent it is very rare; why? With about the same natural, physical, and geological conditions there is yet something needed to explain these anomalies of distribution.

On closing this Flora, one of the latest additions to our counties, the writer of this owns to a disappointment felt, which he thinks he is justified in saying he is not alone in. One cannot but deeply regret the death of its author, and feel that the work of two men (good and true), Webb and Coleman, in their 'Flora Hertfordiensis' (far in advance of its times as it was), would have been carried to a higher standard had he lived to give it to the world.

Arthur Bennett.

British Oribatidæ. By ALBERT D. MICHAEL, F.L.S., F.R.M.S., &c. Vol. II. 8vo. Printed for the Ray Society, London, 1888.

AFTER the lapse of something more than three years we have the pleasure of calling our readers' attention to the publication of the second volume of Mr. Michael's admirable work on the British Oribatidæ. It forms the Ray Society's volume for 1887, and so fully supports the character which we gave of its predecessor that we have no occasion to do much more than announce its appearance.

The volume opens with an amended table of the genus *Tegeocranus*, rendered necessary by the detection in Britain of three species of that genus (two of them described as new) since the publication of the first volume. Descriptions and tables follow of nineteen species of *Notaspis*, seven of *Damæus*, six of *Hermannia*, two of *Eremæus*, thirteen of *Nothrus*, four of *Hypochthonius*, five of *Hoplophora*, and two of *Scutovertex* (with an amended table), making together fifty-four species, all of which are described and figured with the same care and detail as those cited in the former volume. Of these fourteen, or about one fourth, are described as new species; and several of the others, especially belonging to the genus *Notaspis*, have been previously described by the author in the 'Journal of the Royal Microscopical Society.' The habits and transformations of the species are described in the same careful manner as in the preceding volume, and the work is rendered more complete by the addition of further notes on the species therein noticed.

In an appendix Mr. Michael gives us an amended classification of the genera belonging to this curious family of Mites, a further contribution to the knowledge of their anatomy, some interesting notes on the phenomena attending the change from the nymph to the adult state, a bibliography of the literature relating to the Oribatidæ, and last, but not least, a list, with brief notes and references, of recorded species of the family which are not known to occur in Britain. The list is a long one; but, as the author points out, many of the species are imperfectly described and figured, and may turn out to be identical with other recognized species, while some of the names may represent immature forms.

Under any circumstances, whether we consider the full and careful descriptions, or the beautiful series of illustrations, or the manner in which the author has summarized the labours of his predecessors, we have in these volumes one of the most complete treatises that can be conceived, and future students of the Acarina will owe a debt of gratitude to Mr. Michael for his labours, and to the Ray Society for producing their results in so admirable a form.

Campagnes Scientifiques du Yacht Monégasque l'Hirondelle. Troisième Année, 1887. *Excursions Zoologiques dans les îles de Fayal et de San Miguel (Açores).* Par Jules de Guerne. 8vo. Paris: Gauthier-Villars et fils, 1888.

His Highness Prince Albert of Monaco, following the example of some few less distinguished yachtsmen, zealously devotes himself during his voyages to the investigation of various scientific questions. As a rule, perhaps from a feeling that in these investigations he is to be regarded as representing his principality, and with a laudable desire to make it famous for something more than the worship of the black and the red with which the name of Monaco is generally associated in the minds of men, he has generally directed his efforts to the class of researches usually carried on by Government expeditions, and the currents of the North Atlantic, especially the Gulf-stream, the largest of them all, have attracted most of his attention. But while these physical questions have formed the main objects of his voyages, other things have not been neglected, and he has always secured the companionship of two or three naturalists to assist him in working out such zoological problems as may present themselves for solution during the expeditions.

Among these M. Jules de Guerne, the author of the work whose title stands at the head of this notice, seems to have always occupied a place, as we find him contributing papers upon the zoological results of both the Prince's previous voyages in 1885 and 1886. In 1887 the great object of the expedition was a further investigation of the currents of the Atlantic; but a short stay at the Azores was taken advantage of by M. de Guerne for the purpose of studying the freshwater fauna of those islands. His results, as here given, are exceedingly interesting.

In such islands as the Azores of course the amount of fresh water is comparatively limited, consisting chiefly of small lakes generally situated in the hollows formed by extinct volcanic craters. In these the author instituted researches analogous to those which have furnished such interesting results in the case of various European lakes; and these were of the more importance in the case of the Azores, isolated specks in the midst of the ocean, because from the recent date at which the water of these lakes must have accumulated, the time for the introduction of freshwater organisms must have been very limited. It is therefore interesting to find that, as in the case of the majority of the terrestrial animals, the forms are decidedly European, although it must be admitted that in some cases the species are very generally distributed.

A very few species are regarded by the author as new to science. They include a minute Gasteropod, referred with doubt to the genus *Hydrobia*, and named *H.? evanescens*. It seems still to be doubtful, however, whether this mollusk may not be a juvenile form. The only Lamellibranchiate mollusk obtained is also described as a new species, under the name of *Pisidium Dabneyi*, which, from the remarks made upon it, would seem to be most nearly related to the

European *P. fontinale.* Two Edriophthalmous Crustacea (*Philoscia Guernei* and *Orchestia Chevreuxi*) and an Ostracod (*Cypris Moniezi*) are also described as new.

The most important special zoological section of the work is a monographic note on the Rotiferous family Asplanchnidæ, a translation of which is given in the present number of the 'Annals,' and to which therefore we need not further refer, except to say, in continuation of the last paragraph, that it includes descriptions of four new species, only one of which (*A. Imhofi*), however, is peculiar to the locality.

M. de Guerne gives a useful table of the terrestrial and freshwater animals now known to inhabit the Azores (omitting the terrestrial Insects), indicating particularly their distribution as observed by himself in Fayal and St. Michael's, with notes on the records of other writers.

In conclusion, the author discusses the general results of the researches made by himself and others upon the fauna of the Azores, and arrives at results which may be summarized as follows:—The terrestrial fauna of the Azores is of distinctly European character, which is still more the case with that of the fresh waters. The species are generally very widely distributed, many of them probably cosmopolite; they seem to have been chiefly conveyed to the Azores by winds and by birds. The peopling of the Azorean fresh waters has been accomplished rapidly, the lakes being of comparatively modern origin. The fecundity and power of adaptation to new media of the introduced animals, coupled with the absence of the struggle for existence, will account for the rapidity with which the waters have become peopled. The marked differentiation of the terrestrial fauna is explained by the facts that the facilities of transport of these types are less and that its origin is much more ancient. The Alpine character of the terrestrial fauna of the Azores maintained by some writers has not been demonstrated.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

May 9, 1888.—W. T. Blanford, LL.D., F.R.S., President, in the Chair.

The following communication was read:—

"The Stockdale Shales." By J. E. Marr, Esq., M.A., Sec.G.S., and Prof. H. A. Nicholson, M.D., D.Sc., F.G.S.

The Stockdale Shales extend in an E.N.E.–W.S.W. direction across the main part of the Lake District, parallel with the underlying Coniston Limestone Series and the overlying Coniston Flags, with both of which they are conformable. They also occur in the neighbourhood of Appleby, and in the Sedbergh district. They are divisible into a lower group of black and dark grey and blue Graptolite-bearing shales, interstratified with hard bluish-grey mudstones containing Trilobites and other organisms, and an upper group of pale greenish-grey shales, with thin bands of dark Graptolitic shales. The lower group (Skelgill Beds) is well seen in the stream which runs past Skelgill Farm, and enters Windermere near Low Wood; while the upper group (Browgill Beds) occurs fully developed in the Long Sleddale Valley, and its beds are very fossiliferous in Browgill.

The authors divide these shales into a series of fossil-zones in the following order:—

Stockdale Shales	Browgill Beds	Upper	*Bb* 2	
			Bb 1	
		Lower	*Ba* 2	zone of *Monograptus crispus.*
			Ba 1	——— ——————— *turriculatus.*
	Skelgill Beds	Upper	*Ac* 5	——— *Rastrites maximus.*
			Ac 4	——— *Acidaspis erinaceus.*
			Ac 3	——— *Monograptus spinigerus.*
			Ac 2	——— *Ampyx aloniensis.*
			Ac 1	*Monograptus Clingani* band.
		Middle	*Ab* 6	Barren band.
			Ab 5	zone of *Monograptus convolutus.*
			Ab 4	——— *Phacops glaber.*
			Ab 3	——— *Monograptus argenteus.*
			Ab 2	——— *Encrinurus punctatus.*
			Ab 1	——— *Monograptus fimbriatus.*
		Lower	*Aa* 2	——— *Dimorphograptus confertus.*
			Aa 1	——— *Diplograptus acuminatus* & *Atrypa flexuosa.*

Of these zones, the lowest varies, occurring as a thin limestone in Skelgill, with *Atrypa flexuosa*, n. sp., and as Graptolitic shale at Browgill with *Diplograptus acuminatus*, Nich. The others appear to run persistently across the district, with the exception of the zone of *Rastrites maximus*, which has only been discovered in the Sedbergh area. The thicknesses, lithological characters, and fossil contents of these zones were considered, and comparisons made between these beds and the corresponding deposits of other areas. The whole group attains a thickness of from 250 to 400 feet, of which the Skelgill beds usually make up about one quarter.

The authors correlate the Graptolite-zones with those of the Birkhill and Gala groups of Professor Lapworth as follows:—

Lake District.		*South of Scotland.*
Zone of *Monograptus crispus*......	=	Zone of *M. exiguus.*
,, —— *turriculatus*		Not separated.
,, *Rastrites maximus*	=	Zone of *R. maximus.*
,, *Monograptus spinigerus* *Monograptus Clingani* band	=	,, *Monograptus spinigerus.*
Not represented?		,, *Petalograptus cometa.*
Zone of *Monograptus convolutus* ,, —— *argenteus* .... ,, —— *fimbriatus*	=	Zone of *M. gregarius.*
,, *Dimorphograptus confertus*	=	,, *Diplograptus vesiculosus.*
,, *Diplograptus acuminatus*	=	,, *D. acuminatus.*

The zones of *M. convolutus*, *M. argenteus*, and *M. fimbriatus* contain abundance of *M. gregarius*, and the zone of *Dimorphograptus confertus* also contains *Diplograptus vesiculosus* in considerable numbers.

The beds were also compared with the corresponding beds in Sweden, Bohemia, Bavaria, &c., and the fossils other than Graptolites were shown to occur elsewhere in strata of Llandovery-Tarannon age, from which it was concluded that the Stockdale Shales occupy that horizon.

A fault occurs everywhere between the Middle and Lower Skelgill Beds, except perhaps in the Sedbergh district; but it does not seem to cut out a great thickness of rock, and the authors gave reasons for supposing that it was produced by one set of beds sliding over the other along a plane of stratification.

The beds are found to thicken out in an easterly direction, and the possibility of the existence of land in that direction was suggested.

The authors directed attention to the importance of the Graptolitoidea as a means of advancing the comparative study of the stratified deposits of Lower Palæozoic age.

A description was given of the following new species and varieties:—*Phacops elegans*, Boeck & Sars, var. *glaber*, *Cheirurus bimucronatus*, Murch., var. *acanthodes*, *Cheirurus moroides*, *Acidaspis erinaceus*, *Harpes judex*, *H. angustus*, *Ampyx aloniensis*, *Proëtus brachypygus*, and *Atrypa flexuosa*.

May 23, 1888.—W. T. Blanford, LL.D., F.R.S., President, in the Chair.

The following communication was read:—

"On the Skeleton of a Sauropterygian from the Oxford Clay, near Bedford." By R. Lydekker, Esq., B.A., F.G.S.

A description was given of a considerable portion of the skeleton of a Sauropterygian from the Oxford Clay of Kempston, consisting of several upper teeth, most of the mandible (of which the symphysial region is entire), a considerable number of vertebræ mainly from the "pectoral" and dorsal regions, the greater portion of the two pelvic, and fragments of the pectoral limbs, and a considerable proportion of the pectoral and pelvic girdles. These remains were referred to *Plesiosaurus philarchus*, Seeley, and the various parts described in detail.

The Author discussed the advisability of retaining the forms described by various generic names by Professor Seeley, under the name of *Plesiosaurus*, and stated his intention of employing the latter term in its widest sense for the present. With this definition, the form under consideration was shown to present characters intermediate between those of *Plesiosaurus* and *Pliosaurus*, but was retained provisionally in the former genus. Although a direct link in the chain connecting the two genera, *P. philarchus* was not regarded as an ancestor of *Pliosaurus*, since teeth undistinguishable from those of the latter genus occur in the Coralline Oolite.

Finally it was concluded that the evidence brought forward was sufficient to render necessary the abolition of the name Pliosauridæ, and the inclusion of *Plesiosaurus* and *Pliosaurus* in a single family.

June 6, 1888.—W. T. Blanford, LL.D., F.R.S., President, in the Chair.

The following communication was read:—

"On the Occurrence of *Calcisphæræ*, Williamson, in the Carboniferous Limestone of Gloucestershire." By E. Wethered, Esq., F.G.S., F.C.S.

The small hollow spheres, with varying forms of peripheral appendages, described by Prof. Williamson as *Calcisphæræ*, were found in the Carboniferous Limestone of Flintshire, and were suggested by him to be possibly Foraminifera or the reproductive capsules of some marine form of vegetation, although he admitted that no forms hitherto discovered afforded any definite support to this hypothesis. Prof. Judd expressed a belief that the objects were Radiolaria; whilst Mr. Shrubsole discovered similar bodies in the Mountain Limestone near Llangollen, and conjectured that the described forms included both Foraminifera and Radiolaria.

The Author has discovered the *Calcisphæræ* in great numbers in the Carboniferous Limestone of Gloucestershire. He discussed the identity of certain calcareous rings ·005 in. in diameter, seen in sections of the limestone of Clifton, &c., with siliceous bodies which he had described in a recent paper read before the Society, and gave an account of the calcareous and siliceous forms which were both referable to *Calcisphæræ*. He commented upon the character of the carbonate of lime of the calcareous bodies, which presented a granular structure characteristic of the truly organic portion of the limestone, and not a clear crystalline aspect like that of the infilling or replacing calcite; he concluded therefore that the tests had been originally calcareous, and not siliceous replaced subsequently by carbonate of lime. This was urged as a strong argument against regarding the organisms as Radiolaria, and the Author, whilst considering it unwise to come to a decided conclusion, believed it safe to say that they were Protozoa.

June 20, 1888.—W. T. Blanford, LL.D., F.R.S., President, in the Chair.

The following communications were read:—

1. "On the Occurrence of Marine Fossils in the Coal-Measures of Fife." By Jas. W. Kirkby, Esq. (Communicated by Prof. T. Rupert Jones, F.R.S., F.G.S.)

This paper recorded the discovery of fossils of good marine types in the Fifeshire Coal-measures. This coal-field is of limited extent, the Coal-measures dipping under the sea towards the east and south. The prevailing fossils are those characteristic of the Coal-measures in other districts, *Anthracosia*, *Anthracomya*, *Anthracoptera*, *Spirorbis*, many fishes, and some few Amphibian remains. Lately a sinking was commenced in the Upper Red beds, below which, and just above a thin band of poor coal, a thick bed of dark shale was passed through, which proved to be tolerably fossiliferous. *Lingula*, *Murchisonia*, and two species of *Bellerophon* occurred. This horizon was subsequently proved elsewhere in the district, and furnished the following fossils from three localities, namely:—*Strephodus sauroides*?, Ag. (teeth and scales); *Rhizodopsis*, sp. (scales); Palæoniscid scales; *Diplodus gibbosus*, Ag.; *Mesodomodus*, sp. n.; *Petalodus Hastingsiæ*; *Discites rotifer*?, Salt.; *Discites*, sp. (with longitudinal ribs); *Discites*, sp. (smooth); *Orthoceras attenuatum*?, Flem.; *Bellerophon Urii*, Flem.; *Murchisonia* (*Aclisma*) *striatula*, De Kon.; *Sanguinolites*, sp.; *Productus semireticulatus*, var. *Martini*, Sow.; *Discina nitida*, Phill.; *Lingula mytiloides*, Sow.; *Lingula squamiformis*; crinoid stems (*Actinocrinus*?); plant-remains (obscure).

Reference was then made to the occurrence of similar fossils in the same formation elsewhere, and particularly in the West of Scotland, North of England, and Lancashire. The Author concluded, from the frequency of the beds containing true marine remains, that the Coal-measures were formed in low-lying areas; and that, when the land was slightly depressed, at times the waters of the sea had access to such spots, bringing back species of shells and crinoids that had existed in the Carboniferous-Limestone ocean of an earlier period. Some further remarks were made on the peculiar nature of the ordinary fauna of the Coal-measures; and the Author observed, in conclusion, that no marine deposits have been observed as yet in the Upper Red beds (d^{51}) of the Fife or other Scotch Coal-measures.

2. "On the Occurrence of *Elephas meridionalis* at Dewlish, Dorset." By the Rev. O. Fisher, M.A., F.G.S.

The Author's attention was first drawn to this subject on seeing two molars of an elephant in the Blackmore Museum labelled "Dewlish, Dorset." He at once attributed them to *E. meridionalis*. Subsequently he ascertained that they were part of a find made in 1813 by a Mr. Hall. Dr. Falconer, from rubbings, attributed the teeth to *E. antiquus*; and Dr. Leith-Adams would not allow that they belonged to *E. meridionalis*, because that species had never been found so far west. Last year the author and Mr. Mansel-Pleydell went to Dewlish, and the latter has since continued the workings. The remains have been found high up on the face of a steep chalk scarp facing west, 10 feet below the brow and 90 feet above the existing stream, in such a position as to suggest that the deposit was the result of an undercut of the stream when it flowed at a higher level. It probably lies in the prolongation of a line of fault with a deviation to the east. The following section was given:—

	ft.	in.
1. Chalk rubble	0	10
2. Fine sand and flints, with elephant remains	3	0
3. Sand and ferruginous gravel		?
4. Flint-material, waterworn..................		?
5. Sand, the lower portion with different-sized flints		?

There were no shells or Microzoa.

The Author speculated on the probable lapse of time, and on the importance of the discovery of *E. meridionalis*, a preglacial mammal, so far west. A list of the bones found was given.

MISCELLANEOUS.

Transverse Bone of a Chelonian. By G. A. Boulenger.

I regret to see that my paper "On the Transverse Bone of a Chelonian" is published in the last No. of the 'Annals' without the corrections which I made on the proof having been attended to *.

Thus, the bone lettered *vom.* on the figure should be *pal.* and the azygous bone should be lettered *vom.*, as may be seen by a comparison with the text.

I now find that I was mistaken in believing in the existence of a transverse bone in *Hydraspis Hilairii.* Professor Stewart, after examining a young specimen of the same species without finding the bone in question, suggested to me that I might have been deceived by the presence of a very deep groove in the jugal, a view which has been confirmed on complete disarticulation of one side of the skull. I had, however, previously taken the precaution of partly detaching the bones, and, finding the suture formed by the anterior and posterior borders of the groove to extend as far inwards as I could see, it did not occur to me that what appeared to be two distinct bones could in reality be but one.

On the "Nursing"-habits of Dendrobates. By G. A. Boulenger.

Professor Lütken has kindly drawn my attention to a contribution by Wyman which I had overlooked when writing upon the nursing-habits of Batrachians. The curious habit of *Dendrobates* of

* [This was entirely owing to the Author not having returned his proof before the last day of the month.—W. F.]

carrying its tadpoles, recently noticed by Kappler and by H. S. Smith, was observed by Wyman, in Surinam, as early as 1857 (Proc. Bost. Soc., Sept. 1857), and a description and figure were published in the 'American Journal,' 2nd ser. vol. xxvii. 1859, p. 5, fig. 1. The animal is named *Hylodes lineatus*, D. & B.; but it is quite clear from the figure that it is *Dendrobates trivittatus*, Spix. The question of the sex of the parent remains obscure, for although he speaks of it as "the mother," Wyman does not appear to have investigated the matter. A specimen with young was fortunately preserved in the Museum of Comparative Anatomy at Cambridge, U. S. A.

On the Species of Galathea *found on the Coasts of France.* By M. Jules Bonnier.

All the carcinologists who have taken up the study of the Galatheidæ agree in recognizing the difficulties presented by these *Anomura* in the precise determination of the different species. I was led to see the confusion that reigns in this group when, in the course of researches which are being made by Professor Giard and myself upon the Bopyrina, we arrived at the study of the genus *Pleurocrypta*. The necessity of establishing with certainty the name of the host infested by each of our species of Epicaridæ determined me to undertake a preliminary study, if not of the entire group, at least of the species most common on the French coasts. I hope soon to publish the results of my observations, with the necessary details and figures, in the 'Bulletin Scientifique,' and here I will only give the new diagnoses which I propose for some common and insufficiently described species.

* * * *

The genus *Galathea* is represented on our coasts by five species which may be distinguished by the presence or absence and the number of the epipodites on the thoracic feet, and then by the relative sizes of the ischiopodite and meropodite of the third maxilliped.

1. *Galathea intermedia*, Lillj. (= *G. Andrewsi*, Kin., *G. Giardi*, T. Barr., *G. Parroceli*, Gourret).

Upon the thoracic feet there is only a single pair of epipodites placed on the first pair of feet; carapace nearly smooth in the adult and terminated by an acute triangular rostrum, with four pairs of scantily developed lateral teeth; two short spines upon the rostrogastric groove; *ischiopodite of the third maxilliped shorter than the meropodite*; inner branch of the last three pairs of pleopoda in the male only of a single joint. Besides the normal differences of the pleopoda in the two sexes the sexual dimorphism affects the rostrum, which is more elongate in the male, and also the first pair of thoracic feet of the male, which attain a much greater development than in the other sex; sometimes the left, sometimes the right chela presents the deformation characteristic of the male.

This small species, which lives at depths of 10–50 fathoms, has been noted on the Scandinavian, Danish, Dutch, and English shores of the North Sea, in the Channel, in the Atlantic (England, France, Madeira, Azores), and in the Mediterranean.

2. *Galathea squamifera*, Leach (= *G. glabra*, Risso, *G. digitidistans*, Sp. Bate).

The first three pairs of thoracic feet are furnished with epipodites; carapace striated with numerous well-marked grooves furnished with short hairs; rostrum widened, armed with four pairs of lateral teeth, of which the first three pairs are well developed, and the posterior, at the inner angle of the orbital cavity, much reduced; two short spines upon the rostro-gastric groove; basal joint of the inner antenna with three anterior processes; *the ischiopodite of the third maxilliped shorter than the meropodite*; the inner branch of the last three pleopoda in the male is biarticulate; thoracic feet of the male of the same size as those of the female, and presenting in the first pair the sexual deformation in both chelæ.

A littoral species which has been noted in the North Sea and on the English and French coasts of the Atlantic and Mediterranean.

3. *Galathea nexa*, Embl. (non *G. nexa*, Heller).

The first three pairs of thoracic feet are furnished with epipodites; carapace striated with grooves furnished with short hairs; rostrum with nine nearly equal teeth, one median and four lateral pairs, the last pair smaller; no spines on the rostro-gastric groove, which is only undulated; basal joint of inner antenna with three anterior processes; *ischiopodite of the third maxilliped nearly equal to the meropodite*, which is armed with a single spine; the first pair of thoracic feet has the carpopodite and the propodite covered with long close-set hairs; the inner branch of the last three pairs of pleopoda of the male is biarticulate; in the first pair of thoracic feet of the male it is the left chela that is modified.

A species from small depths which has been found in the North Sea, on the Atlantic shores of England, and in the Channel.

4. *Galathea dispersa*, Sp. Bate (= *G. nexa*, Heller).

The first three pairs of thoracic feet are furnished with epipodites; carapace striated with grooves adorned with short hairs; the rostrum has nine teeth, the median one longer than those of the four lateral pairs, which decrease from the first to the fourth, which is much reduced; on the rostro-gastric groove three pairs of teeth, of which the middle ones are the most strongly marked; basal joint of the inner antenna with three anterior processes; *ischiopodite of the third maxilliped longer than the meropodite*; the inner branch of the last three pleopoda is biarticulate; in the first pair of thoracic feet of the male it is the right chela that is modified.

A species from small depths found in the North Sea, on the shores of Ireland, in the Channel, and in the Mediterranean.

5. *Galathea strigosa*, Linné.

There are no epipodites upon any of the thoracic feet; carapace with the regions well marked by deep grooves furnished with long and close-set hairs; rostrum elongated, with nine teeth, of which the median one is the longest and the last lateral pair the smallest; from two to six teeth (according to age) upon the rostro-gastric line; two teeth a little behind the insertion of the outer antennæ and two other lateral ones on the hepatico-gastric grooves; basal joint of the inner antenna with three processes: *ischiopodite of the third maxilliped longer than the meropodite*; the inner branch of the last three pleopoda of the male is biarticulate. The two chelæ of the first thoracic feet are modified in the adult male.

This large species, which is found only at and below a depth of 10 fathoms, is the most widely distributed *Galathea* of our coasts; it has been noted as occurring from the North Cape and all the northern seas of Europe to the Canary Islands, and in the Mediterranean and Red Sea.—*Comptes Rendus*, June 11, 1888, p. 1686.

Remarks on the Phylogeny of the Lamellibranchiata. By Dr. Benjamin Sharp.

The author brought forward some points regarding the classification of the Lamellibranchiata, and stated that in considering this group a diversity of type was to be found that is equal to, if not greater than, that found in any class of the animal kingdom, with the possible exception of the Hexapoda.

In examining the different forms, he pointed out two well-marked extremes, *Ostrea* and *Aspergillum*. In the former, as is well known, the two large unequal shells entirely cover the body, and they are closed by one large muscle, the adductor. The large and important organ, so common in the Lamellibranchiata generally, the foot, is entirely absent. The mantle-edges are separated for nearly their whole extent, and there is no indication whatever of the mantle uniting to form a siphon.

In *Aspergillum*, on the other hand, the two shells are so diminutive that they only cover an exceedingly small area of the animal's body, the siphon is enormously developed, and it is protected by a secretion of carbonate of lime, in which the shells are immovably imbedded; the mantle is closed throughout its entire length, except at the anterior end, where there is a minute opening, and at the mouths of the two siphonal tubes.

His object in making the communication was to prove that these two very marked and different types of Lamellibranchiata arose from a common, or what might be called a central type, and that a divergence from some cause set in, producing on one side the *Ostrea*, and on the other the *Aspergillum*.

As regards the whole class, he said there is no doubt, in his mind at least, that it is a degenerate one. Many anatomical and embryological facts, as well as their life-habits, point to this, it being an acknowledged fact that fixed or stationary animals are as a rule degenerate. The loss of the head in all adult forms, the presence of eyes in the head-area of some free-swimming embryos, and their later total disappearance, are some facts that point unquestionably to the degenerate condition of the whole group.

As to the facts of geology pointing to this conclusion, he quoted from Prof. Heilprin's work on the 'Distribution of Animals,' p. 265: "Almost everywhere, the Cephalophora, or head-bearing mollusks, antedate by one full period the Acephala, or headless forms, which indisputably represent a lower grade of organism." By considering the group as degenerate, the conditions of the case are answered, for the Lamellibranchiata certainly came off from the Gastropoda, after the latter had become well established, as the anatomical and embryological facts show, and the geological evidence would seem to indicate this to be the case.

Assuming, then, that the Lamellibranchiata have come off from the Gastropoda, Dr. Sharp then considered what was the form of the primitive type. It probably had a more or less developed foot, an organ that is present in all the Gastropoda, it possessed gills on each side of the foot, the mantle-edges were separate, and two adductors were present of about equal size. This type has survived to the present day, and, according to Lankester (art. Mollusca, Encycl. Brit. p. 685), is represented by forms like *Nucula* and *Trigonia*. The former belongs to the family Arcidæ (Claus), which is the oldest type that we know of, being found in the Silurian and Devonian. The shells of this family are equal; the adductor muscles of the same size, the mantle free, not being closed to form tubes like a siphon, foot well developed. The fulcrum of the shell is about equidistant from the adductors. In following one branch from this towards *Ostrea*, it is found that one muscle, the anterior, gradually gets smaller, as is the case in *Mytilus*, and exceedingly small in *Pinna*, until, in *Ostrea*, but one muscle is present. From the fact that in this advance the animal becomes more and more fixed, first by a secretion of the foot, the byssus, then by the shell itself, the foot gradually is less and less used as an organ of locomotion, until it entirely disappears in *Ostrea*. The retractor muscles of the foot, now practically useless organs, are, however, still present.

The loss of one adductor muscle can probably be referred to mechanical causes. In studying the change of relation of the fulcrum to the adductors, he found that as the fulcrum moved forward (anteriorly) it increased the distance from the posterior, and lessened the distance from the anterior muscle. As this took place, the muscle furthest from the fulcrum was always the larger; in fact it must of necessity be so, as more power was needed at this point, while the near one, from the fact that it does not require much power, diminishes in size. In *Pinna* one muscle is very much, in fact four or five times, larger than the other, the smaller being close to the apex of the shell, in other words, close to the fulcrum.

As the fulcrum passes still further forward, a point is soon reached when both muscles come in line with the fulcrum; the larger one in this case takes all the work from the smaller one, which, from its now useless position, degenerates to disappearance.

A procedure from regular to irregular shell is to be seen in the freshwater forms. *Unio*, he held, is probably a freshwater *Mytilus*, which does not have any byssus present in the adult, but has one in the embryo. A form that closely resembles the oyster can be traced through *Ætheria* to *Muelleria*, the so-called freshwater oyster. The latter has both adductors in the embryo, but only one, like *Ostrea*, in the adult.

Passing now in the other direction, Dr. Sharp pointed out the stages connecting the central type to the extreme in *Aspergillum*.

In passing out from the central type, the Arcas, the group known as the Siphonata appear, where, besides the large foot, it is found that the aboral portion of the mantle has united at two or three points, forming one or two tubes. In some forms of *Lucina*, by the union of the mantle a single tube is formed, the so-called anal siphon, which corresponds to the superior one when two are present; through this passes the water outwards, the inflowing water passing in through the large space between the mantle-edges, as in the asiphonated forms. In this form of *Lucina* specialization has only determined the direction of the outflowing current, which carries off the deoxygenated water and the excreta.

In *Cardium* the siphon is made up of two tubes; in other words the ingoing and outgoing currents are now determined. The edges of the mantle begin to adhere, leaving room only for the protrusion of the foot. In *Venus* the arrangement is practically the same:—a well-developed siphon, large wedge-like foot, which is a locomotor organ, a shell entirely covering the animal when it is closed, and two well-developed adductors, equal in size. The specialization in this line of development is in the direction of the siphon and closure of the mantle. *Mya* would represent a form leading to *Solen*; here the siphon is large, the mantle more or less adherent, but the foot has degenerated to a useless organ, and the form of the body still somewhat resembles *Venus*, the shell, however, gaping at the aboral or siphonal end.

In *Solen* the edges of the shells cannot be brought together, or they gape, as it is said. In this form the new type has become established, and the animal resembles a cylinder; the large siphon fills up the aboral or gaping portion of the shell, while the boring-foot fills up the oral pole of the shell, the mantle being nearly closed between the foot and the siphonal openings.

The shells of *Mactra* are small for the body, and the siphons are so large that they cannot in any way be drawn into the shell; a large portion of the mantle also is without the limits of the shell, so that the edges of the shell do not touch even in life.

In *Teredo* no hinge-teeth are present, nor is even a ligament formed, an organ that is present in all other Lamellibranchs, except the members of this family and the next one to be considered; besides this a new element is found, namely accessory shell-pieces. The enormously developed siphon is four or five times the size of the rest of the body. The mantle-edges are firmly united except at the oral pole, where the boring-foot protrudes, and at the openings of the siphon. The true shells as well as the accessory pieces are movable, that is, not united with the calcareous secretion of the mantle.

In *Gastrochæna* the shells are very small, but still movable, the animal being enclosed in a calcareous shell, the secretion of the siphon. In *Clavagella*, a similar form, one shell is welded to the siphon-shell, the right one only being free, and in the extreme form of *Aspergillum* both shells are immovably fixed in the shelly tube that encloses the animal.

The freshwater forms *Cyclas, Cyprina*, &c. are probably related to *Cardium* and have received their new forms by moving into fresh water.

In summing up, Dr. Sharp showed two branches in the Lamellibranchiata, one going off from a form related to *Arca*, the other toward *Ostrea*, the fulcrum moving from a position between the two equally large adductors toward the oral pole of the body. This brought the anterior adductor in a line with the fulcrum and posterior adductor, where, being of no use, it disappeared.

In the other direction development is in the antero-posterior direction, the shell, however, not taking part in the growth until a form is reached where the shell is exceedingly small and the animal protected by a supplementary deposit of carbonate of lime.—*Proc. Acad. Nat. Sci. Philad.* March 6, 1888, pp. 121–124.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 8. AUGUST 1888.

XIII.—*On a new Species of Calamite from the Middle Coal-measures* (Eucalamites (Calamites) britannicus, *Weiss, MS.*). By R. Kidston, F.R.S.E., F.G.S.

[Plate VII.]

The fossil which forms the subject of this communication was previously in the collection of Mr. C. Beale, Rowley Regis, near Dudley, by whom it was collected. Before describing the specimen it may be well to give a brief review of the groups into which Dr. Weiss, of Berlin, has subdivided the genus *Calamites*. It must be borne in mind, however, that these groups are not to be regarded as genera, but as convenient divisions—probably of a provisional nature—in which those forms having certain characters in common are brought together.

Nothing but their fructification can afford a satisfactory basis of classification; but as stems of *Calamites* have so rarely been found with cones attached to them, it is impossible at present to classify them from characters derived from the structure of the fruit. In the absence, then, of a sufficiently complete knowledge of the fructification of *Calamites*, we must avail ourselves of such characters as those which enable us to prepare a scheme in which can be brought together those species that have certain points in common.

Although the groups proposed by Weiss may be more or less artificial, the necessities of the case demand some such scheme in which can be arranged the data for a more perfect classification.

Calamariæ.

Calamites, Suckow.

Division A.—Ribs on stems alternating at the nodes or joints.

Group I. Calamitina (emend.), Weiss.

Calamitina (emend.), Weiss, Steinkohlen-Calamarien, part ii. p. 59 (1884)*.

Branch-scars occurring periodically, the nodes bearing scars being separated from each other by a certain number of joints which do not bear branches. In most cases there is a regular increase or decrease in the length of the joints which connect the branch-bearing nodes.

Example :—*Calamites varians*, Sternberg.

Group II. Eucalamites, Weiss.

Eucalamites, Weiss, *ibid.* part ii. p. 96 (1884).

Branch-scars occurring on every joint. The joints are of the same length or of irregularly different lengths.

Example :—*Calamites ramosus*, Artis.

Group III. Stylocalamites, Weiss.

Stylocalamites, Weiss, *ibid.* part ii. p. 119 (1884).

Branch-scars occurring without definite order, of subordinate importance; often long stretches of the stem occur on which the branch-scars are entirely absent. The joints are of equal length or of irregularly different lengths.

Example :—*Calamites Suckowii*, Brongn.

* Part i. in 'Abhandl. z. geol. Specialkarte v. Preussen u. d. Thüringischen Staaten, Band ii. Heft i. (1876); part ii. *ibid.* Band v. Heft ii. (1884).

Division B.—Ribs on the stem not alternating at the joints or nodes.

Group IV. ASTEROCALAMITES, Schimper.

Asterocalamites, Schimper, Terrain de Transition des Vosges, p. 321 (1862).
Archæocalamites, Stur, Culm Flora, p. 2 (1875); Weiss, *l. c.* part ii. p. 141 (1884).

Branch-scars irregularly distributed. Joints unequal in length.
Example:—*Calamites scrobiculatus,* Schlotheim, sp.

Eucalamites (*Calamites*) *britannicus,* Weiss, MS. (Pl. VII.)

Description.—*Stem*: joints as long as broad, outer surface only faintly ribbed, with here and there transverse wrinkles. *Nodal lines* sharp and distinct, bearing a row of chain-like or in part separated, transversely-oval leaf-scars with a central cicatricule. *Branch-scars* large, immediately above the nodal line, transversely elliptical, with concentric zones, distant from each other, only a few in a whorl on each joint (on the surface of the specimen figured two branch-scars are seen on one node and one on the other), somewhat irregularly placed, not regularly alternating. On the upper nodal line between the two large scars occurs a small round scar.

Remarks.—This Calamite, from having branch-scars developed on each node, belongs to the group of *Eucalamites,* but shows also affinities with the *Calamitina* in the form and "chain-like" arrangement of the leaf-scars on the nodal line; the transversely elliptical leaf-scars are somewhat similar to those of *Calamitina Wedekindi,* Weiss *. It also exhibits in the oblique though not exactly alternating position of the branch-scars on the neighbouring nodal lines some similarity to *Eucalamites* (*Calamites*) *cruciatus.* The fossil, which is the impression of the outer surface, shows two joints and a portion of a third one, and exhibits here and there transverse wrinklings, somewhat like those on the surface of the specimen given in 'Steinkohlen-Calamarien,' part ii. pl. xvii. figs. 2 and 3, but not so strongly expressed. These probably indicate the drying and contraction of the outer surface of the stem before fossilization. The outer surface further shows peculiar elongated elliptical marks with a central depression, situated below the nodal lines and similar to those of pl. i.

* 'Steinkohlen-Calamarien,' ii. p. 88, pl. xvii. fig. 1.

fig. 2 ('Steinkohlen-Calamarien,' part ii.); but they are not so regular. They may have originated from fungi; similar formations occur on other plants.

The above description and remarks have been forwarded to me by Dr. Weiss, to whom I sent a sketch of the fossil for his examination and description, as his knowledge of this group of fossils is probably more intimate than that of any other palæobotanist, and especially when impressions of the plant have to be dealt with. The most interesting point in this fossil is the association of the character of *Eucalamites* and the chain-like leaf-scars of *Calamitina* on the same specimen.

I am much indebted to Dr. Weiss for his kind assistance in examining and describing this plant.

Horizon. Middle Coal-measures; in ironstone nodule in shale above "Thick Coal."

Locality. Shut End, between Himley and Kingswinford, South Staffordshire.

EXPLANATION OF PLATE VII.

Eucalamites britannicus, Weiss, n. sp. (natural size).

XIV.—*Notes on some Vertebrate Fossils from the Province of Bahia, Brazil, collected by Joseph Mawson, Esq., F.G.S.* By A. Smith Woodward, F.G.S., F.Z.S., of the British Museum (Natural History).

So long ago as the time of Spix and Martius's travels * the occurrence of vertebrate fossils in the rocks of Brazil had been observed; and during the preparation of his great work upon the "Poissons Fossiles" Agassiz met with numerous examples of fishes from the supposed Upper Cretaceous deposits of the province of Cearà, of which he published two brief notices †. Somewhat later ‡ Mr. Allport made known

* J. B. von Spix and C. F. von Martius, 'Reise in Brasilien,' 1823–31, Atlas, pl. xxii. fig. 5.

† L. Agassiz, Appendix to G. Gardner's "Geological Notes made during a Journey from the Coast into the Interior of the Province of Cearà, in the North of Brazil," Edinb. New Phil. Journ. vol. xxx. (1841), p. 83. Also "Sur quelques Poissons fossiles du Brésil," Comptes Rendus, vol. xviii. (1844), pp. 1007–1015.

‡ S. Allport (with notes by Egerton, Morris, and Rupert Jones), "On the Discovery of some Fossil Remains near Bahia in South America," Quart. Journ. Geol. Soc. vol. xvi. (1860), pp. 263–268, pls. xiv.–xvii.

the occurrence of Reptilian remains, with scales and teeth of *Lepidotus*, in the province of Bahia. Professor Hartt afterwards * added important details in regard to the stratigraphy of the fossiliferous deposits; and still later † several detailed descriptions of the genera and species have been published, notably by Professor Cope. Of the Bahia fossils the most important collections have been made by Mr. Joseph Mawson, F.G.S., of the Brazilian Imperial Central Railway; and a small series recently presented by that gentleman to the British Museum, supplementing previous donations of six years ago, affords material for a few interesting observations.

Mammalia.

The only Mammalian bone is a left scaphoid "from alluvium at Olhos d'Agua, in the interior of the province of Bahia, 13½ kilom. S. of Queimadinhas Station, on the Brazilian Imperial Central Bahia Railway." In size the fossil is quite equal to the corresponding bone of the well-known *Megatherium americanum*, and its characters are so similar that there can be no doubt as to its indicating the presence of a gigantic Megatherioid in the north-east of Brazil in Pleistocene times. Whether, however, the animal is generically distinct from *Megatherium* or merely a hitherto unrecognized species must be determined by the future discovery of more characteristic parts of the skeleton.

Reptilia.

A large number of stout Reptilian teeth and an imperfect caudal vertebra occur among the fossils from the supposed Upper Cretaceous Sandstones of the Bahia coast, and are not improbably referable to the Crocodilian genus *Hyposaurus*, Owen. Prof. Cope has already described satisfactory evidence of one species, *H. Derbianus*, from the Upper Cretaceous of the province of Pernambuco; and it is possible that Mr. Mawson's fossils may pertain to the same form. The teeth, when unworn, are marked by numerous extremely fine,

* C. F. Hartt, "Geology and Physical Geography of Brazil (Thayer Expedition)," 1870.

† E. D. Cope, "On two Extinct Forms of Physostomi of the Neotropical Region," Proc. Amer. Phil. Soc. vol. xii. (1871), p. 53; also "A Contribution to the Vertebrate Palæontology of Brazil," *ibid.* vol. xxiii. (1886), pp. 1–21, pl. i. A. Smith Woodward, "On the Fossil Teleostean Genus *Rhacolepis*, Agass.," Proc. Zool. Soc. 1887, pp. 535–542, pls. xlvi., xlvii.

short, longitudinal rugæ; an anterior and a posterior keel divide the external face from the internal, and the latter is often faintly ribbed by numerous straight longitudinal ridges. Some examples are figured by Allport (*loc. cit.*).

Pisces.

All the fish-remains collected by Mr. Mawson were obtained from the same beds as the Crocodilian teeth upon the coast, and the determinable specimens belong to the four genera *Diplomystus*, *Chiromystus*, *Lepidotus*, and *Acrodus*.

Diplomystus longicostatus, Cope.

A small fragment of this species does not add anything to Professor Cope's description; but it may be remarked that the occurrence of the genus in the Bahia sandstones is not so unexpected a circumstance as might be inferred from the Professor's concluding paragraph. In the first place, the deposit is clearly not marine, but freshwater or estuarine, as demonstrated by the Mollusca and Entomostraca *; and, in the second place, at least one species of *Diplomystus* is abundantly represented in the Upper Cretaceous beds of Syria. Though not hitherto detected, the common "*Clupea brevissima*" of Mount Lebanon exhibits all the typical characters of *Diplomystus*. The dorsal scutes are seen in almost every example, and are especially well displayed in Brit. Mus. no. 49488; they are at least as broad as long, with a longitudinal keel; and the elongate anal fin is quite similar to that of the Wyoming Eocene *D. analis* and *D. pectorosus*, though comprising a slightly less number of rays.

Chiromystus Mawsoni, Cope.

The specimen upon which Prof. Cope founded the new genus and species *Chiromystus Mawsoni* is a large elongated fish, with the vertebral column measuring 0·310 m. in length. It is placed in the Hyodontidæ, and particularly characterized by the enormous development of the preaxial pectoral fin-rays. Of this genus also the present collection comprises two interesting fragments, the one showing some anterior vertebræ and crushed bone, with the left clavicle and pectoral fin, the other the greater portion of the abdominal and caudal regions. The stout pectoral fin-rays are exhi-

* See descriptions of Morris and Rupert Jones in Allport's paper, *loc. cit.*

bited, the feeble pelvic fins, the opposed small dorsal and anal, and the delicate overlapping cycloid scales. These fossils, however, only indicate a fish about 0·15 m. in length, though the proportions are so similar that it seems most probable they merely represent the young of the species already described.

Lepidotus Mawsoni, sp. nov.

Several scales and teeth have already been figured and briefly noticed by Allport and Egerton (*loc. cit.*) ; and, as the result of Mr. Mawson's researches, the British Museum is now provided with a large series of these detached fragments. The scales are in every respect typical of the genus, and derived from all the principal regions of the body. Some are of very large size measuring no less than 0·04 m. antero-posteriorly ; and the majority have a smooth external surface, sometimes irregular, but only rarely showing faint traces of posterior radiating grooves, with a few large posterior crenulations. A most remarkable peculiarity of the scales consists in the enormous thickness of the laminated bony base; for the greater portion of the base (*e. g.* in B. M. nos. 5534 *a*, *b*) not unfrequently becomes swollen into a prominent rounded excrescence, unequalled by any other *Lepidotus*-scale the present writer has had the opportunity of examining. The associated teeth, presumably referable to the same fish, are notably small in proportion. While many of the scales are as large as those of the great *Lepidotus maximus*, the known teeth scarcely attain the dimensions of those of *L. Mantelli*; and it is very unlikely that if the Brazilian species originally possessed teeth equalling those of *L. maximus*, they would hitherto have escaped detection. The latest evidence collected by Mr. Mawson thus appears to confirm Sir Philip Egerton's early suspicion that the Bahia *Lepidotus* is distinct from all other described species ; and the fossils are quite as satisfactory as those upon which many other species of the genus are founded. The fish may therefore appropriately receive the name of *Lepidotus Mawsoni*.

Acrodus nitidus, sp. nov.

A single tooth of *Acrodus* is an interesting addition to the known fauna of the Bahia sandstones. It is elongated in shape, measuring only 0·004 m. in length and 0·0015 m. in maximum breadth; the coronal surface is rounded and slightly raised mesially in the usual manner; and the apex is worn by trituration during life. The coronal surface is remarkably smooth, even more so than in the English Upper Cretaceous species, *A. levis* (unless it be in part due to wear), only a few short, rounded, radiating ridges being observed upon the sides. The indistinctness of the markings, considered in connexion with proportions already noted, separates the tooth from those of all other species yet known; and the name of *Acrodus nitidus* will recall its most prominent peculiarity.

Other remains from the Upper Cretaceous beds are still too imperfect for certain determination. One fragment appears to be a portion of the cranial roof of a large *Arapaima*-like fish; but this and the accompanying fossils must be left for interpretation by further discoveries, which, it is to be hoped, may soon result from continued search.

XV.—*On new or little-known South-African Reptiles.* By G. A. Boulenger.

During a recent visit to Europe Mr. L. Peringuey, Assistant Director of the South-African Museum, Cape Town, submitted to me various interesting Reptiles, which form the subject of the following notes. They were obtained partly by Mr. Peringuey himself in Namaqualand and Damaraland, between the mouth of the Orange River and Walfisch Bay, partly by M. Juste De Coster at Delagoa Bay.

Duplicates of some of the new or rare species, viz. *Homopus signatus*, *Œdura africana*, *Pachydactylus fasciatus*, *Rhoptropus afer*, *Mabuia Peringueyi*, *Typhlops Schlegelii*, and *Homalosoma variegatum*, have been presented to the British Museum by the Trustees of the South-African Museum.

Homopus signatus, Walb.

Two specimens were obtained by Mr. Peringuey at O'Kiep, Namaqualand (2500 feet), and afford the first information as to the animal of this tortoise, known for a century from the shell only. The young specimens referred by Gray to *H. signatus* belong to *H. areolatus*. It is surprising to find that the number of claws in the fore foot is five instead of four, the characteristic number in *Homopus*; the tortoise is none the less a true *Homopus*, owing to the structure of the jaws, and is very closely allied to *H. areolatus*. The small importance of the presence or absence of a claw in this group of Chelonians is also well shown by the Central-Asian *Testudo Horsfieldii*, which, though in every other respect extremely closely related to *T. ibera*, has only four claws to each foot, and would accordingly enter the genus *Homopus* as defined in the 'Erpétologie générale.'

The limbs are scaled as in *H. areolatus*, except that a large conical tubercle is present on the hinder side of the thigh. Forehead covered with numerous small and irregular shields. Head and neck yellowish, spotted with black above.

Sir A. Smith's statement (Illustr. Zool. S. Africa, Append. p. 1) that *H. signatus* is "common throughout the whole of Southern Africa" is probably the result of erroneous identification.

Œdura africana, sp. n.

Head moderate, much depressed, oviform; snout as long as the distance between the eye and the ear-opening, once and a half the diameter of the orbit; ear-opening small, oval, oblique. Head covered with uniform small, round, flat granules; nostril pierced between the rostral and three nasals, the upper of which is large and forms a suture with its fellow behind the rostral; ten upper and as many lower labials; no chin-shields. Back covered with uniform small granules, which are scarcely larger than those on the head; ventral scales larger, subimbricate, smooth. Digits strongly dilated, the basal portion as broad as the distal expansion, which is a little broader than long; two pairs of large plates at the extremity of the basal portion, which is otherwise covered with very small scales. Male with an angular series of thirteen præanal pores. Tail much depressed, as long as head and body; its width at the base nearly equals that of the body; it is divided into very distinct segments, composed of seven or eight transverse series of small smooth scales above and five inferiorly. Greyish above, with small brown spots and transverse brown bands, five on the body and three on the tail.

	millim.
Total length	129
Head	16
Width of head	12
Body	48
Fore limb	21
Hind limb	28
Tail	65

Two specimens were taken from the stomach of the *Pythonodipsas* from Damaraland described below, one half-digested, the other in very good condition.

This discovery is a startling one, the very natural genus *Œdura*, containing five or six species, being, according to previous knowledge, strictly Australian. It reminds us of the curious fact of the nearly related genus *Phyllodactylus* presenting two closely allied species, regarded as identical by some herpetologists, in South Africa (*P. porphyreus*) and in Australia (*P. marmoratus*).

Pachydactylus fasciatus, sp. n.

Head oviform, very distinct from neck; snout a little longer than the diameter of the orbit; ear-opening small, oval, not half the diameter of the eye. Snout covered with enlarged oval granules; hinder part of head with minute granules, intermixed with oval, smooth, or obtusely keeled tubercles; naso-rostrals in contact; eight or nine upper and seven lower labials; mental twice as long as broad, narrower than the neighbouring labials; no chin-shields. Upper parts covered with minute granules intermixed with large trihedral tubercles forming eighteen longitudinal series; ventral scales moderate. Digits dilated at the end; nine lamellæ under the dilated part of the median toes. Tail with transverse series of pointed, keeled tubercles; lower surface with enlarged, imbricate, smooth scales. Pale brown above, with dark brown transverse bands, which are more distinct in the young than in the adult; a dark brown horseshoe-shaped streak round the back of the head and passing through the eyes; three cross bands on the body, the first and second very broad, the third across the sacrum, from eight to ten on the tail.

	millim.
Total length	107
Head	15
Width of head	10·5
Body	34
Fore limb	17
Hind limb	22
Tail	58

Closely allied to *P. Bibronii*; distinguished by a less stout habit, smaller size, smaller ear-opening, and in coloration.

Two examples, a gravid female and a young specimen; Namaqualand.

Agama planiceps, Peters.

Several specimens were obtained in Namaqualand by Mr. Peringuey.

Adult male with the head and tail uniform bright orange and the body and limbs blackish. Half-grown with a yellow vertebral streak, symmetrical yellow spots on the head, and a large orange spot above the axilla.

Mabuia Peringueyi, sp. n.

Snout moderate, obtuse. Lower eyelid with an undivided transparent disk. Nostril just above the suture between the rostral and the first labial; a postnasal; anterior loreal in contact with the first labial; supranasals in contact behind the rostral or narrowly separate; frontonasal broader than long; præfrontals in contact, forming a short suture; frontal as long as the frontoparietals and interparietal together, in contact with the second and third supraoculars; four supraoculars, second largest; five supraciliaries; frontoparietals distinct, smaller than the interparietal; parietals not touching each other; a pair of nuchals; subocular not narrowed inferiorly, much larger than the labials, between the fourth and fifth. Ear-opening oval, about as large as the transparent palpebral disk, with two or three long pointed lobules anteriorly. Dorsal scales strongly tri- or quinquecarinate; 30 scales round the middle of the body, equal. The adpressed limbs do not meet. Subdigital lamellæ smooth. Blackish brown above, with light brown longitudinal streaks corresponding to the series of scales; head pale brown, with the sutures between the shields black; ear-lobules white; sides with white spots; lower surfaces white.

	millim.
Total length	177
Head	17
Width of head	14
Body	83
Fore limb	22
Hind limb	36
Tail (reproduced)	77

Two specimens; Namaqualand.

Very closely allied to *M. homalocephala*.

Typhlops Schlegelii, Bianc.

The collection made at Delagoa Bay by M. Juste De Coster contains two specimens of this very rare snake, of which only one well-authenticated specimen from Mozambique was known. The largest of the two measures 69 centim. in length and 28 millim. in diameter—as great a size as attained by any known *Typhlops.*

Homalosoma variegatum, Peters.

This species was known from a single specimen from Inhambane, Mozambique. Several specimens obtained by M. De Coster at Delagoa Bay belong to two colour-varieties, one of which is identical with the type figured by Peters. The new variety is characterized by the pale olive-brown colour of the upper parts, with a series of large black spots; the anterior of these spots are the largest and transverse; they gradually diminish in size and alternate towards the end of the body, and finally become confluent into a median line on the tail.

Pythonodipsas carinata, Gthr.

Pythonodipsas carinata, Günth., Ann. & Mag. Nat. Hist. [4] i. 1868, p. 426, pl. xix. fig. K.

The rediscovery of this snake, of which but a single specimen, from the Zambesi, was on record, is of great interest. The unique specimen obtained by Mr. Peringuey in Damaraland differs from the type in some trifling points, and from its being in a perfect state of preservation deserves description.

Snout truncate, concave above; nostril pierced vertically between two shields, the nasal and the internasal; a pair of large præfrontals and a pair of small shields between the latter and the frontal; eye surrounded by nine or ten shields, viz. the supraocular, which is as large as the frontal, a præocular, and seven or eight small equal shields; loreals 1 + 1 + 2; temporals small and numerous; parietals broken up into small shields; nine upper labials; six lower labials in contact with the mentals, of which there are two pairs, the front pair as long as and broader than the hind pair. Scales in twenty-one rows, smooth, feebly keeled on the hinder part of the body and on the tail. Ventrals 192; anal entire; subcaudals 55. Pale buff above, with a double alternating series of square, grey, black-edged spots, a few of which coalesce to form transverse bars; lips with vertical grey bars; lower parts white.

Total length 417 millim.; tail 63.

Elapsoidea Decosteri, sp. n.

Closely allied to *E. Sundevallii*, Smith. Snout pointed, projecting; suture between the internasals half as long as that between the præfrontals; frontal as long as its distance from the end of the snout, much longer than broad; parietals as long as their distance from the rostral; one præ- and two postoculars; temporals 1+2; seven upper labials, sixth largest, second in contact with the præfrontal, third and fourth entering the eye; four lower labials in contact with the chin-shields, of which the posterior pair is a little longer than the anterior. Scales in thirteen rows. Ventrals 138; anal undivided; subcaudals 25 pairs. Dark grey above, each scale edged with black; uniform white inferiorly.

Total length 45 centim.; tail 5.

A single specimen; Delagoa Bay. Presented by M. J. De Coster to the South-African Museum.

Vipera Peringueyi, sp. n.

Head very distinct from neck, slightly longer than broad, truncate anteriorly; nostrils and eyes turned upwards; upper head-scales strongly keeled, smallest on the vertex; nostril pierced between three scales, the upper of which is large and separated from its fellow by two scales and from the rostral by two series of scales; one series of scales between the labials and the lower nasals; eye small, surrounded by a circle of eleven small subequal scales; eight scales in a transverse series between the eyes; three series of scales between the eye and the labials; rostral small, broad, crescentic; eleven upper and as many lower labials; mental triangular; first lower labial forming a suture with its fellow behind the mental; one pair of mentals, separated from the first ventral by four series of smooth scales. Scales elliptic, keeled, except the two outer series on each side, in twenty-five rows. Ventrals 132; subcaudals transversely enlarged and smooth, two anterior undivided and 26 pairs. Pale buff above, with three longitudinal series of grey spots, the outer ocellar, enclosing a white centre; sides cream-colour, spotted with grey; belly cream-colour, with a few brown dots; end of tail black.

Total length 250 millim.; tail 27.

A single specimen, obtained by Mr. Peringuey in Damaraland, 10 miles east of Walfisch Bay.

XVI.—*Descriptions of two new Australian Frogs.* By G. A. Boulenger.

The two frogs described here as new form part of a small collection from South-eastern Australia presented to the British Museum by Mr. J. J. Fletcher, of Sydney.

Limnodynastes Fletcheri.

Habit of *Discoglossus.* Tongue subcircular, slightly nicked behind. Vomerine teeth in a straight, scarcely interrupted series behind, and not extending outwards beyond, the choanæ. Snout rounded, not longer than the diameter of the orbit; nostril equally distant from the eye and the tip of the snout; interorbital space nearly as broad as the upper eyelid; tympanum indistinct. Fingers pointed, first not extending quite so far as second; two metacarpal tubercles; toes pointed, slightly fringed, with a very distinct basal web; a small, blunt, oval inner, and a very small outer metatarsal tubercle. The tarso-metatarsal articulation of the adpressed hind limb reaches halfway between the eye and the end of the snout. Skin smooth or feebly warty above. Pale brown above, with irregular insuliform dark spots or marblings; a dark band on each side of the head, passing through the nostril and the eye; a dark bar below the eye; a large subtriangular dark spot between the eyes; upper eyelid, in front of and behind the dark spot, crimson; female whitish inferiorly, closely speckled with brown on the sides of the throat and on the chin; male with large dark brown blotches.

From snout to vent 40 millim.

Two specimens, male and female; Guntawang, near Mudgee, New South Wales.

Allied to *L. tasmaniensis* and *platycephalus*, but differing in the pointed digits and the more distinct web between the toes.

Crinia victoriana.

Vomerine teeth in two very small oblique groups behind the choanæ. Snout rounded, as long as the diameter of the orbit; nostril equally distant from the eye and the tip of the snout; interorbital space broader than the upper eyelid; tympanum hidden. First finger hardly half as long as second; toes free, not fringed; subarticular and metatarsal tubercles indistinct; no tarsal fold. The tibio-tarsal articulation of the adpressed hind limb reaches the shoulder. Skin smooth above and below. Dark brown above, with blackish spots; a black band on each side of the head, passing through the eye; a black transverse band between the eyes; vent in a large triangular black spot; sides of body and limbs finely white-dotted; lower surfaces coppery brown, dotted with whitish and spotted with dark brown.

From snout to vent 27 millim.

A single female specimen; Warragul, Gippsland, Victoria.

XVII.—*Description of a new Species of* Polistes *from South America.* By W. F. Kirby, F.E.S., Assistant in Zoological Department, British Museum (Natural History).

The following interesting species of wasp has lately been acquired by the British Museum.

Polistes orbitalis.

Exp. al. 22 millim.; long. corp. 14 millim.

Black, clothed with very fine down.

Head black, clypeus, orbits, and mandibles yellow; clypeus entire, slightly convex, rather wider than long; mandibles with the teeth blackish; antennæ black, scape yellow beneath, second joint (and sometimes more slightly the tip) reddish beneath; thorax black, prothoracic lobes more or less completely red, with all the sutures narrowly yellow; tegulæ red; scutellum black, narrowly bordered with yellow behind, and with two yellow lateral spots on the sutures before and behind the metathorax, which is deeply channelled above, the channel being bordered with yellow lines; abdomen black, the first two segments bordered behind with pale yellow, the third segment bordered behind with darker yellow, and with a nearly detached oblong spot on each side both above and beneath; the fourth and fifth segments are similarly marked, except that their colour is almost entirely yellow (except the fourth beneath); the sixth is nearly similarly coloured above, but beneath it is marked with a wide, shallow, reddish crescent with the curve directed forwards; the terminal segments are almost entirely yellow. A slender broken median line is visible on the yellow parts of the abdomen above.

Legs red; front coxæ yellow, the four hinder ones black, streaked with yellow on the sides; front femora black at the base and beneath, middle femora with two black stripes, and tibiæ and tarsi varied with black; hind legs almost entirely blackish above.

Wings smoky hyaline, yellowish towards the costa, as in *P. pallipes*, St.-Farg., to which this species is most nearly allied; but the second submarginal cell is smaller and irregularly hexagonal, and the recurrent nervure which enters it is much more distinctly curved outwards in the middle than in *P. pallipes*.

Collected by Herr Michaelis at Lagos, Brazil, Feb. 2, 1887.

The nest and a quantity of grubs were also obtained. The former much resembles that of *P. tepidus*, Fabr., figured by Saussure ('Guêpes Sociales,' pl. viii. fig. 1), except that the pedicel is thicker.

XVIII.—*On new Species of Formicarious* Histeridæ, *and Notes on others.* By George Lewis, F.L.S.

Having at the present time a fairly complete collection of the known *Hetœrii* and of the species in the genera which resemble them, I have interspersed with the descriptions of new species notes on some of the characteristics of such of the old ones as have not hitherto been fully dealt with by authors. I refer chiefly to the specific differences exhibited in the sternal plates. The first *Hetœrius* known to naturalists was described by Olivier in 1789 as *Hister ferrugineus*; the second, *puberulus*, by Motschulsky in 1837; and even as late as 1868 only seven species appear in the 'Munich Catalogue,' as two of the nine given by Harold stand now in *Satrapes* and *Echinodes*. Our list now contains thirty-three, and I propose to separate twenty-four of these from the others under the generic name of *Sternocœlis*, as the meso- and metasterna are widely and deeply excavated, leaving only those in *Hetœrius* which correspond more or less in the structure of the mesosternum with *Hister ferrugineus*, Olivier; and these last really agree better with *Eretmotus* than with *Sternocœlis*.

I do this the more readily because the structure of the sternal plates in the Histeridæ is very important, and in studying the family careful regard must be paid to it.

Pachycrœrus is known from *Platysoma* by the apex of the mesosternum being produced and by its entering the region of the prosternum, which is proportionally incised to receive it; and as we go further down in the catalogue of genera the structure of the sterna receives fuller recognition. And beyond this several describers of species, myself included, have not always been careful in examining and recording the characters which exist in a prominent degree on the under surface of some species when the superstructure fails to suggest details for a satisfactory diagnosis.

The undersides of the Histeridæ are of the utmost importance in classification and intensely interesting as a study of structure. I do not anticipate the discovery of many new species in the genus *Satrapes*, but in *Hetærius* and *Sternocœlis* the next few years are certain to bring many to us, as entomologists are becoming alive to the fact that numbers exist, and that the species, if properly sought for, are not difficult to find. I have taken eleven species myself this year.

Hetærius gratus, Lewis.

This species is very similar to *ferrugineus* above and below, but the prosternal striæ meet each other more acutely in front, and being less sinuate are not at any place so widely separated as in Olivier's species.

Hetærius brunneipennis, Rand.

The sterna here also correspond very closely with those of *ferrugineus*, but the prosternal lines are not sinuate at the coxæ, and, being straighter laterally, they enclose a space which resembles an elongate triangle.

Hetærius plicicollis, Fairm.

The substructure of this insect is peculiar in the widening out, on the same plane as the base, of the anterior lobe of the prosternum, and the limit of the lobe is indicated by a marginal line. The striæ at the base of the prosternum are confined to the region of the coxæ, and the lateral excavations of the mesosternum are small and relatively shallow.

Hetærius optatus, Lewis.

The prosternum is broad and densely opaque, with large and rough punctures closely set together. The anterior lobe is a little deflexed, and the lateral striæ are almost parallel, and therefore end anteriorly widely apart. The mesosternum in front is transversely bistriate, and the lateral foveæ, which constitute the character of a true *Hetærius*, are very shallow.

Hetærius tristriatus, Horn.

Several of the American *Hetærii* are very differently constructed from those of the Old World. This species is one of them. The prosternum is parallel and prominently built out in the central region, and the median part also of the lobe is abruptly built up in the same way; but the sides of the lobe maintain their normal level, and thus the lobe is tripartite; the striæ are very distinct, parallel, and close together in front, widening out only at the coxæ. The mesosternum is marginate in front and bow-shaped; the lateral pits are shallow.

Sternocœlis acutangulus, Lewis.

Breviter ovatus, brunneo-ferrugineus, sat nitidus; thorace dense ocellato-punctato, angulis posticis transversim productis; tibiis anticis aspere ocellato-punctatis.

L. 2·8, c. $3\frac{1}{4}$ mill.

Head and thorax densely punctate, punctures ocellated, especially behind the neck. Forehead with two lateral striæ, which are feebly biangulate and do not meet in front, but continue down part of the clypeus parallel to each other. The thorax is punctate throughout its entire surface, which gives an appearance of opacity; the anterior angles are obtusely produced and slightly reflexed, the sides are narrowly marginate and somewhat parallel for about three fourths of the length, with the posterior angles produced and acuminate. There is a small, rather transverse fovea at the base of the angle, and the scutellum is smooth and triangular. The elytra have three striæ—first complete, second evanescent posteriorly, third basal and short; the dorsal surface is punctulate throughout, with the apices of the elytra clothed with erect hairs. Prosternum broadly canaliculate, the canaliculation being shining, with a few irregular punctures, deep and somewhat narrowed in front, shallow and broad behind, and a little sinuate before the coxæ; the base is broadly emarginate, with the angles on either side produced somewhat acutely behind the coxæ. The sides of the thorax beneath are densely and ocellately punctured. The metasternum is finely and feebly punctulate and wholly depressed, the depression being so deep anteriorly that the mesosternum is almost vertical. Propygidium and pygidium feebly and sparsely punctate, the first having erect hairs. The fore legs are opaque, roughly and densely punctate, punctures rough and often ocellate; the second and third pairs are smoother on the inner surface, with the tibiæ very broad and equilaterally triangular.

This species resembles *S. Bedeli*, Lewis (Ent. Month. Mag. vol. xxi. 1884, p. 83), in the dilatation of the tibiæ, but there the similitude ceases. In *S. Bedeli* the thoracic punctures are scattered irregularly and only a few are ocellated. This is the largest species at present known. Mr. J. J. Walker first discovered it at Tangier, and afterwards found it in Spain, where he also took *Eretmotus tangerianus*. I took fifteen specimens at Tangier last spring.

Sternocœlis cancer, n. sp.

Breviter ovatus, nitidus, postice parce fulvo-hirtus, nigro-piceus, pedibus dilutioribus; fronte opaca, grosse punctata, stria valida; pronoto angulis obliquis, antice vix dense ocellato-punctato, postice parce punctulato; elytris undique punctulatis, tristriatis; prosterno lato in medio transversim elevato, grosse ocellato-punctato, stria basi sinuata, lobo deflexo et læviter emarginato, tibiis valde dilatatis.

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

This species is much larger and darker in colour than *S. punctulatus*, and it wants the close pubescence of *S. Bedeli*. The dorsal region is very distinctly punctulate and the prosternum is relatively wider than in the species named, and the transverse ridge is more conspicuous. The frontal striæ of *Bedeli* and *cancer* are similar, strong and complete at the sides, but opening out behind the clypeus, and running for a very short distance parallel to each other. In *cancer* the front tibiæ are sometimes emarginate on the outer edge, and this may be a sexual character. The examples I have vary a good deal in size.

I found this species at Hamman Rirha, Algeria, last February, and noticed that it was less subterraneous than the yellow species; this may account for its colour, which is nearly black.

Sternocœlis Bedeli, Lewis.

Subrotundatus, piceo-ferrugineus, vix dense sericeo-pubescens, punctulatus; fronte grosse punctata, stria marginali subintegra elevata; pronoto subtransverso, parte anteriore dense sat grosse punctata, angulis anticis obtusis reflexis; elytris tristriatis, primo integro, secundo ultra medium, tertio antice abbreviatis; pygidio piloso; prosterno grosse punctato, meso- et metasterno profunde excavatis; pedibus robustis, tibiis angulato-dilatatis.

L. $2\frac{1}{2}$, c. $2\frac{3}{4}$ mill.

This species may be placed near *punctulatus*, but it is very distinct from all on the list. Its colour and the density of its pubescence, the thickly-set punctures on the anterior part of the thorax, its larger size, and broad tibiæ are its most conspicuous specific characteristics. The prosternum of this species and that of *punctulatus* are on a similar plan, but the punctures are closer together and the transverse ridge more distinct. The tibiæ are nearly as much dilated as those of *Eretmotus sociator* or *tangerianus*, and they are angulated in the same way, and therefore resemble those of *S. cancer*.

Mons. L. Bedel captured three examples at Daya, in the province of Oran, November 1879.

Sternocœlis hispanus, Rosenh.

This species I have taken in Spain (thanks to the kindness of Prof. Don Francisco Martinez y Saez) three times—twice at Madrid and once at the Escorial. At the latter place, on the 29th April last, I found as many as fifteen in one nest of *Aphanogaster*. At Fontanellus, near Cintra, in April 1884, I took one hundred and seventy-six specimens; and this species and *Hister ferrugineus*, Ol., which I took at Bom Jesus the same year, are the only two species yet known from Portugal. Collectors in Portugal will doubtless find others when they search for them in the nests of *Aphanogaster* under stones on clayey slopes. The two insects mentioned here are sand-loving species.

Sternocœlis comosellus, Fairm.

"Breviter ovatus, rufo-castaneus, sat nitidus, sat longe et sat dense fulvo-hirtus; capite dense punctato; prothorace transverso, elytris sensim angustiore, lateribus fere parallelis sed basi ampliato, angulis posticis divaricatis, acutis, dorso dense punctato, ad latera densius, basi ante angulos leviter impresso; elytris convexis, sat dense, sat fortiter asperulo-punctatis, obsolete lineatis, sutura angustissime infuscata; propygidio pygidioque parum dense punctatis; pedibus sat elongatis, compressis, tibiis anticis apicem versus parum ampliatis.

" Philippeville.

" Ressemble beaucoup à l'*H. hispanus*, le corselet étant aussi plus étroit en avant que les élytres, avec les côtés parallèles, brusquement élargis à la base pour former les angles postérieurs, qui sont aigus et embrassent assez la base des élytres; il en diffère par la taille plus faible, la ponctuation plus forte, les impressions de la base du corselet droites et non dirigées obliquement en travers des angles, qui sont plus aigu."

This species I have not seen, but I am assured by Herr Joh. Schmidt, who has seen the type, that it differs specifically from all the others on the list at the end of this paper. The type is in Baron Bonnaire's collection.

Sternocœlis setulosus, Reitter.

I took this species on the cliffs to the east of Oran and also at Tlemcen. It is dark in colour, and the thorax is much more transverse than in *fulvus* and *Walkeri*. The prosternal striæ are not very clearly defined, but they are sinuate and turn inwards at the tips. This species stands in some collections as *cavisternus*, Marseul; but the latter name is a synonym of *punctulatus*, Lucas. Herr Reitter has very kindly lent me the type for examination and comparison.

Sternocœlis Walkeri, n. sp.

Breviter ovatus, ferrugineus, subnitidus, fulvo-setulosus; fronte obscure punctulata, stria ad oculos angulatim elevata; pronoto angulis anticis obliquis, posticis obtuse productis, lateribus marginato parce punctulato; prosterno sublævi bistriato, tibiis modice dilatatis.

L. $1\frac{3}{4}$ mill.

This species is smaller than *hispanus*, with the thorax more quadrate and its hinder angles much less acute; the legs are much shorter, but the dilatation of the tibiæ is almost identical, and the striæ, form, and sculpture of the prosternum are the same. *Walkeri* is also similar to *fulvus*, but it is larger; the first has the base of the thorax wider, and the second has the striæ over the eyes less elevated. In *hispanus* the sternal pit is distinctly angulate in the centre, in *Walkeri* and *fulvus* it is not so.

I took two examples of this insect at Maison Carrée, near Algiers, on the 8th March, 1884; and I have seen other specimens labelled Algiers. This species is named after Mr. J. J. Walker, whose name appears on several of these pages.

Sternocœlis fulvus, n. sp.

Breviter ovatus, rufo-ferrugineus, sat dense fulvo-setulosus; fronte obscure punctulata, stria utrinque elevata, antice late interrupta; pronoto lateraliter bisinuato, angulis posticis obtusis; elytris tenue et obscure tristriatii; tibiis modice dilatatis.

L. $1\frac{1}{2}$, c. $1\frac{3}{4}$ mill.

The above is similar to *setulosus*, *hispanus*, and *Walkeri*, but it is smaller, the thorax is less transverse, and the dilatation of the tibiæ less, and the prosternal striæ are a little more parallel to each other and better defined. The sternal pit is also slightly deeper than in *setulosus* or *Walkeri*.

I obtained a great number of this species in Algeria, at Hamman Rirha (altitude 2300 feet), this spring.

Sternocœlis arachnoides, Fairm.

This insect has long narrow legs, but in its general structure it is similar to those of the *hispanus*-group. The prosternum has well-defined striæ, which are sinuate at the coxæ and then pass forward, widening out slightly from each other. The meso- and metasternal basin is more circular than in the other species known at present.

Sternocœlis puberulus, Motsch.

The prosternum of this species is of very curious structure. It is very prominent, punctured, and without striæ, and the anterior lobe is very short and transverse. I am much indebted to Signor Enrico Ragusa for a specimen of this species. *Hetœrius ferrugineus* is the only species of the Myrmecophilous Histeridæ known from Italy; it is associated with *Formica fusca*. When the nests of *Aphanogaster* are investigated, one or more new species will possibly be found in Sicily or on the adjacent mainland.

Sternocœlis Lewisi, Reitter.

In this species the space between the prosternal striæ is narrow and the striæ are very parallel to each other, widening out only on approaching the base. *S. Merklii*, Schmidt, is compared by the author to *Lewisi*; but the prosternum is concave and apparently without striæ.

Sternocœlis extructisternum, n. sp.

Subrotundatus, ferrugineus, subnitidus, fulvo-pilosus, punctulatus;

fronte opaca, dense punctata, pronoto transverso, antice grosse punctata; elytris tristriatis, punctulatis; propygidio parce punctato piloso; prosterno prominulo grosse punctato; metasterno leviter tuberculato; tibiis anticis modice, mediis et posticis valide angulato-dilatatis.

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

In size and general outline this species agrees with *Lewisi*, Reitter, but it is very pubescent and the prosternum is on quite a different plan. The thoracic punctures are large in front and many are ocellated; but they gradually become smaller and fewer towards the base. The thorax is sinuate laterally, with the hind angles obtuse.

The prosternum is rather wide between the striæ, with large rough punctures, striæ situate between the coxæ and terminate widely apart before the anterior lobe, posteriorly the striæ join to form a margin to the base. The part of the prosternum comprised within the striæ is built up and is on a different plane from the lobe. The mesosternum has a robust apex, which projects well into the prosternum. The metasternum has a small linear tubercle in the anterior median part of its basin, and its whole surface is distinctly but sparsely punctulate.

Algeria (coll. Mouchicourt); no special locality given.

Sternocœlis grandis, Reitter.

The upper surface of this insect is almost identical with that of *lævidorsis*, Fairm., but the prosternum is not striated, it is only roughly and closely punctate. Herr Reitter has kindly allowed me to see the unique specimen. In *lævidorsis* the striæ of the prosternum are distinct ridges, sinuate between the coxæ and very slightly bent inwards at the tips, and the anterior lobe is short and transverse. Mons. R. Oberthür first discovered *lævidorsis* at Bousaada, in Algeria, and more recently it has been taken at Blida by Prof. Ignacio Bolivar.

The four following species are small and very similar in their superfacies:—

Sternocœlis pluristriatus, Fairm.

This agrees closely in many of its characters with *fusculus*, but the thoracic punctures are more sparse and smaller and apparently not ocellated. The prosternum is also broader and the striæ seem to meet anteriorly.

Sternocœlis mauritanicus, n. sp.

Breviter ovalis, rufo-brunneus, nitidus, punctulatus, haud pilosus; fronte, stria utrinque paulo elevata, antice interrupta, obscure punctulata; pronoto antice vix dense, postice parce, punctato; elytris distincte tristriatis, tertio postice abbreviato; tibiis anticis circulatim, posticis angulatim, valde dilatatis.

L. $1\frac{1}{2}$, c. $1\frac{3}{4}$ mill.

This insect above is closely similar to *fusculus* and *pectoralis*, and agrees with them in colour; but beneath the characters to separate it are well defined. The prosternal striæ are connected at the base, and form there a margin to the prosternum; they are very feebly sinuate at the coxæ and anteriorly slightly bent towards each other; the lobe is deflexed. The apex of the mesosternum is moderately projecting and correspondingly sinuate. The thorax is punctured very much like that of *pluristriatus*.

I took this little insect in Morocco on the slope of a hill about two miles from the sea-shore (starting from the ruins of Old Tangier), on the 9th April last. Within the precincts of the same ants' nest I obtained eight specimens of *S. arachnoïdes* and three of *acutangulus*.

Sternocœlis fusculus, Schmidt.

Mr. J. J. Walker has found this insect at S. Roche, in Spain; and Signor Serafin Uhagon has taken it in flood-refuse at Badajoz.

Sternocœlis pectoralis, n. sp.

Breviter ovalis, rufo-brunneus, nitidus, haud pilosus; fronte punctulata, stria utrinque sinuata paulo elevata; pronoto antice magis, postice parce, punctato; elytris punctulatis tristriatis, striis distincte impressis; prosterno prominulo, stria laterali antice sinuata, basi obscure continuata, in medio transverso elevato et parce punctato; mesosterno antice valde producto; tibiis mediis et posticis fortiter angulato-dilatatis.

L. $1\frac{3}{4}$ mill.

The superfacies of this insect agrees somewhat with that of *pluristriatus*, Fairm., of which I possess a type through the kindness of the author. *S. pluristriatus* belongs to a section of the genus which has the elytral striæ clearly defined, and in this section those set together in the list may be included.

S. pectoralis has the prosternal area between the coxæ and the base of the anterior lobe divided in the middle by a very prominent transverse ridge; and if the prosternum is viewed sideways this character will be seen conspicuously. *S. pluristriatus* has a trace of this structure, but it is very feebly brought out.

I took this species at Tlemcen, in Algeria, near the ruins of Mansourah, on the 20th March last, while snow was falling thickly; and I had to use my umbrella to shelter the galleries made by the ants, which otherwise would have been filled up and ants and beetles lost sight of.

Sternocœlis Marseuli, Bris., has the prosternal striæ formed on a plan similar to that of *Gnathoncus rotundatus*, Kugel; it is a little smaller than *mauritanicus* and pubescent.

Satrapes Reitteri, n. sp.

Subcylindricus, convexus, testaceus, nitidus, parce punctulatus; fronte utrinque elevata, sat dense punctulata, clypeo concavo; pronoto in medio convexo, lateribus marginato, angulis anticis paulo reflexis; elytris brevissime setulosis, striis obsoletis, tibiis dilatatis.

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

Taken by Herr Hans Leder at Talyschgebg (Transcaucasus), and I have named it after my friend at Mödling.

This species is larger than *talyschensis*, paler in colour, and more parallel in outline. The anterior angles of the thorax are reflexed in the same way, but are more rounded off. The subhumeral striæ are wider apart and the dorsal striæ quite obsolete; the propygidium is more clearly angulate at the sides and somewhat densely but finely punctulate. Beneath it is known at once from *talyschensis* by the lobe of the prosternum being on the same plane as the base, by the sternum being narrower between the coxæ, and the striæ in front of them are brought close together and then pass forwards in a parallel direction. In *talyschensis* the prosternal striæ are marginal, and therefore wide apart. In *Sartorii* the striæ are more like those of *Reitteri*, but anteriorly they diverge and the lobe of the prosternum is deflexed. This last character is given by Schmidt as generic; as the new species does not possess it, the generic characters must be modified accordingly.

List of Species, arranged systematically.

HETÆRIUS, Erichson, Jahrb. p. 156 (1834). (Type *ferrugineus.*)		
—— ferrugineus, Oliv. Ent. I. viii. p. 19, t. i. fig. 7.	1789	Europe.
quadratus, Kugel. Schneid. Mag. i. p. 519.	1792	
sesquicornis, Preyssl, Mayer. Samml. phys. Aufs. ii. p. 3	1793	
Marseuli, Schaut. Sitz. Ges. Isis, p. 197	1863	
Mars. Abeille, i. p. 348	1864	
—— gratus, Lewis, Ann. & Mag. Nat. Hist. vol. xiii. p. 137	1884	Japan.
—— *californicus, Horn, Trans. Am. Ent. Soc. p. 137	1870	North America.
—— *Blanchardi, Lec. Proc. Am. Phil. Soc. xvii. p. 609	1878	North America.
—— brunneipennis, Rand. Bost. Journ. ii. p. 40	1839	North America.
Mars. Mon. p. 433, t. ii. n. 28, fig. 2	1857	
—— plicicollis, Fairm. Pet. Nouv. ii. n. 151, p. 49	1876	Algeria.
—— optatus, Lewis, Ann. & Mag. Nat. Hist. vol. xiii. p. 137	1884	Japan.
—— tristriatus, Horn, Trans. Am. Ent. Soc. v. p. 21	1874	North America.
—— *morsus, Leconte, Proc. Ac. Phil. p. 70	1859	North America.
STERNOCŒLIS, n. gen., 1888. (Type *acutangulus.*)		
—— acutangulus, Lewis, Ent. M. M. xxiv. p. 164	1887	Morocco and Europe.
—— cancer, Lewis, n. sp.	1888	Algeria.
—— Bedeli, Lewis, Ent. M. M. xxi. p. 83	1884	Algeria.
—— punctulatus, Lucas, Ann. Soc. Ent. Fr. 3 sér. t. iii. p. 4	1855	Algeria.
Mars. Mon. p. 432, t. ii. n. 28, fig. 1	1857	
cavisternus, Mars. Mon. Cat. p. 713	1862	
lioderus, Fairm. Pet. Nouv. ii. n. 148, p. 37	1876	
—— politus, Schmidt, Ent. Nachrichten	1888	Algeria.
—— hispanicus, Rosenh. Thier. Andal. p. 89	1856	Europe.
—— *comosellus, Fairm. C. R. Soc. Ent. Belg. xxvii. p. 13	1883	Algeria.
—— setulosus, Reitter, Berl. ent. Zeitschr. xvi. p. 179	1872	Algeria.
—— Walkeri, Lewis, n. sp.	1888	Algeria.
—— fulvus, Lewis, n. sp.	1888	Algeria.
—— Bonnairei, Schmidt, Ent. Nachrichten	1888	Algeria.
—— arachnoides, Fairm. Pet. Nouv. ii. n. 163, p. 98	1877	Morocco.
—— puberulus, Motsch. Bull. Mosc. p. 123	1837	Europe.
Etud. Ent. p. 188	1858	
Palumboi (Eretmotus), Ragusa, Nat. Sicil. i. p. 7	1881	
—— *Merklii, Schmidt, Deutsch. ent. Zeitschr. p. 238	1885	Europe.

Sternocœlis Lewisi, Reit. Wien. ent. Zeit. ii. p. 143	1883	Europe.
Reit. Deutsche ent. Zeitschr. xxviii. p. 75, pl. i. fig. 4	1884	
—— extructisternum, Lewis, n. sp.	1888	Algeria.
—— grandis, Reitter, Wien. ent. Zeit. ii. p. 143	1883	Europe.
—— lævidorsis, Fairm. Pet. Nouv. ii. n. 148, p. 37	1876	Algeria.
—— incisus, Schmidt, Deutsch. ent. Zeitschr. xxix. p. 440	1885	Europe.
—— pluristriatus, Fairm. Pet. Nouv. n. 163, p. 98	1877	Algeria.
—— fusculus, Schmidt, Ent. Nachrichten	1888	Europe.
—— mauritanicus, Lewis, n. sp.	1888	Morocco.
—— pectoralis, Lewis, n. sp.	1888	Algeria.
—— Marseuli, Bris. Ann. Soc. Ent. Fr. p. 367	1866	Europe.
SATRAPES, Schmidt, Deutsch. ent. Zeitschr. xxix. 1885. (Type *talyschensis.*)		
—— Sartorii, Redtenb. Fn. Austr. p. 311	1858	Europe.
Rayei (Eretmotus), Mars. Abeille, i. p. 348	1864	
—— Reitteri, Lewis, n. sp.	1888	Europe.
—— talyschensis, Reitter, Wien. ent. Zeit. ii. p. 143	1883	Europe.

Note.—An asterisk is attached to the species I have not seen. If naturalists who go to mountainous places and remote forest-lands to collect insects will pay attention to this class of beetles, the number in our cabinets will be quickly doubled.

XIX.—*Biological Studies of Protista.* By Dr. MAX VERWORN *.

[Plate IX.]

I MADE the following researches on Protista when, for the purpose of certain psychophysiological investigations which will hereafter be published in their entirety, I set myself the task of observing the process of shell-formation in the shelled freshwater Rhizopoda. In the case of those forms which build their shells with materials produced by themselves this process has been described and illustrated with figures in previous memoirs, especially by Gruber †, and recently in a very detailed fashion by Schewiakoff ‡; and therefore my

* Translated from the 'Zeitschrift für wissenschaftliche Zoologie,' Band xlvi. pp. 455–470, with a plate.

† A. Gruber, "Der Theilungsvorgang bei *Euglypha alveolata,*" in Zeitschr. f. wiss. Zool. Bd. xxxv., and "Die Theilung der monothalamen Rhizopoden," *ibid.* Bd. xxxvi.

‡ W. Schewiakoff, "Ueber die karyokinetische Kerntheilung von *Euglypha alveolata,*" in Morph. Jahrb. Bd. xiii.

endeavour was to observe it in a form which employs foreign bodies in the construction of its shell. For this I selected a *Difflugia.* By the observations that I made upon this form I was then induced to include a marine Polythalamous form (*Polystomella*) in the range of my studies, and I am indebted to the kindness of Prof. F. E. Schulze for having the necessary material placed at my disposal.

Difflugia urceolata, Carter.

In an aquarium with water from the Halensee, near Berlin, which had stood in the Berlin Zoological Institute since the end of June 1887, numerous individuals of *Difflugia urceolata*, Carter, made their appearance towards the end of October, and these, from their large size, furnished me with favourable material for my investigations. In order to guard against any sudden extermination of this brood of Protista in consequence of unfavourable influences in the aquarium, I separated from it several smaller cultures by distributing many examples with portions of the bottom and aquatic plants in small glasses which I kept in moist chambers. On examining one of these small glasses in the morning of November 9, I found two individuals engaged in conjugation. Any mistake as to a process of division was here excluded, as the shells of both individuals from the commencement of the observation were perfectly black, and by transmitted light both appeared uniformly reddish brown. The two Protista lay with their shell-openings so brought together that their margins were exactly opposite each other, only upon one side there was a narrow fissure between them, from which numerous pseudopodia were protruded. The pair were isolated and kept in a watch-glass. On the morning of the 10th November all the pseudopodia were retracted, and the shells lay immovably with the two openings pressed exactly together. The Protista remained in this state throughout the day. On November 11, in the morning, a small fissure had again been produced between the mouths of the two shells, and through this, as on the first day of observation, numerous pseudopodia issued. As I assumed that the conjugation-process would soon be completed I killed the Protista with osmic acid in the course of the day, when the pseudopodia remained exserted, and stained them with ammonio-picrocarmine. It now appeared that during the staining the two shells had separated from each other, by which a glance into the nature of the protoplasm was rendered possible. The protoplasm had protruded somewhat, and it was distinctly observable that the protoplasmic bodies of the two individuals had become fused into one, in such a manner that the hyaline protoplasm with the pseudopodia formed a circlet surrounding, like a girdle, the endoplasm, which extended into both the shells. I was then astonished to see that in the endoplasm, besides a dark mass consisting chiefly of sand-grains, there were about thirty or thirty-five nuclei of 0·2 millim. in diameter, which presented the ordinary appearance of Difflugian nuclei and appeared of a dark red colour. At first I thought that the appearance of these numerous nuclei must be connected with the conjugation-process, until I ascertained from the examination of other individuals, taken from different glasses and at different times, that all the individuals always contained from fifteen to twenty nuclei, and that, consequently, *Difflugia urceolata* is a multinucleated form. One specimen, from which one side of the shell has been separated under the microscope by means of a very pointed and sharp lancet, is shown in Pl. IX. fig. 2. Within the shell will be observed the greyish-brown endoplasm, which owes its characteristic colour to innumerable very small brownish granules with strong refractive power. In it lie the nuclei (the dark spots in the figure), together with nutritive particles, and finally a great number of sand-grains, the latter partly only adherent, but partly also completely immersed in the protoplasm. In the neighbourhood of the aperture is the hyaline exoplasm, which extends outwards its finger-like pseudopodia.

My interest was most excited by the accumulation of sand-grains which occurred in the endoplasm of the *Difflugia*; and as I found this to be a pretty regular constituent in the protoplasm of all the specimens examined, I supposed that it was employed in the formation of the shell. Bütschli * has already indicated the probability that "the foreign material applied to the construction of the shell was taken up into the protoplasmic body-mass of the *Difflugia* itself and subsequently deposited at the surface for the formation of the shell." Gruber † adopts Bütschli's suggestion, and with reference to the frequently observed phenomenon that other Rhizopoda take up sand into their protoplasmic body-mass he says:—"Scarcely any doubt will remain that Bütschli's opinion with regard to the Difflugian shell is correct, and consequently these animals *themselves* will *select and take up* into themselves

* In Bronn's 'Klassen und Ordnungen des Thierreichs,' Protozoa (1880).

† "Die Theilung &c.," *loc. cit.*

from the water the material, the sand, the Diatomeæ, or whatever it may be. If they then proceed to divide, this and the foundation of the new shell takes place in the same way as in the before-mentioned Monothalamia" (*Euglypha*, *Quadrula*, *Cyphoderia*, &c.).

I now endeavoured in the first place to observe directly the act of inception of sand. For this purpose it was advantageous to furnish the Protista with as much shell-material as possible, in order to give them abundant opportunities of taking it into them. In order that it might be readily recognizable and distinguishable from other materials in my investigations I did not employ sand-grains, but finely-powdered dark blue glass, the smallest fragments of which certainly appeared very clear, although in contrast with the surroundings they always showed a faint bluish tinge. In subsequent experiments I used perfectly black glass, the finest particles of which appeared olive-coloured. After putting a suitable quantity of blue glass-fragments into a watch-glass, I introduced several *Difflugiæ* with water-plants. In a short time the Protista began to extend pseudopodia and to creep about among the powdered glass. They often touched the glass-fragments with their pseudopodia, but pushed them away and crept past without incepting them. I observed them for a very long time and repeatedly; but at first I did not succeed in observing any inception of the glass-granules. Then it chanced that a clumsy *Cypris* came near a *Difflugia* and pushed roughly against its pseudopodia. In a few seconds the surface of the widely extended pseudopodia became wrinkled and knobbed, and some glass-granules remained adhering to them, which were then gradually retracted, together with the pseudopodia, completely into the interior of the shell. This, therefore, was the mode in which the inception of shell-material takes place; by mechanical irritation a reflex contraction of the pseudopodia is produced, and combined therewith a secretion of a sticky coat on their surface, which enables the glass-granules to adhere to the pseudopodia and to be drawn in with them. By a series of experiments, which were repeated upon other species of *Difflugia*, I then ascertained the great regularity of this process. When a *Difflugia* had extended its pseudopodia to a great length and was creeping about between the glass plates, it was irritated with a sharp needle. The same effect was then produced with great exactness; the pseudopodia became tubercular, and while previously no glass-granules were adherent to them, these now clung firmly and were slowly retracted into the shell. Specimens of which the shells were partially removed then showed that the glass-grains not only remained adherent to the surface of the protoplasm, but were actually drawn into it, so that the interior contained a quantity of blue glass-grains.

The mode in which the material for the construction of the shell was taken up was therefore ascertained; but it was some time before I succeeded in discovering individuals engaged in division. I found these in a watch-glass which contained a brood separated from the larger aquarium, but unfortunately only of a few individuals. Nevertheless I had the opportunity of observing different stages of the process of division, and thus of ascertaining that the process is effected in precisely the same way that was accepted by Gruber with regard to the division of *Euglypha*, *Cyphoderia*, &c. First of all there protrudes from the shell-apertures a round, low mound of protoplasm, which issues further and further, and the convexity of which gradually approaches the spherical form. In one instance its form appeared not to be quite regular, but somewhat oblique and impressed on one side. In a further advanced stage the protruded mass of protoplasm had already attained the size of the original individual, and I even found a specimen in which it was somewhat larger and broader than the latter. In an individual whose protruded mass had already approximately acquired the size of the old shell, I observed that a ball of glass-granules had already in part entered the newly formed half, in which the protoplasm with the glass-grains showed a slowly flowing movement (Pl. IX. fig. 1). In the most advanced stage of division the protruded protoplasm had already assumed pretty nearly the form of a Difflugian shell of the present species, and the particles of glass had arranged themselves at its surface. The new half seemed not yet to have a solid shell; but the glass-granules were loosely fitted to one another. On the following day in this specimen the separation of the newly-formed individual was completed, and it was creeping about in the watch-glass with its pseudopodia. Its shell showed the characteristic form, but the pale bluish glass-grains were united to each other by a nearly transparent, but, at any rate, quite colourless connective substance, which only some days later began to acquire a darker brownish colour. Together with this specimen there were on the next day two likewise newly formed individuals which had the same appearance. The other four specimens which I had found engaged in division on the previous day showed scarcely any noticeable alteration since I had left them, and afterwards it turned out that they were dead. The subsequent attempt at nuclear staining was unsuccessful, and only in one individual there was to be seen in the protruded protoplasmic mass a single, very large, but not particularly distinct nucleus; so that from this it is not possible for me to say anything about the behaviour of the nuclei during division. As appears from the observations on *Difflugia*, this genus therefore, as regards the shell-formation during division, approximates directly to the other shelled freshwater Rhizopoda.

To ascertain whether and in what manner the *Difflugia* repairs artificial injuries of its shell by means of the building-material taken up into the protoplasm, I made a series of experiments by division. When the individuals had completely withdrawn into their shells they were cut up with a sharp lancet in definite directions under the microscope, and then preserved in watch-glasses or upon object-slides with the necessary shell-material. They all supported the operation well, and could be kept alive for more than three weeks even upon the object-slide if they were preserved in moist chambers.

First of all the Protista were divided into two portions of nearly equal size by a cut through the middle of the animal in the plane of the shell-aperture (fig. 3, *a*). The divided pieces were carefully examined every day. They appeared quite normal, extended their pseudopodia, and crept about. When irritated they reacted as before, and took up glass-granules, but they showed no regeneration of the shell; the cut margins remained about as irregular as soon after the section. Other individuals were divided into two equal parts by a cut made in the longitudinal direction of the shell (fig. 3, *b*). These portions also were quite normal in their behaviour, but without regenerating the shell. Next specimens were cut into two unequal parts both transversely and longitudinally; but neither the larger nor the smaller divisions showed any alteration at the cut portions of the shell. The experiments were varied in the most multifarious manner (fig. 3, *c*) in a very great number of specimens, but always with the same result; all the fragments still retained the same vitality, but without regenerating the portions of shell which remained to them.

I then modified the experiment by inflicting only quite small injuries, without injuring the protoplasmic body. For this purpose I made small incisions in different parts of the shell of many individuals, and watched whether these would be repaired. Every day a careful examination was made to see whether any change had taken place; but even after the lapse of three weeks the cut parts showed exactly the same appearance as immediately after the operation. The cut margins remained just as irregular as on the first day, and although all the individuals had taken up glass-granules, no deposition of them had occurred at the point of lesion. The experiments were afterwards made with other glass-particles and with sand-grains, but no repair or completion of the shell ever occurred.

Finally, the whole shell was removed from some specimens under a low power, without inflicting any injury upon the protoplasmic body of the Protistan. In this way I obtained perfect *Difflugiæ* without shells, which also behaved quite normally. They took up sand-grains (or glass-particles), crept about with their finger-like pseudopodia, and frequently flattened themselves out, when it was particularly easy to see that the incepted glass-granules formed a small aggregation in the interior of the protoplasm. When only short pseudopodia were emitted the Protista had a great resemblance to *Pelomyxa*, which was still further increased by the greyish-brown coloration, the incepted glass-granules, and the great number of nuclei. I succeeded in keeping these shell-less *Difflugiæ* alive in the normal state for nearly three weeks without any trace of a regeneration of the shell being observable. The surface of the protoplasmic body did not present the least excretion or deposition of solid matter; it was rather soft, performed Amœboid movements, and developed pseudopodia until the last, when the Protista became the victims of an unlucky accident.

When I consider that I made my experiments at different times upon a very great number of *Difflugiæ*, that I varied the experiments in every way, and that I carefully observed and examined the individuals operated upon for more than three weeks, I think I may with perfect certainty arrive at the conclusion *that the* Difflugiæ *do not regenerate the shell when injured or entirely removed.*

POLYSTOMELLA CRISPA, Linn.

As those forms of Rhizopoda which construct their shell of foreign bodies, such as the *Difflugiæ*, are closely united by a great number of intermediate forms with those which secrete their own shells, such as the Polythalamia, it seemed to me desirable to investigate one of the latter forms with respect to the conditions of regeneration of the shell, and I had afforded to me an opportunity of doing this in the case of *Polystomella crispa*, Linn., from Trieste. These Protista also

I was able to keep alive for two months in watch-glasses with sea-water in which small pieces of Ulvæ were placed to produce the necessary oxygen. As their shells were not very thick, I succeeded very well with them also in effecting divisions and injuries with the lancet in definite places, in which the uncommon viscosity of the protoplasm alone caused some difficulty. In the *Polystomellœ* the nucleus is usually situated in the same part, and, indeed, in the neighbourhood of that chamber upon which the youngest chamber is seated externally. In consequence of this we may know beforehand with some certainty whether we shall or shall not have the nucleus in any separated portion. Of course the portions, after the investigations were completed, were also decalcified with acetic acid and stained with carmine, so that there could remain no doubt as to their containing or not containing a nucleus.

The divisions or mutilations were performed in the following manner. First of all from two to four of the first chambers were removed from some individuals. These amputated chambers showed no phenomena of regeneration, although they remained alive for a long time. In the other portions, however, which contained the nucleus, the irregular broken place was usually repaired again in from three to six days in the following manner:—the protoplasm swelled out in a rounded form somewhat above the spot in question, and on its surface a calcareous layer was secreted (Pl. IX. fig. 4). In its form this calcareous layer resembled the outer wall of the youngest chamber of an uninjured Protistan, and showed the typical structure of the shell of a *Polystomella* perforated by numerous small apertures. The ruins of the tubular system of both sides of the last amputated chamber were not again completed into perfect tubules, but remained in their injured condition, and the newly formed wall had founded itself directly upon them. In one case, however, there were already to be seen upon the outer surface of the newly formed wall the indications of a whole new system of tubules (fig. 5), and this evidently would have been completely developed as soon as a new chamber was founded upon the new wall. The newly formed wall in fact on the two sides, where the tubules are formed in the normal chamber-walls, was perforated by apertures of corresponding size, which were surrounded by a low wall, the indication of the future tubules.

In those individuals in which two chambers were mutilated each chamber did not complete itself separately, but a calcareous layer was secreted only on the surface of the outer of the two cut chambers.

Further, in a number of *Polystomellæ* the last ten or twelve chambers were removed in connexion. The chambers thus removed showed no regeneration in a fortnight, although their vital phenomena were by no means extinguished. They were then killed, decalcified and stained, by which means their want of nuclei was demonstrated with certainty. The remaining portions, on the contrary, showed the same form of regeneration as was first described.

Then some specimens were so cut up that a portion was cut away from a series of chambers. The pieces removed lived on, but also without any phenomena of regeneration. The other portion, in which the nucleus was situated, on the other hand, had deposited over all the incised chambers a common, external, continuous calcareous layer, which completely closed the wound and showed the typical shell-structure (fig. 6).

Lastly, smaller lesions were effected in a series of individuals, triangular notches being made with the lancet in certain places, affecting only one or a few chambers. In a few days these wounds also became covered with a continuous calcareous layer.

It frequently happened that, after the removal of the chambers, the protoplasm became retracted from the last open chamber behind the next chamber-wall. In the case of the other wounds also the protoplasm sometimes drew back into the interior, and then the wounds did not heal. But even after a new calcareous wall had been constructed on an injured chamber, the protoplasm frequently drew back out of this chamber, as, indeed, even in uninjured individuals the youngest chamber or chambers are often quitted by the protoplasm.

In order to determine with still more certainty the influence of the nucleus upon the regeneration of the shell, a series of divisions was made in which enucleate pieces of different sizes were separated. I succeeded in keeping such portions alive for nearly three weeks. Even half of the protoplasmic contents of a single chamber remained alive within the fragment of its shell for a fortnight, when the fragment was killed. *All non-nucleate fragments showed not the smallest trace of new formations*, a phenomenon which stands in the fullest accord with the results of Nussbaum's * and Gruber's †

* "Ueber spontane und künstliche Theilung von Infusorien," in Verh. naturh. Ver. preuss. Rheinl. 1884.

† "Zur Physiologie und Biologie der Protozoen," in Ber. naturf. Ges. zuFreiburg i. B. 1886 (see 'Annals,' ser. 5, vol. xvii. p. 473).

experiments on Infusoria. Nussbaum found that in *Oxytricha* only the nucleiferous fragments became regenerated into new individuals, and Gruber was able by his beautiful experiments to establish the same thing with regard to *Stentor cæruleus*. I may mention here that I have myself repeated Gruber's experiments on *Stentor cæruleus* with the same results, and have also made the same experiments on *Lacrymaria olor*. *Lacrymaria*, of which I had great numbers of individuals at my disposal, was so far a favourable object for these experiments, as it was comparatively easy to detach portions without any fragments of nucleus, which I found to be more difficult with my *Stentors*. However, in *Lacrymaria* I have also obtained the same results, and therefore it seems to me indubitable *that regenerations take place under the influence of the nucleus and cannot be effected without it.*

In *Polystomella* I made a further observation upon the non-nucleate pieces which perhaps will be of interest. I made trial whether the non-nucleate portions take in nourishment by placing in the water containing them numerous small marine Protista which might serve them as food. In clear weather the fragments had extended very abundant pseudopodia, and among these the Protista moved about. I now repeatedly observed that swimming Flagellata remained adherent to the pseudopodia, then made movements to escape, and, when they did not succeed in tearing themselves free, were slowly drawn to the shell with the pseudopodia. With one fragment there were with the Flagellata many specimens of *Euplotes charon* in the same drop of water; but these appeared to be too large to be attacked. When they came near the pseudopodia they always made a quick backward movement which placed them out of danger again. Once, however, I observed that a *Euplotes* which chose to run over a whole bundle of pseudopodia remained attached to several pseudopodia at once, and in spite of its endeavours to escape was slowly drawn towards the shell. During this process its movements became gradually weaker and weaker; soon there were only from time to time a few jerking movements of the posterior cilia, and finally, in about twenty-five minutes, all motion ceased. Some time afterwards, when the fragment changed its place, the Infusorian remained behind, and, as I ascertained, was really dead. I made the same observation another time upon a metabolic *Euglena*.

That inception of nourishment should occur in non-nucleate fragments does not strike me as remarkable, as I have recognized it to be a pure reflex action which only takes place upon mechanical irritation (movement of the food-organisms &c.). I could imitate it by means of artificially moved foreign bodies, such as paper-fibres &c. But what appears to me to be of importance is the circumstance that the Protista taken up are killed. This distinctly indicates the occurrence of a chemical action on the part of the fragment upon the protoplasm of the food-organisms. Unfortunately in most cases it is very difficult to ascertain whether a digestive process does or does not occur, and therefore I have communicated this observation only because it may perhaps hereafter be made available in connexion with others.

In order to supplement my own investigations upon the phenomena of regeneration in the Polythalamia I will here refer to the observations which Carpenter * had occasion to make on the material of the 'Challenger' Expedition. Among the Foraminifera of the 'Challenger' Expedition Carpenter found some species of the genus *Orbitolites* which were remarkable for their considerable size. One species, which he named *Orbitolites tenuissima*, grows to the size of 0·6 inch, and is characterized by an exceedingly thin and brittle shell. The consequence of this peculiarity was that among the specimens obtained only a few were uninjured; but, on the other hand, there were many which had repaired earlier injuries. Carpenter gives the following description of the mode of reparation :—"When only small portions of the margin are broken away the next-formed annuli extend themselves along the fractured edge; and thus the cyclical mode of growth is completely maintained with only a temporary irregularity." And it is not only small injuries that, according to Carpenter, are repaired in this form, but the power of regeneration goes so far that even small fragments can complete themselves to form perfect individuals, the outer shell-convolutions of which then have exactly the normal constitution. One of Carpenter's figures shows how such a small fragment has completed itself into a perfect individual. Carpenter says of it :—"I have been able to assure myself that every part of the margin of this fragment—whether broken or unbroken, peripheral, central, or lateral—has contributed to the formation of the first new complete annulus, by which the foundation was laid of the subsequent regular series of concentric zones, thus clearly indicating that a sarcodic extension took place from every chamberlet laid open by the fracture, as well as from the normal pores of the last septal plane, and that these extensions coalesced to form a continuous ring, as in the formation of the ordinary succession of concentric annuli. It is most interesting to observe that

* "Report on the Specimens of the Genus *Orbitolites* &c.," in 'Challenger' Report, vol. vii.

the zone of chamberlets to which this sarcodic ring gave origin is formed upon the *perfected type*, without any reversion to the earlier Peneropline stage." The last remark refers to Carpenter's observation that the shell of *Orbitolites* from its earliest foundation passes through various developmental stages, in which it resembles other Polythalamian shells—*Cornuspira*, *Spiroloculina*, *Peneroplis*, and *Orbiculina*. In the same degree as in *Orbitolites tenuissima*, Carpenter also met with the phenomena of regeneration in *Orbitolites complanata*, Lam., a form which is remarkable for the enormous number of its small-chambers and its narrow annuli. Quite a small fragment suffices to induce the new-formation of a large individual. As regards the relations of the nucleus in the *Orbitolites*, Carpenter found in the protoplasmic mass of the Polythalamian a great number of small round corpuscles, which were irregularly scattered. He assumes these to be the nuclei of the Protistan. Moreover, that this Polythalamian form is multinuclear is rendered extremely probable by the intense phenomena of regeneration of the most various fragments.

In conclusion, a brief summary of the results obtained and a critical discussion of them may not be out of place. The result of the observations and experiments on *Difflugia urceolata* is as follows:—The construction of the carapace is effected in the same way as in the other shelled freshwater Rhizopoda, with this difference, that foreign bodies for the structure of the shell are incepted into the protoplasm by certain reflex processes. Regeneration of the injured or completely removed shell by the protoplasmic body does not occur, although the vital functions take their course in the normal fashion. The experiments on *Polystomella crispa* show quite a different result. It appears that phenomena of regeneration are manifested in a fragment if the nucleus is contained in it, but that they never appear when the nucleus is absent. The observed processes of regeneration consist on the one hand in the healing of the wound by a deposition of calcareous matter, which is secreted by the surface of the protoplasm, and on the other in the formation of new chambers. On the contrary, the reparation of separate injured portions, such as, for example, the remains of the tubular system, never took place. In *Orbitolites tenuissima* and *complanata*, finally, the process of regeneration occurs in the same manner, with the sole exception that the formation of new chambers upon fragments takes place on a much larger scale than in *Polystomella.*

It may be a question what is the reason of the phenomenon that two forms of Rhizopods behave so differently with regard to the regeneration of their shells as *Difflugia* and *Polystomella* or *Orbitolites.* There must evidently be a principial difference between the shells of the two forms which accounts for this difference, and I do not think I am far wrong in finding this in the mode of production of the shells. In *Difflugia,* as in all Monothalamia, the shell originates at the moment of fission, and is completely finished at the separation of the new individual. No subsequent alterations occur, and especially, as Gruber justly notes, no growth of the shell takes place. The protoplasmic body has therefore ceased to have any secretory relations with the shell, the faculty of shell-formation has ceased. In consequence injuries may be inflicted on the shell, or it may be removed altogether, without the occurrence of any regeneration.

The conditions are different in the production of the Polythalamian shells. It must now be regarded as proved by a number of observations that the Polythalamia reproduce by a kind of spore-formation, although this process has not yet been directly observed. At any rate we know that the young Polythalamia occur within the body of the parent as unilocular Protista. If these develop into perfect Polythalamia, they form upon the original chamber a new one, to which another new one is soon added, and so forth. From this it follows that the Polythalamia, so long as they form new chambers, must have the faculty of shell-secretion. The reason that existed in the case of *Difflugia* for the cessation of the shell-secretion no longer exists here, and, in fact, the Polythalamia do regenerate their shells. A natural consequence of this mode of formation of the shell in the Polythalamia is the phenomenon that the forms with comparatively limited chamber-formation, such as *Polystomella,* possess the faculty of regeneration in a much less degree than the forms with an exceedingly strong chamber-formation, like *Orbitolites.* The faculty of regeneration in the Polythalamia is therefore proportional to the faculty of forming new chambers, and the latter again indicates the duration of development; consequently the power of regeneration certainly persists throughout the whole period of development. Gruber characterizes the addition of new chambers only as a growth, and says, on another occasion *, that in the Protozoa in general

* "*Dimorpha nutans,* eine Mischform zwischen Flagellaten und Heliozoen," in Zeitschr. f. wiss. Zool. Bd. xxxvi.

we cannot speak of a development. I cannot adopt this view, for I certainly see in the chamber-formation of the Polythalamia a process which is no mere growth, for the chambers are not equal and similar, and the Protistan has quite a different appearance when it has only a few chambers, and later when it has many. This process seems to me much rather to represent a true development, and I even believe that in particular forms of shells this development will prove to be available for the recognition of their phylogenetic relations.

With regard to the relation between the faculty of regeneration and development, it would moreover be of interest to examine in the case of very old individuals whether the power of regeneration has also sunk to zero, as we must assume to be the case. Further, it would be very desirable to test such forms as *Orbulina* &c., which remain unilocular throughout their lives, as to their regenerative faculty. At any rate we should here meet with similar conditions to those prevailing in the Monothalamous freshwater Rhizopoda.

The demonstration of the influence which the nucleus exerts in the regeneration of the shell in *Polystomella* seems to me to be of particular importance. Of late much attention has been directed to the action of the cell-nucleus; but, although many naturalists have made observations upon its functions, our knowledge of the matter still remains rather limited. Besides the relations to reproduction which the cell-nucleus displays, it has been endeavoured recently to investigate its influence upon direct processes of change of material, and the function of secretion especially has been claimed for it. In the epithelial cells which secrete the chitinous rays of the egg of *Nepa* and *Ranatra*, Korschelt * observed that at the period of secretion the nucleus acquires a peculiar Rhizopodoid form, and emits pseudopodium-like processes towards the side on which the chitinous secretion takes place. He further convinced himself that all cells in which branched nuclei are known to occur have a secretory character. As, however, hitherto there was no direct observation of the share taken by the nucleus in the secretory activity of the cell, it is particularly interesting to become acquainted with such a case in the regenerative processes of the Polythalamia.

* Tageblatt der 59. Versammlung Deutscher Naturforscher und Aerzte in Berlin; No. 5. Sitzungsb. der Sekt. für Zoologie. Korschelt, "Die Bedeutung des Kernes für die thierische Zelle," in Sitzungsb. d. Ges. naturf. Freunde zu Berlin, No. 7, 1887.

EXPLANATION OF PLATE IX.

Fig. 1. *Difflugia urceolata*, Carter, engaged in division and shell-formation. The new shell composed of fragments of glass.

Fig. 2. The same, with half the shell removed. In the endoplasm besides sand-grains there are a number of red nuclei (here black).

Figs. 3 *a, b, c.* Shells of *Difflugia urceolata* divided in various directions indicated by the dotted lines.

Fig. 4. *Polystomella crispa*, Linn. The youngest chambers have been removed and a new calcareous wall has been formed over the lesion.

Fig. 5. The same, showing the regeneration on a large scale. *a*, from the side; *b*, from in front.

Fig. 6. The same, with six chambers partially removed, and with a common calcareous layer deposited over the cut surface.

XX.—*The Species of the Genus* Urodacus *contained in the Collection of the British (Natural-History) Museum.* By R. I. Pocock, Assistant, Natural-History Museum.

[Plate VIII.]

This genus was described by Peters in 1861. It differs from other Scorpions, which are characterized by the possession of a pentagonal sternum and two lateral eyes, by the presence of a median keel upon the lower surface of each of the caudal segments.

Urodacus novæ-hollandiæ, the type of the genus and hitherto its sole representative, was described by Peters (Monatsber. d. k. Akad. Wissen. Berlin, 1861, p. 511) from specimens obtained from West Australia; and Count Keyserling, in his work 'Die Arachniden Australiens,' p. 34, has published a lengthy description of it, the description and accompanying figure (Pl. VIII. figs. 1, 1 *a*) being taken from specimens also from West Australia.

Whilst examining for identification the Scorpions contained in the collection of the British (Natural-History) Museum, I found that this genus *Urodacus* is represented by no less than four well-marked species. Three of these I believe to be new to science, and have consequently described; the fourth I refer to *U. novæ-hollandiæ* of Peters.

Of this last-named form the Museum possesses eleven specimens, a series which presents some interesting and, I believe, new facts connected with the sexual variation and the geographical distribution of the species.

Concerning the latter point, so far as I am aware, the occurrence of this form has hitherto never been reported from any place outside the Australian continent; and within the limits of this area no locality of smaller dimensions than West Australia has ever been assigned to a specimen of it.

It will therefore be of interest to state that in the National Collection there are in the first place four specimens from Ceylon; and in the second place, that of the Australian specimens, while two are ticketed merely W. Australia, three are from the Swan River and one from Port Lincoln.

With regard to the sexes of this species, I do not know that any difference between the two has ever been pointed out. At all events Count Keyserling makes no mention of the existence of any sexual features. But in the series of this species that I have examined two very distinct forms are to be noticed—the one possessing larger pectines and a longer tail, the other smaller pectines and a shorter tail; and, in the absence of any direct evidence of the fact, I judge from analogy that the specimens presenting the former characteristics are males and that those presenting the latter characteristics are females.

The two may with certainty be distinguished as follows:—

Male.—Cephalothorax as long as the first caudal segment + two thirds of the second; tail about four and three quarter times as long as cephalothorax; pectines projecting considerably beyond the distal margin of the coxal segment of the posterior pair of legs; pectinal teeth 19–22.

Female.—Cephalothorax as long as the first and the second caudal segments; tail about four times as long as cephalothorax; pectines not projecting so far as the distal margin of the coxal segment of the posterior pair of legs; pectinal teeth 12–14.

Count Keyserling's figure and description are without doubt taken from a small female specimen. The length of it is 54½ millim., whereas the average length of the adult females that I have seen is about 70 millim.

Urodacus excellens, sp. n. (Pl. VIII. figs. 2, 2 *a*.)

Cephalothorax with a conspicuous circular incision in the middle of its anterior margin, marked throughout its length by a median sulcus, which behind dilates into an equilaterally triangular depression. The right and left portions of the ocular tubercle continued in front as smooth ridges to rather more than one third of the distance between the central eyes and the hind margin of the anterior incision, and behind as smooth ridges to about half the distance between the central eyes and the anterior angle of the triangular depression; posterior two thirds of the cephalothorax laterally depressed, anterior third nearly horizontal; margins of the frontal lobes defined by a shallow impression. Cephalothorax quite smooth, neither granular nor rugose. Eyes slightly nearer the anterior than the posterior margin of the cephalothorax.

The six anterior *abdominal tergites* smooth, with granular posterior margins, each bearing anteriorly in the middle line a low wide crest, which behind divides into three portions, one median and one on each side; seventh abdominal tergite posteriorly and laterally granular, with two faintly defined dorsal keels.

Abdominal sternites perfectly smooth; the anterior half of each, the last excepted, marked with two sulci; the last marked in its posterior half with two smooth keels.

The four proximal *caudal segments* almost entirely smooth, the superior and supero-lateral keels alone being feebly granular; upper surface of fifth segment smooth, sulcate in front, flat behind; superior keel finely granular, supero-lateral keel more finely granular and abbreviated; infero-lateral keels evenly denticulate, converging in front; inferior median keel consisting of two posteriorly diverging series of denticles; space between the lower median and lateral keels smooth, with a granule here and there; vesicle ovate, somewhat coarsely granular beneath, smooth above and at the sides; faintly marked with longitudinal sulci, as in the following species; aculeus gently curved.

Chela.—Upper surface of *humerus* furnished with a few small, scattered granules, anterior and posterior borders granular; anterior surface furnished with two or three larger granules and with inferior border granular; inferior surface proximally slightly granular and rounded off into the posterior surface, which bears two larger granules near its distal end. The superior, posterior, and inferior surfaces of the *brachium* evenly rounded, neither keeled nor granular, posterior surface marked with two irregular series of pores, inferior surface marked posteriorly with a single series; superior and inferior margins of the anterior surface feebly granular.

Hand stout, rounded, and smooth, being feebly rugose on the inner (anterior) upper margin and exhibiting above and at the sides very faint indications of keels; a more conspicuous keel on the under surface of the hand; on each side of this keel is a series of setiferous punctures.

Pectines not projecting so far as the distal margin of the posterior coxæ; number of teeth 17.

Colour piceous.

Measurements in millimetres.—Cephalothorax, length 17, width 16, as long as the first and second and one fourth of the third caudal segments; tail 63, *i. e.* about three and three quarter times as long as cephalothorax; length of fifth segment 15, width $4\frac{1}{2}$, height 4; length of vesicle and aculeus 14. Length of humerus 12, of brachium 14, of hand-back 14, of movable finger 19, width of hand $11\frac{1}{2}$, height $9\frac{1}{2}$; length of pecten 9, of pectinal tooth $1\frac{1}{4}$. Total length 116.

A single dried specimen (which, from the shortness of the pectines and of the tail, I believe to be a female) from Port Essington.

This is a well-marked species, conspicuous for the smoothness of its hands and cephalothorax and for its large size.

Urodacus armatus, sp. n. (Pl. VIII. figs. 3, 3 *a*.)

Cephalothorax with a shallow circular incision in the middle of its anterior margin; furnished throughout its length with a conspicuous median sulcus, which posteriorly dilates into an equilaterally triangular depression. The posterior portions of the right and left halves of the cleft ocular tubercle not terminating behind the eyes, but continuous with the margins of this triangular depression. The anterior third of the cephalothorax above horizontal, not granular, but slightly rugose; the posterior two thirds laterally depressed and granular. Immediately beneath the central eyes is a smooth, slightly depressed area. Eyes very slightly nearer the anterior than the posterior margin of the cephalothorax.

Abdominal tergites finely granular and marked with a low, median, longitudinal crest; on each side of the crest in the middle of the tergite is a faint impression, and in the anterior portion of the tergite an abbreviated sulcus. The granules, crest, and impressions are less conspicuous on the anterior than upon the posterior tergites. The posterior abdominal tergite furnished laterally with two granular keels.

Abdominal sternites perfectly smooth, the anterior half of each, the last excepted, being marked with two sulci, the last furnished in its posterior half with two smooth keels.

The four proximal *caudal segments* smooth; the keels conspicuous and smooth, with the exception of the superior and supero-lateral keels, which are slightly granular; the superior keel posteriorly raised into a conspicuous sharp tooth; upper surface of fifth segment flat and smooth; superior keels granular, supero-lateral keel smooth and abbreviated, infero-lateral keels granular and converging in front, inferior median keel granular, space between the keels of the lower surface granular; vesicle finely granular beneath, smooth above, marked with five faint sulci—one median, two lateral, two inferior; aculeus gently curved.

Chela.—Upper surface of *humerus* bounded in front and behind by a row of denticles and bearing a few smaller tubercles; anterior surface bounded above and below by a row of denticles and furnished with two or three tubercles, inferior surface proximally granular, posterior surface smooth; the inferior surface not separated from the posterior by a row of tubercles. Anterior surface of *brachium* bounded above and below with a row of tubercles; for the rest the segment is smooth, furnished above, below, and behind with four faint keels; posterior portion of inferior surface bearing a row of setiferous punctures.

Hand strongly keeled, stout, faintly reticulated above, sparsely and feebly granular on its anterior (inner) surface, more strongly granular on its anterior-superior edge. Superior surface bearing a conspicuous keel and separated from the posterior (outer) surface by a strong keel, which is continued on to the immovable finger; posterior surface also medianly keeled and separated from the inferior surface by a strong keel, upon each side of which is a series of setiferous punctures; anterior surface bearing two granular keels, the inferior of which separates this surface from the lower surface.

Pectines long, projecting considerably beyond the distal margin of the coxæ of the posterior legs; number of teeth 21–22.

Colour ochraceous.

Measurements in millimetres.—Cephalothorax, length 10, width $9\frac{1}{2}$, as long as the first and three fourths of the second caudal segments; tail 45, *i. e.* four and a half times as long as cephalothorax; length of fifth segment 10, width 4, height 3; length of vesicle and aculeus $9\frac{1}{2}$; length of hand-back 7, width of hand 7, height $5\frac{1}{2}$, length of movable finger $8\frac{1}{2}$; length of pecten 8, of pectinal tooth $1\frac{1}{2}$. Total length about 74.

A single specimen (a male in the dried state) from Port Lincoln, Australia.

This species bears considerable resemblance to *U. novæ-hollandiæ*, Peters, but may at once be distinguished from it by the form of its superior caudal keels.

Urodacus abruptus, sp. n. (Pl. VIII. figs. 4, 4 *a*.)

Cephalothorax with a conspicuous incision in the middle of its anterior margin, marked throughout its length by a median sulcus, which near the hind margin terminates in a deep transverse depression, the sulcus and depression somewhat resembling respectively the handle and head of a hammer. The anterior and posterior terminations of the right and left portions of the ocular tubercle scarcely at all continuous behind and in front with the margins of this sulcus. Anterior third of cephalothorax above smooth and horizontal, posterior two thirds thickly granular and laterally depressed; margins of the frontal lobes defined by a very shallow sulcus; eyes a little further from the anterior than from the posterior margin.

Sides and posterior margins of the first six *abdominal tergites* granular, the rest smooth and shining; the anterior tergites more granular than the posterior; each of these tergites marked with four impressions, two anterior and crescentic, two posterior and straight; posterior tergite granular and furnished on each side with two short keels.

Sternites smooth and shining, marked with the usual abbreviated depressions; posterior tergite marked with four smooth keels, two near the middle line being very short.

Caudal keels well developed, the three inferior keels on the first three segments smooth, those of the fourth finely denticulate; the superior and supero-lateral keels of the first four segments denticulate, the posterior denticle of the superior keel being the largest; intercarinal spaces of these segments very finely granular; superior surface of the fifth segment distally flat; superior keels very finely denticulated, the three inferior keels strongly denticulate, the denticulations increasing in size from before backwards, lateral and inferior intercarinal spaces granular; vesicle below punctured, furnished beneath with two shallow sulci and on each side with one sulcus; aculeus slightly curved.

Superior surface of *humerus* sparsely and coarsely granular, bounded in front and behind by a row of denticles; anterior surface finely granular, with a few larger tubercles; posterior surface smooth, not separated from the inferior surface by a row of tubercles; inferior surface proximally granular. *Brachium* almost smooth, very finely granular above and with the upper and lower margins of the anterior surface very slightly roughened; inferior surface marked behind with a keel, upon the anterior side of which is a series of setiferous punctures.

Hand generally resembling in appearance that of *U. armatus* (*cf.* measurements).

Pectines projecting posteriorly as far as the distal margin of posterior coxæ; number of teeth 11–12.

Colour piceous, legs paler.

Measurements in millimetres.—Cephalothorax, length $6\frac{3}{4}$ width $7\frac{1}{2}$, as long as the first caudal segment + the second and one fourth of the third; length of tail $25\frac{1}{2}$, *i. e.* about three and two third times as long as cephalothorax; length of fifth caudal segment 6, width $2\frac{2}{3}$, height $2\frac{1}{2}$; length of vesicle and aculeus $5\frac{1}{2}$; length of humerus $4\frac{1}{2}$, of brachium $5\frac{1}{2}$, of hand-back $5\frac{1}{4}$, of movable finger 6; width of hand 5, height $4\frac{1}{4}$; length of pecten 4, of tooth $\frac{1}{2}$. Total length 47.

Of this species I have seen two dried females, one ticketed Adelaide, the other merely New Holland.

Synoptical Table of Species.

a. Hands smooth, with scarcely a trace of keels; cephalothorax laterally smooth, not granular .... *excellens*, sp. n.

b. Hands strongly keeled; cephalothorax laterally granular.

- *a*¹. Right and left portions of ocular tubercle abruptly terminating behind the eyes; cephalothorax marked behind with a hammer-shaped depression............ *abruptus*, sp. n.
- *b*¹. Right and left portions of ocular tubercle not abruptly terminating behind the eyes, but continuous with the margins of an equilaterally triangular depression.
  - *a*². Superior keels of the four proximal caudal segments in male produced behind into a large, sharp, upwardly directed tooth .... *armatus*, sp. n.
  - *b*². Superior keels of the four proximal caudal segments in male not produced into a large tooth.................. *novæ-hollandiæ*, Peters.

EXPLANATION OF PLATE VIII.

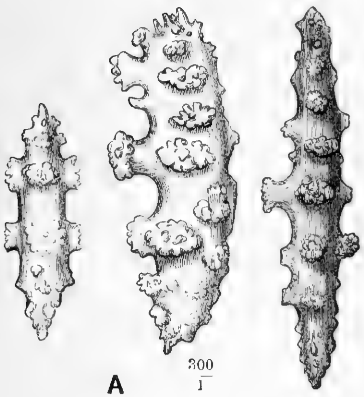
Fig. 1. *Urodacus novæ-hollandiæ*, Peters, ♂. Nat. size.
Fig. 1 *a*. The same. Tail.
Fig. 2. *Urodacus excellens*, sp. n., ♀. Nat. size.
Fig. 2 *a*. The same. Sternum and pectines.
Fig. 3. *Urodacus armatus*, sp. n., ♂. Nat. size.
Fig. 3 *a*. The same. Tail.
Fig. 4. *Urodacus abruptus*, sp. n., ♀. Nat. size.
Fig. 4 *a*. The same. Cephalothorax, × 2.

XXI.—*Description of* Xiphigorgia Ridleyi. By Prof. F. Jeffrey Bell, M.A.

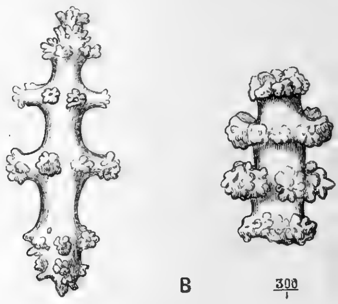
Some four years since the Trustees of the British Museum acquired by purchase a specimen which was referred to the genus *Xiphigorgia* by my former colleague Mr. S. O. Ridley, but which has not yet been specifically identified. As it appears to be still undescribed, though no doubt allied to *X. anceps* *, I propose to call it *X. Ridleyi.*

Corallum commences to branch much nearer its base than in *X. anceps*, it branches more frequently and into more slender parts; the whole forms a wider, less bushy, but more compact mass. The branches are flatter than in *X. anceps*, and are not marked by any median crest. The cortex is white, except at the edges, which are purplish red, and is smoother than in *X. anceps*. Verrucæ small, obsolete, separated from one another by about their own width.

The form of the spicules, as usual, will be better understood from the accompanying woodcut (fig. A) than from any



A $\frac{300}{1}$



B $\frac{300}{1}$

description; the spicules of *X. anceps* have already been figured by Kölliker †; but those of *X. setacea* have never yet been given ‡. I take therefore this opportunity of figuring

* I cannot think that Dr. Horn was correct in regarding *X. setacea* of Milne-Edwards and Haime as synonymous with "*G. juncea*" of Pallas, nor is there any good reason for keeping *X. simplex* of Valenciennes (not "*Gorg.*;" see Proc. Philad. Soc. 1860 (1861), p. 368) distinct from *X. setacea.*

† Icones Histiolog. pl. xviii. figs. 32 and 33.

‡ The spicule figured by Mr. Savile Kent is hardly typical of the species.

them (fig. B). It will be noticed that the new species has "scaphoid spicules" almost as well marked as those of *X. anceps*, but these are wanting in *X. setacea*. For the present I content myself with calling attention to this fact, which must, obviously, be borne in mind when the questions are asked, Are scaphoid spicules of generic value? and Is the genus *Xiphigorgia* a natural one?

Hab. St. Thomas, West Indies. Coll. B.M.

XXII.—*On the Geographical Distribution of the Genus* Diaptomus. By MM. J. DE GUERNE and J. RICHARD*.

RECENT works relating to lacustrine faunas have called attention to the freshwater Calanidæ. These Copepods, and especially the *Diaptomi*, are much more numerous in species and much more widely distributed than is generally supposed.

If we except some forms recently described † most of the common types have been confounded and indicated under the name of *Diaptomus castor*. From this it results that the geographical distribution of these species cannot be established in a complete fashion. However, the numerous data which we have been able to bring together and the kind assistance of several zoologists ‡ enable us, leaving out of consideration all doubtful observations, to trace an outline of the distribution of the genus *Diaptomus* on the surface of the globe.

The European species that we admit §, not taking into account purely nominal or insufficiently described forms, are *fifteen* in number. Among them *six* species are known only from a single locality in the extreme north, the centre, or the south of Europe (Lapland, Germany, Russia, Spain). Three others appear to be peculiar to the mountainous regions of Central Europe, but have never been met with together.

* Translated from the 'Comptes Rendus,' July 2, 1888, pp. 47–50.

† See in the 'Bulletin de la Société Zoologique de France,' vol. xiii. (February and June 1888), the descriptions of eight new *Diaptomi*, by MM. Richard, Lilljeborg, Poppe, and Richard and de Guerne.

‡ In this connexion we have to thank particularly Profs. Lilljeborg, G. O. Sars, and Wierzejsky, and M. Poppe, who have been kind enough to furnish us with little-known types or with descriptions of unpublished species.

§ See our "Révision des Calanides d'eau douce," which will shortly appear in vol. i. of the 'Mémoires' of the Zoological Society of France.

The remainder—that is to say, *D. castor*, Jurine, *D. cœruleus*, O. F. Müll., *D. denticornis*, Wierz., *D. gracilis*, G. O. Sars, *D. graciloides*, Lillj., and *D. laticeps*, G. O. Sars—are more or less diffused in the north, east, and west of Europe.

In France and in the British Isles we only know *D. castor* and *D. cœruleus*, which are also noted in Sweden and Germany. *D. cœruleus* lives in numerous troops in clear waters of a certain extent; *D. castor*, on the contrary, is met with in small pools or in the littoral region of lakes. *D. gracilis* occurs throughout northern and central Europe; it is the most widely diffused of the lacustrine forms; an allied species, *D. graciloides*, is met with throughout Sweden and into Russian Lapland (Lilljeborg). *D. denticornis* is known in Scandinavia, in Switzerland, and in the Tatra mountains. *D. laticeps*, indicated in Finland * and in Norway, has been recognized by S. A. Poppe in the Salzigersee, near Halle on the Saale.

In Asia, at points very distant from each other (Behring Island, Turkestan, Shanghai, Ceylon, and Jerusalem), we know *six* species of *Diaptomus*. It is certain that future researches will lead to the discovery in this country of a great number of other forms, and this is the more probable because, except as regards Turkestan, the types at present noted have been met with at a short distance from the coasts.

Scarcely any investigations have been made in Africa; and the only *two Diaptomi* brought from that continent are new. Both come from Algeria. One was collected near Algiers by M. Letourneux; the other, discovered in the neighbourhood of Oran by M. Raphael Blanchard, has also been found by him at Temacin, to the south of Tougourt.

In America the *Diaptomi* have been the object of only a few researches in the United States. Among many ill-defined species we may distinguish *five*, which certainly do not represent the whole richness of the genus in that country †.

South America has hitherto furnished only one well-recognizable *Diaptomus*; another species, brought from Patagonia by Charles Darwin, indicates the extension of the genus into the southern regions.

Moreover *four* species noted in Oceania lead us to suppose that the genus is largely represented in the southern hemi-

* It is a mistake, in our opinion, for Dr. O. Nordqvist to unite *D. laticeps* with *D. gracilis* ("Die Calaniden Finlands," in Bidr. till Känned. af Finl. Nat. och Folk, part 47, p. 7, note 3).

† Under the name of *castor* Bucholz has indicated a *Diaptomus* collected in East Greenland in February 1870, the determination of which appears doubtful to us.

sphere. Prof. G. O. Sars has obtained in Christiania a still undescribed *Diaptomus* by cultivating muds brought dry from Australia.

This fact possesses much interest as regards the geographical distribution of the genus. It indicates a ready means of dissemination and enables us to explain the presence of a *Diaptomus* in considerable quantities in the neighbourhood of Oran (*vide suprà*), in chotts which remain dry during the greater part of the year.

In connexion with this we may also call attention to the fact that certain *Diaptomi* appear to adapt themselves easily to waters of very different degrees of saltness. Dr. Raphael Blanchard has collected the species already mentioned in water which held in solution as much as 29·15 grains of chlorides per litre on April 1, 1888. At the same time this Copepod occurred in water containing not more than 14·04 grains of chlorides per litre. Analogous facts have been previously noted with regard to *D. salinus* and *D. laticeps.* This latter species lives as well in the fresh waters of Scandinavia as in the Salzigersee, near Halle, the water of which contains 0·15 per cent. of salts.

Thus, the genus *Diaptomus* may be regarded as cosmopolite. In all probability future researches will lead to the discovery of new species in different parts of the globe, and will enable us to ascertain a much more extended geographical distribution for the described forms.

XXIII.—*Critical Studies upon some Odontoceti of the Genera* Tursiops, Orca, *and* Lagenorhynchus. By M. Chr. Lütken *.

I.

About twenty years ago Prof. Steenstrup acquired at Trieste the skin and skeleton of a small Dolphin captured in the Adriatic. On the amalgamation of our natural-history museums these two specimens passed into the Cetological collection of the University, and were mounted there, in 1865 and 1866, under the name of *Delphinus parvimanus*. In

* Translated from the 'Kongelige Danske Videnskabernes Selskabs Skrifter, naturvidenskabelig og mathematisk Afhandlingar,' ser. 6, vol. iv. pp. 391–397. The Danish memoir of which this is an Abstract occupies 54 pages (pp. 337–390), and is illustrated with two plates and a considerable number of woodcuts.

fact, the late Prof. Reinhardt, from considerations indicated by him in the Journal of the Museum, had arrived at the conclusion that this must be a new and undescribed species of the group of Dolphins to which belongs *Tursiops tursio*, also known in the North; but he did not publish any description of the species in subsequent years, during which he displayed great activity in other directions, also as an author. For my own part I was anxious to take up this question, partly because this name of *D. parvimanus*, unknown in literature, and not objectively justified, must attract the attention of competent visitors, and partly because some Italian zoologists who had remarked it, and for whom it had a special interest, had applied to me for explanations of this matter. The investigation was facilitated for me by the memoir which Prof. Flower, Director of the Natural History Museum in London, and one of the first cetologists of our time, has just published upon the genera of the family Delphinidæ, which rendered it possible to limit and define the question more clearly than before. It soon became evident to me that the young animal in question was a species of the genus *Tursiops*, and that, in many respects, it might be regarded as a dwarf form of the above-mentioned *T. tursio*. To clear up the question completely it would certainly have been desirable not to be confined to an isolated young individual, even though represented, as in this case, by both the skin and the skeleton; but it is nevertheless reassuring to be able to employ as terms of comparison four complete skeletons and ten crania belonging to the type-species of the genus. It is seldom that researches of this nature can be founded upon such abundance of material, and it is precisely for this reason that they have often given unsatisfactory results.

I at once perceived that it is vain to seek in the characters of the cranium for a certain criterion of the independence of the supposed new species. The most reliable character is perhaps the smallness and fineness of the teeth, although experience proves that we cannot absolutely trust to this. This was the case also with nearly the whole skeleton; throughout in the specimens of *T. tursio* there appeared a variation, partly dependent upon and partly independent of age, which exceeded anything that we could reasonably expect. The number of vertebræ, for example, varied from 62 to 64, and one could not count upon the number of the ribs. That there is a variation dependent upon age as regards, for example, the degree of development of the apophyses of the vertebræ, is easily understood when we know that these parts are not completely ossified until late, and, in consequence, that in young individuals they must present themselves in an abbreviated and comparatively undeveloped form; and there are many other variations which may be explained in an analogous manner. But the difficulty commences when an aged individual behaves in one or more particulars as if it was younger; in other words, when one of the features of organization which ordinarily accompany a certain age or a certain size is deficient, or at any rate is in a backward state—which of the two we do not at all know. Such experiences are very valuable, not only to explain an isolated case, but in general for the appreciation of the osteological differences that we observe between individual and individual, or between species and species; and they are only arrived at when we have sufficiently numerous materials to work upon. Hence the necessity of not giving to Natural-History collections too limited an extent, and the duty of seeking, by comparisons judiciously made, to obtain general results which may be made use of in analogous cases upon which the insufficiency of the materials does not enable us to judge directly. I will cite a few examples. The second of the first two cervical vertebræ, which are soldered together in these animals, always presents on each side a comparatively strong process or a transverse apophysis, which, when completely developed, is pierced by a large aperture; in the young animal it is short and imperforate, the portion which surrounds the aperture being still cartilaginous and no longer remaining in the skeleton when this is macerated. But what are we to think when we find that this part is nevertheless deficient in a skeleton which, by its size and other peculiarities, shows that it is older than another which possesses it; or, what comes to the same thing, that this formation appears in its full development in a skeleton which, in other respects, appears to be younger than another which does not possess it? The first piece of the sternum, the *manubrium sterni*, in the young *T. tursio*, as in many other Dolphins, is furnished with an apophysis on each side; in old individuals this apophysis is soldered below to the body of the *manubrium* by the ossification of a cartilaginous or tendinous ligament, which then appears to be perforated on each side by a round aperture. But how surprised one is at finding in still older individuals this hole opened out and converted into a notch, and the apophysis free, although we might have expected to find the contrary the case.

In the young *T. tursio* the first five ribs are the only ones which have a double articulation with the thoracic vertebræ, namely, by a tubercle with the transverse apophysis, and by the head with the body of the vertebra; all the rest have only the first of these articulations, for the simple reason that they have neither neck nor head. I now find in a good-sized *T. tursio* that the sixth rib has also this double articulation; and if in a *T. tursio* of medium size I have already observed an intermediate phase, that is to say, a neck in course of formation but without the head and too short to reach the body of the corresponding vertebra, I see with satisfaction that all is regular, for the enigma resolves itself quite simply into a gradual and rather slow ossification of the tendinous ligament which, in the sixth rib, takes the place of the neck. But, for this very reason, my surprise is the greater when, in a still larger skeleton, I find only five pairs of completely developed ribs, without any traces of head or neck on the sixth pair.

Being thus rendered doubtful with regard to all those characters which, at the first glance, seemed to be of importance, and having lost nearly all hope of discovering one which could serve me for the small form, whose right to constitute a species I am seeking to establish, I proceed in the last place to the comparison of the *limbs*, although prepared beforehand to obtain only a negative result, as I know very well that the number of phalanges in the digits is very variable in these animals, and that for a perfectly analogous reason, namely, that the ossification of the extreme phalanges only takes place at a late period, and is consequently irregular. But while the number of joints in *T. tursio* is pretty nearly as follows:—1–2, 7–9, 6–7, 2–3, 1–2, so that the second digit is always the longest, and the one that has the most joints, I find here that this number in *T. parvimanus* is:—2, 6, 8, 3, 1, or, in other words, *it is the third digit that is the longest and composed of the most joints*, and at once it is placed beyond doubt that this form is a species distinct from *T. tursio**.

As to whether it may be identified with the other little-known and doubtful species of the genus *Tursiops* (such as *T. catalania*) is a secondary question, which, moreover, can-

* Its diagnosis is as follows:—*Tursiops parvimanus* (Reinhardt): Minor, dentibus $\frac{25}{24}$, minoribus, gracilioribus (diametro antero-posteriore 6 mill.), vertebris 62, costis 13 paribus, quorum anteriora sex articulatione duplici cum vertebris conjuncta sunt; vertebræ caudales inde ab 43tia canali verticali utrinque ad basin processus transversi perforatæ; pinnæ pectorales minutæ, octavam partem longitudinis totius parumper superantes, digito tertio longiore, octo-articulato, secundo breviore sex-articulato. Caput, dorsum et pinnæ nigrescentes, venter griseo-albus. Longitudo pedes sex paullo superat. (In mari Adriatico semel inventus, forsan sæpius cum *T. tursionibus* junioribus confusus, vel crania sub nomine *T. catalaniæ* vel *T. cymodoceæ* descripta?)

not be solved until we possess authentic skeletons of these nominal species, only the crania of which are known, this, as we have seen, not being sufficient. The case under consideration has, in fact, taught us that a species of Dolphin may be perfectly justified as such, although we cannot indicate any distinctive character in the cranium.

II.

Eschricht, as is well known, in his uncompleted memoir upon the 'Carnivorous Cetacea,' arrived at the conclusion that in the northern seas there are no fewer than three species of the genus *Orca*. Death prevented him from proposing the names that they should bear. One of them, that which evidently has the best right to be recognized as a species distinct from the type-species (*O. gladiator*, Lac.), namely, the "Bovhidehval" of the inhabitants of the Faeroës, has since received the name of *Eschrichtii* from M. Steenstrup. Since then the question has remained in the same position. Reinhardt, who also accepted it, arranged it in the Museum under the name of *O. minor*, a name which was introduced into zoological literature by the late M. Malm. If we closely examine the ascertained differences between *Orca minor* and *O. gladiator*, both of which have the same very characteristic coloration, these differences (leaving out of consideration the supposition that the dorsal fin must always be higher in the old male *O. gladiator*) become reduced to this, that *O. gladiator* has 54 vertebræ and 12 pairs of ribs, while *O. minor* has respectively only 52 and 11. This is certainly not much, and therefore we need not be greatly surprised that this distinction has not been generally adopted by cetologists. Moreover, it must be admitted that scarcely any two authors agree as to their mode of regarding the supposed species of this genus, so that in taking for our guidance the opinions of cetologists, and the manner in which they arrange the different forms, we get lost in an inextricable confusion. Here, however, I have been able to introduce into the discussion some new materials which have led me to a definite opinion as to the species called *O. minor*. In September 1872 a family of three Grampuses was captured in the Limfjord, and of these the skeletons were acquired by the Museum, while the opportunity was taken to make a very good drawing of the adult female. The skeleton of the male, which was a little smaller than that of the female, was handed over by my predecessor to the Berlin Museum, but the other two, those of the female and of a young individual, have remained here, and some time since received a place in our Cetaceum. Reinhardt had referred them to *O. minor*, but without giving any reason for this determination. As both of them have 53 vertebræ and 12 pairs of ribs, it would seem from this alone that there is no real limit between this form and *O. gladiator*. Of course I did not stop at this, but I have carefully examined and compared our five skeletons of *Orca gladiator* (*minor*) of different sexes and ages, as well as a certain number of crania, separate limbs, &c., without being able anywhere to find anything to support the *specific* differences indicated by my predecessors. In this respect I must range myself by the side of the northern zoologists who, by the study of their own materials, have arrived at the same results. As in *Tursiops*, I find in all the characters individual variations and variations arising from age, but nothing more. I have particularly directed my attention to the crania, to which one is in the habit of appealing in the first place, and I have convinced myself that they present no differences of any importance. But by this we have succeeded only to a very small extent in advancing the question as to how many species the genus *Orca* includes, and what these species are. As regards the north I can only recognize two, and one of these, that which bears the name *O. Eschrichtii*, needs to be further studied upon new materials.

III.

Although the two northern species of the genus *Lagenorhynchus* are well known as regards their osteological characters, I have thought that it might be useful to submit to a new comparison the very considerable materials at my disposal, because these materials apparently form a more numerous collection than exists elsewhere, and because, in general, one has not often the opportunity of making such comparisons between two very distinct species of the same genus of Odontoceti. It is therefore permissible to believe that the results thus obtained may have a more general interest by aiding in the solution of analogous questions in cases where the materials available are not so complete. The principal results furnished by the comparison of four skeletons and of several crania of each of the species in question are given in the following statement:—

L. albirostris, Gr.	*L. acutus*, Gr.
The length of the skull in the adult animal is to that of the whole skeleton as 2 : 11, and is equal to the length of 16 vertebræ. The	The length of the skull is a little more than two elevenths or one sixth of the whole skeleton, and corresponds to 14 vertebræ. The muzzle

muzzle is shorter than the cranium properly so called, and its width at the base is about two thirds of its length. The upper part of the intermaxillaries in front of the nostrils (the "triangle") is inflated, and the part of the maxillaries which accompanies it is hollowed out into a groove. The teeth are about 26 in number in the half of each jaw, and there are never more than 30; they measure as much as 19 millim. in length and 7 millim. in diameter at the base; there are about 4 of them to one inch.

Vertebræ: 88–92=7+15–16+23–24+43–45. The last neurapophysis and the last parapophysis occur respectively upon one of the 76–79th and 69–72nd vertebræ, and the first perforant vascular canal upon one of the 67–69th vertebræ. The first two cervical vertebræ alone are soldered together by their bodies; in old individuals their comparatively short and broad spinous apophysis is also soldered to the two following; their transverse apophysis is rounded and massive, and the superior transverse apophysis of the seventh cervical vertebra is not shorter than that of the first thoracic vertebra. The *prosternum* is flat, with a deep notch starting from the anterior margin (it may also be perforated). The first 6 or 7 pairs of ribs are furnished with a head and a neck. The scapula is comparatively broad; its height is to its breadth as 2 : 3. The whole skeleton is exceedingly robust in old individuals, the intervals between the neurapophyses are insignificant, and strictly speaking there is no part of the vertebral column in which the metapophyses are completely wanting. The longest neurapophyses correspond with $6\frac{1}{2}$ vertebræ, the longest parapophyses with 5, and the neurapophyses of the caudal vertebræ are more vertical.

The broad anterior limbs in adult individuals are not quite one sixth as long as the whole length of the skeleton. The number of joints in the digits is 1, 9 (10), 7, 4, 3; the

is in general longer than the cranium properly so called, and its width at the base is equal to about half its length. The upper part of the intermaxillaries (the "triangle") is flat and slightly hollowed, and the contiguous parts of the maxillaries are not hollowed out. The teeth are about 35 in number, and not more than 40; they are about 10 millim. long and about 3 millim. in diameter at the base; there are about 5 of them to one inch.

Vertebræ: 78–82=7+14–15+18–22+38–41. The last neurapophysis and the last parapophysis are respectively upon one of the 67–70th and 63–65th vertebræ, and the first vascular canal upon one of the 55–61st vertebræ. The first four cervical vertebræ, in adult individuals, are soldered together both by the bodies and the arches, their spinous apophysis is high and delicate; the transverse apophysis of the first two is flat, and the transverse apophysis of the seventh is not much developed. The prosternum is perforated, but without a notch, very convex or as if broken, and its anterior part is hollowed out crosswise. The first 5–6 (7) pairs of ribs are furnished with a head and a neck. The scapula is not so wide, its height being to its width as 2–2·5. The skeleton is of a less robust character, the intervals between the apophyses of the vertebræ are greater, there are 11–16 vertebræ without distinct metapophyses, the longest neurapophyses correspond to $4\frac{1}{2}$ vertebræ and the longest parapophyses to $3\frac{1}{2}$. The neurapophyses of the caudal vertebræ are directed more obliquely forward.

The length of the narrow and pointed anterior limbs is scarcely one seventh of that of the whole skeleton. The number of joints in the digits is 2 (3), 10 (9), 6 (7), *L. albirostris*, Gr.

thumb therefore consists only of the metacarpus.

As to the animal itself, it is well characterized by the white colour of the upper lip, by the large size and breadth of the anterior limbs, and the faint indication or total absence of the whitish band or spots.

L. acutus, Gr.

3 (1), 1, and the thumb has consequently 1 (2) true phalanges.

The smaller and more pointed anterior limbs, the dark-coloured upper lip, and the distinct and clearly defined light lateral band well characterize this species.

I do not attempt to contribute anything towards the knowledge of the exotic species of the same genus, which, in general, seem capable of being referred to the two preceding types, but the relations of which to the northern species have not yet been submitted to a critical examination; but I will nevertheless remark that the late Prof. Malm, in a memoir which has unfortunately escaped the notice of Prof. Flower, has recorded a *Lagenorhynchus clanculus*, captured at Cape Horn, the skeleton of which contains only seventy-one vertebræ. It is therefore without doubt a distinct species from *L. albirostris*, and the diagnosis of the genus, so far as the number of vertebræ is concerned, must in consequence be modified. Nor will it be superfluous to remark that the genus *Lagenorhynchus* must be ranged in that division of the Odontoceti (the true Dolphins) to which belong the genera *Delphinus*, *Prodelphinus*, *Steno*, *Tursiops*, and *Sotalia*, and which is distinguished by the character of having the beak plainly separated from the frontal convexity.

BIBLIOGRAPHICAL NOTICES.

The Flora of West Yorkshire, with a Sketch of the Climatology and Lithology in connection therewith. By Frederic Arnold Lees. 8vo. Pp. 843, with Map. London: Lovell Reeve and Co., 1888.

A volume of 843 pages with the numberless facts that a Flora of a large district implies is a difficult subject to compress into a short notice, especially when there are matters touched on in this work that a student of our Flora from its distribution-point would be tempted to be too discursive on.

The author dedicates his book to the late Rev. W. W. Newbould, and a better dedication could not be, for to few men are given the power of unselfish help that he possessed.

One peculiarity of this Flora may well be mentioned; the author has (as in other places) attempted a phraseology which Mr. H. C. Watson almost made his own; the master has passed away, his would-be pupil lacks the power though not the will to express it. Readers will note at its first page an innovation, where he uses a word not often seen in modern English books, *i. e.* "Foreword."

A map showing the districts adopted, as well as other matters, has here (as, unfortunately is the case with other Floras) too much crowded into it; the expense of a second map would perhaps have been too much, still it is a pity. For working purposes the botanical districts alone should be shown and all the other matters relegated to a second map.

The Climatology is treated fully in sixty-one pages; the conditions prevailing in a district where the hills ascend to 2414 feet altitude must naturally present many features of interest, and these the author has worked out fully, though sometimes arriving at conclusions hardly compatible with the facts. We are not yet in a position to dogmatize too much on many of these points. Some of the tables given are well worth careful study.

With regard to cold and the action of frost on various soils, the writer of this thinks a fact has been lost sight of with respect to its power of destroying vegetation, *i. e.* the rending power it possesses when freezing the soil. In sandy soil covered by snow for three winters to about an equal degree, plants of the Channel Isles survived great cold; in the next winter, with hardly any snow, they were killed *wherever the soil was fissured with frost*; but close by, with slight protection from other plants, they survived; on examination being made the roots were found to be torn asunder wherever the fissures were—hence their death.

A chapter on Lithology, of twenty pages, treats of the "Rock types" as differentiated by M. J. Thurman. Mr. Baker, who first applied the arguments of M. Thurman to our Flora, has been followed by the author, with, of course, local differences.

Respecting dry and calcareous soils, it may be noted that where the Upper Chalk joins the pebble-beds of the Thanet Sands in Surrey apparently the same conditions prevail as to heat and moisture; on both water rapidly drains away, and the mechanical coherence or the chemical constituents must make the difference in the vegetation. The Horseshoe Vetch exactly marks the demarcation of the chalk; although seeds must be blown on the pebble-beds, yet not a plant of it can be found on them. *Verbascum lychnitis* grows (or grew) in abundance on chalk by the roadside; on the same roadside not a single plant has ever been seen by the writer on the pebble-beds, yet the physical conditions are such that seeds *must* be carried by rains &c. on to them.

Following the Lithology is the "Bibliography, 1548–1885," a "Plan of the Flora," and the Flora proper, the Phanerogams and higher Cryptogams with 412 pages, followed by the rest of the Cryptogams in 253 pages. "Addenda-Omissa" and indexes complete the book.

A good many "British" plants seem to find their north (native) limit in Yorkshire, though it is by no means to be assumed that such will be the case when some portions of southern and south-western Scotland come to be more carefully examined; the writer of this believes that many will be found to extend to that part of Scotland though skipping the northernmost counties of England.

In a few instances the author has not availed himself of the full material at his command, notably under *Geranium nodosum* (p. 179) and *Carex Gibsoni* (p. 465), yet he quotes Borrer's *herberium* at p. 344, presumably seen by himself (*vide* explanation of Flora).

For the Batrachium Ranunculi Dr. Lees constructs a "schema" of his own, although he has arrived "at a profound conviction of the truth of the grouping given by Sir J. D. Hooker in the third edition of the 'Student's Flora.'"

Whatever Dr. Lees's var. *incumbens* of "*Ficaria verna*" may be, the plant of Boswell-Syme is certainly not a hybrid of the usual form with *Caltha palustris.*

Under *Hieracium Gibsoni* the author observes "this has yellow styles, and it runs into *H. maculatum*; it is clearly allied to *H. cæsium*." After having *H. Gibsoni* growing for some years along with *H. vulgatum* var. *maculatum* and others of the genus the writer demurs to this, and would say that it keeps perfectly distinct and can be picked out by its seed-leaves alone from *maculatum* &c. He also gives the *H. maculatum* of Smith as a synonym of *vulgatum* var. *maculatum* of Backhouse; according to Syme, in 'English Botany,' this is not so, as Backhouse named specimens of Smith's plant—"var. *nemorosum* of *vulgatum*."

Under *Potamogetum pusillus* "var. *rutilus*, Wolfgang," the description of this supposed plant will easily apply to forms of *pusillus*; the true plant of Wolfgang is rare, and many specimens so named are not it!

One query suggests itself at the last: Are not our Floras becoming too bulky? If Cryptogamic botany still advances with the rapid strides it has done lately it will become a matter of consideration whether it would not be well to publish the Cryptogams as a volume. ARTHUR BENNETT.

Bulletin of the New-York-State Museum of Natural History. No. 3. March 1888. 8vo. Albany, 1888. Pp. i–vi, 7–152.

THE whole of this number of the Bulletin is occupied by a paper by John C. Smock on the "Building Stone in the State of New York." The rocks are arranged as I. "Crystalline," and II. "Subcrystalline and Fragmental." The former comprise 1. Granites, syenites, gneisses, mica-schists; 2. Trap-rocks; 3. Marbles, serpentines. The latter have 1. Quartzytes [*sic*] and sandstones; 2. Limestones; 3. Slates; and these are arranged in geological groups, all except some "New Red Sandstone" belonging to either the Silurian or the Devonian formation. The geological position and geographical distribution of the various Building-stones in the New-York-State are described at pages 9–24; and descriptive notes of these materials, the quarry-districts, and the quarries follow (pp. 25–143). Some statistics of the quarries and their products are given at pp. 145 and 146; and a useful index follows. The author supplies careful notes on the size of the quarries, the date of opening, the possessor, and the buildings constructed of the several kinds of stone; also particulars as to the dip of the strata, direction of joints and cleavage, petrography, water in the stone, the size of obtainable blocks, and the machinery employed in raising them. This memoir has been the work of an industrious and conscientious observer, who acknowledges the kind help of numerous owners, managers, and superintendents of quarries, and refers to specimens of the rocks, illustrating their nature and economic value, that have been deposited in the New-York-State Museum at Albany.

MISCELLANEOUS.

Note on the Sense of Direction in a European Ant (Formica rufa). By Dr. Henry C. McCook.

The author remarked that during the summer of 1887 he had made an observation upon the well-known "horse-ant," or *Formica rufa*, of Great Britain. While visiting the Trosachs of Scotland he found a number of nests of this species scattered throughout the glen known as the Pass of Achray, through which flows the little Achray River, "the stream that joins Loch Katrine to Achray." These nests are found on either side of the foot-walk which leads from the Trosachs glen to the "sluices," as they are popularly called, which regulate the stage of water in Loch Katrine.

1. *Structure of the Ant-hills.*—The mounds raised by the rufous ants are heaps of earth intermingled with chippage of various sorts; they rise to the height of about three feet, and some of them are six or seven feet in diameter across the base. They stand amid the tall bracken which overhangs them, and at times almost conceals them from the passer-by. The surface of the mounds is covered with bits of straw and leaves, stalks of grass and ferns, and various material of like sort which forms a quite decided thatch. Numbers of openings appear upon the surface at irregular intervals from the summit to the base, and in the afternoon at 4 o'clock the workers in vast numbers were dragging the chippage back and forth, apparently engaged in closing the doors for the night, although time did not permit an observation of the actual closure.

2. *Character of Roads and Engineering Skill.*—That which especially attracted Dr. McCook's attention was the character of the roads leading from the ant-hills to the various points in the sur-

rounding woods. These roads or trails were distinctly marked upon the surface of the ground, having in places a width of from two to four inches which was stained a dark brown or black, probably by the formic acid exuded from the insects; the leaves and grass upon which the trail was made were pressed down and smoothed by the constant action of innumerable legs upon the surface. So well marked were the trails that even without the presence of the columns of insects that thronged back and forth upon them they were distinctly and easily traced. While following up one of these roads the observer was impressed by the fact that it showed scarcely any deviation from a straight line. In order to test this matter more carefully, he selected a large mound from which three roads radiated. These were all traced to their termination at three several oak-trees, up which the columns of ants ascended in search of food-supply from numerous aphides which infested the branches of the trees. The ant-roads were then carefully marked out by stakes stationed at short intervals, a course which was made necessary by the fact that they were carried for considerable distances beneath the tall bracken, which had to be pushed aside in order to reveal them. The result of his observations is as follows:—

Road no. 1 was twenty-one paces in length (about 65 feet) and was carried in an almost perfectly straight line from the nest to the terminal tree. No. 2 was twenty-three paces in length (about 70 feet). It varied less than 3 inches from a direct line measuring from the nest to a point within 2 feet of the terminal tree. There the column made a detour of about 6 inches from the straight line; but an abandoned path, continuous with the main road, which had apparently been used at a recent date, was traced for a considerable distance further without any deflection. No. 3 was the longest road of the three, being thirty-four paces in length. It extended for six paces in a straight line from the nest, at which point it touched an old stump, which evidently deflected the path at a slight angle. From this point it was again continued in a nearly straight line as far as the beaten foot-path through the wood. Here the ant-trail was obliterated by the friction of passing human feet, but the ants themselves thronged over the pathway in a column much broadened by continual interference and loss caused by foot passengers. The trail was, however, resumed at a point nearly opposite that at which it touched the path, and was continued again in a straight line six paces further to the tree, where it terminated. When the entire trail was staked off it was found that its terminus deviated less than 3 feet from a straight line drawn from the point of departure at the ant-hill. The greater deviation in this case seemed evidently to have been caused by the peculiar difficulties in the chosen track. The three roads so radiated from the nest that they were included within about one quadrant of a circle, of which the two shorter trails might represent the radial boundaries of the quadrant, while the longer trail was drawn nearly midway between the two.

Taking the results of the three observations together it is manifest that the ants showed an accurate sense of direction in marking out and following their approaches to the trees. It would be scarcely reasonable to attribute such mathematical accuracy as above shown to mere accident. The roads in point of directness were as accurately laid down as ordinary roads made by the engineering skill of men. The skill of the ants was all the more apparent from the fact that their paths were carried through the jungle of bracken and various other wood-plants. The same fact appears to indicate that the insects could not have been largely directed by the sense of sight *. It would perhaps be idle to speculate upon the manner in which this feat of emmet-engineering was accomplished, as there were no facts observed which give a clue to the mode of proceeding; but the problem is one well worth study by naturalists on the ground.

3. *Engineering of Texas Cutting-Ants.*—The author in this connexion alluded to an observation which has heretofore been placed on record † describing an underground route of the cutting-ant of Texas (*Atta fervens*). This route extended 448 feet, entirely beneath the surface of the earth, at some places as deep as 6 feet, and having an average depth of 18 inches. From the points at which the ants came to the surface the road was continued in a straight line 185 feet further to a tree in a gentleman's private grounds, which the ants were engaged in defoliating. The entire length of the roadway was thus 669 feet, and the path as laid out by a young engineer who assisted in the observation shows scarcely less deflection from a straight course than that of the rufous ants recorded in the above observation.

4. *Sentinels.*—The longest of the three trails alluded to made by the Scotch ants terminated upon an oak-tree, which was also occupied by a column of ants from a neighbouring hill. The two columns rigidly maintained their places on opposite sides of the trunk. Sentinels were scattered along either margin of both columns, and these exhibited great watchfulness and sensitiveness to the approach of any object. The author, on approaching his finger to these sentinels, observed that they seemed to perceive his finger when it reached a point an inch or an inch an a half distant from the bark. At once the ants thrust out their antennæ, extended their heads, then the two front legs, and finally the middle legs, thus hanging to the bark of the tree by the hind legs alone, the abdomen being slightly turned underneath the body, as though prepared to eject formic acid upon any adversary. In one case at least the ant hung to the bark by one hind foot alone, extending the whole body in a perpendicular direction from the surface of the tree It presented a grotesque appearance, and exhibited every sign of eagerness and vigilance in the discharge of its duty as watchman.

* The vision of ants is probably limited within a very short distance from the eyes; under any circumstances, therefore, it could have but little influence in determining such a phenomenon as here recorded.—H. C. McC.

† See the author's 'Tenants of an Old Farm,' p. 264, fig. 90.

Several individuals were taken from one column and placed in the line of march of the ants from the other nest. They showed the usual evidences of strangeness and failed to fraternize; but, on the other hand, no one was assaulted by the passers by, a toleration worthy of note, as showing some degree of community among the various nests of the one species.

The time which the author could give to these observations was limited to several hours of a summer afternoon, which he spent as a tourist in this interesting mountain-region; but they present some conclusions which appear to be reasonably decisive, and which at least may serve to stimulate further observations in the same line extending over greater periods and including a greater number of cases.—*Proc. Acad. Nat. Sci. Philad.* November 1, 1887, p. 335.

On some new Species of Ceponina. By MM. A. Giard and J. Bonnier.

The Ceponina, or Epicarides parasitic upon the Brachyurous Decapods, until within the last few years were known only by a very small number of species which were very insufficiently described. Since the publication of our Monograph on *Cepon elegans*, with a revision of the group, we have received abundant materials for study, which enable us to extend considerably the notions arrived at with regard to these curious Isopoda.

Prof. Milne-Edwards has furnished us with a Ceponian parasitic upon the *Nautilograpsus minutus*, Fabr., of the Sargasso Sea. Prof. J. R. Henderson, of Madras, has sent us a *Portunicepon* parasitic upon the *Thalamita callianassa*, Herbst, of the Indian seas. Lastly, M. A. Agassiz, having been kind enough to confide to us for description the superb series of Epicarides belonging to the museum of Harvard College (Cambridge, Mass.), we have found in this collection a very interesting type, collected at the Society Islands upon *Trapezia dentifrons*, Latr.

The Cepon of the *Nautilograpsus*, which we shall call *Grapsicepon Edwardsi*, appears to be a comparatively abundant species. Of 326 *Nautilograpsi* collected on the 4th August, 1883 (voyage of the 'Talisman'), 32 bore parasites either on the right or on the left of the carapace, 2 were infested at the same time both to the right and left, and the two sexes are equally attacked by this *Cepon*.

This parasite produces no apparent deformation of the carapace of the *Nautilograpsus*. Nevertheless it is easy to recognize its presence in consequence of the transparency of the integuments of the crab, which enables us vaguely to distinguish the outlines of the Bopyrian. The reddish colour of the adult female of *Grapsicepon Edwardsi* persists very well in alcohol and greatly facilitates the search for it. The influence exerted upon the internal organs of the host seems to be very slight. A good number of infested females of the *Nautilograpsus* bear ova under the tail in as considerable quantities as the healthy females.

As in all the *Grapsicepones*, the pleal plates of the female of *G. Edwardsi* are finely and regularly fringed. The maxillipede has exactly the same form as in *G. Messoris*, Kossm., but it is distinguished specifically by the absence of all denticulation. There are two dorsal bosses, upon the middle of the sixth and seventh thoracic segments, that on the seventh segment being the larger.

Hitherto the males of *Grapsicepon* were unknown. That of *G. Edwardsi* is very remarkable. By its much smaller amount of degradation than in the other Ceponians it approaches the *Leidyæ*. The pigmentation is very strong; the segments of the pleon become narrower very rapidly from in front backwards; each of them bears *biarticulate* pleal feet. The lateral appendages of the pygidium, although not so long as those of the males of *Leidyæ*, are very prominent and inflected towards the ventral surface. The median ventral bosses extend upon the first three pleal segments and are sometimes much pigmented.

We have only been able imperfectly to study the *Cepon* parasitic upon *Trapezia dentifrons*. Having at our disposal only a unique specimen collected by J. M. Barnard (*fide* A. Garrett), we have been obliged to abstain from any dissection; but the mere external examination of this parasite, which we name *Grapsicepon amicorum*, possesses much interest. In fact there still exists a certain amount of hesitation as to the systematic position of the *Trapeziæ*. Prof. H. Milne-Edwards made these Crustacea, under the name of "*Cancériens quadrilatères*," into a group intermediate between the Catometopa and the Cyclometopa, with which he connected them through the *Eriphiæ*. E. Nauck, relying upon the characters furnished by the stomachal armature, regards the *Trapeziæ* as quite distinct from the Cyclometopa, and inclines to approximate them to the division Heterodonta, in which he places the Gelasimidæ and Pinnotheridæ.

The study of *Grapsicepon amicorum* seems rather to furnish arguments in favour of Milne-Edwards's opinion. The female is very large relatively to the size of the host. It is of a brownish colour and its dorsal integument is shining, like that of *Trapezia*. There are no dorsal bosses, which approximates this species to *Cepon typus*, from which it differs completely, however, by the form of the coxal pads. The plates and appendages of the pleon are like those of *Grapsicepon*; the male is much pigmented; the ventral bosses exist only upon the first segment of the pleon; they are voluminous and covered with denticulate scales. The pleopoda are biarticulate, with the terminal joint rudimentary. The lateral lobes of the pygidium are much shorter than in *Grapsicepon Edwardsi*. In fact the characters of this species approximate it rather to the Ceponians parasitic upon the *Grapsi* than to the *Leidyæ*, parasites of the *Gelasimi*; therefore, to avoid the establishment of too many generic groups, we place it provisionally in the genus *Grapsicepon*.

We give the name of *Portunicepon Hendersoni* to the Ceponian parasite of *Thalamita callianassa*, Herbst (*Goniosoma*, A. Milne-Edwards). This species appears to be pretty frequent at Madras, whence Prof. Henderson has sent us four specimens upon *Thalamitæ* collected in 1887 in shallow water. The parasite produces a very slight deformation of the carapace. The female is at once distinguished from that of *Portunicepon portuni*, Kossm., by having only two dorsal bosses, upon the sixth and seventh thoracic segments (that of the sixth segment much larger than the following one). The fringes of the pleal appendages are fine but unequal, and the pleon is less elongated than in *Grapsicepon*. The male is much degraded; the pigment is scanty, and the lateral lobes of the pygidium are nearly confounded with the median portion; the pleal feet are very rudimentary; nevertheless they exist, while, according to Kossmann, they are entirely wanting in *Portunicepon portuni*. The ventral buttons are not very visible and much less prominent than in *Grapsicepon*. In fact, as might be expected from the systematic position of the host, the parasite of the *Thalamitæ* especially resembles the Cepons of *Portuni*, and we place it provisionally in the genus *Portunicepon*.

Hitherto the Bopyrians have been met with upon the Crustacea which live in small bays with quiet water. *Grapsicepon Edwardsi* shows us that the Sargasso Sea also furnishes conditions of medium favourable to these animals; moreover, we already know there *Bopyroides latreuticola*, Gissler, a parasite of *Latreutes* (*Hippolyte*) *ensiferus*, M.-Edw. But a recent discovery demonstrates that even the Crustacea of great depths are not exempt from the attacks of the Epicarides. Prof. A. Milne-Edwards has kindly sent us a superb Bopyrian, *Pleurocrypta formosa*, G. & B., which is parasitic upon *Ptychogaster formosus*, A. M.-Edw., a splendid species of Galatheid dredged at a depth of 946 metres at the Canary Islands, during the voyage of the 'Talisman.' We shall shortly publish a description of this Epicarid; but we cannot conclude this note without publicly thanking MM. A. Milne-Edwards, A. Agassiz, and J. R. Henderson for the valuable materials of which they have enabled us to make use.—*Comptes Rendus*, July 2, 1888, pp. 44–47.

On Henops brunneus, *Hutton*. By W. M. Maskell, F.R.M.S.*

About October last a resident in the Wairarapa district sent down to the Colonial Museum a few twigs of apple quite covered over with some black substance, amongst which were slowly crawling about half a dozen rather large flies; and he desired some information on this, which he considered as a new "blight," stating that it occurred on both apple- and peach-trees in his garden. The specimens were referred to me; and at first sight I thought the sooty-black coating to be the usual fungus accompanying scale-insects, the flies being unconnected with it. Closer examination, however, showed that

* From the 'Transactions of the New-Zealand Institute,' vol. xx. Communicated by the Author.

the black mass was really composed of many thousands of eggs; and the flies were soon observed to be still laying more of these eggs on the twig, until in a short while it was so thickly covered with them as to be quite hidden. With the assistance of Mr. G. V. Hudson I found that the flies were undoubtedly *Henops brunneus*, a species of Dipteron hitherto only reported (in Hutton's 'Catalogue of New-Zealand Diptera') from Lake Wanaka. I was able to assure the gentlemen who sent the specimens that probably they would not do great harm to his trees.

But the investigation so far showed that the knowledge of *Henops* hitherto possessed was incomplete. The available works in which it is mentioned were Hutton's 'Catalogue' and Westwood's 'Classification of Insects.' In the former the description given is very short and indefinite; in the second it is stated that *Henops* and its allied genera are very little known and "the larvæ have not been observed." I placed one of the apple-twigs covered with eggs in a glass box, in the hope that the larvæ might possibly be hatched, and after about five or six weeks I found a perfect cloud of minute larvæ, wriggling in the liveliest manner. Having thus achieved a further stage of knowledge of this species, and the fly itself being in some respects rather a curious one, I have ventured to bring forward the following description of the larva and the imago. Unfortunately, not being able to procure a supply of apple- or peach-leaves, I have not succeeded in feeding the larvæ and obtaining pupæ. I tried various leaves as food for them, as well as giving them earth to burrow in, but they all died.

Order *DIPTERA*.

Suborder OVIPARA.

Family Acroceridæ, Leach.

(*Inflatæ*, Latreille; *Vesiculosæ*, Macquart.)

Body short and thick; head bent down, small, entirely occupied by the eyes; thorax and abdomen large, inflated; proboscis variable, sometimes long, sometimes absent.

Genus Henops, Illiger.

(*Ogcodes*, Latreille.)

Proboscis very short, scarcely noticeable; antennæ of two short joints with a long style. Eyes naked, compound. Abdomen broader than the thorax.

Henops brunneus, Hutton.

(Cat. of Dipt. 1881, p. 25.)

Flies rather large, but squat-looking and heavy; motions very slow. Thorax much elevated, the head being bent down beneath it, so as not to be visible when the insect is viewed from above. Abdomen round and swollen, wider than the thorax, but seeming as if cut off short, the posterior extremity being turned under; there are six segments in the abdomen. *Colour* dark brown, almost black, on the thorax, with short yellow hairs; abdomen dark brown, with a yellow band marking each segment; head black; wings hyaline; halteres yellow. The *winglets* are very large and scale-like. *Eyes* very large, compound, occupying all the upper part of the head, but not highly convex. *Antennæ* inserted in front, between the eyes; two-jointed, both joints very short; the style is very long, inflated near the base, narrow in the shaft and slightly dilated at the tip, where there are two short bristles. *Proboscis* very short, almost obsolete, conical, placed so much beneath the down-turned head as to be extremely difficult to detect. *Feet* long and slender; tarsus five-jointed; claw double, with three pulvilli. *Wings* with brown costal and subcostal veins; discoidal cell open; cubital cell large; the postical vein appears to have a branch almost if not quite disconnected. *Length* of the body, in the usual position, nearly $\frac{1}{5}$ inch.

The eggs of this insect are very small, sooty black, truncate-ovate; as stated above, they are laid in such numbers as to cover a twig with a black coating.

The [newly hatched] larvæ are very minute, about $\frac{1}{60}$ inch long; dark grey or brown in colour; elongated, narrow, tapering at both ends, with twelve distinct segments, of which the fourth from the head is the widest; on each segment is a row of short fine hairs. They have a wriggling mode of progression forwards, and are in constant motion. The head is pointed and terminates in two very small hooks, with a pad or pulvillus. The posterior extremity is also acute, ending in three very minute points, with, on each side, a thin curved appendage. The spiracles are only two, very minute circular orifices, situated on the last segment but one.

Both Mr. Hudson and I tried without success to procure the pupæ. The larva of a fly not far removed from *Henops* (*Clitellaria*) is said to take more than two years before undergoing its transformation.

In consideration of the fact that the larvæ of the whole family of Acroceridæ have not hitherto been known, and that the descriptions of the various genera are but fragmentary, the above account of *Henops brunneus* may be of interest. The larva would seem to be perhaps more similar to those of *Cecidomyia* than to any others of the order, though the perfect fly is quite different.

On the Systematic Position of the Genus Hero. By M. A. Vayssière.

Among the Opisthobranchiate Gasteropods there are some genera the systematic position of which is still uncertain. Having had the opportunity of capturing, in the Bay of Marseilles, two or three individuals belonging to one of these genera, I set myself the task of establishing their characters.

The genus *Hero*, established by Lovén in 1839 for some small mollusks collected in the seas of the north of Europe, has hitherto been placed, by all naturalists (Alder and Hancock, G. O. Sars, Bergh, Fischer, &c.) who have paid any attention to it, in the family Dendronotidæ, one of the subdivisions of the great group of the Tritoniadæ. All these different naturalists seem to have had at their disposal only individuals preserved in alcohol; the figures given by Bergh and Sars would lead to the belief that the appendages with which the whole extent of the margin of the mantle is furnished are dendritic in form. We believe that this appearance is the effect of preservation in alcohol.

The study of the jaws and radula ought to have shown that the genus had nothing to do with the Dendronotidæ.

On observing living individuals, we at once see, from the conformation of their lateral appendages, that the genus *Hero* belongs to the great group of the Æolididæ; in fact, these appendages, which, in individuals preserved in alcohol, have a dendriform appearance, are really true fusiform dorsal cirri, arranged symmetrically in pedunculated groups upon the lateral parts of the back. These groups of cirri have much analogy with those of *Calura Cavolinii*; only in the genus *Hero* we find in front of the body, on the sides of the cephalic region between the labial tentacles and the rhinophores or dorsal tentacles, a pair of tufts of cirri which are entirely deficient in the genus *Calura*. These two tufts possess the longest and most numerous cirri; all the groups posterior to the rhinophores each present only one, two, or three rudimentary cirri.

From our investigations, the following generic diagnosis may be drawn:—

General form of the body resembling that of the Tritoniadæ, with its dorsal margins distinctly keeled; foot a little wider than the body.

Labial tentacles strong and recurved; rhinophores simple and non-retractile. Dorsal cirri fusiform, inserted dichotomously upon short peduncles arranged on the lateral parts of the back; the peduncles of the first pair, placed in front of the rhinophores, are the only ones forming groups well-furnished with cirri; all the post-rhinophorian peduncles bearing only one, two, or three rudimentary cirri. Cnidophorous sac with numerous nematocysts.

Anus in the middle of the right flank; sexual orifice on the same side, but placed further forward. Penis unarmed.

Jaws with irregular denticulations on the masticatory margin. Radula triseriate; median tooth with the plate denticulated.

Œsophagean ring composed of four ganglia (two cerebroid and two pedal ganglia); eyes pedunculate; otocysts with numerous otoliths.

The individuals taken in the Bay of Marseilles differ in several characters derived from the radula and jaws from the *Hero formosa* studied by Sars and Bergh. We regard them as representing a new species.—*Comptes Rendus*, July 9, 1888, pp. 136–138.

On Fascicularia radicans, *C. Vig., a new Type of Anthozoan.* By M. Charles Viguier.

When dredging in the mud of the harbour of Algiers, about the middle of last April, we collected this little Alcyonarian, which lived for two months in the aquaria of the new Zoological Station. I made a detailed investigation of this new type, but it is unfortunately incomplete in several points.

The only specimen collected was a female colony attached to a fragment of charcoal, which it covered with a network of slightly flattened anastomosing stolons, from 3 to 6 millim. broad. Upon these stolons, at very variable intervals, and sometimes nearly touching each other, rose groups of polyps, which, when in the extreme state of contraction, considerably resembled those of *Paralcyonium.* But as soon as the colony begins to expand, it is seen that we have to do with a very different type.

Thus while in *Paralcyonium* the basal portion is surmounted, in the state of complete expansion, by another common portion of still larger dimensions, or, in one word, the polypary divides into two portions—one soft and retractile, the other hard, within which the former folds itself up,—in *Fascicularia* there is no other common portion than the base itself, and far from the polyps being fixed one upon the other, or, more correctly, incompletely separated, they are here entirely distinct to the level of the apex of the basal column, and at this point their separation is very clearly marked by white lines, produced by spicules occupying the top of the interpolypary partitions. The rest of these partitions does not contain any spicules; but the common wall which surrounds the bundle of polyps is sustained by a palisade of long white vertical spicules which give it its characteristic rigidity. If we make a section perpendicular to the axis of this basal column, we see that the cavity of each of the polyps is perfectly distinct from that of its neighbours, and that even the young polyps are separated very early from that upon which they have budded forth. Moreover, each of the polyps retracts itself separately into its proper cell, or, more correctly, into its basal portion, and enjoys a perfect independence with respect to its neighbours. It is only when the retraction of all the polyps is complete that the column itself begins to retract as much as is permitted by the spicules with which its wall is furnished.

The free portion of the polyps in the state of extreme expansion may attain double the height of the basal column, which gives, for the whole, a maximum height of 16–18 millim, The number of polyps does not appear to exceed 10–12 per bundle. These polyps have the tentacles relatively very long, and of a bright greenish yellow on the buccal surface. On the outer surface, on the contrary, these tentacles, as well as the whole of the œsophagean region of the polyp, are of a very dark brown colour, upon which there is a pure white collar, formed of spicules with a peculiar crystalline texture, in no respect resembling the ordinary spicules. Below the œsophagean region the colour of the polyp becomes much lighter; the tube becomes almost translucent, and allows the lines of insertion of the septa to be traced. Then the colour deepens again to the point of union.

From this description it will be seen that we have to do with an animal perfectly distinct from *Paralcyonium*, although it is with that form that it presents the most affinities. *Fascicularia*, I think, must form the type of a third subfamily, the Fascicularinæ, intermediate between the Cornularinæ and the Alcyoninæ, into which, at present, it is generally agreed to divide the family Alcyonidæ.—*Comptes Rendus*, July 16, 1888, pp. 186, 187.

On the Resemblance of the Primitive Foraminifera *and of Ovarian Ova.*

Prof. Ryder remarked that upon cutting sections of nearly mature ovarian ova with their investing membrane, zona radiata, in place, it was found that, in quite a number of cases, fine protoplasmic processes or pseudopods extended from the peripheral layer of protoplasm of the egg, through its capsule or zona, and joined the cells of the granulosa or discus proligerus. This arrangement reminded one forcibly of the filamentous pseudopods extended from a Heliozoön, or of the slender pseudopods extended through the perforations in the walls of the single chambers of *Globigerina*. This resemblance is all the more suggestive if one will compare a section of one of the chambers of a *Globigerina* made through the calcareous shell and its contained protoplasm with a similar section through the ovum of the Gar Pike, where the zona is formed of pillars of homogeneous matter. Such prolongations of pseudopods through the investing zona radiata, in the case of many species of animal forms, shows fairly well that this must be the principal means by which new matter is taken up from without and incorporated, as there is no direct extension of the vascular system into the egg, by which it can take up nutriment. It is thus seen that the early stages of the growing ovum not only resemble some of the lower forms of Heliozoa and Foraminifera as respects the grade of their morphological differentiation, but also as to the mode in which they exhibit their nutritive or physiological activities. This resemblance is still further heightened if a form like *Orbulina* is compared with certain stages of the development of ova. It is thus seen that, in many cases, the ovarian germ, at least, passes through a stage which may be morphologically as well as physiologically compared with some of the lowest grades of the Protozoa.—*Proc. Acad. Nat. Sci. Philad.* Feb. 14, 1888, p. 73.

The Pelagic Fauna of the Lakes of Auvergne. By M. Jules Richard.

M. Jules Richard has printed a tabular statement of the pelagic fauna of the Lakes of Auvergne which is of much interest in connexion with the increased attention now being paid to the inhabitants of the deeper parts of lakes in Europe and elsewhere. It is as follows:—

Names of Species. (The pelagic species are marked with an asterisk.)	Lake Pavin.	Lake Chambon.	Lake de Guéry.	Lake Montcineyre.	Lake Bourdouze.
*Daphnia longispina, *Leydig*	*****	..	**	*	***
*Hyalodaphnia cucullata, *Sars*, var. apicata, *Kurz*	..	*****			
Polyphemus pediculus, *de Geer*	*				
*Daphnella Brandtiana, *Fischer*	..	***	..	..	***
*Holopedium gibberum, *Zaddach*	..	..	*****	***	
Sida crystallina, *O. F. Müller*	..	..	..	*	*
*Ceriodaphnia pulchella, *Sars*	..	..	..	*****	***
*Bosmina longirostris, *O. F. Müller*	..	*	****	**	***
Alona affinis, *Leydig*	*	..	..	***	**
Acroperus leucocephalus, *Koch*	..	..	..	..	*
Chydorus sphæricus, *Jurine*	..	..	..	..	*
*Diaptomus cæruleus, *Fischer*	*****	..	..	****	*****
*Cyclops strenuus, *Fischer*	*****	****	****	..	*****
—— coronatus, *Claus*	..	..	..	****	***
*Ceratium longicorne, *Perty*	..	..	..	**	**
*Conochilus volvox, *Ehrenberg*	****	..	..	***	
*Anuræa longispina, *Kellicott*	****	**			
—— cochlearis †, *Gosse*	..	..	..	*	*
—— curvicornis †, *Ehrenberg*	..	***			
*Asplanchna helvetica, *Imhof*	..	..	****	..	*****
*—— Girodi, *de Guerne*	..	***			
Atax crassipes, *O. F. Müller*	..	..	..	*	
Axona versicolor, *O. F. Müller*	..	..	..	*	
Nesæa reticulata, *Kramer*	..	*			
—— rotunda, *Kramer*	..	..	..	..	*

The asterisks placed in the columns indicate by their number the relative rarity or abundance of the species.

† These *Anuræa* were found in the stomachs of *Asplanchnæ*; the author has rarely found them free. This may be due to the meshes of the net used not being fine enough.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 9. SEPTEMBER 1888.

XXIV.—*The Genus* Acinetoides, *g. n., an Intermediate Form between the Ciliated Infusoria and the* Acinetæ. By Dr. L. Plate *.

[Plate X., A.]

In the spring of 1886 I found upon colonies of *Zoothamnium* from the Bay of Naples two peculiar, still undescribed Suctoria, which are of some interest because they remain throughout life in the same stage of development which is represented in other Acinetæ by the freely motile buds. They justify the conclusion expressed in the title of this article, that we have here to do with an animal-form which combines in itself some of the characteristic features of the Ciliated Infusoria and the Acinetæ. The two species which have come under my observation in Naples may in future be united under the generic name *Acinetoides*, which at the same time indicates that the Protozoa in question in their general habit nevertheless are more nearly allied to the Suctoria than to the Ciliata.

* Translated from the 'Zoologische Jahrbücher, Abth. für Anatomie und Ontogenie der Thiere,' Band iii. pp. 135–143 (May 1888).

Figure 1 (Pl. X., A) represents the larger of the two species, which I venture to name *Acinetoides Greeffii*, in honour of Prof. R. Greeff, to whom we are indebted for various valuable investigations upon Protozoa. The animal attains a length of 0·046 millim. and an elevation of 0·02 millim. In form it greatly reminds us of the swarm-buds of many Acinetæ, for example *Dendrocometes paradoxus*, St., but the arrangement of the cilia is quite different. *Acinetoides Greeffii* has a plano-convex form. Seen from above or below (fig. 2) the animal shows an elliptical outline; the convex surface of our Infusorian may be denominated the back, and the flat one the belly. The latter is seldom quite plane, but generally hollowed out like a basin, as shown in fig. 1. Only one end of it, which we shall regard as the anterior, usually makes an exception to this, and projects beyond the ventral margin of the body in the form of a low cone, bearing in its middle the organ for the inception of nourishment, a sucking-thread clubbed at the extremity, which may be traced far into the interior of the cell-body and is distinguished only by its remarkable shortness and rigidity from the similar organs of most other Acinetæ; at least I have never found specimens which had completely retracted their tentacle into the cell-plasma; but even in greatly disturbed animals this short sucking-thread was always visible. Of the minute structure of this organ I was unable to ascertain much, owing to the want of high objectives; it appeared to me to be a plasma-rod traversed by a longitudinal canal.

The persistent ciliation of the ventral surface is highly characteristic of the genus *Acinetoides*. It does not extend over the whole lower surface, but, as may be seen by an inspection of the ventral surface (fig. 2), only occupies an elliptical inner area, leaving the whole peripheral border free of cilia. The cilia are arranged in longitudinal rows, and appear to stand in special grooves; at least we observe upon the ventral surface a delicate longitudinal striation which extends over an area of exactly the same size as the cilia. Each stria consists of granules lying one behind the other, and thus produces about the same impression as the rows of granules in *Stentor*, between which the myophanic fibrils take their course. I have been unable to detect in *Acinetoides* any threads which might represent the latter, although it is quite certain that the ventral surface of *Acinetoides Greeffii* possesses a high degree of contractility; I suppose therefore that an examination by means of very powerful objectives may reveal the presence of muscular fibrils in our animal also. By means of this contractility it is able somewhat to modify its form, and especially to render the convexity of the dorsal surface sometimes quite hemispherical, sometimes much flatter. Further on, in describing the mode of life of our Infusoria, I shall come back to this and indicate the use which the species of *Acinetoides* make of this faculty.

Acinetoides Greeffii is bounded externally throughout by a thin cuticle. The interior of the cell-body is destitute of any special peculiarities. We find in it an elongated nucleus, often curved into the form of a sausage (fig. 1, N), which extends through almost the whole cell, possesses a finely granular structure, and is enclosed by a special membrane; and, further, numerous granules of fatty lustre, and a contractile vacuole situated close to the ventral surface (figs. 1, 2, *cv.*).

The second species of the genus, which, from its dwelling-place, may bear the name of *Acinetoides zoothamni*, resembles that above described in nearly all points. It is, however, considerably smaller, namely about half the size of *A. Greeffii*, and it possesses a nucleus of different form, spherical and of comparatively very small size.

The specific difference of the two Infusoria just noticed is also distinctly recognizable in their mode of life. Common to both is that thay reside upon colonies of the Vorticelline genus *Zoothamnium*, and feed by sucking out the individuals of their colonies. They are therefore parasites and become exceedingly injurious to the elegant structures in question. I have often met with bushes of them which, on some branches, had lost all the individuals by the *Acinetoides* which swarmed around them. It is remarkable that each species of *Acinetoides* attaches itself to a definite region of the body of a *Zoothamnium*. The individuals of *Acinetoides Greeffii* always select the base of the animal on which they prey at the point where the muscle of the contractile stem radiates in a tuft into the bell (fig. 3), and they fix themselves here by bending the body transversely in the middle, and thus attach themselves closely to their victim. Evidently they are enabled to do this only by the great contractility of the ventral surface, seeing that the attachment is effected by the production of a vacuum within the basin-like ventral surface. While the plasma of the Vorticelline flows over into the *Acinetoides*, the cilia of the latter are in general quite quiet; sometimes, however, for a few moments they move again, wholly or partially, a proof that in the attachment only the peripheral border of the ventral surface of our Suctorian is adherent to the prey. In this position the *Acinetoides* often remains for a considerable time—an hour or more—but frequently only for a few minutes. Shortly before the separation the cilia begin to work more vigorously, the animal moves a little to and fro, nay, it sometimes rotates around the sucking-tube, which is still inserted in the prey, and finally separates entirely from its victim. Its movements while swimming freely about are very irregular and exactly resemble the spasmodic movements of the buds of Acinetæ. I have frequently observed that within about a minute of their separation the animalcules had attached themselves again.

Acinetoides Greeffii is so large that only two individuals can find room at the same time upon a *Zoothamnium*, as the species always selects the base of the bell for fixation. It is otherwise, however, with the smaller species. This avoids the neighbourhood of the peduncle and attaches itself by preference to the peristomial region or the sides of the body; and in consequence of its small size we often see from three to five individuals occupied at the same time in sucking out the same *Zoothamnium*. The death of the latter occurs very soon after the attachment of an *Acinetoides*, so that this evidently brings its prey in contact with some corrosive fluid. The loss of substance which the *Zoothamnium* thus suffers causes the collapse of the anterior part of the bell, the cuticle of which falls into numerous wrinkles and folds. It is remarkable that the animalcules never completely exhaust their victims (even when several of them prey upon the same individual), but they confine themselves to a portion of the plasma and then fall upon another Infusorian. The only probable reason of this is that the body-substance of the *Zoothamnium* is altered by long action of the destructive fluid secreted by the Acineta, and then no longer suits the taste of our animalcules.

As to the reproduction of the genus *Acinetoides*, I could learn nothing except from the smaller species. Of course a thorough knowledge of this is of the greatest importance, seeing that without it there is always a possibility that the Protozoa described are only swarm-buds of other Suctoria, as they are distinguished from these only by the presence of *a single sucking-tube*. That such a supposition was incorrect was indeed quite clear to me from the first, as I always observed the *Acinetoides* in great numbers together, and on the colonies of *Zoothamnium* attacked by them there were in addition only a few *Podophryœ*, which were smaller than the Suctoria here described, and therefore could not possibly be connected with them. Moreover the swarming-buds of these *Podophryœ* also occurred; they had quite a different form of body from the species of *Acinetoides*, and, further, possessed no sucking-tentacle. The conclusion that these were independent organisms, and not mere developmental forms, was therefore unavoidable, and it was afterwards confirmed by the observation of the reproduction of *Acinetoides zoothamni* by simple transverse fission. The individuals in course of division sometimes swam about and sometimes remained seated upon their food-animals; but I did not succeed in the latter case in observing a double sucking-tentacle.

The reproduction by transverse division furnishes a further proof of the intermediate position which the genus *Acinetoides* occupies between the Ciliata and the Suctoria. Such a mode of reproduction has indeed already been observed in various other Acinetæ, as in *Podophrya fixa*, *Acineta mystacina*, *Urnula epistylidis*, and some others; but it is nevertheless a rare mode of increase among the Suctoria, quite subordinate to the reproduction by external or internal budding; while, on the contrary, among the Ciliata the new individuals in general originate by transverse or longitudinal division, and are produced as buds only in some attached genera. This contrast, as regards reproduction, which exists between the Ciliated Infusoria and the Acinetæ is not principial, but only caused by the different mode of life. With respect to the possibility of nourishment, a sessile organism is always at a disadvantage as compared with one of the same structure but capable of free locomotion, and therefore for the continuance of its species requires a larger progeny, a purpose which is of course better attained by the formation of numerous small buds than by simple division, which furnishes only two descendants from one parent-animal.

What systematic position the genus *Acinetoides* has to occupy cannot be doubtful after what has been said; it is to be referred to the Suctoria and to be regarded as a transition-form between these and the Ciliated Infusoria. *The existence of such an intermediate form, it appears to me, furnishes a fresh argument in support of the opinion already maintained by several naturalists, that the Acinetæ are modified Ciliata*, which have acquired peculiar sucking and grasping filaments, to be regarded as organs *sui generis*, in connexion with the acquisition of a sessile or parasitic mode of life. This notion is founded principally upon the fact that the buds of the Acinetæ resemble the true Infusoria in their holo-, hypo-, or peritrichous coat of cilia, so that the Acinetæ in their youth pass through a ciliatiform stage. It has been urged against this conception of the swarm-buds (I think erroneously) that the so-called "biogenetic fundamental law" is not applicable to unicellular organisms, and therefore the free mobility of the Acinetan offshoots must be regarded as a special phenomenon of adaptation. If there is really the tendency in the organism to recapitulate in its ontogeny certain morphological conditions which correspond in their sequence with the phylogenetic development, it is a matter of no consequence whether these conditions are displayed by *one* cell or by a cell-complex. In the formation of buds in which the parent and its offspring are even externally of such different structure, the micellar structure of the plasma in the bud will very probably also differ from that of the parent; and it is quite conceivable that the former agrees approximately with the plasmatic structure proper to the ancestors of the Infusorian under consideration, and therefore the biogenetic law may also apply to the developmental history of the bud. This is impossible only when a Protozoon divides into two portions which behave exactly alike both as regards their external characters and in their further phenomena of growth; this, however, is not the case in multiplication by buds. Suctoria of the nature of the genus *Acinetoides* can be naturally referred only to Ciliated Infusoria (whether directly or by the derivation of both families from a common stock), and therefore the view, which Maupas * has recently supported, that the Acinetæ are more nearly allied to the Rhizopoda, and especially to the Heliozoa †, seems to me not to be correct. For if the sucking-organs of the Suctoria have really proceeded from Rhizopod pseudopodia, these ought always to be present in considerable number, whereas in *Acinetoides* only *one* such tentacle occurs. For the maintenance of Maupas's conception, therefore, we must assume a reduction in the number of tentacles for the genus just mentioned, a hypothesis which it is difficult to reconcile with its other primitive characters. In support of his hypothesis Maupas ‡ cites a statement of Engelmann's according to which the cilia in the lower plants and animals are so diffused that in phylogenetic investigations no value is to be attached to their presence or absence. I believe that the above-mentioned naturalists go rather too far in their deductions. It is certainly true that organs which, like the cilia or eye-pigment-spots, recur in the most various classes, are to be very cautiously made use of in phylogenetic questions; but they are certainly not therefore wholly without significance, for even their arrangement and position are governed by heredity. It is only in this way explicable that

* "Contribution à l'étude des Acinétiens," in Arch. de Zool. Expér. tome ix. (1881), pp. 299–368.

† *Ibid.* p. 367. ‡ *Ibid.* p. 363.

nearly allied Acinetæ frequently have swarm-buds with a ciliation arranged in the same or a similar manner, of which the Suctorian described in the next article, whose nearest ally is undoubtedly *Dendrocometes paradoxus*, furnishes a good example. We may therefore justly conclude from the ciliary clothing of the Acinetan buds that the Suctoria are genealogically connected with the Ciliata, a conclusion which is the more naturally arrived at because we know many Ciliated Infusoria which have lost their buccal aperture by adaptation to peculiar conditions of life.

In *Sphærophrya magna* Maupas * has detected tentacles which greatly resemble the pseudopodia of the Rhizopoda. They are contractile rods composed of a plasmatic axis and a cortical layer, and therefore are not hollow, and are not continued into the proper body of the Acinetan. They terminate in a knob which very quickly kills and then holds fast such Infusoria as may come in contact with it. Then the tentacle increases greatly in thickness, which Maupas, probably with justice, places to the account of an invisible current of plasma flowing out from the Suctorian to the prey and probably penetrating into it. Finally a current in the opposite direction is observed, which conveys the plasma of the captured animal to the body of the *Sphærophrya*. The inception of nourishment therefore takes place here in exactly the same manner as with true pseudopodia, namely without any pumping movement. Such organs, however, are by no means characteristic of the whole class of the Acinetæ, but are at present known only in that single form. Specially peculiar to the Suctoria are the "sucking-tubes," plasma-rods traversed by a canal, which generally originate far within the cell-body and extract the nourishment from the prey by a pumping movement. In most genera we find only such structures, which can be referred back neither to the cilia of the Ciliata nor to the pseudopodia of the Heliozoa, but are to be regarded as organs *sui generis*; from these, in a higher grade of differentiation, have proceeded in the first place those pseudopodium-like tentacles, and in the second the grasping-threads, which serve only for seizing the prey, and the investigations into the structure of which are not yet concluded. In *Podophrya gemmipara* R. Hertwig ascribes to them a solid structure, while Maupas states that he has found a canal in their interior.

The latter naturalist has indicated † that nucleoli are at present known only in certain Ciliata and some Suctoria, but

* *L. c.* p. 300 *et seqq.*

† *L. c.* p. 364.

have not been found in Rhizopoda; and this circumstance is in favour of the old theory to which I have here endeavoured to give further support.

Lastly, it may be mentioned that in the process of conjugation homologies between Acinetæ and Ciliata may be demonstrated. In *Dendrocometes paradoxus*, for example, as I have shown in a previous memoir *, the nucleus at the commencement of this process grows into a long filament and then breaks up into numerous pieces, just as is known to be the case in many Ciliated Infusoria (e. g. *Paramœcium aurelia* and *putrinum*). The Suctorian which will be fully described in the following article displays a further interesting stage of conjugation, which at present can only be compared with a similar one of *Paramœcium aurelia.* However, we are still too imperfectly acquainted with the conjugation of the Acinetæ to be able to deduce genealogical relationships from it.

EXPLANATION OF PLATE X., A.

Fig. 1. *Acineta Greeffii*, from the side.
Fig. 2. The same, from beneath.
Fig. 3. The same, two individuals attached to *Zoothamnium.*

The letters have the same signification in all, namely:—N, nucleus; *t*, tentacle; *cv.*, contractile vacuole.

XXV.—Asellicola digitata, *Stein's "gefingerte Acinete."* By Dr. L. Plate †.

[Plate X., B.]

The Acineta described in the following pages is a near relative of *Dendrocometes paradoxus*, St., and lives upon the branchial plates of *Asellus aquaticus*; it is generically distinct from all Suctoria at present known, and I propose for it the generic name of *Asellicola*, in allusion to the place of its occurrence. I have selected the specific name *digitata* because the distinguished naturalist F. von Stein very clearly described and figured it in his first great publication on the

* "Untersuchungen einiger an den Kiemenblättern des *Gammarus pulex* lebenden Ektoparasiten," in Zeitschr. f. wiss. Zool. Bd. xliii. pp. 175-241.

† Translated from the 'Zoologische Jahrbücher, Abth. für Anatomie und Ontogenie der Thiere,' Band iii. pp. 143-155 (May 1888).

Infusoria *. When he discovered the *Asellicola* Stein erroneously regarded the Acinetæ as developmental states of the Ciliated Infusoria, and gave our animal provisionally only the designation of the "fingered Acineta," as he had not yet found the ciliated form belonging to it; he seems also not to have studied it thoroughly, as in his description he mentions only the general form of the body, without entering into details as to the structure of the tentacles, the nature of the nucleus and of the interior of the cell, the reproduction, and the conjugation †.

Asellicola digitata (Pl. X., B. fig. 4) is a non-pedunculate hemispherical Acineta furnished with a nucleus (N) and contractile vacuole (*cv.*), and which adheres closely to the surface of the gill-lamina by its flattened but gently rounded under surface. It attains a maximum length of about 0·11 millim. and an elevation of 0·06 millim. The whole body is covered with a thin cuticle, which nevertheless appears to have a double contour and is continued over the numerous tentacles (*t*) which radiate from the dorsal surface and in form and grouping are very characteristic of our species. The cuticle is of equal thickness and colourless over the whole of the body proper, except that on the underside it forms in the middle an elliptical thickened ring (*r*), which rises above the basal surface, and by means of which the animal is attached to its point of support. Of course, as in all Suctoria, the form of the body is liable to small deviations, some of which the reader will find figured by Stein ‡. The outlines of the body may also be altered by reagents. While in living individuals the basal surface is always closely applied to the branchial lamina, it swells into a hemispherical convexity when the animals have died in the water, and it is then seen very clearly that the *Asellicola* only adheres by the above-mentioned ring. The same result may be attained by means of acetic acid and other agents which produce a swelling of the plasma.

While *Dendrocometes paradoxus* attaches itself but rarely to the margin of the gill-laminæ of *Gammarus pulex*, and is generally met with on the actual surface of the plate, *Asellicola digitata* acts just in the contrary way. The individuals

* F. Stein, 'Die Infusionsthiere auf ihre Entwicklungsgeschichte untersucht,' Leipzig, 1854, p. 228.

† Claparède and Lachmann ('Etudes sur les Infusoires, &c.' i. p. 386) and S. Kent ('Manual of the Infusoria,' ii. p. 812), as I now find, place the *Asellicola* in the genus *Trichophrya*, without, however, supporting this view by their own observations; but *T. epistylidis* differs so much, especially in the structure of the tentacles, from the "gefingerte Acinete," that a new genus must unquestionably be established for the latter.

‡ *Loc. cit.* Taf. v. figs. 19–22.

of the latter settle themselves close together upon the border of the branchial lamina, and, indeed, chiefly upon the parts which are situated outwards and posteriorly. The inward-directed side of the edge, as well as the surface of the lamina, is only exceptionally inhabited, usually only when the outer margin is already densely covered. I have also frequently observed on branchiæ which displayed very numerous *Asellicolæ* seated close together that the few specimens on the inner border were all smaller, *i. e.* younger, than the others, so that it may be assumed that the swarm-buds of our animalcule, notwithstanding their want of external sense-organs, are very well able to distinguish the different surfaces of the laminæ and only content themselves with the inner margins when the outer ones are overfull. This evidently purpose-like mode of procedure in so lowly an organism cannot very well be regarded as purely mechanical. It is true that in consequence of the position and movement of the gill-laminæ the flow of water in both Crustaceans passes over these organs of respiration from without inwards, and the marked preference of the *Asellicola* for the outer margin is readily intelligible on account of the more abundant supply of food which is here presented to it. But, on the other hand, the swarm-buds of *Dendrocometes* are in exactly the same case, and yet they attach themselves indifferently to any part of the surface of the lamina, but carefully avoid the margin, as if they knew beforehand that the basal membrane * of the developed animal can only find a suitable support upon a flat surface.

Spirochona gemmipara, Stein, also quite unmistakably prefers the outer margins of the laminæ, of which I have convinced myself by an examination of my permanent preparations, and it also agrees with *Asellicola* in that specimens but seldom pass on to the peripheral surfaces of the laminæ. We must therefore ascribe to the swarm-buds of the three gill-frequenters here referred to the faculty of distinguishing those parts of the laminæ which best suit their species in the adult state from those which are less favourable. In consequence of this instinct we find the young *Asellicolæ* frequently seated so close together that subsequently, when they have grown to their full size, they have not room enough, and by reciprocal pressure give each other a quadrangular form, or drive a weaker individual from the margin on to the surface of the lamina.

The plasma of the cell-body does not, as in many Acinetæ,

* L. Plate, "Untersuchungen einiger an den Kiemenblättern des *Gammarus pulex* lebenden Ektoparasiten," in Zeitschr. f. wiss. Zool. Bd. xliii. p. 179.

divide into a central and a cortical layer, but presents the same constitution throughout. The nucleus (N) has an elongated sausage-like shape and is often furnished with hemispherical projections and small irregular side-branches. Not unfrequently it has the outlines of an irregular cross. Externally it is bounded by a delicate nuclear membrane and in the interior we observe a fine granulation as the expression of a very close meshwork. There are no nucleoli; but the *Asellicolæ* frequently possess those little round balls which stain strongly with colouring-materials (fig. 4, *ti*) such as I have previously described as "Tinctinkörper" in *Dendrocometes*. These are evidently assimilation-products of some kind which have nothing to do with the nucleus, for they are subject to considerable variations in their number and size. In well-fed animals containing numerous fat-drops we frequently find as many as thirty scattered through the interior of the cell; in other specimens, again, they are entirely wanting. That they are not to be identified with the nucleoli of the Ciliata appears with certainty from the circumstance that they undergo no alteration during conjugation.

In *Asellicola digitata*, as in *Dendrocometes*, there are also not unfrequently green or yellowish-green bodies of 0·003–0·005 millim. in diameter, which at the first glance greatly remind us of chlorophyll. Here again I have convinced myself that the globules are formed by the Acineta itself, and therefore do not merely get into the animal with the food; for in the first place they are destitute of any cellular structure, so that all confusion with unicellular Algæ is excluded, and, secondly, they remain unaltered in the plasma often for hours; they may often be seen in specimens which have retracted all their tentacles, a process which occupies considerable time. As the Protozoa universally rapidly digest and at the same time decolorize true chlorophyll-grains which are taken up with the food, there only remains one interpretation, according to which these green structures represent assimilation-products of some kind. The green colouring-matter can be extracted by alcohol, and then there remain granules which cannot be distinguished from the other shining granules of the cell.

The contractile vacuole of *Asellicola digitata* (fig. 4, *cv.*) is placed near the lower margin of one of the lateral poles of the body. It opens, as in *Dendrocometes paradoxus*, directly outwards by a small duct, and contracts so that the fluid which has collected in it must be pressed out through this tubule. The intervals of time at which the pulsations follow one another are very various and depend apparently upon the condition of the animal. In lively individuals several pulsations may take place in one minute, while in those which have been kept for a long time in watch-glasses they are repeated much more slowly.

The cytoplasm of *Asellicola* shows a peculiarity which may easily lead the observer astray. Above the cuticular ring with which our Acineta attaches itself to its support we observe a striated structure radiating like a fan in all directions, producing an impression as if a great number of fine canals met together at this point. The individual rays are directed obliquely upwards and the outer ones form an angle of about 45° with the basal surface. As they may be distinctly traced up to the level of the nucleus, and therefore pretty far into the interior of the cell, I at first supposed that the canals which traverse the tentacles throughout their length were continued to the centre of the lower surface. This, however, is not the case; the striated structure of the plasma is in no way connected with the sucking-organs, but has probably only the office of giving the cell-body an increased degree of firmness at its point of fixation by the development of rigid rods.

The tentacles (fig. 4, *t*) proceeding from the dorsal surface fix the interest of the observer more than any other part of our Acineta. In comparison with the tentacles of the other Suctoria they are remarkably broad, acutely terminating processes of the body of 0·036 millim. in length on the average, which are met with in very variable numbers in different individuals, and may originate from any part of the dorsal surface. So far as they radiate from the true back they are in general quite straight, while those grouped in the neighbourhood of the basal margin are usually gently bent upwards. As regards their minute structure, they are externally clothed with a thin membrane, a continuation of the cuticle of the body, which becomes very delicate towards the apex. The plasma of the tentacles appears quite clear, as there are none of the coarser granules in it. In the middle it is traversed longitudinally by a canal filled with a limpid fluid, which opens at the anterior end. I could detect no special wall in this canal, and therefore regard it as a simple longitudinal fissure in the plasma. Owing to its great fineness it is often not perceptible in the living animal, but may almost always be demonstrated with certainty by means of osmic acid. This canal is not continued, as is the case with the sucking-tubes of most Acinetæ, into the interior of the cell; at least this is never the case with fully extended tentacles. Frequently, however, the latter are retracted into the body by a slow process lasting several hours, and in such tentacles, when reduced to about half their size, I have seen the canal penetrate inwards for a short distance. But when the tentacles have become completely incorporated with the cell-plasma every trace of these canals has disappeared.

The near relationship of *Asellicola* to *Dendrocometes*, which has already been repeatedly referred to, is also evidenced by a careful examination of the free extremities of the sucking-tubes. If we fix one of these for a few minutes in a lively specimen we observe that the extreme tip raises itself from the tentacle as a distinct tentaculet, which is constantly (several times in a minute) pushed out and retracted. This pumping movement therefore takes place even when the tentacle is not in a position to take up nourishment. Why it occurs is hard to say. We may suppose that the animals either inhaust water, which is then subsequently got rid of again through the contractile vacuole, or that we have here to do with a sort of involuntary movement which is of service to the individual only when by chance an Amœba, an Infusorian, or some other kind of nourishment has come in contact with the tentacle and remained adhering to it. In opposition to this last notion it may, however, be urged with justice that the tentaculets are often only in part in activity, while the others on the same animal are quite quiescent.

In the fully extended state the hinder limit of the tentaculet is scarcely recognizable. But as soon as the invagination, which begins at the base of the tentaculet, has commenced, a small cushion is produced which distinctly separates the two divisions from each other and becomes more and more marked in proportion as the terminal member disappears. When the latter is finally completely retracted the pad appears in optical section as two shining knots situated at the extremity of the tentacle. These tentaculets exactly resemble the points of the fingers which occur in great numbers upon each tentacle of *Dendrocometes paradoxus*, only they are somewhat larger (0·0025 millim. in diameter) and therefore more easily investigated in their structure and mode of action. In the last-mentioned Acineta, therefore, each tentacle is apparently produced by the fusion of several tentacles such as we meet with in *Asellicola*. *Dendrocometes* also so far represents a higher stage of differentiation as each canal starting from a fingerlet possesses a delicate proper wall, and by means of this penetrates deeply into the cell-body.

The tentaculets of *Asellicola* very probably secrete a viscid substance, for I have frequently observed that very small

Flagellata remain adherent to them without coming in contact with the anterior orifice or being sucked out. In the case of such small organisms the nutriment is simply pumped into the tentacular canal by means of the tentaculet. Their sucking power does not appear to suffice to overpower larger prey, such as small Infusoria, for in such cases our Suctorian adopts another mode of proceeding. It draws in the greater part of the whole tentacle, so that it shows only one fourth or one third of its original length. The tentaculet also entirely disappears, and the tentacle acquires the form of a short tube, the uppermost end of which is somewhat widened, and possesses a much folded and wrinkled wall. By a movement exactly corresponding with that of the tentaculet this upper part of the arm then extends itself a little (by which means the folds disappear) and contracts itself again, in this way effecting in a few moments the complete exhaustion of small organisms, such as *Vorticellæ*, so that the cuticle of the captured animal alone remains attached to the tentacle as an empty vesicle. To get rid of this from the sticky point of the tentacle often gives the *Asellicola* a good deal of trouble. It proceeds in this way: it extends the free extremity of the tentacle into a small narrow tube, then retracts this again suddenly, and thus endeavours to throw off the vesicle.

By the mode of feeding above described a peculiar appearance is produced which may not unfrequently be observed in our Acineta. Thus we find the lower region of the tentacles densely covered with small rod-like Bacteria, which are attached by one end, but for the rest stand off obliquely upwards and outwards (see fig. 5). This foreign covering ceases in all the tentacles at the same level, nearly corresponding to the dimensions which the tentacles acquire when devouring prey of considerable size. Evidently the Bacteria can attach themselves only to the proximal parts of the tentacles, because the distal parts are too often retracted during feeding.

As regards the position and grouping of the tentacles no regularity prevails in *Asellicola digitata*. They may shoot forth anywhere upon the upper surface of the body and may also be retracted again quite independently of each other. Not unfrequently we meet with individuals quite destitute of tentacles. The protrusion of the sucking-organs occupies several hours; it is therefore effected rather slowly. During reproduction they generally disappear only in the immediate vicinity of the aperture for the exit of the swarm-offshoots. But if the animal is compelled to quit its previous dwelling-place by the change of skin of the gill-plate, it previously retracts all the tentacles and moves away in a fashion which I shall fully describe further on. In individuals engaged in conjugation we usually find the tentacles unaltered; sometimes, however, they are only developed laterally upon the right or the left half of the body, but generally without any agreement in this respect between the two united animalcules. Lastly, it may be remarked that the sucking-tubes at their first appearance in the form of pale, narrowly conical processes of the body do not possess any tentaculets; but as soon as they have attained about one third or one half of their definitive size this retractile terminal member also makes its appearance.

With regard to the *reproduction* of *Asellicola* I may be brief, because it exactly resembles that of *Dendrocometes paradoxus*, which I have already described in detail. Here, indeed, the bud-formation is by no means so easy to observe as in the above ectoparasite of *Gammarus pulex*, because the plasma of *Asellicola* is far more densely granular and less transparent. The formation of the swarm-buds is first indicated by the appearance of a second contractile vacuole below the middle of the dorsal surface. There is formed, from the back, a flask-shaped invagination, which finally, by the closing of the external opening, produces a cavity closed all round and situated in the interior of the cell. The next stage leaves the observer no room for further doubt that we have here really to do with reproduction. We observe, nearly parallel to the basal surface and surrounding the inner cavity equatorially, a circlet of long cilia (fig. 5), which strike irregularly to and fro. After this first band of cilia two others are formed, and at the same time the bottom of the cavity is driven up into a hump, so that it closely approaches the roof, leaving only a narrow fissure between them. Lastly, a fresh aperture is produced upon the back, leading into the brood-cavity; the bud, *i. e.* the part driven up, pushes itself through this aperture, and only then becomes constricted off from the parent-animal. The division of the nucleus also takes place only at the moment of the liberation of the bud by simple constriction of the maternal nucleus, which has been somewhat elongated. The spot where the young animal separates from its parent is not a fixed point upon the back, but is situated sometimes in one place sometimes in another.

The freely motile young stage of *Asellicola digitata* has nearly the same form as the adult animal, only the dorsal surface is less convex and the body of course much smaller (0·048 millim. in length and 0·02 millim. broad). The plane lower surface bears three oval circlets of cilia (fig. 6), which are generally placed somewhat obliquely and unsymmetrically, not running exactly parallel to the outer margin. One pole of the long axis of the swarmer is almost always somewhat altered by the constriction separating it from the parent; it has a small pit or a short tubercle. At this end of the body the bands of cilia of the two sides do not pass into each other, but they are interrupted for a small space. In the interior of the swarmer there are a nucleus of elongated or irregular form, a contractile vacuole, and not unfrequently those green grains and "Tinctinkörper" which I have already mentioned. The animalcules swim about irregularly, and immediately attach themselves when they have found a suitable dwelling-place. They almost exactly resemble the buds of *Dendrocometes paradoxus*, and really differ from them only in this point, that the circlets of cilia advance more towards the centre of the under surface, while in the latter Acineta they are seated quite at the outer margin. They also agree in that sometimes the ventral surface is nearly as convex as the superior surface.

When the swarm-bud has attached itself it loses its cilia in some manner not exactly ascertained and passes directly into the form of the old animal by pushing out delicate tentacles. It is remarkable that the nucleus of individuals which, judging from their size, have not long assumed the sessile mode of life, not unfrequently shows an exceedingly sharp longitudinal striation. This arrangement of the chromatic elements in the nucleus seems subsequently to give place again to the ordinary form of a fine meshwork; at least I never observed it in old specimens. I have not found it also in the nuclei of the swarm-buds. I must leave it undecided why this structure occurs; but it is certain that it is not connected with the divisional phenomena of the Acineta.

When *Dendrocometes paradoxus* is compelled to seek a new dwelling by the change of skin of the gill-lamina, it exhibits, as I have already indicated, a very peculiar behaviour. It passes through all the stages of bud-formation and becomes converted, with the loss of the basal membrane and of a small vesicle of plasmatic substance, into an embryo which is nearly as large as the parent-animal. The same phenomenon occurs also in *Asellicola*, so that on gill-plates of which the cuticle has lifted a little we not unfrequently find all the individuals apparently engaged in reproduction. The only difference is (? always) that the whole of the plasma of the mother passes into the body of the swarmer without leaving behind any residual substance.

The most interesting part of the biology of *Asellicola digi-*

tata consists in its conjugation. Although in many points of its progress this agrees with the same process in *Dendrocometes*, there is an essential difference between the two, which is much in favour of the view that the conjugation of the Infusoria represents a sort of foreshadowing of the act of fecundation. Thus it comes to a stage in which the nuclei of both animals lie close together for a considerable time and then separate from each other, a process which seems to indicate a reciprocal influence of the nuclei. As the *Asellicolæ* in general do not sit so close together that they touch each other, and therefore can directly become fused together, those individuals which are about to conjugate are almost always compelled to unite themselves by means of a process of the body. For this purpose they avail themselves of one of the tentacles situated at one end of the body, which then grows enormously beyond its ordinary size. Fig. 7 shows a Suctorian in this stage, and exhibits very plainly the structure of the tentacle, and especially the presence in it of a central longitudinal canal. Frequently I found two animals seated near each other, both of which displayed a "conjugation-tentacle" of this kind, so that here both had evidently endeavoured to conjugate, while in other cases only one of the pair furnished the bridge of union. The conjugation-tentacle is slowly moved to and fro by the *Asellicolæ*, as if feeling about, until they have attained their object. The animals are apparently in a high degree governed by the desire for such a union, for one must often wonder at the size of the canals which are produced for this purpose; they are frequently longer than the individual animals. When the two individuals have succeeded in uniting, the fissure in the plasma originally destined to conduct nutriment disappears, and then the conjugation-canal gradually becomes thicker and thicker, more of the body-substance from both sides passing into it (fig. 9). Although the cytoplasm of the two animals is in this way very intimately mixed in the canal, the distinctness of the individualities is not effaced. We recognize this from the fact that on the least disquietude the cell-bodies separate from each other in the middle of the canal, and lie towards each other covered by a thin membrane. As slight disturbances of the conjugated *Asellicolæ* are almost inevitable in the separation of the gill-laminæ, the observer very frequently finds in the middle of the canal a perpendicular or somewhat oblique partition-wall (fig. 9), which consists of these two membranous layers pressed together; it disappears again when the pair is placed under favourable conditions.

When the bridge of union has grown, in the manner described, to about half the height of the individuals, it swells up still more in the middle (fig. 10), so that frequently, in each pair, the adherent disk, originally situated in the centre of the underside, comes, by the displacement of the plasma, to be situated at one end of the body; and then follows the stage which I have briefly indicated above, and which attracts our interest in the highest degree—the nuclei of both individuals of a pair, which hitherto have shown no alteration (or at the utmost sometimes an extension in length), migrate into the canal of union and towards one another, at the same time bend the approximated ends downwards at a right angle (about one third of the whole length), and in this form closely approach each other (fig. 10). I have never met with individuals of which the nuclei were directly in contact; but there was always a narrow wall of plasma between them, and this was sometimes so wide that the above-mentioned membranous lamella could be developed in it. It would of course be going too far if we were to deny the possibility of a transitory actual fusion of the nuclei, for it is quite conceivable that this stage of the conjugation may have escaped my notice. On the other hand, however, there are at present no grounds for assuming anything of the kind, because there is no doubt that during this period of mutual approximation the nuclei undergo no change of structure.

After the nuclei have thus reciprocally influenced each other for a time (how long I am unable to say) they migrate back into their original position, at the same time assuming their old form. Simultaneously with this the plasma returns out of the canal of union into the proper cell-body, and the former in consequence becomes narrower and narrower (fig. 8), until it finally ruptures in the middle and its remains are completely retracted by the respective individuals. Even at the time represented in fig. 8 (see the animal to the left), or only when the paired individuals have separated from each other, the nuclei begin to divide and to become constricted, and they finally break up into a number of larger and smaller pieces, which are scattered through the whole of the cell-body. Unfortunately I have not succeeded in ascertaining unmistakably the regeneration of the new nucleus. As the *Asellicolæ* cannot be kept long alive in the damp chamber I was compelled to deduce the course of the conjugation from the combination of as many individual stages as possible, which, from the simplicity of the whole process, can hardly affect injuriously the accuracy of our judgment. The final stage, unfortunately, has only once come under my observation, and according to this the new nucleus in each paired individual appears to proceed from the union of the fragments of the old one. In *Dendrocometes*, very probably, the new nucleus originates in a somewhat different manner; the fragments of the old one dissolve (wholly or partially) in the plasma, and separate again as a unitary body, very much as crystals, under certain conditions, grow out of their mother-liquor.

An observation which I have frequently made upon *Asellicola* is of theoretical importance, namely that sometimes three individuals conjugate with each other by means of two canals of union. It still remains to be ascertained, however, how in this case the nucleus of the middle animalcule behaves towards the other two nuclei.

In our Acineta conjugation is by no means a rare phenomenon, as it is in almost all other Infusoria. In it, also, we may speak of a sort of "epidemic," inasmuch as we are pretty sure to find pairs upon all the branchial laminæ of a Crustacean if we observe them upon one. In general it is middle-sized individuals that conjugate, while bud-formation is the duty of the full-grown ones.

EXPLANATION OF PLATE X., B.

Fig. 4. *Asellicola digitata*, St., adult, × 540.
Fig. 5. The same, commencing bud-formation, × 235.
Fig. 6. The same, a free bud from beneath.
Fig. 7. The same, individual seeking conjugation, × 540.
Fig. 8. The same, the end of conjugation, × 540.
Figs. 9, 10. The same, stages of conjugation, × 540.

In all the figures the letters have the following signification:—N., nucleus; *n.*, nucleolus; *c. v.*, contractile vacuole; *t.*, tentacles; *ti.*, tinctin-globules.

XXVI.—*Descriptions of some new Species of Coleoptera in the British Museum.* By L. Péringuey.

Geodephaga.

Mantichora congoensis.

Nigra, subnitida, capite magno prothoraceque antice atque lateraliter punctatis; elytris elongatis, subrectis, a medio ad apicem valde deflexis et tuberculis acutis crebre tectis.

Long. 40, lat. 18 mm.

Size of *M. tuberculata*; head and prothorax similar; elytra somewhat linear and narrow, with the humeral serration but little developed, and with the dorsal part strongly declivous from near the base to the apex, covered with small but acute slightly setigerous tubercles, not set so closely as in *M. tuberculata* or in *M. latipennis*, and without any erect bristles posteriorly; each elytron with a small raised line nearly in the centre.

A truly distinct species, easily recognized by the sublinear form of the elytra, as well as by the great declivity of the posterior part of the disk. The legs and underside as in *M. tuberculata.*

One male from Congo in the British Museum. I at first doubted the habitat of this insect. I have, however, seen another example, also a male, in Mr. H. W. Bates's collection from the same locality.

Ophryodera Bohemani.

Obscure cuprea, capite prothoraceque albo-pubescentibus; elytris inæqualiter punctulatis, fascia flavescente lata sinuataque a basi intra apicem ducta lunula mediana alteraque triangula subapicali includente, illa cum suturam conjuncta in singulo ornatis.
Long. 21, lat. 7 mm.

A very distinct species. Head and prothorax as in *O. rufomarginata*; elytra with a very broad golden-yellow sinuated band, disconnected from the margin and the suture, narrowed on the median part, where it encloses a small rounded spot (background), enlarged from past the middle, narrowed towards the apex, and forming within the subapical sutural part a dent which leaves an irregular triangular patch of the background visible.

Legs and underside as in *C. rufomarginata.*

This splendid insect (a female) comes from Angola.

Ophryodera rufo-marginata, Bohem., var. *Bradshawi.*

Obscure cuprea, capite prothoraceque albo-pubescentibus; elytris sutura, linea subhumerali introrsum ducta, puncto in medio fasciaque marginali intra apicem albis.
Long. 20, lat. 7 mm.

The markings of this insect vary very much according to localities. The present variety is, however, well separated from Boheman's type; it is larger and of deeper bronze colour; the elytra have lost the large triangular antemedian lunule, and there is only left a slightly curved line starting from the outer margin and reaching the centre of the elytron; the mark of interrogation (*vide* Boheman's description) is reduced to a mere dot, evidently the apex of the said marking; the sutural band and the apical marginal one connected with the sutural line remain the same. These markings are of a chalky white instead of the rich golden-yellow of the type.

From the Zambezi.

Ophryodera rufo-marginata, Bohem., var. *Oberthueri.*

A very large female specimen which I have seen in Mons. René Oberthür's magnificent collection is closely allied to the preceding variety.

It is larger, the sutural band is the same, the antemedian band is similar to that of var. *Bradshawi*, but the postmedian macula is altogether missing, and the apical marginal band is very narrow and ascends higher along the outer margin; the colour of the markings is also the same.

I believe I have seen an example of this variety in Mr. H. W. Bates's collection; both these specimens were collected by my friend the late Dr. Bradshaw near the Zambezi River.

Lastly, I have received from Northern Damaraland another variety of this polychrome Cicindelid, which I intend to describe shortly, and which unites all these varieties with the typical insect described by Boheman.

Graphipterus angolensis.

Niger, subnitidus; antennis elytrisque rufescenti-brunneis, fronte prothoraceque utrinque albido-pubescentibus, hoc brevi, subcordato; elytris subrotundatis, denudatis, striatis margine laterali albo-pubescente.

Long. 10, lat. 6 mm.

Head covered with a white pubescence; prothorax cordiform, grooved in the centre, with the sides densely pilose; elytra shaped like those of *G. ferruginosus*, Chaud., somewhat more rounded in the female, denuded, with six raised costæ; costæ and interstices strongly punctured, and with the outer margin clothed with thick whitish hairs; legs reddish brown.

Two examples from Angola.

Graphipterus velox.

Niger, ovatus, pube supra cinereo-brunnea, subtus albida tectus;

prothorace medio denudato; elytris vitta sublata prope suturam posita in singulo ornatis.

Long. 14, lat. 6 mm.

Shape and size of *G. adamantinus*, Péring.; prothorax much narrower and cordiform, as in *G. limbatus*, denuded in the middle; the elytra are also narrower near the base, covered with an ashy brown villosity, and have each a moderately broad black band a little distant from the suture, reaching nearly to the apex but not the base; sides of the abdomen and underside of thorax covered with short white hairs; legs brown.

One example from Angola.

Rhynchophora.

Brachycerus maculicollis.

Ovatus, niger, grisco-squamosus; rostro apice dilatato, basi subtuberculato, a capite disjuncto; prothorace granulato, utrinque acute spinoso, medio antice canaliculato, maculis quatuor ochraceis notato; elytris crebre granulatis, tuberculis majoribus duplici serie in singulo instructis.

Long. 20–26, lat. 10–16 mm.

Black, covered with a greyish pubescence. Rostrum moderately long, depressed, scrobiculated, and with two small tubercles on each side of the apex, separated from the head by a transverse groove; prothorax covered with depressed setigerous warts, produced in an acute spine on each side, having a deep impression with raised smooth walls on the anterior part and four thick, ochraceous, squamose patches, one on each side of the fore part of the disk and two on the posterior part; the basal part is also squamose; elytra ovate, convex, covered with closely set, comparatively large granules, and each with two rows of larger, rounded, slightly setigerous tubercles, somewhat acute posteriorly; the wing-cases have here and there a few irregular white scales. Underside black, squamose, with two round ochraceous spots on the sides of the abdomen, also on the segments; apex of femora annulated with white; tibiæ tomentose, brown.

One example from Natal. I have received this insect also from Delagoa Bay and Upper Damaraland. It is allied to *B. lubrusca* and *B. natalensis.*

Brachycerus brachyceropsides.

Elongatus, niger, terreno-squamosus; rostro elongato, prothorace valde ampliato, supra subdeplanato; elytris rugosis, angustis, ad medium attenuatis, supra convexis, tuberculis seriatis duplici serie in singulo positis.

Long. 26, lat. $10\frac{1}{2}$ mm.

Black, covered with a brown squamosity. Rostrum elongated, shaped like that of *B. setipennis*; scape of antennæ elongated, the other joints closely set, the apical one cylindrical; prothorax very rugose, much ampliated, shaped like that of *B. cornutus*, with the sides subangular, much sinuated anteriorly, as broad as the elytra, which are very elongated, narrowed in the middle, slightly ampliated posteriorly, convex, very rugose, and each provided with two rows of tubercles, the discoidal more conspicuous than the second row. Legs as in *B. setipennis*.

One example from Natal.

Cape Town,
July 25, 1888.

XXVII.—*On the Fossil Fish-spines named* Cœlorhynchus, *Agassiz*. By A. Smith Woodward, F.G.S., F.Z.S., of the British Museum (Natural History).

Among the most interesting of undetermined Ichthyodorulites are some straight, long, slender, round, ribbed spines, met with in the Upper Cretaceous and Tertiaries, and originally described by Agassiz as the rostral bones of sword-fishes under the name of *Cœlorhynchus* *. Their dermal nature was first pointed out by Williamson †, who published a detailed microscopical description; and fragments of the fossil have since been recognized from various parts of the world.

Cœlorhynchus cretaceus occurs in the Chalk of England ‡, and fragments of a similar spine in the "Mucronatenkreide" of Lüneburg §. Agassiz (*loc. cit.*) named *C. rectus* and *C. sinuatus*, without description, from the Bracklesham Beds and the London Clay of Sheppey respectively ||. Le Hon ¶, P.

* L. Agassiz, Rech. Poiss. Foss. vol. v. pt. i. (1843), p. 92.

† W. C. Williamson, "Investigations into the Structure and Development of the Scales and Bones of Fishes," Phil. Trans. 1849, p. 471, pl. xliii. figs. 35–37; *ibid.* 1851, p. 668.

‡ F. Dixon, Geol. and Foss. Sussex, 1850, p. xii, pl. xxxii. fig. 10.

§ W. Dames's paper quoted below, p. 148.

|| *C. rectus* is erroneously ascribed to the London Clay in the original notice. See figures by F. Dixon, *op. cit.* pl. x. figs. 14–17, pl. xi. fig. 26.

¶ H. Le Hon, 'Préliminaires d'un Mémoire sur les Poissons tertiaires de Belgique,' 1871. Figures given in Burtin's 'Oryctographie de Bruxelles,' 1784, pl. vi. figs. A–H.

J. van Beneden *, and Winkler † have made known *C. rectus* and *C. Burtini*, from the Bruxellian Eocene of Belgium; and Schafhäutl ‡ has described *C. sulcatus*, from the Eocene of Kressenberg, Bavaria, while erroneously identifying another specimen from the same formation with *C. cretaceus*. Similar fossils are known from the Eocene of Alabama, U.S.A. Dames § briefly notices other fragments from corresponding beds in the island of Birket-el-Qurūn, Egypt; and the impression of one small example in the British Museum was obtained from India, probably from the Nummulitic series of Sind ‖.

Having so wide a distribution, and being everywhere associated with numerous other fish-remains, it is somewhat remarkable that as yet no clue has been discovered as to the affinities of the genus to which these spines originally pertained. They have been fully described in some of the works quoted above, and several times figured; but no naturalist has hitherto succeeded in offering a plausible explanation of them, and the large series of examples in the British Museum only adds one new fact to our knowledge of the subject, namely the occasional occurrence of specimens representing fishes of very large size. On referring to the published descriptions it will be observed that the known Cretaceous forms of *Cœlorhynchus* are relatively small, perhaps not attaining a greater length than 0·14 m. and a maximum diameter of 0·004. Those of the Bracklesham Beds are much larger, one measuring at least 0·26 in length and having a diameter of about 0·013 at the base; while the specimen now to be described attains to proportions comparatively gigantic. This was obtained from Egypt, having been extracted from the rock of the Great Sphinx and presented to the British Museum in 1838 by Colonel Howard Vyse. The specimen is in three fragments (nos. 893–895) and measures in the widest portion preserved no less than 0·022 across. It tapers very gradually as usual, and, if of the same proportions as the Bracklesham fossils, must have originally

* P. J. van Beneden, "Recherches sur quelques Poissons fossiles de Belgique," Bull. Acad. Roy. Belg. [2] vol. xxxi. (1871), p. 161.

† T. C. Winkler, "Mémoire sur les Dents de Poissons du terrain bruxellien," Archiv. Mus. Teyler, vol. iii. (1874), p. 303.

‡ K. E. Schafhäutl, 'Süd-Bayerns Lethæa Geognostica,' 1863, p. 249, pl. lxiv. fig. 5.

§ W. Dames, "Ueber eine tertiäre Wirbelthierfauna von der westlichen Insel des Birket-el-Qurūn in Fajum (Aegypten)," SB. k. preuss. Akad. Wiss. 1883, vol. i. p. 148.

‖ R. Lydekker, "The Fossil Vertebrata of India," Rec. Geol. Surv. India, vol. xx. (1887), p. 70.

attained a length of at least 0·44 m. The superficial longitudinal ribs are broad, close, and somewhat flattened, very even, and several times bifurcated. Distally the section is almost circular and the internal cavity very small; more proximally the cavity enlarges considerably and the section becomes oval. The fossil is evidently distinct from all others yet named, and, presenting well-marked characters, may be provisionally quoted as *C. gigas*.

While, however, the described specimens and those in the British Museum afford no clue to the affinities of the fish bearing the spines under discussion, one small Chalk fossil in the collection of Henry Willett, Esq., F.G.S., in the Brighton Museum, furnishes some slight information upon the subject *. This is the imperfect anterior portion of a small fish-skeleton (no. 99), exhibiting, apparently on the dorsal aspect, a perfect example of "*Cœlorhynchus cretaceus*" 0·043 m. in length. The portions of endoskeleton preserved show well that they originally consisted of cartilage, calcified merely at the surface, as in Selachians and Chimæroids; and the particles of the thin film of hard material are not sufficiently large to be distinguished by a lens. In front of the fossil are two large fragments, probably to be interpreted as parts of the head; and close behind is a broad vertical bar, completely separated at a short distance, and very suggestive in every respect of half of the pectoral arch of a shark or Chimæroid. Immediately above the supposed pectoral arch is the base of the slender spine, having no unornamented inserted portion and directly in contact with a fragment of cartilage. There are no traces of a vertebral column.

It therefore seems evident that *Cœlorhynchus* is the spine of a cartilaginous fish, that probably occupied a forward position upon the back; and, if the interpretation of Mr. Willett's fossil be correct, the genus must pertain either to the sharks or the Chimæroids. The microscopical structure of the fossil accords with this supposition, although somewhat anomalous; and as the dorsal spines in no true shark, so far as I am aware, are destitute of a smooth inserted base, I would venture to refer the fish provisionally to the Chimæroids. The extinct members of the latter order do not all possess dorsal spines of the normal type observed in the living *Chimæra*, as shown by Dr. von Zittel's *Chimæropsis* †; and the possibility

* For the opportunity of studying this specimen the writer is indebted to the kindness of Mr. Willett and of Mr. Edward Crane, Chairman of the Brighton Museum Committee.

† K. A. von Zittel, 'Handbuch der Palæontologie,' vol. iii. (1887), p. 113.

of the problematical spines under discussion pertaining to the same group is thus rendered more worthy of consideration. In any case the name *Cœlorhynchus* is obviously inappropriate, as well remarked by Williamson; but it has yet to be determined whether the dentition of the same fish has not already become known under some other suitable generic title.

XXVIII.—*Description of a new Bat of the Genus* Nyctophilus. By Oldfield Thomas.

Among the mammals obtained by Mr. H. O. Forbes at Sogere, South-east New Guinea, and acquired by the Natural-History Museum, there occur two specimens of a bat belonging to the widely-spread genus *Nyctophilus*, but apparently not referable to *N. timorensis*, the only previously recognized species of the genus. I propose to call it

Nyctophilus microtis, sp. n.

General characters as in *N. timorensis*, but the ears very much smaller, when laid forward not reaching beyond the tip of the muzzle; their connecting band across the forehead nearly or quite obsolete in the centre. Upper third of outer margin of ears straight instead of convex, the tip of the ear being therefore narrower and more pointed than in *N. timorensis.* Otherwise the shape of the ears, of the tragus, and of the nose-leaf are all much as in that species, as also are the colour and distribution of the fur, the insertion of the wing-membranes, the development of the postcalcaneal lobe, and the characters of the interfemoral membrane.

Measurements of the type, an adult male in alcohol:—Head and body 49 millim.; tail 42; ear, length above crown 12, breadth 11; tragus, length of internal edge 5·2; forearm 37·8; lower leg 17·3; hind foot 7·7; calcaneum 14.

The second specimen has a forearm 39 millim. in length.

The species is therefore rather smaller than *N. timorensis*, which has a forearm varying in length from about 41 to 48 millim. Owing to its small and unconnected ears *N. microtis* is quite without that look of resemblance to the European long-eared bat so characteristic of *N. timorensis*—a species which, as Dr. Dobson has remarked, "evidently takes the place of *Plecotus auritus* in the Australian region."

XXIX.—*On the Mollusca collected by Mr. G. A. Ramage at the Island of Dominica.* By EDGAR A. SMITH *.

WITH the exception of a small *Vaginula* none of the fifteen species of terrestrial Mollusca in the collection made by Mr. Ramage are new to the fauna.

Mr. R. J. Lechmere Guppy † was the first to attempt a complete list of the terrestrial forms occurring in Dominica, and this list with some modifications was reproduced by Kobelt ‡ in his series of papers on the distribution of land-mollusks. Twenty species are there enumerated, of which nine are said to be peculiar to the island, the remaining eleven being met with on one or other of the neighbouring islands.

In 1881 Mr. A. D. Brown § criticized some of Mr. Guppy's observations respecting the distribution of certain forms, and gave a list of twenty species collected by himself. Eight of these are not quoted by Mr. Guppy.

An abstract of Mr. Brown's paper is given in the 'Journal of Conchology,' vol. iii. p. 182.

Mr. G. F. Angas ‖ has since published an account of the species he collected during a short visit in the early part of the year 1883. Of the twenty species he obtained three are new to both Brown's and Guppy's catalogues. Altogether, including the new species of *Vaginula*, the total number of species from Dominica now amounts to thirty-three. Ten of these, so far as at present known, are peculiar to the island, and the remainder are variously distributed; about five of them occur as far north as Porto Rico, three or four at St. Vincents and St. Kitts, two or three at St. Thomas, and two species at Barbados. More species, however, are common to Guadeloupe and Martinique than to any other of the islands, and this, from their greater proximity to Dominica, would naturally be expected. A few species, however, range beyond the West Indies, one or two occurring in Mexico, one at Panama, one in Peru, and another in Bolivia.

* This collection forms part of the first consignment of specimens recently received from Mr. Ramage, who, under the auspices of a joint committee of the Royal Society and the British Association, is making collections of the fauna and flora of the Lesser Antilles. The species collected by Mr. Ramage are marked with an asterisk in the list appended.

† Ann. & Mag. Nat. Hist. 1868, vol. i. pp. 429–435.

‡ Jahrb. Deutsch. Mal. Gesellsch. 1880, p. 283.

§ 'American Naturalist,' 1881, vol. xv. pp. 56, 57.

‖ Proc. Zool. Soc. 1883, pp. 594–597.

As no references are given by Guppy, Brown, Angas, or Kobelt, I have appended a complete list of all the known species, supplying that desideratum, and at the same time indicating the known geographical distribution of each species.

1. **Vaginula occidentalis* (Guilding).

Onchidium occidentale, Guilding, Trans. Linn. Soc. 1823, vol. xiv. p. 323, pl. ix. figs. 9–12.

Hab. St. Vincents, Guadeloupe; Dominica (*Angas and Ramage*).

2. **Vaginula*, sp.

Six specimens, averaging about three quarters of an inch in length, were obtained by Mr. Ramage, which seem distinct from the preceding species. They are in rather poor, soft condition, and scarcely fit for describing. They are darker above and below than *V. occidentalis*, shorter, apparently less tapering at the extremities, and have the foot as well as the lower surface on each side dotted. The general tint is coffee-brown, varied on the dorsal surface, which does not exhibit a pale median line, with irregular blackish dots and spots. The lower surface, especially the creeping-disk, is paler and is also dark-dotted. The dotting on the foot is down the centre, leaving pale lateral margins. The female orifice is equidistant from the extremities and quite close to the foot.

3. *Oleacina perlucens* (Guppy).

Glandina perlucens, Guppy, Ann. & Mag. Nat. Hist. 1868, vol. i. p. 430.
Oleacina perlucens, Pfeiffer, Mon. Hel. vol. viii. p. 324.

Hab. Dominica (*Guppy*).

4. **Stenogyra octona* (Chemnitz).

Hab. Many of the West-India islands, Panama, Caraccas; Dominica (*Guppy*, *Brown*, *Angas*, *Ramage*).

For the synonymy and references of this species see Pfeiffer's Monogr. Heliceorum.

5. *Leptinaria lamellata* (Pot. et Mich.).

Achatina lamellata, Pot. et Michaud, Gal. Moll. vol. i. p. 128, pl. xi. figs. 7, 8; Pfeiffer, Mon. Hel. vol. ii. p. 272, vol. iii. p. 523 (*Tornatellina*).

Pupa lamellata, Küster, Conch.-Cab. p. 147, pl. xviii. figs. 1, 2.
Achatina lamellata, Deshayes, in Férussac's Hist. Moll. vol. ii. p. 170, pl. cxxxiv. figs. 12–14.
Cionella (*Leptinaria*) *lamellata*, Pfr. Nomen. Helic. p. 335.

Hab. Bolivia, Peru; Dominica (*Angas and Brown*).

With this species Mr. Angas has united *Lep. antillarum.* With this determination I agree, and am also of opinion that *L. Funcki*, Pfr., *L. perforata*, Pfr., *L. lamellosa*, Rve., and *L. concentrica*, Rve., also are mere slight varieties of the same form.

6. **Helix* (*Macrocyclis*) *concolor*, Férussac.

Helix concolor, Férussac, Hist. Moll. vol. i. p. 98, pl. lxxxii. fig. 2; Delessert, Recueil. pl. xxvi. fig. 1; Pfeiffer, Conch.-Cab. no. 525, pl. lxxxv. figs. 4–6; Chemn. Ill. Conch. pl. viii. fig. 15, pl. xii. fig. 1; Reeve, Conch. Icon. pl. lxi. figs. 304 *a*, *b*.
? *Helix Baudoni*, Petit, Journ. Conch. 1853, p. 364, pl. xi. figs. 4, 5.
Hyalina Baudoni, Guppy, Ann. & Mag. Nat. Hist. 1868, vol. i. p. 430.
Zonites concolor, Angas, P. Z. S. 1883, p. 594.

Hab. Porto Rico (*concolor*), Guadeloupe (*Baudoni*); Dominica (*Angas, Brown, Guppy, and Ramage*).

I think it somewhat doubtful if Angas is right in uniting the above two forms. The difference of colour, the smoother surface, and flatter whorls of *H. Baudoni* may be sufficient to distinguish it.

7. **Helix* (*Dentellaria*) *Josephinæ*, Férussac.

Helix (*Helicodonta*) *Josephinæ*, Fér. Prodr. 125; Hist. Moll. vol. i. p. 151, pl. lvi. figs. 5–10.
Helix Josephinæ, Pfeiffer, Conch.-Cab. pl. lxii. figs. 11, 12; Reeve, Conch. Icon. pl. lvi. fig. 272.

Hab. Guadeloupe and Martinique; Dominica (*Guppy, Brown, Angas, and Ramage*).

8. **Helix* (*Dentellaria*) *badia*, Férussac.

Helix (*Helicodonta*) *badia*, Fér. Prodr. 124; Hist. Moll. vol. i. p. 150, pl. lvi. figs. 1–4.
Helix badia, Pfeiffer, Conch.-Cab. no. 366, pl. lxiii. figs. 7–10; Reeve, Conch. Icon. pl. lvi. fig. 274.

Hab. Martinique, Guadeloupe, Cayenne; Dominica (*Guppy, Brown, Angas, and Ramage*).

9. *Helix* (*Dentellaria*) *dentiens*, Férussac.

Helix (*Helicodonta*) *dentiens*, Férussac, Hist. Moll. vol. i. p. 147, pl. xlvii. fig. 2, pl. xlviii. fig. 2, pl. xlix A. fig. 2.
Helix dentiens, Wood, Index Test. Suppl. pl. vii. fig. 48; Pfeiffer,

Conch.-Cab. ed. 2, pl. xv. figs. 11–13; Reeve, Conch. Icon. pl. lii. fig. 250.
Helix isabella, Férussac, Reeve, *l. c.* pl. lii. fig. 249.
Helix dentiens, Angas, Proc. Zool. Soc. 1883, p. 596.

Hab. Martinique, Guadeloupe, Cayenne; Dominica (*Guppy, Brown, and Angas*).

10. **Helix* (*Dentellaria*) *nigrescens*, Wood.

Helix nigrescens, Wood, Ind. Test. Suppl. pl. vii. fig. 32; Pfeiffer, Conch.-Cab. ed. 2, no. 50, pl. x. figs. 15, 16; Reeve, Conch. Icon. pl. lvii. fig. 280.

Hab. Guadeloupe; Dominica (*Angas, Brown, Guppy, and Ramage*).

11. **Bulimus* (*Leiostracus*) *laticinctus* (Guppy).

Bulimulus laticinctus, Guppy, Ann. & Mag. Nat. Hist. 1868, vol. i. p. 431.

Hab. Dominica (*Guppy and Ramage*).

Two varieties of this species are mentioned by Mr. Guppy, one with and the other without bands. The single specimen obtained by Mr. Ramage belongs to the banded form.

12. *Bulimus* (*Leiostracus*) *virginalis*, Pfeiffer.

Bulimus virginalis, Pfeiffer, Mon. Helic. vol. iv. p. 405; Novitat. Conch. vol. iii. p. 422, pl. xcvi. figs. 1, 2.

Hab. Mexico; Dominica (*Brown*).

13. *Bulimus* (*Leiostracus*) *liliaceus*, Férussac.

Helix (*Cochlogena*) *liliaceus*, Férussac, Prodr. 401; Hist. Moll. vol. ii. pt. 2, p. 83, pl. cxlii B. figs. 11–14.
Bulimus liliaceus (Guilding), Reeve, Conch. Icon. pl. xlv. fig. 287.

Hab. Porto Rico, St. Kitts, and Mexico; Dominica (*Angas*).

14. *Bulimus* (*Leiostracus*) *multifasciatus*, Lamarck.

Bulimus multifasciatus, Lamarck, Delessert, Recueil. pl. xxviii. fig. 3; Reeve, Conch. Icon. pl. xlvi. fig. 295; Pfeiffer, Conch.-Cab. no. 337, pl. lxiii. figs. 11, 12.
Bulimus picturatus, Férussac, Potiez et Michaud, Galér. Moll. p. 147.

Hab. Guadeloupe, Martinique, Cayenne, La Guayra; Dominica (*Angas and Brown*).

15. **Bulimus* (*Thaumastus*) *Nichollsi*, Brown.

Bulimus Nichollsi (Brown), Amer. Nat. 1881, vol. xv. p. 57; Angas, Proc. Zool. Soc. 1883, p. 596, p. 595. figs. 2, 3.

Hab. Dominica (*Brown, Angas, and Ramage*).

16. *Bulimus* (*Thaumastus*) *exilis* (Gmelin).

Helix exilis, Gmelin, Syst. Nat. p. 3668.

For the synonymy of this common West-Indian shell see Pfeiffer's Monogr. Hel. vol. ii. p. 224, iii. p. 433, iv. p. 498, vi. p. 146.

Hab. Guadeloupe, St. Thomas, Porto Rico, Cayenne, Barbuda, Barbados; Dominica (*Guppy and Angas*).

17. *Bulimus* (*Peronæus*) *stenogyroides*, Guppy.

Bulimulus stenogyroides, Guppy, Ann. & Mag. Nat. Hist. 1868, vol. i. p. 431.

Hab. Dominica (*Guppy*).

18. **Amphibulima patula* (Bruguière).

Bulimus patulus, Brug. Encycl. Méth. vol. i. p. 305.
Amphibulima cucullata, Lamk. Ann. du Mus. vol. vi. pl. lv. fig. 1.
Succinea patula, Deshayes, Hist. Moll. vol. ii. pt. 2, p. 140, pl. xi. figs. 14–16, pl. xi A. figs. 12, 13.
Succinea cucullata, Blainville, Man. Mal. p. 455, pl. xxxvii. fig. 2.
Succinea patula, Pfr. Mon. Hel. iii. p. 21; Reeve's Conch. Icon. pl. iii. fig. 21; Fischer (anatomy), Journ. de Conch. 1874, vol. xxii. p. 141, pl. v. figs. 8–12.
Amphibulima patula, Angas, P. Z. S. 1883, p. 595, fig. 1.

Hab. Guadeloupe, St. Kitts, Marie Galante; Dominica (*Guppy, Angas, and Ramage*).

19. *Amphibulima rubescens* (Deshayes).

Succinea rubescens, Deshayes, Mag. de Zool. 1830, pl. iv.; Guérin's Icon. Règ. Anim. pl. vi. figs. 8, 8 *a*; Hist. Moll. vol. ii. pt. 2, p. 139, pl. ix B. fig. 3; Pfeiffer, Conch.-Cab. p. 36, pl. iii. figs. 34, 35.
Amphibulima (*Rhodonyx*) *rubescens*, Fischer, Journ. de Conch. 1874, vol. xxii. p. 145, pl. v. fig. 13 (anatomy).

Hab. Guadeloupe; Dominica (*Brown*).

20. **Amphibulima tigrina*, Lesueur.

Succinea tigrina, Lesueur, Férussac's Hist. Moll. vol. ii. pt. 2, p. 140, pl. xi A. fig. 4; Angas, Proc. Zool. Soc. 1883, p. 595.

Amphibulima pardalina, Guppy, Ann. & Mag. Nat. Hist. 1868, vol. i. p. 432.

Hab. St. Vincent; Dominica (*Guppy*, *Angas*, *Ramage*).

21. *Succinea approximans*, Shuttleworth.

Succinea approximans, Shuttl. Bern. Mittheil. 1854, p. 147; Pfeiffer, Mon. Hel. vol. iv. p. 817.

Hab. Guadeloupe?, Porto Rico, St. Thomas, St. Lucia; Dominica (*Guppy and Angas*).

22. *Homalonyx guadeloupensis* (Lesson).

Testacellus guadelupensis, Lesson, Rev. Zool. 1838, p. 250.
Testacella Matheroni, Potiez et Michaud, Gal. Moll. vol. i. p. 63, pl. xi. figs. 1, 2.
Homalonyx guadeloupensis, Fischer, Journ. de Conch. 1874, p. 138.
Succinea (*Omalonyx*) *guadeloupensis*, Angas, Proc. Zool. Soc. 1883, p. 595.

Hab. Guadeloupe; Dominica (*Angas*).

23. *Cyclophorus amethystinus (Guppy).

Cyclotus amethystinus, Guppy, Ann. & Mag. Nat. Hist. 1868, vol. i. p. 433.
Cyclophorus amethystinus, Pfeiffer, Mon. Pneum. vol. iv. p. 112; Angas, Proc. Zool. Soc. 1883, p. 597.

Hab. Dominica (*Guppy*, *Angas*, *Ramage*).

24. *Cyclophorus Schrammi*, Shuttleworth.

Cyclostoma (*Cyclophorus*) *Schrammi*, Shuttleworth, Journ. de Conch. 1856, vol. v. p. 269.
Cyclophorus Schrammi, Pfeiffer, Mon. Pneum. vol. ii. p. 64.

Hab. Guadeloupe; Dominica (*Brown*).

25. *Helicina fasciata*, Lamarck.

Helicina fasciata, Lamk. Anim. s. Vert. vol. vi. p. 103; Pfr. Conch.-Cab. ed. 2, p. 48, pl. iii. figs. 26–35.
Helicina picta, Sowerby, Thesaurus Conch. vol. i. pl. ii. fig. 56, pl. iii. figs. 140, 141.
Helicina fasciata, id. *op. cit.* vol. iii. pl. cclxxiv. figs. 312, 313; id. Conch. Icon. pl. ix. fig. 73.

Hab. Porto Rico, St. Vincent, Barbados, Martinique, St. Kitts; Dominica (*Angas*).

26. *Helicina plicatula*, Pfeiffer.

Helicina plicatula, Pfr. Mon. Pneumon. vol. iv. p. 340; id. Conch.-Cab. p. 13, pl. viii. figs. 36–39.

Hab. Martinique; Dominica (*Guppy*).

27. *Helicina epistilia*, Guppy.

Helicina epistilia, Guppy, Ann. & Mag. Nat. Hist. 1868, vol. i. p. 433; Pfr. Mon. Pneumon. vol. iv. p. 254.

Hab. Dominica (*Guppy*).

28. *Helicina Guppyi*, Pease.

Helicina humilis, Guppy, Ann. & Mag. Nat. Hist. 1868, vol. i. p. 434.
Helicina Guppyi, Pease, Proc. Zool. Soc. 1871, p. 467; Pfeiffer, Mon. Pneumon. vol. iv. p. 257.

Hab. Dominica (*Guppy*).

29. **Helicina velutina*, Guppy.

Helicina velutina, Guppy, Ann. & Mag. Nat. Hist. 1868, vol. i. p. 434; Pfeiffer, Mon. Pneumon. vol. iv. p. 257; Angas, Proc. Zool. Soc. 1883, p. 597.

Hab. Dominica (*Guppy*, *Angas*, *Ramage*).

30. **Helicina rhodostoma*, Gray.

Helicina rhodostoma, Gray, Zool. Journ. vol. i. p. 68, pl. vi. fig. 9; Reeve, Conch. Syst. vol. ii. pl. clxxxvi. fig. 5; Sowerby, Thes. Conch. vol. i. pl. ii. fig. 71, vol. iii. pl. cclxxvii. figs. 412, 413; Pfeiffer, Conch.-Cab. ed. 2, p. 60, pl. vii. figs. 4, 5; Guppy, Ann. & Mag. Nat. Hist. 1868, vol. i. p. 435; Angas, Proc. Zool. Soc. 1883, p. 597.

Hab. Guadeloupe; Dominica (*Guppy*, *Angas*, *Ramage*).

31. *Helicina conuloides*, Guppy.

Helicina conuloides, Guppy, Ann. & Mag. Nat. Hist. 1868, vol. i. p. 435; Pfeiffer, Mon. Pneumon. vol. iv. p. 246.

Hab. Dominica (*Guppy*).

32. **Helicina platychila* (Mühlfeldt).

Helix platychilos, Mühlfeldt, Verhandl. Berl. Ges. i. 4, p. 219, pl. iii. fig. 11.

Helicina platychila, Pfeiffer, Conch.-Cab. p. 24, pl. iv. figs. 22–24, pl. vii. figs. 8, 9.
Helicina lutea, Sowerby, Thes. Conch. vol. i. p. 6, pl. ii. fig. 59, pl. iii. fig. 142, vol. iii. p. 289, pl. cclxxiv. figs. 310, 311; id. Conch. Icon. pl. xi. figs. 87 *a*, *b*.

Hab. Guadeloupe, Martinique, Cuba?; Dominica (*Brown*, *Ramage*).

33. *Helicina antillarum*, Sowerby.

Helicina antillarum, Sowerby, Thes. Conch. vol. i. p. 7, pl. ii. figs. 68–70, vol. iii. p. 292, pl. cclxxv. figs. 359–361; id. Conch. Icon. pl. xx. figs. 176 *a*, *b*; Reeve, Conch. Syst. vol. ii. pl. clxxxvi. fig. 15; Pfeiffer, Conch.-Cab. p. 46, pl. iii. figs. 1–3; Crosse, Journ. de Conch. 1874, vol. xxii. p. 203, pl. iv. fig. 5.

Hab. Guadeloupe; Dominica (*Brown*).

XXX.—*Descriptions of new Species of Lepidoptera, chiefly from Central America.* By Herbert Druce, F.L.S., F.R.G.S., F.Z.S.

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

Rhopalocera.

Papilio, Linn.

Papilio Langeni, sp. n.

Primaries black, with three indistinct white spots forming a broken band beyond the cell, crossing the wing from near the costal margin towards the outer margin; secondaries black, with a large central creamy white band, in shape almost the same as in *P. albinus*, Wall. Underside of the primaries black, with the indistinct white spots as above: secondaries uniformly black, with a small orange streak well above the anal angle. In some specimens the white spots on the primaries are almost gone. Expanse $4\frac{3}{4}$ inches.

Hab. Ké Island (Mus. Druce, Godman and Salvin).

This species is allied to *P. albinus*, Wallace, from New Guinea; but it is at once distinguished from that insect by the entirely black underside of the secondaries. I have little doubt that it is peculiar to Ké Island.

Papilio argynnus, sp. n.

Papilio agamemnon, local form *b*, Wallace.

Primaries the same as in specimens of *P. agamemnon* from New Guinea; secondaries entirely black, a very narrow green streak extending from the costal margin to the middle of the cell. The undersides of the primaries are identical with those of *P. agamemnon*; the secondaries reddish brown. Expanse $4\frac{1}{4}$ inches.

Hab. Ké Island (Mus. Druce).

Mr. Wallace obtained a single specimen of this species from Ké Island, and considered it a variety of *P. agamemnon*. I have five specimens before me that do not show any variation, and have little doubt it is a species peculiar to that island.

HETEROCERA.

Fam. **Sphingidæ**.

Subfam. *MACROGLOSSINÆ*.

PACHYGONIA, Feld.

Pachygonia ericea, sp. n.

Primaries dark greyish brown, crossed by numerous waved lines of a darker brown; a wide band of the same colour crosses the wing from the costal margin to the anal angle, beyond which are several greyish-white lunular-shaped markings; a submarginal black line, edged on the inner side with yellowish brown, extends from the apex to the anal angle: secondaries dark brown, with a large chrome-yellow patch extending from the base to about the middle but not touching the costal margin; two narrow greyish-white lines close to the anal angle. Underside dull brown, spotted with whitish-brown markings near the apex of the primaries and the anal angle of the secondaries. Head, thorax, abdomen, and legs dark brown; tegulæ darker brown, edged with pale brown; antennæ reddish brown. Expanse 3 inches.

Hab. Panama, Volcan de Chiriqui (*Trötsch*).

This fine and very distinct species is in the collection of Dr. Staudinger. It is not nearly allied to any species known to me.

Perigonia, Walk.

Perigonia tacita, sp. n.

Primaries bright reddish brown, with a large ∧-shaped darker brown mark extending from the middle of the inner margin nearly to the costal margin, edged on both sides with greyish-brown lines; two small black dots at the end of the cell, and several indistinct undulating dark brown lines crossing the wing from the costal margin to near the anal angle; several silvery-brown lunular-shaped marks close to the apex: secondaries dark brown, broadly banded with chrome-yellow from the base to near the apex; several very indistinct greyish lines cross the wing from the anal angle towards the apex. Underside of all the wings yellowish brown, and reddish brown along the outer margins. Head, thorax, abdomen, and legs dark brown; antennæ yellowish brown. Expanse 2½ inches.

Hab. Panama, Volcan de Chiriqui (*Trötsch*, Mus. Staudinger).

This species is most nearly allied to *Perigonia stulta*, Herr.-Sch., but very distinct from that insect.

Aleuron, Boisd.

Aleuron tachasara, sp. n.

Primaries brownish olive-green, crossed from the costal to the inner margin by five indistinct waved dark brown lines; a silvery grey mark on the costal margin nearest the apex, almost crossing to the middle of the outer margin and then extending to the anal angle: secondaries blackish brown, greenish at the base and along the costal margin to the apex. Underside: primaries, the basal half brownish black, the outer half olive-brown with an indistinct silvery line crossing from near the apex to the inner margin: secondaries olive-brown, with a silvery gloss extending over the wing from the base to the central whitish band, which crosses from the costal margin near the apex to the inner margin. Head, thorax, abdomen, and legs brownish olive-green, the underside of the thorax and abdomen paler than above; antennæ brown. Expanse 4 inches.

Hab. Panama, Volcan de Chiriqui (*Trötsch*, Mus. Staudinger).

This fine species is very distinct from all I have seen, but it is allied to *A. chloroptera*, Perty, from which it is at once distinguished by the greener colour of the primaries and the entirely different secondaries; it is also a much larger insect.

Subfam. *Chœrocampinæ.*

Chœrocampa, Dup.

Chœrocampa jocasta, sp. n.

Primaries pale silvery fawn-colour, thickly mottled with olive-brown; a wide central olive-brown band crosses the wing from the costal to the inner margin; on the outer side of the band two indistinct waved lines, beyond which two patches of olive-green, the first close to the apex, the second the largest and about the middle on the costal margin: secondaries blackish brown, with an indistinct fawn-coloured band crossing the wing from the anal angle to near the apex. Underside pale yellowish fawn-colour, thickly irrorated with dark brown scales; a narrow blackish line crosses the middle of both wings. The head, thorax, and base of the abdomen olive-green; the underside of the thorax and the abdomen pale yellowish fawn-colour; the legs and tegulæ are of the same colour; antennæ greenish. Expanse $3\frac{1}{4}$ inches.

Hab. Guatemala (Mus. Staudinger).

One specimen, without any exact locality in Guatemala, is in Dr. Staudinger's collection; it is totally unlike any other species known to me.

Subfam. *Sphinginæ.*

Amphonyx, Poey.

Amphonyx Staudingeri, sp. n.

Primaries pale yellowish green, thickly irrorated with brown scales; the markings are much the same as in *A. rivularis*, but are all more distinct and of a rich madder-brown colour: secondaries madder-brown, with a small spot at the base chrome-yellow and an indistinct central band of the same colour extending from the anal angle to the costal margin nearest the apex; on the outer margin near the anal angle are three irregular-shaped yellowish-green spots, irrorated with dark brown scales. On the underside this species very closely resembles *A. rivularis*, from which it chiefly differs in having a dark brown zigzag line, edged with yellow scales on each side, crossing the primaries from the costal to the inner margin. The head and thorax greenish yellow; the sides of the head and the tegulæ rich madder-brown; on each side of the base of the thorax is a tuft of black hairs tipped with bluish white; the upper surface of the abdomen yellowish brown, with six narrow yellow lines extending from the base to the anus; the underside of the abdomen pale yellow; antennæ and legs dark brownish black. Expanse 6½ inches.

Hab. Nicaragua, Chontales (*Belt*, Mus. Oxford); Panama, Volcan de Chiriqui (*Trötsch*, Mus. Staudinger).

I have much pleasure in naming this grand insect after Dr. Staudinger, to whom I am much indebted for his kindness in submitting all his Central-American Heterocera to me for examination. This species is most nearly allied to *Amphonyx rivularis* of Butler, which was originally described from the Amazons, but is also found in Central America. *A. Staudingeri* differs from all the described species of *Amphonyx* by the entire absence of the yellow spots on the sides of the abdomen.

Our description is taken from Dr. Staudinger's specimen.

Isognathus, Feld.

Isognathus yucatana, sp. n.

Primaries pale grey, thickly irrorated with dark brown scales, and very indistinctly banded with a waved brown line, which crosses the wing from the costal to the inner margin; a zigzag black line crosses from the costal margin beyond the middle nearest the apex to the middle of the inner margin, where it joins a black streak from the base, and a marginal row of black spots extends from the apex to the anal angle: secondaries reddish, broadly bordered with brownish black from the apex almost to the anal angle, where it is greyish. Underside of all the wings reddish brown, palest near the base. Head, thorax, and abdomen brownish grey; the abdomen with two central narrow brown lines extending from the base to the anus; the underside of the thorax and abdomen paler than above; antennæ and legs greyish brown. Expanse 3½ inches.

Hab. Mexico, Yucatan (Mus. Staudinger).

This species resembles *Dilophonota ello* in colour, but is at once distinguished from it by its different form and the entire absence of the black band on the abdomen.

Hyloicus, Hübn.

Hyloicus haterius, sp. n.

Primaries pale grey, streaked with brown lines, which are very indistinct along the inner margin, an indistinct row of black dots along the outer margin from the apex to the anal angle: secondaries uniform dark brown, the fringe greyish. The head, thorax, and abdomen greyish brown; a central black line extends from the base of the abdomen to the anus. The underside of all the wings dark brown, palest at the base of the secondaries. Antennæ and legs greyish brown. Expanse 2 inches.

Hab. Mexico, Yucatan (Mus. Staudinger).

This small species closely resembles *Hyloicus juniperi*, Boisd., from South and East Africa.

Fam. **Agaristidæ.**

Pseudolypia, Edwards.

Pseudolypia Walkeri, sp. n.

Primaries and secondaries on the upper and underside uniformly dull black: the primaries crossed just beyond the cell on the costal margin by a narrow white band that extends to the anal angle, where it is slightly hooked: a narrow metallic line extends from the base along the costal margin, but not beyond the white band, one at the end of the cell, and several between it and the inner margin. The head, thorax, and abdomen glossy black, as also the legs and antennæ; the tegulæ orange-red. Expanse 2 inches.

Hab. Mexico, Acapulco (*J. J. Walker*).

This species is allied to *Pseudolypia* (*Agarista*) *radians*, Felder, a species also said to come from Mexico, but as yet only known to us by Dr. Felder's figure. *P. Walkeri* is at once distinguished from it by the white band on the primaries.

Fam. **Zygænidæ.**

Subfam. *Euchromiinæ.*

Macrocneme, Hübn.

Macrocneme hesione, sp. n.

Primaries black, shot with purple, the apical half of the wing greyish, the veins black, a minute white dot close to the base: secondaries deep black. Underside: primaries purplish black, broadly white from the apex to the anal angle; the fringe black: secondaries black, shot with purple along the costal margin. Head, antennæ, thorax, legs, and abdomen black; anus and underside of the abdomen metallic green. Expanse $1\frac{3}{10}$ inch.

Hab. Panama, Volcan de Chiriqui (*Trötsch*, Mus. Staudinger).

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

MASTIGOCERA, Boisd.

Mastigocera splendens, sp. n.

Primaries glossy greenish black, with five bright orange-coloured spots, four of them forming a straight row from the base to the outer margin, the two close to the base quite small, the others considerably larger; the fifth spot on the costal margin is small: the secondaries black, with the base and a round central spot bright orange. The underside of all the wings the same as above, the orange spots very bright in colour. The head, thorax, and abdomen glossy greenish black, the sides of the abdomen banded with orange; the antennæ and collar brownish-orange; the legs greenish black. Expanse $1\frac{1}{4}$ inch.

Hab. New Providence, Bahama Islands (Mus. Druce).

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

Subfam. *EUNOMIINÆ*.

ARGYROCIDES, Butl.

Argyrocides minuta, sp. n.

Primaries and secondaries hyaline, shaded from the base to beyond the middle with pale yellow, all the veins deep black. The head, antennæ, thorax, and legs black; abdomen black, broadly banded at the base with yellowish white. Expanse $\frac{3}{4}$ inch.

Hab. Honduras (Mus. Staudinger).

This small species is allied to *Argyrocides menephron*, Druce, from which it is at once distinguished by its smaller size and entirely different coloration.

Subfam. ANTICHLORINÆ.

ANTICHLORIS, Hübn.

Antichloris ruatana, sp. n.

Primaries and secondaries smoky black, slightly palest close to the apex of the primaries. Head, thorax, abdomen, legs, and antennæ all black. Expanse 1 inch.

Hab. Honduras, Ruatan Island (*Gaumer*).

A distinct species, allied to *A. anthracina*, Walk.

Fam. Ophideridæ.

PHYLLODES, Boisd.

Phyllodes imperialis, sp. n.

♂. Primaries fawn-colour, banded with darker brown, as in *Phyllodes Verhuellii*, Voll.: secondaries bluish black, paler at the base. A wide pink-coloured fascia crosses the wing for quite two thirds of its width, from the inner margin above the anal angle to the costal margin nearest the apex. The underside is more uniform in colour, and the pink fascia considerably smaller. Head, thorax, and antennæ brownish fawn-colour; legs brown, abdomen blackish brown. ♀. Larger than the male and much darker in colour, but in other respects identical, excepting the apex of the secondaries being irrorated with white scales. Expanse ♂ 6 inches, ♀ $6\frac{3}{4}$ inches.

Hab. Aola, Guadalcanar Island, Solomon Islands (*C. M. Woodford*, Mus. Druce).

This fine moth is very distinct from all the described species of *Phyllodes*, from which it is at once distinguished by the wide pink fascia of the secondaries.

Fam. Uraniidæ.

Alcides latona, sp. n.

Primaries and secondaries of the same shape as in *A. aurora*, Salvin (P. Z. S. 1877, p. 150, t. xxii. figs. 5, 6). ♂. Upper side: primaries and secondaries deep glossy black, the metallic green extending from the base to about the middle of the primaries, the same as in *A. aurora*, but of a bluer shade, beyond which a narrow green line crosses the wing from the costal margin towards the anal angle, but does not nearly reach it:

secondaries, the basal half blue-black, the outer half nearly the same as in *A. aurora*, but with a wide submarginal blue-black band much broken on the outer edge extending from the apex to the anal angle, the fringe snow-white. Underside bluish grey: the primaries with the outer margin and two wide bands crossing from the costal to the inner margin bluish black: secondaries crossed below the middle by a wide bluish black band, the outer margin black from the base to near the apex. Head, thorax, and upper part of the abdomen bluish black, the sides greyish, the underside orange; antennæ black, legs greyish brown. ♀. Primaries black, crossed about the middle, from the costal to the inner margin near the anal angle, by a wide greenish-blue band, beyond which is a narrower band, corresponding with that in the male: secondaries black, with a wide greenish-blue band crossing the wing below the middle, from the apex to the inner margin above the anal angle. Head, thorax, and the upperside of the abdomen bluish black, the sides bluish grey; the underside and the anus orange, but not so bright in colour as in the male; antennæ black, legs greyish brown. Expanse ♂ $4\frac{1}{4}$ inches, ♀ $4\frac{1}{2}$ inches.

Hab. Aola in Guadalcanar Island, Solomon Islands (*C. M. Woodford*, Mus. Druce).

The collection contained one male and three females of this beautiful species: it is allied to *A. aurora*, Salvin.

XXXI.—*Descriptions of some new Coleoptera from Japan.* By Dr. D. Sharp.

No members of the Coleopterous families Parnidæ and Georyssidæ had been described from Japan till the present year, when H. von Schönfeldt described a species of *Stenelmis* from Hiogo. Mr. Lewis has possessed for some years an example of *S. foveicollis*, Schönf.; and I now describe two other Japanese genera of the family, and also a species of *Georyssus*, brought to England by him.

Elmomorphus, n. gen. Parnidarum.

Antennæ breves, basi auriculatæ, articulis externis compressis: caput receptum. Pedes elongati. Corpus subtus tomento aerifero vestitum, supra fere nudum.

This insect has more the appearance of an *Elmis* than of a

Parnus, but by the structure of its antennæ it is allied rather to the latter genus; its nearest described ally is *Elmoparnus*, from which it differs in so many details that it is better to treat the two as distinct genera. The body is oval, with elongate legs and very long tarsi. The antennæ are very short; the first two joints are of a different form from the rest, and serve to close the cavity into which the antennæ are deflexed in repose; the other joints are short and broad, and form a small mass acuminate at the extremity. The head, the sides of the thorax, and the whole of the elytra have a peculiar silky opacity, such as is seen in many Elmides; the under surface is entirely covered with the peculiar tomentum for bearing air, except the middle of the metasternum and prosternum, and here there is a large smooth space. The maxillary palpi are rather long, the terminal joint slender, oval, three or four times as long as the preceding; the prosternum is elongate, and extends further forwards than the front of the pronotum; the front coxæ are small, very widely separated; and the middle legs are even more widely separated. There is no trace of striæ or impressions on the thorax.

Elmomorphus brevicornis, n. sp.

Niger, supra subænescens, prothorace nitido, fortiter punctato, tarsis, antennis oreque rufis; subtus tomento grisescente vestitus.
Long. $3\frac{3}{4}$ millim.

Thorax much narrowed in front, anterior angles greatly produced, very acute, the base lobed in the middle, the lobe emarginate in adaptation to the large scutellum, hind angles acute, the surface coarsely punctate, quite shining in the middle, dull at the sides. Scutellum smooth, shining. Elytra dull, with an extremely minute setosity, with regular series of coarse punctures that become quite obsolete at the extremity. Tibiæ finely pubescent internally towards the apex.

Kobé, South Japan: two specimens found by Mr. G. Lewis in May 1871, and recorded in his Catalogue of Japanese Coleoptera as "862. *Helichus*, spec.?" *Helichus*, Er., is, however, as I have shown elsewhere, the same as *Dryops*, auct.

Leptelmis, n. gen. Parnidarum.

Corpus gracile, haud parallelum. Antennæ 11-articulatæ, tenues. Palpi maxillares tenues. Pedes omnes distantes; coxis posterioribus latius separatis.

This insect, though allied to *Stenelmis*, cannot be placed in that genus; it differs in several respects, more especially in the great separation of the hind legs and the very dependent front of the prosternum. The form is different from that of *Stenelmis*, and the sculpture is not similar to that of any other Elmid known; the eyes, too, are much smaller than in *Stenelmis*, and the terminal joint of the maxillary palpus more slender.

Leptelmis gracilis, n. sp.

Minus parallelus, niger, antennarum basi pedibusque piceis; prothorace valde inæquali, anterius profunde transversim depresso; elytris subovatis, dense seriatim foveolatis.
Long. $2\frac{1}{2}$ millim.

Antennæ very slender, black externally, piceous towards the base, the basal two joints nearly yellow. Thorax narrow in front, with a very broad and deep transverse depression extending across it near the front; on the disk with two oblique depressions convergent behind, the spaces between them nodularly elevated. Elytra much broader than the thorax, broader behind, densely covered with deep foveæ arranged in series. Legs slender, very long.

Tokio: one mutilated example. Discovered by Mr. Tanaka of that city.

Stenelmis foveicollis.

Stenelmis foveicollis, Schönfeldt, Ent. Nachrichten, xiv. (1888) n. 13, p. 193.

"*St.* elongatus, niger, antennis basi unguiculisque rufis, prothorace ante medium foveolato utrinque obsolete impresso, elytris punctato-striatis, interstitio secundo, quinto septimoque carinatis. Long. 3·3 millim."

Has been found in a swiftly running brook in the neighbourhood of Hiogo.

Georyssus canalifer, n. sp.

Brevis, niger, elytris fortiter profundeque seriatim punctatis; prothorace anterius sculpturato, medio usque ad basin canaliculato.
Long. 2 millim.

Thorax with some irregular elevations on the front part, the lateral margins crenate; along each side a series of fine elevations extending to the base, and on the middle an elongate channel. Elytra shining, with regular series of very coarse punctures.

This is allied to *G. pygmæus*, but is larger and more coarsely sculptured, and readily distinguished by the elongate channel on the thorax. It has evidently, like its European ally, the curious habit of covering itself with grains of sand or earth.

Sapporo, Japan. Taken abundantly in August 1880.

List of Species.

Elmomorphus brevicornis, n. sp.	Stenelmis foveicollis, *Schönfeldt.*
Leptelmis gracilis, n. sp.	Georyssus canalifer, n. sp.

XXXII.—*On the African Specimens of the Genus* Scorpio *(Linn.) contained in the Collection of the British Museum.* By R. I. Pocock, Assistant, Nat. Hist. Museum.

It is much to be regretted that there exists amongst arachnologists considerable difference of opinion with respect to the generic nomenclature of those Scorpions (and their allies) which form the subject-matter of the present paper; and it is the desire to see the uniform adoption of certain names that urges me to venture upon a few remarks on the question.

Amongst the species of *Scorpio* described by Linnæus, there are two which at the present moment claim our special attention; these are *Sc. africanus* and *Sc. maurus.* Of these two, the latter was re-named *palmatus* by Ehrenberg, and placed, in conjunction with another species named *spinifer*, in the genus *Heterometrus* of that author.

Now Dr. Thorell, wishing to abolish *Scorpio* as a generic name, substituted *Pandinus* in its place, and kept as the type of *Pandinus* a W.-African Scorpion, which he believed to be the *africanus* of Linnæus. And further, believing *maurus* (Linn.) to be generically distinct from *Pandinus*, he reserved for its reception the genus *Heterometrus*, a name which, as stated above, had been given to it as *palmatus* by Ehrenberg. *Spinifer*, Ehrenberg's second species of *Heterometrus*, Thorell placed in a new genus *Palamnœus*, distinct from both *Heterometrus* and *Pandinus.*

Dr. Karsch, on the other hand, keeps the generic name *Scorpio*, and regards *maurus* (Linn.) as the type of it; and, agreeing with Thorell respecting the generic separation of *maurus*, *africanus*, and *spinifer*, he refers *africanus* to the genus *Pandinus*, and makes *spinifer* the type of *Heterometrus.*

Yet a third view is held by M. E. Simon, who restores for *africanus* the name *Scorpio*, and makes *Pandinus* synonymous with it; *maurus* he refers to *Heterometrus*, and *spinifer* (I presume) to *Palamnæus*.

The three views may be tabulated as follows:—

Thorell.		*Karsch.*		*Simon.*
Heterometrus	=	Scorpio	=	Heterometrus.
Pandinus	=	Pandinus	=	Scorpio.
Palamnæus	=	Heterometrus	=	Palamnæus.

It will be seen from this that Karsch differs from Thorell in two points, and that Simon differs from Thorell in one point, whilst Simon differs from Karsch in all points; and that which makes the matter more complicated still is the fact that each author has plenty to say in support of his own view.

I think, however, that the case can be in a great measure simplified by the adoption of a fourth view, which is to a certain extent a combination of the two held respectively by Dr. Karsch and Mons. Simon.

In the first place, I cannot see that Thorell had adequate grounds for changing *Scorpio* into *Pandinus*, and I do not know that any author, with the exception, perhaps, of Count Keyserling, has followed him in this respect. If, then, it be agreed to restore the name *Scorpio*, it will be seen, I think, that the main difficulty to be contended with arises from the idea that *maurus* is generically distinct from *africanus*.

Now the reason for the separation of the two is found in a difference in the shape of the humerus or second segment of the chela, that segment in *maurus* presenting a form which has not yet been met with in *africanus* and its allies. But the fact that the shape of the humerus is not constant in all the species allied to *africanus* shows that the character is one of no great importance; and further, since *maurus* is the only species which possesses a peculiarly-shaped humerus, the question may well be asked, What is gained by its separation? Obviously, nothing. On the contrary, much of the confusion above pointed out has resulted from it; and if I were to follow on this point the example of my predecessors, consistency would compel me to form new generic names for the species described below as *exitialis* and *cavimanus*. But this I shall not do. I shall content myself with regarding them and *maurus* merely as well-marked species of *Scorpio*, and if this view be followed by other authors the solution of the problem becomes easy; for *spinifer*, the other species of *Heterometrus*, can then stand as the type of that genus, and *Palamnæus* will be a synonym of *Heterometrus*, as *Pandinus* is a synonym of *Scorpio*.

The adoption of the genus *Scorpio* will necessitate the alteration of the family name from Pandinoidæ or Heterometroidæ into Scorpionidæ, or, as Thorell would call it, Scorpionoidæ.

It is unfortunate that there is so much uncertainty respecting the identity of *africanus* (Linn.), the type of the genus *Scorpio*. All the useful information concerning it is that it is an African species, hairy, and possessing twelve or thirteen pectinal teeth; but the conclusions hitherto arrived at on the subject are as different as they are unsatisfactory. Simon supposed it to be the *Buthus cæsar* of C. Koch, Thorell the *Rœseli* of Simon, and Becker the *asper* of Thorell. To each of these views, however, exception may be taken. Firstly, *cæsar* is an East-Indian species; secondly, *Rœseli* has sixteen pectinal teeth; thirdly, *asper* is probably synonymous with *Swammerdami*, which is also an Indian species. I am inclined to think that the species that I have named below *dictator* may be the unknown *africanus* of Linnæus. At all events the description of Linnæus, so far as it goes, applies to this species, as I believe it applies to no other, and I have consequently regarded *dictator* as questionably synonymous with *africanus*.

Scorpio cavimanus, sp. n.

Cephalothorax.—Anterior margin with a median semicircular excision; margin of the excision and of the frontal lobes piliferous and dentate; the posterior deeper portion of the median longitudinal sulcus bounded on each side by a low, finely granular prominence; the frontal lobes, the slightly depressed area immediately in front of the ocular tubercle, and the lateral and postero-lateral regions of the cephalothorax finely granular; the rest smooth; the central eyes nearer to the semicircular excision than to the hind margin of the cephalothorax; median eye of lateral series nearer to the anterior than to the posterior eye of the same series.

Tergites granular, more coarsely so anteriorly than posteriorly; each marked with two abbreviated sulci in front, and with an obsolete crest behind; posterior tergite bearing a conspicuous median finely granular prominence; the granules upon this tergite more coarse, and showing laterally a tendency to arrangement in definite series.

Sternites perfectly smooth, furnished with the usual sulci, the last bearing posteriorly four very faint keels.

Tail.—Inferior keels of two proximal segments quite smooth; inferior keels of third segment and the spaces between these keels slightly granular posteriorly; inferior keels and inferior intercarinal spaces of the fourth and fifth segments granular; superior keels and the superior intercarinal spaces granular, the latter more so before than behind; the lateral intercarinal space also granular; vesicle furnished with series of granules beneath, smooth above; aculeus somewhat sharply curved at the apex.

Chela.—Humerus with somewhat convex upper surface, which is furnished in front and proximally with a few larger and smaller granules, and bounded in front and behind by a row of denticles; anterior margin smooth, bounded above by an oblique series, and below by a straight series of denticles; inferior surface smooth; posterior surface smooth, but for two or three granules near its upper margin; brachium almost smooth, slightly roughened above and behind, finely granular in front above, and finely denticulate in front below, furnished below and behind with two irregular series of setiferous punctures. Hand remarkably wide; convex from side to side proximally, but conspicuously concave at the base of the immovable finger; its anterior margin evenly rounded and smooth, neither granular nor denticulate; superior surface granular posteriorly, slightly roughened in the concavity, the rest smooth and sparsely punctured; inferior surface sparsely granular distally; immovable finger remarkably wide at the base (*cf.* measurements of this and other species). Fingers hairy.

Femora of legs anteriorly finely granular, roughened beneath. Legs hairy.

Pectines projecting beyond the margin of the posterior coxæ. Number of teeth 15.

Colour piceo-castaneous; hands castaneous, fingers very dark green; legs and under surface ochraceous.

Measurements in millimetres.

	Length.	Breadth.	Height.
Total	100		
Cephalothorax	$16\frac{1}{2}$	$18\frac{1}{2}$	
First caudal segment	$7\frac{3}{4}$	7	$5\frac{1}{2}$
Fifth caudal segment	11	5	$4\frac{1}{4}$
Tail	$52\frac{1}{2}$		
Vesicle	$6\frac{1}{2}$	$5\frac{1}{2}$	$4\frac{1}{4}$
Aculeus	$3\frac{1}{2}$		
Humerus	$11\frac{1}{2}$		
Brachium	13		
Hand	17	$17\frac{1}{4}$	7
Back of hand	$9\frac{1}{2}$		
Movable finger	18		
Immovable finger	12	$7\frac{1}{4}$ (at base)	
Pecten	9		
Pectinal tooth	$2\frac{1}{2}$		

Tail rather more than three times as long as cephalothorax.

Cephalothorax equalling in length the 1st + the 2nd + $\frac{1}{3}$ of the 3rd caudal segments.

This species may be at once distinguished by the width of the hand and by the remarkable depression it bears upon its upper surface. I have seen two specimens of it—one (dried) brought from Kilima-Njaro by Mr. M. J. Jackson; the other, which, being preserved in spirit of wine, I have selected as the type, brought by Capt. Speke from Umyamuezi. Both appear to be males. The specimen from Kilima-Njaro is smaller and slightly less granular than the other.

Scorpio exitialis, sp. n.

Cephalothorax.—Anterior margin circularly excised in the middle line; marked throughout its length with a shallow median sulcus, which deepens and terminates immediately in front of the hind margin; laterally this deeper portion is bounded by a smooth flat area corresponding with the usually rounded elevations of other species; ocular tubercle conspicuous, deeply cleft, and not continued before and behind into distinct ridges; anterior portion of cephalothorax nearly smooth; a smooth area extending from this anterior portion along the upper surface on each side of the ocular tubercle almost to the above-mentioned smooth flat area; in the immediate neighbourhood of the ocular tubercle behind and at the sides are a few granules, in front of the tubercle the cephalothorax is sparsely granular for some distance; laterally the cephalothorax is conspicuously though somewhat sparsely granular, the granules appearing to be smaller and closer set posteriorly; central eyes a little nearer to the posterior margin of the cephalothorax than to the circular excision; the central eye of the lateral series nearer to the anterior than to the posterior eye of the same series.

Tergites posteriorly and laterally beset with fine granules, anteriorly smooth; with very faint indications of a median elevation and of an anterior right and left abbreviated sulcus; upper portion of last tergite smooth, with an anterior median elevation and a posterior depression, bounded on each side by a coarsely granular ridge, beneath which are smaller anterior and larger posterior granules.

Sternites perfectly smooth, sparsely punctured, each furnished in front with a right and left abbreviated sulcus; the posterior tergite furnished behind with very faint traces of four smooth keels.

Tail slender. Inferior surface of the three proximal segments smooth, with conspicuous keels; inferior surface of the fourth segment furnished behind with a few small denticles, smooth in front; inferior keels and posterior inferior margin of the fifth strongly denticulated, the posterior inferior margin bearing six larger denticles, two upon each lateral angle and two in the middle line. The inferior-lateral intercarinal spaces with a few small denticles. The superior and superolateral keels denticulate, the distal more strongly so than the proximal. The upper surface of the segments depressed in the middle line and smooth; in the fifth segment the denticles of the superior keels spread to a slight extent upon the upper surface of the segment and considerably upon the superior lateral intercarinal space. Vesicle remarkably large, wider than any of the caudal segments, smooth above and at the sides, granular beneath; aculeus equal to about half the length of the vesicle, with its distal half bent almost at right angles to its proximal half.

Chela.—Superior surface of humerus furnished with more or fewer larger and smaller tubercles, which, on the proximal portion of the segment, blend with those of the anterior surface; distal portion of anterior surface smooth, proximal portion furnished with an oblique row of tubercles; inferior surface proximally tubercular, distally smooth; posterior surface smooth but for the presence of a single series of setiferous punctures. Superior surface of brachium furnished with two uneven setiferous keels; anterior surface finely granular, bearing below proximally a few tubercles, and separated from the inferior surface by a row of tubercles; inferior surface flat, smooth, bearing behind three irregular series of setiferous pores. Hand much resembling in shape that of *Sc. Rœseli,* but less convex above; its upper surface covered with many close-set rounded tubercles, which, especially near the posterior surface, show a tendency to fuse together and to constitute ridges; inferior surface of the hand sparsely tubercular distally, and bearing two distinct rows of tubercles in its proximal half. The segments of the palp and of the legs bear longish hairs; anterior surface of the femora of the second, third, and fourth pairs of legs slightly granular.

Pectines absent.

Colour blackish or piceous above, paler beneath; legs testaceous.

Measurements in millimetres.

Tail nearly four times as long as cephalothorax.
Cephalothorax about equal in length to the first two caudal segments.

	Length.	Width.	Height.
Total	125		
Cephalothorax	17	18	
Tail	$66\frac{1}{2}$		
First caudal segment	$8\frac{1}{2}$	7	5
Fifth " "	15	5	5
Vesicle	9	$7\frac{1}{2}$	7
Aculeus	$5\frac{1}{2}$		
Humerus	$11\frac{1}{2}$		
Brachium	$13\frac{1}{2}$		
Hand	$17\frac{1}{2}$	16	$7\frac{1}{2}$
Back of hand	$10\frac{1}{2}$		
Movable finger	$17\frac{1}{2}$		
Immovable "	$12\frac{1}{2}$		

A single specimen (dried), from Shoa in Abyssinia.

Owing to the unfortunate destruction of the pectines I am unable to describe the characters presented by these organs, and in addition cannot tell the sex of the specimen. It, however, is a very distinct form, differing from all other individuals of the genus known to me in the remarkable size of the poison-vesicle. It is mainly, though by no means entirely, on the strength of this characteristic that I have ventured to give a new name to it.

Scorpio maurus, Linnæus.

Scorpio maurus, Linn. Syst. Nat. p. 1037.
Heterometrus palmatus, Ehrenb. Symb. Phys. (Scorpiones, pl. i. fig. 4.)

Although possessing a number of specimens of this species from Arabia and Syria, the British Museum has only three from Africa. These are from Tunis.

Scorpio dictator, sp. n.

Syn. ? *Scorpio africanus,* Linn. Mus. Adolphi Friderici, p. 84.

Cephalothorax.—Anterior margin semicircularly excised in the middle line; marked throughout its length by a median longitudinal sulcus, which deepens and terminates near the hind margin; on each side this deeper portion is bounded by a rounded prominence; cephalothorax everywhere beset with coarse granules. Central eyes equally distant from the posterior margin of the cephalothorax and from the apex of the anterior excision. Central eye of lateral series slightly nearer to the anterior than to the posterior eye of the same series.

Anterior half of each *tergite* smooth, posterior half coarsely granular; each furnished in the middle with two short sulci in front and with an obsolete crest behind; the last bearing in its posterior half a sparsely granular prominence, behind which is a smooth depression; the lateral portion furnished behind with two indistinct series of granules above, smooth below, granular in front; the lateral portion separated from the superior portion by a distinct row of fine denticles.

Sternites perfectly smooth; all, except the last, marked with an abbreviated sulcus on each side in front.

Tail.—Inferior surface of the three proximal segments smooth beneath, with very feebly developed keels; the infero-lateral keels of the third segment posteriorly showing faint indications of denticulations; inferior keels of the fourth distinctly denticulated, those of the fifth strongly denticulated; superior keels of all the segments denticulated, the denticles being stronger upon the posterior than upon the anterior segments; all the intercarinal spaces almost entirely smooth; vesicle smooth above, furnished below and at the sides with finer and coarser denticulations; aculeus gently curved.

Chela.—Upper surface of humerus bounded behind and in front with a row of strong denticles, and bearing others scattered, larger and smaller, for the most part on its proximal two thirds; anterior surface bounded below by a straight row of denticles and above by an oblique series; inferior surface smooth, bounded behind for a third of its length by a row of small blunt denticles; posterior surface smooth, bearing a single longitudinal series of setiferous tubercles. Upper surface of brachium bearing a single row of small denticles, posterior surface bearing two roughened keels; inferior surface smooth, with two rows of setiferous punctures near the hind margin; inferior surface separated from the anterior surface by a few conspicuous denticles; anterior surface finely granular. Upper surface of the hand convex, as in *Rœseli*, and with anterior margin similarly rounded, covered with a reticulated pattern composed of smooth irregular ridges, which result from the confluence of rounded tubercles; these ridges may assume a definite longitudinal arrangement, which imparts to the hand a subcostate appearance; anterior (inner) margin of the hand denticulated; inferior surface proximally smooth, distally sparsely denticulated, the denticles not arranged in definite series. Fingers granular above and below, all the segments of the palp sparsely pilose.

Upper and lower surfaces of the femora of the legs somewhat coarsely granular; anterior surface, those of the first pair excepted, finely granular.

Pectines not projecting so far as the distal margin of the posterior coxæ; number of teeth thirteen.

Colour.—Very dark green or black above, with a reddish tint; brownish beneath.

Measurements in millimetres.

Tail four times as long as cephalothorax.
Cephalothorax slightly shorter than the first two caudal segments.

	Length.	Breadth.	Height.
Total	166 (about $6\frac{1}{2}$ English inches)		
Cephalothorax	$22\frac{1}{2}$	25	
Tail, total	90		
First caudal segment	$10\frac{1}{2}$	$9\frac{1}{4}$	8
Fifth " "	19	$7\frac{1}{2}$	7
Vesicle	11	$8\frac{1}{2}$	7
Aculeus	8		
Humerus	15		
Brachium	17		
Hand	$23\frac{1}{2}$	$21\frac{1}{4}$	10
Back of hand	14		
Movable finger	23		
Immovable finger	$16\frac{1}{2}$	(at base) $7\frac{1}{2}$	
Pecten	$8\frac{1}{4}$		
Pectinal tooth	$2\frac{1}{4}$		

This scorpion rivals in size *imperator* and *Rœseli*, and to both of them it bears considerable resemblance. It may, however, be generally distinguished from both by the greater coarseness of its granules and by the smaller number of pectinal teeth; and particularly from *imperator* by the position of the central lateral eye, and from *Rœseli* by the fact that the upper surface of the cephalothorax is furnished behind, on each side of the middle line, with a conspicuous granular prominence, the same area in *Rœseli*—at least in the series of that species that I have seen—being depressed and nearly always smooth; further, the caudal intercarinal spaces are smooth and the tubercles of the hand less pronounced and more fused.

The British Museum possesses two female specimens, one from Fernando Po, presented by Capt. Birch, the other labelled W. Africa from the collection of Mr. Dalton.

Scorpio Rœseli (Simon).

1871. *Heterometrus Rœseli*, E. Simon, Rev. Mag. Zool. xxiii. p. 54, pl. vi. fig. 4.
1877. *Pandinus africanus* (Linn.), Thorell, Etudes Scorpiol. p. 128.
1880. *Scorpio Rœseli* (Simon), L. Becker, Ann. Soc. Ent. Belg. xxiv. p. 138, pl. ii. fig. 2.

This appears to be the commonest, as it is the finest, West-

African species. The Museum possesses nine specimens, five males and four females—one from Fernando Po, one from Onitsha, one from Gambia, two from Fantee, one from the Gold Coast, the rest labelled West Africa. The largest specimen (female) measures 182 millim. from the margin of the cephalothorax to the end of the tail. The number of pectinal teeth varies from fifteen to eighteen, but is usually sixteen; the hairs upon the chelæ and legs vary much in number and length. The granules also vary considerably in coarseness and distribution.

Scorpio imperator (C. Koch).

1842. *Buthus imperator*, C. Koch, Die Arachniden, ix. p. 1, fig. 695.
1877. *Pandinus imperator* (C. Koch), Thorell, *loc. cit.* p. 130.
1880. *Scorpio imperator* (C. Koch), L. Becker, *loc. cit.* p. 138, pl. ii. fig. 2.

Writing in 1880 Mons. L. Becker says:—" On ne connaît, je crois, que trois exemplaires de cette espèce: (1) le type de C. Koch appartenant au Musée de Berlin; (2) un exemplaire faisant partie de la collection de M. Simon; (3) un individu que j'ai pu acquérir, appartenant actuellement au Musée de Bruxelles." To this list I can add one more, belonging to the British Museum. It is a male from West Africa, obtained by Captain Birch, R.N. It has four distinct ocelli upon the left side, the supplementary ocellus being developed in front, as if to make up for the backward position of the central lateral ocellus, a feature which is so characteristic of this species.

Synoptical Table of Species.

a. Upper surface of hand conspicuously concave towards the base of the immovable finger; anterior margin of hand smooth; width of hand greater than length of cephalothorax .... *cavimanus*, sp. n.

b. Upper surface of hand not distally concave; anterior margin granular or denticulate; width of hand not greater than length of cephalothorax.

  *a*¹. Width of first caudal segment less than the width of the vesicle and equal to the height of it................................ *exitialis*, sp. n.

  *b*¹. Width of first caudal segment greater than width of vesicle and still greater than the height of it.

    *a*². Humerus somewhat rounded off in front; its anterior surface not separated by a strong ridge from the upper and under surfaces .... *maurus*, Linn.

b^2. Humerus less rounded off in front; its anterior surface separated by a conspicuous ridge from the upper and under surfaces.

a^3. Central eye of the lateral series nearer to the posterior than to the anterior eye of the same series; tergites very finely granular; pectinal teeth 16–18.. *imperator* (C. Koch).

b^3. Central eye of the lateral series not nearer to the posterior than to the anterior eye of the same series.

a^4. Pectinal teeth 16; granules finer; caudal keels less coarsely denticulate; intercarinal spaces granular; cephalothorax furnished behind with a triangularly depressed area .... *Rœseli* (Simon).

b^4. Pectinal teeth 13; granules coarser; caudal keels more strongly denticulate; intercarinal spaces smooth; cephalothorax furnished behind with two conspicuous granular prominences .... *dictator*, sp. n.

The following African species are known to me only from descriptions and figures:—

Scorpio bellicosus, L. Koch, Ægyptische und Abyssinische Arachniden, Nürnberg, 1875, p. 1, pl. i. fig. 1. From Cairo.

Scorpio meidensis, F. Karsch, Mitth. Münchn. ent. Ver. 1878, p. 127. From Somali Land.

Scorpio setosus, C. Koch, Die Arachn. viii. p. 87, fig. 657; redescribed by Karsch, Abh. nat. Ver. Bremen, ix. p. 67 (1884). From West Africa.

For a synoptical table of many species of *Scorpio*, including the three just mentioned, see Karsch, *l. c.* p. 68.

Note.—In taking the breadth of the cephalothorax, to avoid error owing to possible shrinking in dried specimens, I have measured from the middle line to the lateral margin, and arrived at the total width by doubling the amount so obtained. In the case of the caudal segments I have measured along the supero-lateral keels, and in the case of the palp measurement has been taken along the greatest length of each segment.

The palpi have been described as if projecting at right angles to the long axis of the body.

XXXIII.—*Researches at the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).—On Larval Actiniæ parasitic on Hydromedusæ at St. Andrews.* By Alfred C. Haddon, M.A. (Cantab.), M.R.I.A., Professor of Zoology, Royal College of Science, Dublin.

Several larval Actiniæ, together with the Leptomedusæ on which they were found, were sent to me by Prof. W. C. M'Intosh in the month of February in the present year. None of the specimens were sufficiently advanced for me to be able to say with certainty to what genus or species they belong, but Prof. M'Intosh has kindly promised to get me more specimens, and I hope that with increased material I may be able to do better justice to the beautifully preserved specimens which my friend has entrusted to me.

I have previously referred (1) * to the recorded instances of larval Actiniæ being found as ectoparasites of Medusæ, one of the first records being that of Dr. T. Strethill Wright (2) from the Firth of Forth. The Actiniæ attach themselves to the upper or under surface of the bell, or to the margin, or to the gastric region of the Medusæ.

The Actiniæ from St. Andrews are of slightly different ages; the youngest exactly corresponds to the stage of *Halcampa chrysanthellum* described and figured by me (*l. c.* pl. xi. figs. 1–5). At this time there are eight larger mesenteries which correspond in position and in the arrangement of their longitudinal retractor muscles with the eight mesenteries of *Edwardsia*, but in addition there are four smaller mesenteries which form the complemental pairs to the four lateral larger mesenteries. There are also only eight short tentacles, which are arranged in two groups of three, the two others being opposite one another and between the two groups. The tentacles arise from the chambers between the eight large mesenteries. The inter-mesenteric chambers (entocœls) of each lateral pair of mesenteries are not prolonged into tentacles, and it is the four gaps, corresponding to these chambers, which cause the arrangement of the tentacles noted above. It will be seen that the central tentacle of each of the groups of three corresponds with the entocœl between each pair of directive mesenteries. As in the parasitic larva of *Halcampa chrysanthellum* there is a single deep œsophageal groove; the grooved end of the œsophagus likewise extends a short distance below the normal lower border of the œsophagus.

* See list of papers at end of this article.

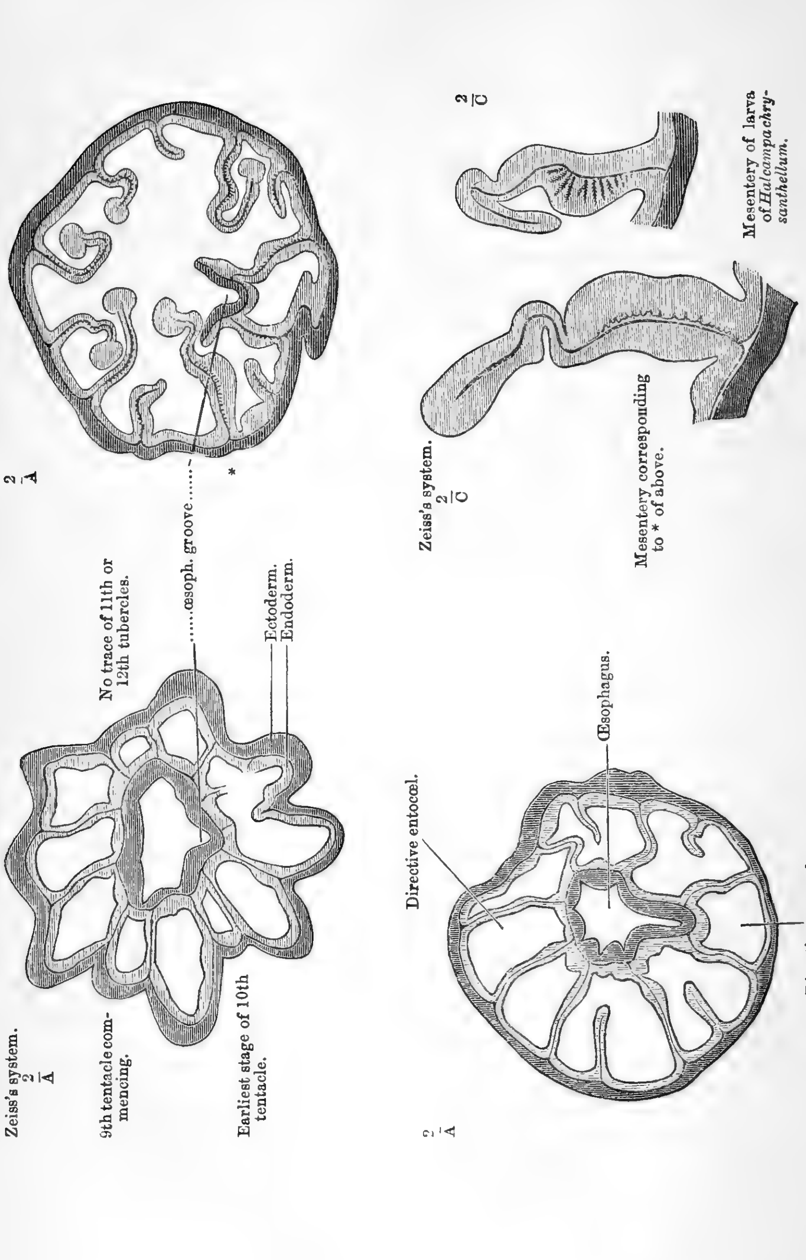
In the slightly older larvæ the general structure and disposition of the parts is precisely as above, except that, of course, the size is larger, the tentacles longer, and that new tentacles are making their appearance in the lateral entocœls. I am not yet in a position to state whether there is any particular order in their development.

In a paper (3) which will shortly appear in the Transactions of the Royal Irish Academy, I am pointing out the great importance of the earlier stage in the development, ontogenetic and phylogenetic, of the Actiniæ, and it is highly satisfactory to find another example of it in these forms.

We now come to the question, To what genus and species can we refer these interesting little parasites? At first sight they bear an unmistakable resemblance to the larva of *Halcampa chrysanthellum*, both externally and anatomically; so we may confidently consider them to be closely allied. The presence of twelve mesenteries precludes their being Edwardsidæ. The genera *Peachia* and *Ilyanthus* are usually associated with *Halcampa*; of the second of these I can say nothing, as it has never been anatomically described, besides, it is quite a rare form, and our larvæ are decidedly common. We then narrow the problem to the genera *Halcampa* and *Peachia*. Only two British species of *Halcampa* are known—*H. chrysanthellum* of North-European distribution (4), and *H. arenaria*, discovered and described by me (5) from the south-west of Ireland; of this only two specimens have been obtained.

I have made sections through three parasitic larvæ of *H. chrysanthellum*, and am therefore well acquainted with it, and although they agree perfectly with the St.-Andrews forms in their general appearance and structure, still there are distinctions in their histology which cannot now be gone into. One point, however, deserves special mention, and that is, the appearance of the longitudinal retractor muscle of the larger tentacles. In the earlier stages of *H. chrysanthellum* the muscle is relatively more extended than in the adult, but the more distal plications are of considerable length, and decidedly recall those of the adult. In a later stage this is naturally still more marked. The corresponding muscle in the St.-Andrews specimens is much less conspicuous, it extends for a greater distance across the mesentery, consequently the plications are more numerous; but, on the other hand, they are very much shorter and simpler than in *H. chrysanthellum*.

In transverse sections through *Peachia hastata* I find that the retractor muscles are very greatly developed, forming a regular close-set fringe to the border of the mesentery, and



Three Diagrams of Transverse Sections of Actinian Larvæ (*Peachia hastata* ?) parasitic on Hydromedusæ at St. Andrews.—A. C. Haddon.

thus constituting a type of muscle very different from the reniform section of the retractors in *Halcampa*. My material, as I have previously said, is insufficient for me to pronounce an unqualified opinion, but there is nothing in the character of the longitudinal muscles of the mesenteries antagonistic to the view that these are the larvæ of *Peachia hastata*. The latter species, according to Prof. M'Intosh (6), is common in the neighbourhood. I would further point out that the St.-Andrews larvæ, stage for stage, are decidedly larger than those of the *Halcampa* which occurred to me; this would also correspond with the greater size of the adult *Peachia* as compared with that of *Halcampa*.

According to Prof. Verrill (7), the young of an American species of *Peachia* is parasitic in the lip-folds of *Cyanea arctica*. Prof. M'Intosh quite recently published a note on our form, which he assumes to be the larva of *Peachia hastata*, without, however, adducing any evidence in favour of his supposition, except the statement that the adult is very common. The parasitic actinian certainly appears to be not at all unfrequent. So far as my evidence goes, it supports, but does not prove, Prof. M'Intosh's conclusion.

List of Papers referred to in above Report.

(1) A. C. Haddon.—"Note on the Arrangement of the Mesenteries in the parasitic Larva of *Halcampa chrysanthellum* (Peach)." Proc. Roy. Dublin Soc. (n. s.) v. 1887, p. 473, pl. xi.

(2) T. S. Wright.—"Observations on British Zoophytes. On *Peachia Fultoni*, a parasitic Actinia." Proc. Phys. Soc. Edinb. ii. 1859, p. 91; New Edinb. Journ. xii. 1860, p. 156; Ann. & Mag. Nat. Hist. [3] viii. 1861, p. 132.

(3) A. C. Haddon.—"Revision of the British Actiniæ.—Part I." Trans. Roy. Irish Acad. 1888 (*in the press*).

(4) A. C. Haddon.—"Note on *Halcampa chrysanthellum*, Peach." Proc. Roy. Dublin Soc. (n. s.) v. 1886, p. 1.

(5) A. C. Haddon.—'Actinozoa' in "First Report on the Marine Fauna of the South-west of Ireland." Proc. Roy. Irish Acad. (2) iv. Sci. p. 616. (See also Trans. Roy. I. Acad. 1888.)

(6) W. C. M'Intosh.—"Invertebrate Marine Fauna of St. Andrews." Ann. Mag. Nat. Hist. [4] 1874, xiii. p. 220.

(7) A. E. Verrill.—"On the Polyps and Echinoderms of New England." Proc. Boston Soc. Nat. Hist. x. 1866, p. 338; also in Rept. U. S. Fish Comm. i. (1871-72), 1873, p. 739.

(8) W. C. M'Intosh.—"Notes from the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).—No. VII. 3. On the Commensalistic Habits of the Larval Forms of *Peachia*." Ann. Mag. Nat. Hist. [5] 1887, xx. p. 101.

XXXIV.—*Descriptions of some Indian Species of Longicorn Coleoptera.* By C. J. Gahan, M.A., Assistant, Zoological Department, British Museum.

Monohammus auratus, n. sp.

Fuscus, dense aureo-flavo, sericeo pubescens; articulis antennarum a tertio apicibus fuscis; prothorace dorso leviter inæquali, antice et postice transverse bisulcato; elytris pubescentia undulata, apicibus oblique truncatis vel subrotundatis.

Long. 21–29 mm., lat. 7–9½ mm.

Hab. Silhet.

Dark brown, closely covered by a dense golden-yellow, somewhat silky pubescence; the pubescence darker and duller on the head, antennæ, and legs; no punctures are anywhere visible. The prothorax is slightly uneven on the disk, and is crossed by four transverse grooves—two anterior and two posterior—which are distinct enough. The wavy pubescence of the elytra gives the idea that the latter are longitudinally carinate; but this is not the case. The antennæ, more than twice the length of the body in the male and not quite twice the length in the female, with the apices of the joints from the third and the middle of the eleventh fuscous; the cicatrix of the scape broad and distinct, but its bordering-rim not quite complete.

Monohammus bimaculatus, n. sp.

Fuscus, griseo-brunneo pubescens; scutello fulvo; elytris ad basin punctatis, singulo ad medium macula magna nigro-velutina, apicibus rotundatis.

Long. 14–19 mm.

Dark brown, with a greyish-brown pubescence. Head and prothorax almost impunctate, with a scanty greyish or tawny pubescence. The thorax even on the disk, the transverse grooves indistinct. Scutellum fulvous. Elytra somewhat coarsely punctured at the base, the punctures disappearing towards the apex; on the middle of each elytron a large, more or less rounded, velvety black spot, margined with pale grey. The legs and underside of the body dark grey, minutely speckled with brown. The antennæ, of which the scape has a distinct, broad and completely margined cicatrix, are in the male about twice the length of the body, in the female about half as long again as the body. The sternal processes simple.

Monohammus amicator (White, MS.).

Castaneus, breviter griseo pubescens; capite impunctato; prothorace antice et postice bisulcato, dorso æquali vix punctato; elytris ad basin granuloso-punctatis, postice gradatim attenuatis, apicibus subsinuato truncatis; tibiis mediis non emarginatis; prosterno angustissimo; antennis (♂) articulis 3° et 4° paulo incrassatis.
Long. 26 mm., lat. 9 mm.

Hab. N. India (Silhet).

With a reddish-brown derm, clothed with a very short greyish pubescence. Head rather strongly exserted, impunctate. Prothorax with a few small granulate punctures on each side of the middle of the disk. Elytra somewhat coarsely punctate at the base, the punctures not visible beyond the middle, the apices obliquely and somewhat sinuately truncate. Antennæ reddish brown, with the scape dark grey and the bases of the third to eighth or ninth joints pale grey; the third and fourth joints, in the male, thick. The prosternal process very narrow. The mesosternal process with a feeble carinate tubercle behind. Middle tibiæ without any notch or groove.

This species bears in the British-Museum collection the name which I have adopted. I have not been able anywhere to find a description of it.

Monohammus griseatus, n. sp.

M. amicatori similis, sed differt capitis fronte sparse punctata, prothorace dorso punctato; elytris non granulosis, usque apicem punctatis.
Long. 25 mm., lat. 7½ mm.

Hab. India.

Resembles the last species, but is slightly more pubescent. There are a few scattered punctures on the head. The punctures on the thorax are more numerous, and are shallow and depressed. The shallow punctures of the elytra are largest at the base, and gradually diminishing in size backwards extend up to the apex. The middle tibiæ, as in *M. amicator*, are without notch or tubercle; the sternal processes are narrow, especially the prosternal; and the mesosternal is very feebly carinate. The antennæ in the female about twice the length of the body.

Monohammus ocellatus, n. sp.

Fuscus, cervino-pubescens; capite impunctato, lobis oculorum inferioribus magnis; prothorace dorso impunctato, leviter inæquali; elytris foveis sparsis ocellatis, apicibus oblique vel sinuato truncatis; antennis fuscis, (♂) corpore plus quam duplo longioribus, (♀) corpore sesqui-longioribus.

Long. 17–25 mm., lat. 5–8 mm.

Hab. N. India and Penang.

Dark brown, with a dark grey or fawn-coloured pubescence. The head impunctate, pubescent. The lower lobes of the eyes large. The prothorax somewhat uneven above, closely pubescent, with a few minute granules on each side of the disk behind the middle; the transverse grooves, two anterior and two posterior, not very distinct. Elytra with scattered, broad, shining, ocellate punctures, which are smaller, closer, and somewhat asperate towards the base; the apices obliquely and more or less sinuately truncate, with the outer angles in some specimens very feebly produced. Antennæ in the male dark brown, nearly three times as long as the body, with the scape greyish and somewhat rugulose along its outer border; in the female dark brown, about half as long again as the body, and with the scape greyish and smooth; the "cicatrix" with a complete rim. The legs and underside of the body pubescent like the upper. The middle tibiæ without a notch or groove. The intercoxal process of the mesosternum with a feeble tubercle in front.

Synonymical Remarks.

The genus *Cacoscapus* of Thomson ('Revue et Magasin de Zoologie,' 1878, p. 47) is evidently, from its description, identical with the genus *Stratioceros* of Lacordaire, which stands first among the Monohammides in that author's great work, the 'Genera des Coléoptères.' Thomson's type species, *Mouhotii*, is also, as far so I can judge from his description, synonymous with the *princeps* of Lacordaire. The same locality is given for each. M. Thomson's blunder is the less excusable since the genus is not only well-marked, but the species is, as Lacordaire justly said, one of the finest in the group.

In the same paper Thomson describes, under the name of *Leprodera arista*, a species which was previously described by Pascoe as *Leprodera verrucosa*.

Monohammus Fredericus, White, agrees in every respect with the description of Thomson's *Monohammus deperatus*; the latter name has the priority of date, and of the two localities given for the species, viz., India and New Holland, the second is no doubt erroneous.

The Fabrician species *Lamia rotator* (*Monohammus rotator* of the Munich Catalogue) is, as I find from the type in the Banksian Cabinet, identical with the North-American species *Goes tigrinus*, Degeer. The locality—India or.—given by Fabricius, is of course wrong. As both descriptions—the Fabrician and that of Degeer—appeared in the same year, it is doubtful which has priority of date. Degeer's name being better known, and his description being fuller and accompanied by a figure, there is no reason why it should not be retained, and the Fabrician name sunk into a synonym.

XXXV.—*Researches at the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).—On the Embryology of the Retina of Teleosteans.* By Dr. R. Marcus Gunn, M.A., M.R.C.S., Surgeon to Moorfields Hospital, London.

In the investigations hitherto made on the development of the eye in the bony fishes the ova of freshwater forms have been employed. I am indebted to Professor M'Intosh, F.R.S., for an opportunity of examining carefully prepared sections of embryos of marine Teleosteans, which he had succeeded in maturing in the St.-Andrews Marine Laboratory.

Several causes combine to render accurate results more difficult of attainment in the case of fish than in other instances where ova can be watched during maturation. Not only do the ova of fish vary much in the rapidity with which they mature after impregnation in different genera and species, but even in the same species, according to external conditions, especially the temperature of the water. Indeed, Professor M'Intosh tells me that in the same series of ova, matured under identical conditions, some individuals develop more quickly than others. Great diversity, moreover, obtains in the stage of development attained before hatching in different fish, and even to some extent in different individual ova of the same fish.

I have consequently been obliged to base my calculations of advance in development simply on histological features observed, although the remarks made on the slides at the laboratory as to the age of the ovum are also very valuable as a guide.

In this way I have examined preparations of the following ova:—

1. *Gadus æglefinus*:

(1)	2nd	day	after	fecundation.	
(2)	4th	,,	,,	,,	
(3)	9th	,,	,,	,,	(Several.)
(4)	14th	,,	,,	,,	(Several.)
(5)	17th	,,	,,	,,	
(6)	2nd	,,	,,	emergence.	(Several.)
(7)	3rd	,,	,,	,,	
(8)	4th	,,	,,	,,	
(9)	6th	,,	,,	,,	
(10)	8th	,,	,,	,,	
(11)	14th	,,	,,	,,	
(12)	17th	,,	,,	,,	

2. *Gadus merlangus*:

9th day after fecundation.

3. *Gadus morrhua*:

2nd day after emergence.

4. *Liparis Montagui*:

"March 11, 1885." ? Age.

5. *Gastrosteus spinachia*:

(1) About to emerge. ? 4th week.
(2) Later specimen.

6. *Cyclopterus lumpus*:

(1) "A Embryo." ? Age.
(2) "June 16, 1885." ? Age.
(3) "No. 1 slide." ? Age.
(4) "July 2, 1885." ? Age.
(5) Just emerged. (Several.)

7. *Anarrhichas lupus*:

Many specimens examined, marked "January," February," "March," "April," "May," "June."

8. *Molva vulgaris*:

(1) "May 8th." ? Age.
(2) "May 10th."

9. *Trigla gurnardus*:

(1) 4th day after fecundation.
(2) 13th ,, ,, ,, 3rd day out.
(3) 6th ,, ,, emergence. (Several.)
(4) "June 30th, 1886." ? Age.
(5) "July 25th." ? Age. (Several.)

10. *Cottus*, ? species:

(1) "April 6th, 1886." ? Age.
(2) "April 7th, 1886." (Several.) ? Age.
(3) "April 13th, 1886." ? Age.
(4) "April 14th, 1886." ? Age.

11. *Pleuronectes flesus*:

(1) 9th day after fecundation.
(2) 10th ,, ,, ,,
(3) 11th ,, ,, hatching (?).
(4) "May 18th, 1886." ? Age.
(5) "June 18th, 1886." ? Age. (Several.)

I also examined ova of *Salmo salar* at the following stages:—

(1) 40 days after fecundation.
(2) 1st day after emergence. (Several.)
(3) 13th ,, ,, ,,
(4) 45th ,, ,, ,,

Very briefly, my conclusions may be stated as follows:—
The first appearance of the Teleostean eye consists in a solid outgrowth from the brain, which latter is at this stage itself also solid, and both structures are formed of cells similar throughout.

A little later a cavity first becomes visible on the optic outgrowth and on the central nervous mass, and consequently at this stage the developing eye may, for the first time, be truly described as an optic vesicle. The outer wall of this vesicle is about twice the thickness of the inner, the former being about four cells and the latter about two cells deep. The cells in both walls are similar in appearance, being of an oval form and uniform size, and they are arranged radially, *i. e.* with their long axes perpendicular to the slit-like cavity. The only exception to this arrangement is anteriorly and posteriorly, where the two walls become continuous with one another; in these situations the radial disposition seems not to exist. The nuclei of the inner wall of the vesicle are rather more deeply stained than those of the outer. The cells of the developing brain are very like those of the optic vesicle, and are similarly arranged in relation to its central cavity. At this stage is also observed a slight thickening of the deep layer of the cuticular epiblast corresponding to the position of the future lens; but this is not so far advanced as to indent the outer wall of the vesicle. A prolongation of cells from the same deep layer of cuticular epiblast is now observed lining the sides and base of the optic vesicle, so as to separate it from the brain.

The cavity of the optic vesicle seems soon to disappear, for at the next stage examined, while there are few important changes, there is only a faint line of separation between the outer two thirds and the inner one third of the cells. Internal to the vesicle there is a double layer of elongated cells, their long axes being parallel to the wall of the vesicle. One of these layers follows the curve of the vesicle, while the other (inner) layer is closely applied to the central nervous mass. Where the rows diverge anteriorly large cells from below the cuticular epiblast dip into the angle so formed. The lens develops rapidly and is already well advanced, indenting the outer wall of the optic outgrowth, and so forming a "secondary" optic vesicle. At this stage no pigment-granules are discernible.

Differentiation now soon occurs in the optic outgrowth, so as to indicate roughly the position of the future layers. We may therefore in future speak of it as "retina," and describe the position of the layers in relation to the secondary optic vesicle or optic cup instead of to the outer wall of the embryo as we have hitherto done. A series of elongated deeply staining cells, arranged closely side by side and with their long axes radial, form a single row most externally in the retina. Though longer than any others in the retina, these cells are as yet comparatively short; their nuclei are large. These represent the future retinal sight-epithelium, a layer of rods and cones with their nuclei. The inner mass of cells remains for a short time unchanged, except that midway they are more loosely placed, indicating faintly a line of separation between its outer and inner halves. Between this cell-mass and the future cone-layer there is a distinct space, corresponding to the position of the late vesicle-cavity and of the future outer molecular layer. Internally the retina is indistinctly bounded by a line, showing the foundation of the layer of nerve-fibres, for fibrillation soon becomes distinct in it near the optic nerve entrance. In the cells previously described as occurring between the optic outgrowth and brain, and which now appear (on section) long-oval and flattened horizontally, pigment-granules begin to form. When first visible these granules closely surround the cell-nucleus only, the remainder of the cell being free. The pigment forms first in the cells at the anterior and lower part of the fundus of the eye, and in those cells in front of the periphery of the lens which correspond in position with the future iris. In one or two preparations this pigment-layer was accidentally turned over to some extent in cutting the sections, and we thus obtain a surface view; the cells are now seen to be of good size, flat, with large nuclei, and arranged as a pavement-epithelium. About this time pigment also begins to appear here and there over the brain, especially anteriorly, occurring in the flat cells previously described. Both here and round the retina therefore the pigment is formed in cells derived, I believe, from the deep layer of the cuticular epiblast, not, in the case of the Teleostean eye, from the inner wall of the optic vesicle. To be confident on this point, however, further observations are necessary, and especially a complete series of preparations of ova of one species, a desideratum that can only be satisfied by a marine laboratory such as that of St. Andrews.

A finely granular layer (internal molecular) next appears on the large cell-mass, dividing it into a smaller inner and larger outer part. At first both sets of cells are about the same size; but those internal to the inner molecular layer soon become distinctly larger than those outside it; the former represent the ganglion cell-layer, the latter the layer of inner granules. The outermost cells of the inner series very soon become distinct from the others, staining more deeply and being arranged in a regular single row. About the same time the segments of the cones become visible. We have now six retinal layers, distinguishable by the following characters :—

1. *Cone-layer.*—Vertically placed, elongated, deeply staining cells, with very slight, fine, clear projections from their outer extremities. Their bases stain most deeply.

2. *External molecular layer.*—No longer clear, but now forming a distinct, thin, dark, finely granular line.

3. *Inner granules.*—Cells about six deep.

4. *Internal molecular layer.*—Uniform, rather thick, non-staining.

5. *Ganglion cell-layer.*—Cells about four deep and rather larger than the inner granules. Distinct one-celled row externally.

6. *Nerve-fibre layer.*—A thin, non-staining streak, with horizontal fibrillation just evident.

The *pigment* occurs in distinct, flat, horizontal, long-oval deposits. These nearly all touch one another, so as to form an almost continuous layer traceable forwards to the iris.

Outside the pigment layers of fibrous-looking tissue are now formed, which can be traced forwards to the front of the equator of the lens, where it is anterior to the pigment of the future iris. This is a mesoblastic formation forming the iris, choroid and sclerotic. The cornea is still very thin, apparently consisting as yet mainly of epiblastic structures.

A single row of horizontally-flattened cells next appears just internal to the outer molecular layer. The inner molecular layer becomes broader, and soon shows a distinct, fine, dark, median band. The ganglion-cells further increase in size. The pigment develops rapidly, and soon sends down processes between the segments of the rods and cones. An external limiting membrane now becomes visible. The cornea also shows intrusion of mesoblastic elements into its central part, and a further thin process of mesoblast lines it internally, forming Descemet's membrane. In the marine Teleosteans the vitreous chamber is late in developing, but shows itself about the stage now reached.

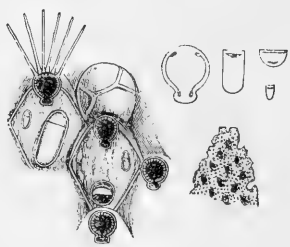
MISCELLANEOUS.

Description of a new Species of Retepora *from Port Western, Victoria.* By R. Kirkpatrick.

Miss E. C. Jelly recently sent to the Natural-History Museum an interesting specimen of *Retepora* from Port Western, belonging to an undescribed species. I propose to call the species

Retepora sinuosa, n. sp.

Zoarium (in the specimen) contorted, with walls anastomosing to form tubular alveoli; walls thick; fenestræ small, ovoid, smaller than the trabeculæ; zoœcia rhomboidal, separated by raised lines starting from middle of margin of each side of orifice; front surface flat, slightly tuberculated, semi-hyaline; orifice almost figure-of-8-shaped, the lower and smaller loop forming a wide sinus; with a beaded rim, except within sinus; six oral spines, stout, glassy, with imperfect joint at base; at the foot of each zoœcium a medium-sized circular avicularium, occasionally a long oval one; scattered about over the cells small oval avicularia; dorsal surface granular, vibicate, with small circular and oval avicularia, numerous on margins of fenestræ. Oœcia subglobose, hyaline, smooth, but marked with irregular raised lines.



For chitinous appendages see woodcut.

Loc. Port Western, Victoria.

The peculiarities of this species consist chiefly in the shape of the orifice and the absence of peristome. The shape of the orifice varies slightly; generally the sinus is curved; but in some cells the lower border is almost straight, so that the mouth has a shape characteristic of *Lepralia.*

Observations on a Colouring-matter of the Water of the Lake de Bret. By M. J. B. Schnetzler.

At the meeting of the 18th June, 1856, I communicated to the Society some observations upon a red colouring-matter deposited at the bottom of the fountain of the baths of Alliaz, $2\frac{1}{2}$ leagues to the north-east of Vevey. The water holding the red colouring-matter in suspension swarmed with small organisms, which, under the microscope, presented a fine rose-colour. They were of an elongated form, rounded at the two extremities; their average length was 0·01 millim., and their width $\frac{1}{400}$ millim. At that time I had only a microscope of low power; but the vortices of molecules around these bodies led me to infer the presence of vibratile cilia.

At the time of which I speak these little organisms were regarded as Infusoria by zoologists; Perty ('Zur Kenntniss kleinster Lebensformen,' 1852) placed them in the genus *Chromatium*. Their mode of reproduction even then led me to foresee their vegetable nature. Rabenhorst ('Flora Algarum Europ.' iii. p. 28) described these same organisms under the name of *Pleurococcus roseo-persicinus*. Ray Lankester, Waring, and Zopf now class them among the Schizomycetes.

Zopf ('Zur Morphologie der Spaltpflanzen,' 1882) describes, under the name of *Beggiatoa roseo-persicina*, Zopf, a Schizomycetan of which the organism that I observed in sulphurous water of the Alliaz is only a phase of development. Zopf distinguishes two principal forms of *Beggiatoa roseo-persicina*:—

1. The *Leptothrix*-form.—Very thin filaments, with the articulation very indistinct or almost null in most of the length of the thread, except at the base. These filaments are attached to plants or animals in course of decomposition. They are usually of a rose- or violet-colour; sometimes they become nearly colourless, and in this case they are not to be distinguished from *Beggiatoa alba*. As in this last species, these filaments contain granules of sulphur. By means of suitable colouring, however, it may be demonstrated that they consist of small segments. In this way true micrococci are obtained.

2. The *Zooglœa*-form.—The micrococci of the filaments of *Beggiatoa* separate by little and little, by rounding off their angular cells and dividing into two. According to their dimensions we distinguish micrococci and macrococci, which I observed in the water of the Alliaz.

By the division and multiplication of these cocci gelatinized colonies are formed, sometimes of a lobate form, sometimes mulberry-shaped, which are known by the name of *zooglœa*. The colour of these colonies varies; some are even colourless. The cocci of the colonies of zooglæa can become transformed into bacilliform cells. According to an observation of Zopf's, the micrococci of the zooglææ of *Beggiatoa alba* also became transformed into bacilli, which, after swimming in the water, produced the Leptothrix-form. Zopf adds that it appears that the micrococci of the zooglææ can pass over the formation of bacilli and become elongated directly into filaments.

In my communication of 1856 I had already observed this formation of zooglææ—an observation which has passed without any recognition. The following is my observation:—"This resemblance to the phenomena of vegetable life is still further increased during a state of immobility and repose through which the young *Chromatia* sometimes pass. In fact, we often find great agglomerations of these red vesicles bound together by a mucilaginous material; they then resemble those red spots which are sometimes formed upon bread. When the agglomerations of which I have spoken are observed for some time, a curious fact is noticed in them. A breath of life seems to come to animate this inert mass. The vesicles of which it is composed vibrate; those of the margin become detached and swim rapidly; in this way the spot gradually breaks up into young *Chromatia,* with which the water soon swarms."

Last autumn Prof. Forel brought me a red colouring-matter found in suspension in the water of the Lac de Bret, which was coloured red by it. Under the microscope I found irregular, lobate, rounded masses of a red colour, formed by micrococci. Notwithstanding this state of partial decomposition, I regarded this red matter as the zooglæa-state of *Beggiatoa roseo-persicina.* I directed my preparator, M. Tonduz, to look for the red colouring-matter this spring in the water of the Lac de Bret; but he did not find any of it. On the other hand, however, in the eastern part of the lake, he saw a material of a bluish-black colour, forming a streak of about 4–5 metres in length. The colouring-matter occurred especially in the fissures of the ice, or at the boundary between the ice and the water.

On examining this material, I found in it a great number of Diptera in process of decomposition; they served as the starting-points of long colourless filaments of *Beggiatoa.* This Leptothrix-form was accompanied by blackish zooglææ and free micrococci. At the first glance, the *Beggiatoa* taken on 3rd April in the Lac de Bret resembles *Beggiatoa alba,* which, like *B. roseo-persinica,* develops upon animal and vegetable materials in decomposition; but Zopf himself states that when this latter species is decolorized it no longer differs from the former. As M. Forel found *Beggiatoa roseo-persicina* in the water of the Lac de Bret, I am disposed to refer to that species the organism which produced the bluish-black coloration found by M. Tonduz.

In 1856 I had already foreseen the relations which exist between the zooglæa- and leptothrix-forms of *Beggiatoa roseo-persicina.* I had observed a vegetable organism in the form of very thin filaments which diffused in the water red corpuscles animated by a peculiar movement which strikingly resembled the first phases of *Chromatium.* These red globules afterwards combined into masses which became covered with filaments (leptothrix-form).

The masses of zooglæa observed in the blackish colouring-matter of the Lac de Bret have presented the fact, mentioned doubtfully by Zopf, that the cocci united into zooglææ can produce filaments of the leptothrix-form without passing through the bacillus-form.

In the preceding observations we find facts which serve to support

Zopf's observations, which demonstrate that the same Schizomycete may pass through the phases of leptothrix, micrococcus, zooglæa, bacillus, &c.

The Dipteron found abundantly in the midst of the filaments of *Beggiatoa* could not be exactly determined in consequence of its state of decomposition. I think, however, that it may be referred to *Hydrobœnus occultans*, Fries, a little fly of a dead black colour, $1\frac{1}{2}$ millim. in length, which appears in enormous quantities in the early spring, running about and leaping on the surface of the water. When there is any wind these insects take up their position upon the stems of grasses, from which the wind transports them to the water, where they then form a continuous black layer. It is in part to these flies that we must attribute the black coloration observed upon the eastern part of the Lac de Bret.

From what precedes, it must not, however, be inferred that the waters of the Lac de Bret are insalubrious. The *Beggiatoæ* which occur there are met with in all the sulphurous mineral waters which thousands of people drink every year as remedies. As to the flies driven by the wind upon this water, they are not infectious like those which station themselves upon dead bodies. Moreover, their decomposition is accelerated by the *Beggiatoæ* themselves, which transform the bodies of these small insects into gaseous matters, in great part set free into the air.

All round the Lac de Bret at present (April) we find, immersed in the water, green globular masses formed by Algæ belonging to *Zygnema Vaucheri* and *Z. cruciatum*.—*Bulletin de la Société Vaudoise des Sciences Naturelles*, sér. 3, vol. xviii. pp. 152–155 (June, 1888).

On the Calanidæ *of the Boulonnais.* By M. Eugène Canu.

M. Eugène Canu, of the Zoological Laboratory at Wimereux, published lately the first part of a description of the marine nonparasitic Copepods of the Boulonnais, in which the Calanidæ obtained on that part of the French coast are discussed at some length. He follows generally the classification adopted by Mr. G. S. Brady in his Monograph of the British Copepoda. The forms noticed are as follows:—

Subfamily I. Calaninæ.

1. *Paracalanus parvus*, Claus.

A species not recorded as British, but very abundant at Wimereux, and widely distributed in the European seas.

2. *Dias discaudatus*, Giesbrecht.

A species originally described from Kiel, and not noticed by

Brady, but recorded by J. C. Thomson as occurring near Liverpool. Brady describes *Dias longiremis*, Lillj., as British; two other European species are *D. bifilosus*, Giesbr., and *D. intermedius*, Poppe; and Mr. Norman has described a species under the name of *Dias* (?) *Mossi*.

With regard to the oviposition of the species of this genus, the author remarks that Lilljeborg described *D. longiremis* as bearing its eggs united into a single packet on the ventral surface of the abdomen, but that no one else has seen the ova in this situation, and that Giesbrecht suggested that the notion was founded on the analogy of the other Calanidæ. This view would seem to be confirmed by an observation of Grobben, who found the ova of *Dias longiremis*, with others, free in his aquaria.

3. *Temora longicornis*, Müller.

Exceedingly abundant at Wimereux as throughout the European seas.

In connexion with this species the author discusses in some detail the characters and peculiarities of the genera *Temora*, Baird, and *Temorella*, Claus. The former genus, established by Baird in 1850 upon the above species (which he identified with the *Monoculus finmarchicus*, Gunn.), was increased in 1853 by the addition of *T. velox*, Lillj., and in 1866 of *T. armata*, Claus. In 1876 Hoek described *T. Clausii* from the brackish water of the fortifications of Leyden, and in 1880 Poppe noticed a form nearly allied to the latter under the name of *T. affinis*, from the fresh and brackish waters of the great estuaries of North Germany. In 1881 Claus concluded that *T. velox* had been described from the male of *T. affinis* and the female of *T. Clausii*, so that it must be suppressed, and he indicated differences in the characters of the species which led him to found the genus *Temorella* for *T. Clausii* and *affinis*. In the same year Giesbrecht arrived at nearly the same conclusion, and proposed the establishment of two subgenera—*Halitemora* = *Temora*, Claus, and *Eurytemora* = *Temorella*. He described a new species from Kiel under the name of *Euryt. hirundo*, and finally adopted Claus's nomenclature. *Temorella lacustris* was described in 1887 by Poppe from the lakes of Westphalia; and it was noted by Nordqvist, in the same year, from Lake Ladoga under the name of *T. intermedia*.

Thus *Temora*, with the species *longicornis* and *armata*, and *Temorella*, with the four species above indicated, differ in their mode of existence, the former being more thoroughly marine, while the species of the second genus can exist even in the fresh water of lakes and rivers. The author indicates briefly the distinctive characters of the two genera. The anterior antennæ are shorter and more robust in the females of *Temorella*, and the right anterior antenna in the male *Temora* has the flagellum longer and more numerously jointed than in *Temorella*. The inner maxillipedes are shorter and thicker in *Temorella*. The appendages of the fifth thoracic segment in the males of *Temora* have on the second joint a spiniform process, which is wanting in *Temorella*; while in *Temorella* the penultimate joint presents a spine which is deficient in *Temora*. In *Temora* the outer ramus of the first pair of feet is biarticulate, in *Temorella* uniarticulate. No species of *Temorella* seems as yet to have occurred near Wimereux, but *T. affinis* has been met with off Honfleur.

4. *Isias Bonnieri*, sp. n.

"Syn. *Isias clavipes*, Boeck, 1864 (?), non Brady, 1878 (!)."

The cephalothorax is of a rounded oval form and without a dorso-cervical impression. The head bears a bifurcated frontal rostrum, deeply incised. The antennæ attain the first segment of the abdomen and are of twenty-four joints in the females and of twenty-one in the males; in both sexes they are bent into the form of an S. In the males the geniculation is between the eighteenth and nineteenth joints of the right antennæ, which are furnished at their anterior margin with a denticulated crest; the seventeenth joint bears a strong articulated spine. The cephalic appendages resemble those of *Centropages* and the genera of the *Calanus* section, especially those of *Clausia*, Boeck. The natatory appendages of the first four thoracic segments do not resemble the feet of *Centropages typicus*, Kröy.; they are shorter and broader; the outer ramus terminates with a long spine denticulated exteriorly, like that found in the same place in *Temora longicornis*. The limbs of the fifth thoracic segment present characters which enable us to separate *I. Bonnieri* from its congener. In the adult female the outer ramus is triarticulate, the second joint having a long hooked spine on its inner margin; the inner ramus is simple. In the adult males the biarticulate outer rami are as in *I. clavipes*, but the inner rami differ, especially upon the right side. On both sides the inner ramus is of a single joint, which on the right side is reduced to a mere tubercle armed with two short spines. The abdomen, of five segments in the male and of four in the female, has in both sexes a tubercle on the ventral surface of the third somite. In the adult female the genital segment formed by the first and second abdominal somites has a long ciliated spine on each side of the genital aperture. The fovea is as long as the last thoracic segment and formed of two broad pieces bearing five terminal setæ of moderate size. The species is common at Wimereux, but the female has not been found bearing an ovigerous sac.

5. *Centropages typicus*, Kröyer.

Not uncommon off Wimereux.

6. *Centropages hamatus*, Lilljeborg.

A littoral species.

Subfamily II. Pontellinæ.

7. *Pontella Wollastoni*, Lubbock.

Very common off Wimereux during the summer. The females are never found with ovigerous sacs.

8. *Pontellina Lobiancoi*, Giesbrecht, MS.

A large species, measuring 6 or 7 millim. in length and further remarkable for its brilliant coloration, a mixture of white, red, and blue, much resembling that of *Anomalocera Patersonii*, Templ. Common off Wimereux in the summer. In general form it resembles *Pontellina gigantea*, Claus. The body is elongated, nearly cylindrical, and consists in the male of twelve and in the female of nine segments and the furca. The frontal beak is bifid, with the two branches widely divergent. The cephalic segment bears on each side, at the limit of the anterior third, a point recurved backwards, and the fifth thoracic segment has on each side a wing-like process terminating in a point. The abdomen of the male has five and that of the female only three segments. The last abdominal segment in both sexes is deeply incised on its ventral face, and on the two lobes thus formed are fitted the broad and short furcal pieces. The author notes other peculiarities of structure characteristic of this species, which has been already described by M. Giesbrecht under the above name in a memoir on the pelagic Copepoda which he is preparing for publication in the 'Fauna und Flora des Golfes von Neapel.'—*Bulletin Scientifique de la France et de la Belgique*, sér. 3, Année i. (1888), pp. 78–106.

The Freshwater Infusoria of the Wellington District, New Zealand. By W. M. Maskell.

In communicating to the Wellington Philosophical Society a notice of some freshwater Infusoria, in continuation of a previous paper on the same subject, the author has the following remarks on the resemblance existing between the Infusoria of New Zealand and those of Europe. He says:—

"In the 'Journal of the Royal Microscopical Society' for February 1887 Professor A. C. Stokes, of New Jersey, in an account of some new American Infusoria, remarks that it is rare to find in America forms which are also found in European fresh water. The experience of the compilers of the present paper leads to quite the contrary view as regards the New-Zealand animalcules. Probably the ambition of every 'systematic' observer in any branch of zoology or botany is to discover some new species; and this, laudable as it doubtless is to a proper extent, has unfortunately led to a multiplication of specific distinctions and names, often on the slenderest grounds, which subsequent investigation will have to largely diminish, at some trouble to students. The members of the Wellington Microscopical Section have steadily endeavoured to resist this tendency, believing that much less error and confusion will result by neglecting the frequently most minute differences from European types observable in almost every Infusorian examined. Examples of this may be found in *Rhipidodendron Huxleyi*, *Amphileptus anser*, *Metopus sigmoides* in our former paper, or *Monas irregularis*, *Codosiga botrytis*, &c. in the present one. There are certainly minute points of difference in such as these which might tempt some observers to raise them, if not to specific, at least to 'variety' rank. But in truth there is very often no absolute stability even in the same individuals amongst the Infusoria; and we have thought it best to avoid to the utmost any more cumbering of scientific classification and nomenclature than was absolutely necessary. The couple of dozen animalcules herein set down as new species are considered to be sufficiently deserving of the distinction.

"But Professor Stokes's statement as to the New-Jersey Infusoria, compared with what has just been said, raises a question as to the reason for the identities observed between the New-Zealand and the European forms. It may be remarked that similar identities appear to be noticeable also amongst the freshwater Algæ, as several of our Desmidieæ and Diatomaceæ are found at both sides of the globe, and many others present differences so trifling as to be unimportant. That specific similarity should be so rare as Professor Stokes declares it between two countries in the same hemisphere, as New Jersey and France or England, and so frequent in two so nearly antipodal as England and New Zealand, is not a little curious; and it becomes still more so if, as seems to be the case, the differences in the 'higher' zoological and botanical orders and families are in a reverse ratio. The 'higher' American fauna and flora approximate to the European much more than the New-Zealand fauna and flora do. It is therefore not quite clear why the microscopical forms of animal and vegetable life should not follow the same lines. The answer might possibly be found in an extension of research, leading to comparisons between countries of about the same latitude and climate. Yet New Jersey, France, and New Zealand are not, in these respects, very differently situated."

The apparent contrast between New Jersey and New Zealand would be of much interest if absolutely demonstrated; but Mr. Maskell has indicated a very probable source of doubt. At the same time he is, perhaps, a little uncharitable in the motives which he ascribes to the describers of new species. Observers differ considerably in their views of what constitutes a specific difference.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 10. OCTOBER 1888.

XXXVI.—*The* Staphylinidæ *of Japan.* By Dr. D. SHARP.

THIS memoir is intended to add to our knowledge of the Coleoptera of Japan by description of the new species of Staphylinidæ obtained by Mr. George Lewis during his tour in the islands in 1880–81. Previous to the year 1874 only three or four species of the family Staphylinidæ were known as occurring in Japan; but in that year I enumerated, in the 'Transactions of the Entomological Society of London,' 190 species that had been obtained in the islands by Mr. Lewis during his first residence there; this total has since been increased by Weise and others to 218, as recorded in Herr von Schönfeldt's recent Catalogue of the Coleoptera of Japan. To this number I am now able to add 249, making a total of 467 species of the family at present known as inhabiting the archipelago.

Thanks to the efforts of Mr. Lewis we have attained a fair knowledge of the Coleoptera of the Japanese islands, his entomological work there having resulted in the formation of a collection of about 4000 or 5000 species of the order. Some considerable parts of this large and interesting collection have been thoroughly examined—the Geodephaga, with 406 species, and the Longicorns, with 236 species, by Bates; the Chrysomelidæ, 303 species, by Baly and Jacoby *. These families, with the Staphylinidæ, make a total of about 1400 species, and as they comprise insects of very varied habits, they may be taken for statistical purposes as probably fairly representative of the whole collection. Bates has already discussed † the relations of the Coleopterous fauna, so far as the ground-beetles and Longicorns are concerned, to that of the various adjacent regions; but as we can now make use of a much larger material, and as he followed Wallace's plan of using generic statistics for the purposes he had in view, it is still of interest to make a somewhat similar comparison, making use of the species of the four great groups I have mentioned above instead of the genera of the two groups treated by Bates.

Of the 1406 species found in Japan only 210 are known to occur in Europe and Siberia; so that only about 15 per cent. are common to the two subregions. A similar proportion appears to be maintained in the rest of the order Coleoptera, as von Heyden has stated, in the introduction to Schönfeldt's Catalogue of Japanese Coleoptera, that out of the 2682 species recorded in it 391, or rather less than 15 per cent., are also known to occur in Siberia or Europe. This is a very small amount of community for the two provinces; but there is considerable reason for supposing that the discrepancy between the two faunas is at present much greater than it will prove to be when our information is more exhaustive. Lewis's collections have been formed chiefly in the southern islands, whereas it is of course in the more northern island of Yezo that we should expect to find the greater amount of similarity with Siberia. Moreover the Coleoptera of the extreme east of Siberia are not very well known, so that I consider it far from improbable that as much as 30 or 40 per cent. of the species of Japanese Coleoptera may ultimately be proved to exist also in Siberia, though at present the amount is only 15 per cent.

A comparison of the Coleoptera of Japan with the fauna of the parts of the Asiatic continent more to the south than Siberia can at present be made only in a very imperfect manner; it is probable that we do not know more than one tenth of the species of Coleoptera inhabiting Mantchuria,

* Some other families have been worked through by Lewis himself and by Gorham and Reitter, but to these, for my present purpose, I need not specially refer.

† Trans. Ent. Soc. Lond. 1883, p. 205 *et seq.*, and Journ. Linn. Soc. xviii. pp. 205–207.

Northern China, and Korea, so that no useful purpose would be served by estimating what percentage of the Japanese Coleoptera is at present known from there. A paper has recently been published by Herr Kolbe that gives us some, if only a little, information on the question of the relation between the Coleopterous faunas of Japan and of the other portions of Wallace's Mantchurian subregion. Describing * a small collection of 142 species of Coleoptera made by Dr. Gottsche in Korea, he has entered fully into the question of the geographical relations of the species, and announces that Korea is "faunistically extraordinarily closely related to Japan," 77 out of the 142 species detected there being known as occurring also in Japan. This certainly leads us to infer that a considerable amount of community exists between the two provinces; but it appears to be by no means so great as might have been expected, for although we have a fair knowledge of the Coleoptera of the southern islands of Japan, it appears that out of 142 species from the Korea 65, that is nearly 46 per cent., are not known to be Japanese. Kolbe states also that the Korea has more in common with Japan than it has with China; but this is probably connected with the fact that we know so much more of Japanese than we do of Chinese Coleoptera.

I think it will be admitted that with such imperfect data as we possess we cannot pretend to form any trustworthy estimate of the exact relations of the Coleopterous fauna of Japan to those of other provinces. At present what we know seems to indicate a larger amount of endemicity than we should have expected from its geographical position and from its proximity at more than one point to other lands; its fauna, too, seems to have affinities extending over a wide area, including some undoubted and even striking points of resemblance with North America and with East India.

The geographical position of the islands gives their fauna a considerable interest, which is much increased by the fact that the islands themselves are well separated from one another: a comparison of the fauna of the island of Yezo with those of Nipon, Saghalien, and Mantchuria could not fail to throw light on such questions as the exact relation between endemicity and geographical isolation, and as the correlation between present climatic conditions and the distribution of species; but for all such purposes it is necessary to have a complete knowledge of the faunas of the various regions involved, and this we are very far from possessing. Mr.

* Arch. f. Nat. 1886, i. pp. 139–240.

Lewis has probably obtained somewhere between 50 and 80 per cent. of the beetles of Japan; but Yezo has been comparatively neglected, and of the Coleoptera of Saghalien and the Kurile Islands we know really nothing, whilst our knowledge of the beetles of the adjacent parts of the continent of Asia is quite rudimentary.

One of the points that has seemed to occasion some surprise is the occurrence in Japan of forms we were previously only acquainted with from the eastern tropics; but this is probably due to our great ignorance as to the fauna of extreme eastern Asia. In most other parts of the northern hemisphere, as is indeed well known, the tropical fauna is separated from that of the temperate regions by intervening zones of barren country, very different in climate and in capacity for supporting life from the regions adjacent to them. In the extreme east of Asia there seems to be no such barrier to the spread of tropical forms of life into temperate regions, or of temperate forms into tropical regions, and such information as we possess about this region seems to show that a great mixture exists. Bates has already pointed out that there is a large tropical element in the Coleoptera of Japan; and Fairmaire tells us * of Yunnan, far to the south, that there is a great mingling of European genera with tropical forms; and Sémenow again, in remarking † on the Coleoptera collected in China and Mongolia by Potanin, says that three faunas are represented, one of them eminently palæarctic. At present therefore it appears very doubtful whether in this part of the world any natural separation between Palæarctic and Oriental regions exists.

In the present paper I have not included the names of all the species of Japanese Staphylinidæ, those that have been recorded in my previous paper on the subject (Trans. Ent. Soc. 1874, pp. 1–103) only being mentioned when I have some addition or correction to make. I have, however, included the names of all other species that I know of as recorded from the islands; so that this and the paper just mentioned give a complete list of Japanese Staphylinidæ up to this date.

* Ann. Soc. ent. Belg. 1887, p. 87.
† Hor. Soc. ent. Ross. xxi. p. 390.

Subfam. *ALEOCHARIDÆ.*

Group ALEOCHARINA.

Aleochara claviger.

Aleochara claviger, Sharp, Tr. Ent. Soc. Lond. 1874, p. 7.

Mr. Lewis has brought from Hakodate a single specimen, having the elytra of a clear pale red colour. I do not know whether it is distinct or only a variety of *A. claviger*. It comes very near to *A. celebensis*, Fauv., but is more finely punctate.

Aleochara discoidea.

Aleochara discoidea, Sharp, Tr. Ent. Soc. Lond. 1874, p. 7.

A small series of examples from different localities on the main island show that this is either a very variable species or that there may be two or three species in Japan very closely allied to *A. fuscipes*, L.; but the material is quite insufficient to form a judgment on.

Aleochara lata?

Aleochara lata, Gravenhorst, Col. Micr. p. 186.

Kiga and Miyanoshita; two specimens. These examples do not agree exactly with either European or North-American specimens, and may possibly be distinct; they are very broad and densely punctate.

Aleochara asiatica.

Aleochara asiatica, Kr., Wiegm. Arch. f. Nat. xxv. p. 13 (sep. pag.).
Aleochara japonica, Sharp, Tr. Ent. Soc. Lond. 1874, p. 8.

We have not yet obtained in Japan any examples with red elytra, such being, according to Kraatz, the ordinary form in Ceylon; but both Kraatz and myself have pointed out that the speciés is variable in colour, and I have no doubt that the two forms are not distinct.

Aleochara niponensis, n. sp.

Nigra, fusco-pubescens, antennarum basi pedibusque testaceis; dense punctata; antennis apicem versus latioribus, articulis 5^{o}–10^{m} transversis.

Long. 6 millim.

Antennæ short, rather stout, the three basal joints sordid red; ninth and tenth joints quite similar to one another. Thorax strongly transverse, densely and finely punctate and pubescent. Elytra about as long as the thorax, densely, moderately finely punctate, the hind margin very slightly red. Hind body much narrowed to the extremity, densely, moderately finely punctate; last dorsal plate with the hind margin simple.

Kiga, Nagasaki, and Nikko; four specimens.

The place of this species is between *A. bipunctata* and *A. asiatica*; from the former it is distinguished by the finer punctuation and shorter and thicker antennæ, and from *A. asiatica* by denser and finer punctuation and the unemarginate last dorsal plate.

Aleochara nitida.

Aleochara nitida, Grav. Col. Micr. Bruns. p. 97.

Found on the main island at Inoshima and in Yezo at Hakodate; several examples.

Aleochara squalithorax (Fauvel in litt.), n. sp.

Opaca, fusco-nigra, breviter flavo-setosa; prothorace peropaco, obsolete punctato; elytris abdomineque densissime punctatis; antennarum basi pedibusque fuscis.

Long. 4 millim.

Antennæ small and not thick, penultimate joint evidently transverse. Head narrow, quite dull, almost impunctate. Thorax transverse, remarkably dull, sparingly and obsoletely punctate, along the middle an obscure, rather broad, scarcely elevated space quite free from sculpture. Elytra scarcely longer than the thorax, very densely and roughly sculptured. Hind body very densely punctate. Mesosternum very strongly carinate quite to the apex.

Hagi (*Fauvel*), Hakodate (*Lewis*).

I have preserved the name proposed for this curiously sculptured species by the well-known French savant.

Aleochara trisulcata.

Aleochara trisulcata, Weise, Deutsche ent. Zeitschr. 1877, p. 88.

Hagi (*Weise*), Hakodate (*Lewis*).

Only one example of this very peculiar little insect was obtained by Mr. Lewis.

Homœusa acuminata.

Euryusa acuminata, Märkel, Stett. ent. Zeit. 1842, p. 143.

Miyanoshita, May 1880; one example, agreeing exactly with European specimens.

Homœusa lævigata, n. sp.

Nigra, subnitida; antennis, pedibus anoque rufo-sordidis; subtilissime punctulata; thorace fere lævigato.
Long. $3\frac{1}{2}$ millim.

Antennæ rather short, much thicker externally, fifth to tenth joints transverse, terminal joint elongate, nearly as long as the preceding three together. Thorax strongly transverse, considerably broader than the elytra, bisinuate on each side at the base; hind angles acute, sharply defined, the surface sparingly and excessively finely punctate, somewhat shining. Elytra about as long as the thorax, very finely punctate. Hind body acuminate behind, very finely punctate.

Seba, July 30th, 1881; one specimen in an ant's nest.

Homœusa longicornis, n. sp.

Picea, haud nitida, thoracis lateribus anoque testaceis; elytris brunneis; antennis pedibusque rufis; subtiliter punctata; antennis sat elongatis, articulo penultimo vix transverso.
Long. $3\frac{1}{2}$ millim.

This insect is considerably larger than *H. japonica* and has quite different antennæ, these organs being more slender and elongate than they are in *H. japonica* or the other known species of the genus. The thorax is strongly transverse, a little rounded at the sides, bisinuate behind, the hind angles slightly acute; the surface finely punctate and pubescent. Elytra about as long as the thorax, rather closely and finely punctate. Legs rather long.

Sapporo; one specimen.

Aspidobactrus, nov. gen.

Tarsi anteriores 5-articulati. Antennæ breves, crassæ, fusiformes, rigidæ. Pronotum magnum, anterius semicirculare, posterius bisinuatum. Coxæ intermediæ contiguæ.

Of this peculiar insect Mr. Lewis obtained only one example, and although I can see its characters only very imperfectly, I have little or no doubt that it is allied to *Homœusa*, and distinguished from it and other neighbouring genera by the very peculiar antennæ, the joints of which are consolidated, so that they cannot be easily counted; the terminal joint is elongate, acuminate, about equal in length to the rest of the consolidated mass; the first joint is distinct, the second and third small and slender, the following joints considerably larger, consolidated.

Aspidobactrus claviger, n. sp.

Ferrugineo-testaceus, abdomine obscuriore apice testaceo, subtiliter punctulata; thorace anterius rotundato, abdomine acuminato.
Long. 3 millim.

Antennæ short, thick, rigid, subacuminate. Head immersed under the large thorax; this latter completely rounded at the front and sides, the base strongly bisinuate, the hind angles acute and projecting backwards, the surface finely punctate and pubescent. Elytra considerably shorter and narrower than the thorax, strongly sinuate near the outer hind angle, finely punctate; scutellum not visible. Hind body strongly narrowed from base to apex, feebly punctate, rather strongly pubescent. Tarsi rather short, very slender, especially at the extremity.

Nikko; one specimen.

This is one of the most remarkable of the Staphylinidæ captured by Mr. Lewis, and is pretty certainly either myrmecophilous or termitophilous in its habits.

Thiasophila oxypodina, n. sp.

Elongata, subparallela, minus depressa, subtilissime punctata, evidenter pubescens, opaca, rufo-testacea, abdomine medio nigricante.
Long. $2\frac{1}{2}$ millim.

Antennæ red, thick, thicker externally, second and third joints subequal, fifth to tenth strongly transverse. Head rather narrow. Thorax slightly transverse, densely punctate, base scarcely bisinuate, hind angles very minutely acute. Elytra slightly longer than the thorax. Hind body slender, rather sparingly punctate, basal two segments deeply transversely impressed at the base.

Hakone, Suyama, Miyanoshita, in company with a small ant.

This little insect seems better placed in *Thiasophila* than in *Oxypoda*, but will probably prove to belong to a distinct genus between these two and also related to *Homœusa*.

Oxypoda luridipennis, n. sp.

Elongata, angustula, nigra; elytris fusco-ferrugineis, antennis pedibusque testaceis; dense subtilissime punctulata, opaca; antennis sat elongatis.
Long. 4 millim.

Antennæ slender, not thicker externally, each joint longer than broad; terminal joint elongate, but not so long as the two preceding together. Head orbicular, not much more than half as broad as the elytra. Thorax not strongly transverse, but evidently broader than long, rounded at the sides and a little narrowed in front, very densely punctate. Elytra rather long, distinctly longer than the thorax, very finely punctate. Hind body excessively finely and densely punctate. Legs clear yellow.

Yokohama, Oyama; two specimens.

Oxypoda subrufa, n. sp.

Elongata, angusta, rufa, opaca, dense subtilissime punctulata pubescensque; thorace elytrisque obscurioribus, capite nigricante, pedibus testaceis.
Long. $2\frac{3}{4}$ millim.

Antennæ short, third joint shorter than second, fourth short, slightly transverse, fifth to tenth differing little from one another, each rather strongly transverse, terminal joint obtuse, not twice as long as the tenth. Head narrow, closely and finely punctate. Thorax rather broader than long, front angles extremely depressed, rather broader at the base than in front, very finely and densely punctate. Elytra longer than the thorax. Hind body elongate and narrow, very densely and finely punctate, and delicately pubescent, not so dull as the front parts.

Nagasaki, in February and March; three specimens.

Oxypoda hilaris, n. sp.

Angustula, rufa, dense subtilissime punctata pubescensque, opaca; capite, elytris posterius abdomineque ante apicem fuscescentibus, pedibus testaceis.
Long. 3 millim.

Antennæ short and stout, third joint longer than the second, fifth to tenth strongly transverse, terminal joint as long as the two preceding joints together. Head infuscate red, rather broad and short, very finely punctate. Thorax strongly transverse, nearly twice as broad as long, base much rounded, very finely punctate. Elytra yellow at the base, fuscous for a large space at the outer apical angle, a good deal longer than the thorax, very densely punctate. Hind body with the basal two segments yellow, the following three fuscous, closely very finely punctate.

Nikko, Yokohama, Kuromazu; five examples.

Oxypoda læta.

Oxypoda læta, Weise, Deutsche ent. Zeitschr. xxi. (1877) p. 97.

Hagi; not found by Lewis.

Calodera desdemona, n. sp.

Elongata, angustula, fusco-testacea; antennis pedibusque pallidis, abdomine medio nigricante; dense subtilissime punctata; prothorace sat elongato.

Long. 3 millim.

Antennæ entirely pale red, fourth joint much broader than the third, fourth to tenth very similar to one another, each transverse, terminal joint twice as long as the tenth. Head suborbicular, piceous. Thorax about as long as broad, densely and very finely punctured, with a transverse impression in front of the base in the middle. Elytra a little longer than the thorax, finely, very densely punctate. Hind body closely and finely punctate.

Yokohama; one specimen.

Closely allied to *C. æthiops*, but about twice the size.

POROCALLUS, nov. gen.

Tarsi omnes 5-articulati. Palpi maxillares triarticulati, articulo tertio lato, cyathiformi.

This genus is most nearly allied to *Callicerus*, agreeing with it in the peculiar structure of the maxillary palpi, which are of the type seen in some genera of Pæderidæ, the penultimate joint being broad and truncate at the apex and no doubt receiving the fourth joint, which is invisible; the labial palpi are triarticulate, the basal joint stout, the terminal joint minute and slender; the genæ are very obsoletely margined. The middle coxæ are distinctly separated, the mesosternum much produced between them, but not quite meeting the raised margin of the metasternal process. The basal joint of the hind tarsus is very long, longer than the three following together. By this character the genus is well distinguished from *Callicerus.* In *Callicerus* the anterior tarsi are said to be only four-jointed; in *Porocallus* they appear to me to be five-jointed, but I may possibly be mistaken, as I have only one example at my disposal, and in it the feet have been clogged with gum-tragacanth.

Porocallus insignis, n. sp.

Niger, capite, thorace elytrisque fusco-nigris, densissime punctatis, opacis; abdomine nitido, crebre punctato; antennis, palpis pedibusque rufis.

Long. 6 millim.

Antennæ elongate, rather stout, but little thicker externally, third joint longer than the second, little longer than the fourth, longer than broad, terminal joint elongate, considerably longer than the tenth. Head broad and short, extremely densely punctate, quite dull. Thorax a little narrower than the elytra, transverse, slightly narrowed behind, extremely densely, moderately coarsely punctate, quite dull. Elytra broad, longer than the thorax, dull, densely punctate, the colour towards the hind margin brown, the punctuation there rather coarser and less dense. Hind body with each of the basal segments depressed at the base, and there densely punctate, each behind more sparingly and finely punctured.

Yuyama, May 11th, 1881; one specimen, probably a female.

Group Myrmedoniina.

Saphocallus, nov. gen.

Tarsi anteriores 4-, intermedii et posteriores 5-articulati. Palpi maxillares triarticulati, articulo tertio sat gracili, apice truncato.

Antennæ elongate. Head narrow, with convex eyes. Thorax quadrate. Middle coxæ slightly separated, but neither the metasternum nor the mesosternum is much produced between them, so that a great space in the longitudinal direction exists between the margins of these two parts. Legs elongate. The hind tarsi long, the basal joint elongate, not twice as long as the second joint, this latter a little longer than the third, the two together about as long as the basal joint; terminal joint slender, about as long as the basal joint.

The place of this genus will be between *Myrmœcia* and *Callicerus*; the insect resembles *Callicerus obscurus* in appearance, but it is well distinguished by the structure of the breast.

Saphocallus parviceps, n. sp.

Angustulus, fuscus, antennis pedibusque rufis: elytris fusco-ferrugineis; thorace subquadrato, densissime punctato, opaco, elytris illo longioribus, fortiter punctatis.

Long. $3\frac{1}{2}$ millim.

Antennæ elongate, red, darker at the base, third joint quite as long as the second, tenth as long as broad, terminal joint elongate, nearly twice as long as the tenth. Head narrow, and considerably narrowed behind the prominent eyes. Thorax evidently narrower than the elytra, nearly as long as broad. Elytra rather roughly punctured, conspicuously emarginate near the outer hind angle. Hind body slender, shining, the base of each segment punctate and somewhat depressed. In the male there is a tubercular elevation on each wing-case near the suture behind; a short denticle on the middle near the hind margin of the penultimate dorsal plate of the hind body; the hind margin of the terminal dorsal plate is emarginate, and the genital armature projects as two short, stout, corneous processes.

Nagasaki, 6th April, 1881; one specimen.

Atemeles sinuata, n. sp.

Rufula, capite, thorace (lateribus exceptis), abdomine ex parte pectoreque nigris; thorace punctulato utrinque foveolato, lateribus valde emarginatis, basi in medio longe lateque lobato.

Long. 5 millim.

Antennæ moderately long and stout, penultimate joint slightly transverse. Head small, narrow, black, quite dull. Thorax transverse, irregular in shape, sides much elevated, a large fovea on each side, the base much produced in the middle. Elytra a little longer than the thorax, densely, very finely punctate. Hind body densely tufted at the sides and less conspicuously at the apex.

This is allied to *A. emarginata*, but has the thorax considerably more eccentric in form.

Chiuzenji; a single specimen, 21st August, 1881, in company of *Myrmica*.

Hoplandria convexa.

Hoplandria convexa, Weise, Deutsche ent. Zeitschr. xxi. (1877), p. 88.

Hagi. Described by Herr Weise from a single example; the genus is doubtful.

Myrmedonia optata, n. sp.

Nitida, capite, thorace, pectore elytrorumque angulis externis nigris, pedibus flavis; antennis, elytris abdomineque testaceo-ferrugineis, hoc apicem versus piceo-variegato; prothorace parce profundeque punctato, basi in medio profunde foveolato; elytris crebrius profunde punctatis.
Long. 6 millim.

Antennæ long and stout, penultimate joints strongly transverse. Head very shining, with a few deep punctures. Thorax broader than long, very distinctly punctate. Elytra a little longer than the thorax. Hind body with the terminal segments marked with black; at the base of each segment a fine punctuation.

Kashiwagi and Chiuzenji; two specimens.

This is closely allied to *M. Haworthi*, but is much smaller, has the antennæ comparatively larger, and the elytra more finely punctate.

Myrmedonia Haworthi.

Aleochara Haworthi, Steph. Ill. Brit. Ent. v. p. 126, pl. xxvi. fig. 3.

Hitoyoshi and Kashiwagi; two examples.

Myrmedonia fugax, n. sp.

Capite cum antennis, elytris, pectore abdominisque apice nigris; thorace abdomineque læte rufo-testaceis, pedibus flavis, antennis articulo ultimo testaceo; thorace transversim subquadrato parce obsoleteque punctato.
Long. 5 millim.

Antennæ thick, fourth to tenth joints strongly transverse. Head shining black, smooth in the middle, sparingly punctate at the sides. Thorax a good deal broader than long, sparingly and subobsoletely punctured, with a basal depression in the middle, very shining, bright yellowish red. Elytra only slightly longer than the thorax, black, shining, rather closely and coarsely punctate. Hind body bright yellowish red, with the terminal segments black, shining, with some fine punctures at the base of each segment.

Kioto, June 10th, 1881; one specimen.

A distinct species of the subgenus *Zyras*.

Myrmedonia particornis, n. sp.

Capite cum antennarum basi, elytris, pectore abdominisque apice nigris; thorace abdomineque rufo-testaceis; antennis extrorsum albidis, pedibus flavis; thorace subquadrato, obsolete punctato.
Long. 5 millim.

Antennæ black at the base, the apical joints quite white, fifth to tenth joints transverse. Head shining black, obsoletely punctate. Thorax a good deal narrower than the elytra, slightly broader than long, a little narrowed behind, foveolate at the base in the middle, sparingly and obsoletely punctured. Elytra slightly longer than the thorax, shining black, coarsely, moderately closely punctate. Hind body with a few fine punctures at the base of each segment.

Kioto, July 2nd, 1881; one specimen.

This also belongs to the subgenus *Zyras*; it is very remarkable on account of the colour of the antennæ.

Myrmedonia picta.

Ilyobates pictus, Sharp, Trans. Ent. Soc. Lond. 1874, p. 11.

This insect was met with again near Nagasaki. There are only four joints in the front feet, so the species must be removed to *Myrmedonia* and placed in the subgenus *Zyras*.

Myrmedonia cognata, var. *japonica*.

Myrmedonia cognata, Märkel, Stett. ent. Zeit. 1842, p. 142.

On his previous visit to Japan Mr. Lewis found only a single example of this insect; but more recently he has procured a good series in the nests of *Formica japonica* at Bukenji. These examples differ from European examples of *M. cognata* in being of a more uniform and dark colour and more densely punctate; but as they agree in other respects I prefer to treat them as a variety, though, if these slight characters prove to be constant when examples have been found in other localities, the two forms may be really distinct. In Europe *M. cognata* inhabits the nests of *F. fuliginosa*, a species closely allied to *F. japonica*.

Myrmedonia similis.

Myrmedonia similis, Märkel, Germar's Zeitschr. v. p. 200.

Kiga and Miyanoshita; four examples. The species is rather rare in Europe, where it inhabits the nests of *Formica fuliginosa.* The ant to whose nest it is attached in Japan has not been noted.

Myrmedonia indiscreta, n. sp.

Fusco-picea, minus nitida, subtiliter punctata; antennis pedibusque rufis, abdominis segmentis basalibus piceis; thorace valde transverso, basi et lateribus rotundatis.
Long. 4 millim.

Antennæ rather short, much thicker externally, fourth to tenth joints transverse, the last twice as broad as long, terminal joint moderately acuminate, quite twice as long as the tenth. Head black. Thorax about twice as broad as long, moderately closely and finely punctate; hind angles very obtuse and indistinct. Elytra a little longer than the thorax, densely and very finely punctate. Hind body impunctate.

Seba and Hakodate; six specimens.

This is similar to the European *M. laticollis,* but is much smaller and narrower and differs in numerous minor points.

Myrmedonia spreta, n. sp.

Nigra, elytris brunneis, antennis pedibusque rufis; antennis brevibus, apicem versus latioribus; prothorace fortiter transverso, lateribus rotundatis, sat crebre asperato-punctato, basi in medio foveolato.
Long. 5–6 millim.

Basal three joints of antennæ clear red, the others more obscure, third joint much longer than the second, fifth to tenth each transverse, each narrower at the base; penultimate joint more than twice as broad as long, terminal quite acuminate. Head broad and very short; eyes large. Thorax nearly twice as broad as long, sides and base rounded; hind angles very obtuse, the surface very distinctly, not densely punctate, minutely pubescent. Elytra a little longer than the thorax, closely and finely punctate, of a pale brown colour, darker at the outer apical angle. Hind body shining, impunctate.

Sapporo and Hakodate.

A very distinct species, somewhat similar to *M. laticollis* and *M. similis,* but with peculiar punctuation on the thorax.

Thamiaræa diffinis, n. sp.

Fusco-cinnamomea, abdomine nigro, segmentis basalibus ad latera rufo-maculatis, antennarum basi pedibusque testaceis; capite, thorace elytrisque subtiliter punctatis, abdomine nitido, fere impunctato.
Long. 5 millim.

Antennæ moderately long and slender, setose, third joint elongate, longer than the second, fifth nearly as long as broad, sixth to tenth transverse, terminal joint acuminate, more than twice as long as the tenth. Head broad and short, not much more than half as broad as the elytra, sparingly and finely punctured. Thorax strongly transverse, the base rounded, the surface even, finely, moderately, closely punctate, shining. Elytra a little longer than the thorax, and rather more distinctly punctured.

This is larger than the European *T. cinnamomea*, and has longer and more slender antennæ, and the upper surface is more shining.

HOMALOTA.

Mr. Lewis's collection contains examples of several species of this genus in addition to those I have described or determined; but the specimens are not sufficiently numerous or well preserved to describe from in this most obscure genus—the most difficult to deal with of all the genera of Coleoptera.

Homalota variolosa.

Homalota variolosa, Weise, Deutsche ent. Zeitschr. xxi. 1877, p. 89.

Hagi; one specimen. This has not been found by Mr. Lewis. The genus is doubtful.

Homalota Hilleri.

Homalota Hilleri, Weise, Deutsche ent. Zeitschr. xxi. 1877, p. 90.

Hagi, on the sea-shore.

Homalota niponensis, n. sp.

Parva, nitida, nigra; elytris fusco-testaceis, pedibus testaceis; prothorace transverso, medio late profundeque impresso, abdomine crebre punctato.
Long. $2\frac{1}{3}$ millim.

Antennæ small, rather slender, but little thicker externally, basal joint fuscous, the others black; fourth to tenth joints slightly transverse. Head black, shining, impunctate, almost without pubescence. Thorax about as broad as the elytra, not twice as broad as long, rounded at the sides, very slightly narrowed in front, very delicately punctulate, shining, on the middle with a very large depression, not extending quite to the front. Elytra a little longer than the thorax, sordid testaceous, blackish at the base, very finely punctate. Hind body with all the segments finely, moderately closely punctate.

Nagasaki, 22nd February, 1881; two examples.

This may be placed near the European *H. nigra*, to which it is not, however, at all closely allied; if the remarkable thoracic depression be sexual, the two examples are no doubt males, but there is no peculiar structure of the hind body to indicate this.

Homalota lutulenta, n. sp.

Parva, rufula, antennarum basi, thorace, elytris pedibusque testaceis; antennis extrorsum, capite abdomineque ante apicem fuscescentibus; crebre punctata, abdomine fortiter acuminato, crebrius conspicueque setosello.

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

Antennæ short and rather stout, thicker externally, third joint rather shorter than the second, fifth to tenth joints transverse, the last of them rather strongly so; terminal joint about as long as the two preceding together. Thorax convex, rounded at the sides and base, and narrowed in front, bright yellowish red, finely punctate, rather feebly transverse. Elytra slightly longer than the thorax, coloured like it, rather more closely punctate. Hind body very acuminate, rather closely punctate, evidently pubescent, and with the exserted setæ very distinct.

Yokohama and Nagasaki.

This is one of the species with most strongly acuminate hind body; it may be easily distinguished from the equally bright-coloured *H. vivida* by its smaller size, thicker antennæ, and more closely punctate hind body.

Homalota oligotinula, n. sp.

Parva, brevis, subdepressa, testaceo-ferruginea, pedibus flavis; subtilissime punctulato; antennis brevibus, crassis.

Long. 2 millim.

Antennæ stout, very short, thicker externally; fourth to tenth joints transverse, the tenth quite twice as broad as long. Head stout, about half as broad as the elytra. Thorax quite twice as broad as long, base and sides greatly rounded, the surface without depressions, scarcely visibly punctate. Elytra a little longer than the thorax, very minutely punctate. Hind body shining, almost impunctate, narrower behind.

Suyayama and Kumamoto; two specimens.

Homalota gyrophænula, n. sp.

Brevis, subdepressa, rufo-testacea; antennis extrorsum, pectore abdominisque segmentis 4^{o}–6^{m} nigricantibus; elytris fusco-testaceis; antennis brevibus, apicem versus crassioribus.
Long. 2 millim.

Antennæ very short, third joint small, fifth much broader than the fourth, fifth to tenth transverse, the last of them strongly so; terminal joint short, obtuse. Head small, about half as broad as the elytra. Thorax strongly transverse, quite twice as broad as long; base strongly rounded, surface even, delicately pubescent, scarcely visibly punctate. Elytra longer than the thorax, very finely punctate. Hind body broad and short, finely punctate.

Thectura armata, n. sp.

Elongata, angusta, parallela, depressa, nigra; elytris fuscis; antennis, palpis pedibusque testaceis; capite fortiter punctato, thorace medio longitudinaliter impresso.
Long. $2\frac{1}{4}$ millim.

Antennæ short and rather stout, reddish, outwardly more obscure, fifth to tenth joints transverse. Head subquadrate, slightly narrower than the thorax, rather closely and coarsely punctate. Thorax feebly transverse, very finely punctate. Elytra longer than the thorax, very finely punctate. Hind body narrow and elongate, very obsoletely punctate. In the male the last dorsal plate is armed in the middle behind with a projection, close to which on each side there is a fine spine; the outside of the hind margin has a long conspicuous spine.

This differs from *T. cuspidata* in the male characters and is of larger size.

Falagria myrmecophila, n. sp.

Brunnea, antennis pedibusque testaceis, dense subtiliter punctata, subopaca; antennis crassiusculis; thorace profunde canaliculato, scutello simplice.

Long. 3 millim.

Antennæ stout, fourth to tenth joints transverse. Thorax nearly as long as broad, narrower than the elytra, much narrowed behind, closely and finely punctate, deeply canaliculate from the front to near the base, where the channel expands into a fovea. Elytra a little longer than the thorax, a little narrowed at the shoulders, densely punctate; scutellum densely punctate. Hind body a little narrower towards the base, densely punctate, the basal segments slightly paler than the others.

Kashiwagi, Nara, Sheba, Shimonosuwa, Bukenji, Sapporo.

This is closely allied to *F. thoracica*, but it is rather larger and of a nearly uniform brown colour, the antennæ are considerably thicker, and the punctuation is denser. Like the European species it inhabits the nests of ants in trees.

Falagria sulcata.

Staphylinus sulcatus, Payk. Mon. Staph. Suec. p. 32.

Yokohama and Hakodate.

[To be continued.]

XXXVII.—*Notes on the Palæozoic Bivalved Entomostraca.*—No. XXVI. *On some new Devonian Ostracoda.* By Prof. T. Rupert Jones, F.R.S., F.G.S. *With a Note on their Geological Position*, by the Rev. G. F. Whidborne, M.A., F.G.S.

[Plate XI.]

I.

The new Ostracodous genus herein described is founded on numerous specimens discovered by the Rev. G. F. Whidborne, F.G.S., in a Devonian Limestone at Daddy-Hole Cove, near Torquay, Devonshire.

Kyamodes, gen. nov.

Carapace bivalved, subconvex; dorsal edge straight, ventral boldly rounded; ends rounded and nearly equal; like a short Windsor or broad bean *. The valves have a crumpled appearance at the mid-dorsal region, due to the presence of three unequal tubercles (on each valve) and intervening furrows, close together, and diverging more or less from the middle of the hinge-line towards the depressed area within the marginal rims. The tubercles are hollow inside, and vary somewhat in the two valves and with individuals. The free, curved edges of the valves are thick and generally somewhat raised; and the left valve overlaps the right to some extent ventrally. The hingement appears to be perfectly simple. The surface of the valve is smooth, being destitute of any ornament.

Numerous individuals of this new genus, sometimes with perfect valves closed together, but often imperfect, occur in thin seams of limestone near Torquay, Devon (see Mr. Whidborne's Note at page 298). They constitute a considerable portion of the rock, and become visible, like the other organisms, only by the weathering of the limestone, whereby it loses its blue colour and takes on tints of red and grey.

There are two chief forms of this curious fossil, one semicircular and the other semielliptical in the ventral curve. The latter is a variety, relatively larger and rarer than the ther; it has the three tubercles distinct (almost Beyrichian) n the smaller or younger condition (fig. 8), and less so in he larger individuals (fig. 10). Another variety (fig. 9) has the tubercles still further reduced to two unequal prominences.

1. *Kyamodes Whidbornei*, gen. et sp. nov.
(Pl. XI. figs. 1–7.)

Size	Figs. 1–5:	Long $1\frac{9}{10}$ mm., high $1\frac{1}{2}$ mm., thick 1 mm.
	Fig. 6:	Long $1\frac{1}{2}$ mm., high $1\frac{1}{5}$ mm.
	Fig. 7:	Long 2 mm., high $1\frac{1}{2}$ mm.

Semilunar in outline, being straight on the dorsal edge, and otherwise almost semicircular, except that one end (anterior) has a more rapid curve than the other, the posterodorsal thus becoming sharper than the front angle. The edge view (fig. 4) is narrow-oval, modified ventrally by the thickened edges of the valves, and dorsally showing in its middle divergent furrows and intervening tubercles, somewhat like the undeveloped limbs of some embryo (fig. 5).

* Hence the generic name *Kyamodes*, from *κυαμώδης* (for *κυαμοείδης*), like a bean (*κύαμος*).

The end view is roughly cuneiform, lumpy above, and notched below (fig. 3).

On the right valve (fig. 1) three medial tubercles are defined near the back and close together. One in front is curved; the middle one is low down and weak; and the hinder tubercle rises a little above the dorsal line, and the valve is gently swollen behind it. In the opposite valve (fig. 2) the anterior has coalesced with the middle tubercle, and protrudes beyond the dorsal line, while the hinder tubercle does not rise high up and has a slight subsidiary ridge behind it.

In figs. 6 and 7 the interiors of two left valves show modifications of the hollows which correspond to external elevations.

1*. *Kyamodes Whidbornei*, var. *elliptica*, nov. (Pl. XI. figs. 8 and 10, *a*, *b*.)

Size { Fig. 8: Long $1\frac{1}{5}$ mm., less than $\frac{1}{2}$ mm. high.
Fig. 10: Long $2\frac{1}{4}$ mm., $1\frac{1}{5}$ mm. high.

With greater length, less height, and less convexity, the adult form of this variety differs from the type described above. The tubercles are not so strongly pronounced, the two chief knobs being equal, not very prominent, and more widely separate than in figs. 1 and 2. The middle tubercle is much reduced, though visible on the anterior side of the broad sulcus.

In the smaller (probably younger) form, fig. 8, all three tubercles are prominent, being defined by two intermediate sulci and two curved furrows within and parallel with the raised terminal margins of the valve. A Beyrichian alliance of the genus is indicated by the distinctness of the lobes, the width of the intervening depressions, and the greater relative width of the posterior lobe, with the faint subdivisions of its surface. The essential characters, however, are the same as in fig. 10, and even there they are not specifically distinct from those of the other forms (figs. 1–7) which have departed so far from the Beyrichian type.

1**. *Kyamodes Whidbornei*, var. *obsolescens*, nov. (Pl. XI. fig. 9.)

Size: Long 2 mm., high $1\frac{1}{4}$ mm.

Here the sulcus is not so strong as in either of the other forms; the anterior and middle tubercles are represented only by a local swelling; and the posterior lobe alone remains as an important eminence, with an indefinite swelling behind it. In shape this valve is not so long as fig. 10, and is not so semicircular as figs. 1, 2, 6, and 7.

EXPLANATION OF PLATE XI.

[The figures are magnified 20 diameters.]

Fig. 1. *Kyamodes Whidbornei*, gen. et sp. nov. Carapace; right valve shown, with the edge of the other valve.
Fig. 2. The same. Left valve seen.
Fig. 3. The same. Posterior aspect.
Fig. 4. The same. Ventral aspect.
Fig. 5. The same. Dorsal aspect.
Fig. 6. The same. Interior of a left valve.
Fig. 7. The same. Interior of another left valve.
Fig. 8. *Kyamodes Whidbornei*, var. *elliptica*, nov. Small individual; right valve.
Fig. 9. *Kyamodes Whidbornei*, var. *obsolescens*, nov. Right valve.
Fig. 10. *Kyamodes Whidbornei*, var. *elliptica*, nov. Left valve. *a*, outside; *b*, outline of edge view.

II. *Note on the Geological Position of the Specimens.* By the Rev. G. F. Whidborne, M.A., F.G.S.

In order to define the position of the beds in which the Devonian Ostracoda here described by Professor Rupert Jones occur, it will be necessary to go somewhat into detail.

The cliffs of Meadfoot Bay consist of a mass of shales, surmounted on the east side by the *Pleurodictyum*-beds under Kilmorie and on the west by the mass of limestone which forms the plateau of Daddy-Hole Plain. The latter limestone has been shown by the late Mr. Champernowne * to be much folded and doubled on itself, and its beds are truncated parallel to the general shore-line by a great open fault which is filled in with Triassic Conglomerate, and which has evidently been subjected to subsequent movement, as even quartz-pebbles contained in it have their surfaces levelled and striated.

The western arm of Meadfoot Bay terminates in a sharp crag, cut off from the main mass by this fault, and curiously like the little island a few hundred feet beyond it called the "Shag," which is evidently a continuation of the same bed thrown eastward by a second fault. Between this crag and the main promontory of Daddy-Hole Plain come in order two

* Trans. Devonshire Assoc. &c. vol. vi. 1874, p. 548.

quarries and a cove. The first of these quarries is small, and is worked in dark limestones, dipping south-west, veined with calcite and containing Crinoid stems, *Serpulæ*, and Corals. Its back is formed by the fault, behind which shaly beds are to be seen. Crossing the fault at the western edge of this quarry we enter a second and larger quarry, which has been excavated in grey, thick-bedded, and very lenticular limestones, also dipping south-west. Below these come some alternating beds of thin limestones and shales, overlying the shales mentioned before, and the highest of which forms the north-east slope of the quarry. As the workmen have not troubled to work below this, it is only towards the front of the quarry that the succession of these alternating beds is exposed. Their edges, bent upwards and ultimately crumpled by the great fault before referred to, show nine or ten thin limestone bands, giving altogether a thickness of about 5 feet. It is from the upper surface of one of the most central of these bands that the Ostracods were obtained, and I have not found them in any of the other beds. In this band, however, they occur in crowds, and they are accompanied more rarely by a minute spiral *Vermetus* (?) with lamellar rings, and by a small Brachiopod (*Athyris concentrica*, Buch). Both the interiors and the exteriors of the valves are exposed, and occasionally the two valves occur united, so it would appear that they were living at the time of the deposition of the strata. The succeeding cove is the one described by Mr. Champernowne, in which he found *Calceola* *.

The *Beyrichia* which Professor Rupert Jones will describe in another communication was found by Mr. T. Roberts, Mr. Solly, and other members of Professor T. M'Kenny Hughes's Cambridge party during their visit to Torquay last Easter, in the red beds of the "New Cut" or Lincombe-Hill Drive, from which Mr. Champernowne obtained his *Homalonotus* some years ago †. These beds lie high up on the slope of the Ilsham valley, some hundred yards to the north of Meadfoot Bay. They are considered by Professor Hughes to be the same as, or, more probably, slightly lower than, the *Pleurodictyum*-beds of Kilmorie, and he has obtained *Pleurodictyum* and other fossils from beds in their immediate neighbourhood.

* *Loc. cit.* p. 549.

† See Geol. Mag. 1881, pp. 487–491, pl. xiii., and 1882, pp. 157, 158, pl. iv. fig. 3.

XXXVIII.—*Diagnoses of new Species of* Pleurotomidæ *in the British Museum.* By Edgar A. Smith.

I have already published in these 'Annals'* numerous descriptions of Pleurotomidæ in the collection of the British Museum. Although it is difficult to recognize the species from the diagnoses alone, through having published names attached to them they become scattered abroad in continental and other collections, and by this means become known.

Already several of the species previously described have been correctly identified and figured by other writers; and it is to be hoped that the remainder will sooner or later find their way into illustrated monographs. In this, as in the previous papers, I have adopted the plan of placing all the forms in the comprehensive genus *Pleurotoma*, at the same time giving in brackets the group or section to which they belong or to which they seem most nearly related.

Pleurotoma (*Surcula*) *fuegiensis.*

Testa breviter fusiformis, purpureo-rosea, cauda pallidiore ornata; anfract. 7, primi 2, apicem constituentes, magni, læves, rotundi, cæteri superne læves, leviter concavi, inferne convexiusculi et costis perobliquis ad 12 (in anfr. ultimo medio evanidis) instructi; apertura longit. totius $\frac{2}{5}$ adæquans; labrum tenue, superne ad suturam late profundeque sinuatum; columella in medio leviter arcuata, basi obliqua; canalis brevis, latus, paululum recurvus.
Long. $11\frac{1}{2}$ mill., diam. 4.

Hab. Straits of Magellan (*Dr. Cunningham*).

The apex of this species is large and obtuse. The oblique ribs are thickest at their upper ends, and below the middle of the body-whorl the purple-pink colour is deepened, forming an obscure spiral band.

Pleurotoma (*Drillia*) *unifasciata.*

Testa solida, oblonga, turrita, subrimata, fulvescens, circa anfr. ultimum ad peripheriam zona latiuscula fusca cincta; anfract. 12, convexi, superne paululum concavi, costis crassis rotundatis inferne incrassatis (in anfr. ultimo 7 ad peripheriam obsoletis) instructi, transversim tenuiter lirati; apertura albida, longitudinis totius $\frac{3}{7}$ adæquans; columella valde callosa; canalis latissimus, brevis; sinus latissimus, profundus.
Long. 35 mill., diam. 13.

* Vol. xix. (1877) pp. 488-501; vol. x. (1882) pp. 206-218, 296-306; vol. xiv. (1884) pp. 317-329.

Hab. Ceylon and China Sea.

A species of solid structure, of a palish fulvous colour, with a single brown band around the periphery of the body-whorl.

Pleurotoma (*Drillia*) *crassa.*

Testa crassa, ovato-fusiformis, alba, ad apicem dilute violacea, hic illic (præcipue infra suturam) fusco notata; anfract. 11? (apice abrupto), in medio aliquanto angulati, superne ad suturam oblique breviter lirati vel crenulati, costis medio subacuto angulatis, superne suturas vix attingentibus (in anfr. ultimo ad 12 fere basi continuis) liris elevatis spiralibus (in anfr. superioribus 2–3 in ultimo 15–16 supra costas nodosis) clathrati; apertura alba, longitudinis testæ $\frac{3}{7}$ æquans; columella rectiuscula, callo crasso suturam versus tuberculoso induta; cauda crassa, subrimata; labrum paululum post marginem costa ultima maxima incrassatum; sinus modice profundus; canalis brevissimus, recurvus.
Long. 22 mill., diam. fere 8.

Hab. Bombay.

A species of a solid build, white, with a violet apex and a few brownish spots scattered here and there on the upper halves of the ribs, and dotted with the same colour immediately beneath the suture. It is allied to *P. sacra*, Reeve, but differs from it in having fewer ribs which are angled, and the upper ends of them are not nodose at the suture, and the coloration is different in the two forms.

Pleurotoma (*Drillia*) *roseobasis.*

Testa ovato-fusiformis, spira acuminata, alba ad basim anfract. ultimi roseo tincta; anfract. 10, superne leviter concavi, deinde convexiusculi, costis modice gracilibus, superne versus suturam evanidis (in anfr. ultimo 12 basi continuis) instructi; sulcis spiralibus distantibus (in anfr. superioribus 4, in ultimo circa 13) insculpti; anfr. ultimus latus; apertura supra alba, inferne rosea, longit. totius ad $\frac{3}{7}$ æquans; sinus parvus, minime profundus; canalis brevis, recurvus.
Long. $22\frac{1}{2}$ mill., diam. $8\frac{1}{2}$.

Hab. ——?

The characteristic style of coloration at once indicates this species. The spiral sulcations are situated on the lower half of the whorls, the upper portion having but a few rugose lines of growth upon it.

Pleurotoma (*Drillia*) *ventricosa.*

Testa ovata, superne acuminata, rubro-testacea, albo rubroque minute articulata, spiraliter conferte lineata ; anfract. $10\frac{1}{2}$, primi $2\frac{1}{2}$ vitrei, politi, cæteri superne aliquanto concavi, inferne rotundati, costis obliquis infra excavationem subtruncatis (in anfr. ultimo ad 12 versus basim evanidis) instructi, liris spiralibus confertis minime elevatis incrementique lineis flexuosis concinne ornati ; apertura intus rubro-fusca, longit. totius fere $\frac{1}{2}$ æquans ; columella subrecta, callo tenui superne incrassato labroque juncto induta ; sinus rotundatus ; labrum margine albo crenulato, extra costa maxima validissime incrassatum ; canalis brevis, latus, recurvus.

Long. $27\frac{1}{2}$ mill., diam. $9\frac{1}{2}$.

Hab. Between Percy Island and Queensland, E. Australia (*McGillivray*).

The general tone of this shell is reddish testaceous, slightly washed with white ; one of the white lines a little below the middle of the whorls is more conspicuous than the rest.

Pleurotoma (*Drillia*) *granularis.*

Testa fusiformi-ovata, ochracea, circa medium anfractuum zona alba fasciata ; anfract. 10, superne leviter excavati, longitudinaliter oblique et transversim sulcati, granularum seriebus spiralibus (in anfr. superioribus 4–6, in ultimo circiter 20) ita productis, infra suturam obtuse carinati vel incrassati ; apertura alba, longit. testæ totius $\frac{5}{11}$ adæquans ; columella subrecta, crasse callosa, ad suturam tuberculosa ; sinus latiusculus ; labrum extra incrassatum ; canalis brevis, recurvus.

Long. 22 mill., diam. 7.

Hab. ——?

The longitudinal sulci are about sixteen in number on a whorl, and thus the rows of granules in a longitudinal direction are about the same. The granules are paler than the furrows which produce them.

Pleurotoma (*Drillia*) *rimata.*

Testa livido-carnea, elongata, crassa, aliquanto turrita, distincte rimata ; anfract. 13 convexiusculi, superne leviter concavi, costis obliquis, suturas vix attingentibus medio subangulatis (in anfr. ultimo circiter 11 basi evanidis) instructi, liris spiralibus (in anfr. superioribus 5–6, in ultimo 16–18) cincti ; anfr. ultimus basi minime attenuatus, circa rimam paululum inflatus, pone labrum subaurantio tinctus ; apertura livido-purpurea, longitudinis testæ $\frac{2}{5}$ æquans ; sinus latus, prope suturam situs ; columella valde callosa, obliqua ; canalis brevissimus, recurvus.

Long. 31 mill., diam. 9.

Hab. ——?

The distinct rimation and the livid purplish flesh-colour are the chief characters of the species.

Pleurotoma (*Drillia*) *essingtonensis*.

Testa elongate fusiformi-ovata, rubro-fusca, circa anfractuum medium liris duabus albis cincta; anfract. 10, primi 3 læves, politi, cæteri convexiusculi, superne leviter concavi, ad suturam incrassatione crenulata ornati, costis obliquis (in anfr. ultimo 11 basim versus obsoletis, ultima pone labrum validissima) instructi, liris spiralibus ad 8, circa medium duabus supra costas albis quam cæteris majoribus, cincti, incrementique lineis striati; anfr. ultimus liris circa 25 ornatus, tribus paululum infra medium albis; apertura longit. totius $\frac{9}{20}$ adæquans; columella callosa; sinus mediocris; canalis brevis, recurvus.
Long. 20 mill., diam. 6.

Hab. Port Essington, North Australia.

The spiral lirations are somewhat thickened on the ribs, thus producing a subnodulous appearance.

Pleurotoma (*Drillia*) *parva*.

Testa ovata, fusco-alba, prope suturam fuscescens, circa anfr. ultimi medium supra costas punctorum fuscorum serie unica et zona pallidiore infra illam, ornata; anfract. 6, primi 2 læves, cæteri superne juxta suturam constricti, deinde planiusculi, costis superne nodulosis (in anfr. ultimo 9, ad basim liris spiralibus 4–5 circa caudam interruptis) instructi, incrementi lineis striati; apertura longitudinis totius $\frac{2}{5}$ adæquans; columella callo crassiusculo induta; sinus profundus; labrum tenue.
Long. $7\frac{1}{2}$ mill., diam. 3.

Hab. Gulf of Suez (*MacAndrew*).

The last rib on the body-whorl, which is situated at some distance from the margin of the labrum, is much larger than the others and is stained with brown. The slight constriction a little below the suture gives the ribs a nodulous aspect at their upper ends. A similar appearance exists at the bottom of the ribs on the last whorl, occasioned by a like depression.

Pleurotoma (*Drillia*) *jucunda*.

Testa acute ovata, spira alba, circa medium anfractuum et inferne ad suturam linea fusco-cornea ornata, anfr. ultimi dimidio inferiore lutescente, paululum infra medium serie spirali guttarum albarum cincto; anfract. $7\frac{1}{2}$ convexiusculi, superne leviter constricti, longitudinaliter costati, costis superne attenuantibus (in anfr. ultima 10 aliquanto infra medium evanidis) instructi, spiraliter minutissime incrementique lineis striati; cauda anf. ultimi liris crassis 4 circumdata; apertura long. totius $\frac{8}{17}$ æquans; labrum costa ultima valide incrassatum, superne vix sinuatum; canalis brevissimus.

Long. $8\frac{1}{2}$ mill., diam. $3\frac{1}{2}$.

Hab. ——?

From the middle of the body-whorl upward the shell is white, with the exception of two fine brownish lines, one around the middle of the whorls and the other at the inferior suture.

Pleurotoma (*Drillia*) *consanguinea.*

Testa elongate ovato-fusiformis, dilute fusca; anfract. 11–12 sutura carinata undulata discreti, infra carinam sulco spirali minime profundo leviter constricti, infra sulcum costis subdistantibus leviter obliquis (in anfr. ultimo ad 10 versus peripheriam obsoletis) instructi, ubique striis spiralibus distinctis supra interque costas continuis ornati; anfr. ultimus infra medium vix constrictus; apertura angusta, longitudinis testæ $\frac{2}{5}$ æquans; labrum margine tenui, extra valde incrassatum; sinus magnus, paululum infra suturam situs; columella subrecta, superne tuberculata, callo tenui induta; canalis brevissimus, recurvus.

Long. 20 mill., diam. $6\frac{1}{2}$.

Hab. ——?

There is every probability of this species being an inhabitant of the Chinese seas, since it possesses so much of the general character of several forms from that region. *P. sinensis*, Hinds, appears to be its nearest relative. The general form, and especially that of the body-whorl and the much shorter canal, are the principal marks of distinction; also the ribs are less angular, and the colour is uniform.

Pleurotoma (*Drillia*) *rubro-fusca.*

Testa acuminato-ovata, rubro-fusca, costis, apice et cauda lutescentibus ornata; anfract. 8, convexiusculi, superne ad suturam carina crassissima cincti, deinde costis crassis (in anfr. ultimo 8 versus basim obsoletis) instructi, transversim incrementique lineis striati; apertura rubro-fusca, longit. totius $\frac{1}{3}$ paululo superans; columella callo fusco superne labro juncto induta; canalis brevissimus; sinus aliquanto profundus.

Long. $11\frac{1}{2}$ mill., diam. 4.

Hab. China Sea.

The last rib on the body-whorl is considerably larger than the rest. The keel below the suture is very large.

Pleurotoma (*Drillia*) *bilirata.*

Testa fusiformis, fusca; anfract. 11, primi 2 læves, politi, cæteri convexiusculi, superne inferneque ad suturas carinati (carina superiore maxima) costis rotundatis versus suturas evanidis (in anfr. ultimo 9 ad peripheriam obsoletis) instructi, circa medium liris spiralibus duabus supra costas valde prominentibus et striis tenuibus ornati; anfr. ultimus liris circiter 15 succinctus; apertura purpureo-fusca, long. totius vix $\frac{2}{5}$ æquans; columella subrecta, callo tenui superne cum carina ad suturam tuberculo parvo formante induta; canalis mediocris, vix recurvus; sinus rotundatus, infra carinam situs.
Long. 19 mill., diam. $5\frac{1}{3}$.

Hab. —— ?

The two lirations encircling the middle of the whorls are very prominent on the ribs and almost obsolete in the interstices.

Pleurotoma (*Drillia*) *suavis.*

Testa ovato-fusiformis, lutescens, inter costas rufo tincta; anfract. $7\frac{1}{2}$, primi $2\frac{1}{2}$ læves, convexi, cæteri superne concaviusculi, inferne convexi, costis versus suturam superne evanidis (in anfr. ultimo 12 in medio obsoletis) instructi, liris spiralibus conspicuis 3 (2 circa medium, tertia juxta suturam inferiorem) striisque tenuibus ornati; anfr. ultimus liris circa 14 supra costas subnodosis cinctus; apertura longit. totius $\frac{5}{12}$ adæquans; sinus subprofundus, paululum infra suturam situs; canalis brevis, vix recurvus.
Long. 12 mill., diam. 4.

Hab. Cape Three Points (*Voyage H.M.S. 'Herald'*).

The two apical whorls are large and give the apex a mammillated aspect.

Pleurotoma (*Drillia*) *cretata.*

Testa acuminato-turrita, alba; anfract. 11, superne concavi, inferne convexi, costis obliquis versus suturas evanidis (in anfr. ultimo 12 basi attenuantibus) instructi, striis spiralibus (in anfr. superioribus 5–6, in ultimo circiter 17) insculpti; apertura longitudinis totius $\frac{1}{3}$ adæquans; columella callo crassiusculo ad suturam valde tuberculosa labroque juncto induta; sinus amento similis; canalis brevis, recurvus.
Long. 24 mill., diam. 8.

Hab. Panama (*A. H. Cooke*).

This species differs from *P. pallida*, Sow., in having the upper part of the whorls excavated, in the ribs being almost obsolete above and not ending nodulously, as in that species, and the spiral striæ are finer.

Pleurotoma (Drillia) multicostellata.

Testa elongate ovato-fusiformis, subturrita, alba ; anfract. 11, primi 3 convexi, politi, læves, cæteri planiusculi, superne sutura undulata carinata discreti, infra carinam sulco spirali angusto impressi, infra sulcum costis tenuibus subrectis regularibus (in anfr. ultimo 14–16 inferne subnodulosis fere ad basim continuis) instructi, sulcis spiralibus concinne ornati ; anfract. ultimus infra peripheriam leviter constrictus ; apertura parva, longitudinis totius $\frac{2}{5}$ adæquans ; sinus angustus ; canalis brevissimus.
Long. 18 mill., diam. fere 6.

Hab. Philippines.

This pure white shell is remarkable for the regularity of the ribs, abruptly terminated above by the narrow furrow, which is situated just below the keel at the suture. The transverse sulcations are very regular. Its closest ally is *P. sinensis*, Hinds.

Pleurotoma (Drillia) fijiensis.

Testa fusiformis, alba, superne inferneque ad suturam dilute flavo fasciata ; anfract. 9, primi 2 politi, convexi, læves, pallide rubescentes, cæteri convexi, superne concave excavati, costis obliquis superne attenuatis (in anfr. ultimo 11 basi evanidis) instructi, liris spiralibus 3 supra costas nodulosis in interstitiis obsoletis ornati ; anfr. ultimus liris circiter 15 (quarum modo superiores 3 nodulosæ sunt) cinctus ; apertura longit. totius $\frac{10}{23}$ æquans ; canalis subelongatus, dextrorsum inclinatus, recurvus ; sinus magnus, profundus ; columella leviter tortuosa, callo induta.
Long. $11\frac{1}{2}$ mill., diam. $3\frac{1}{2}$.

Hab. Ovalau, Fiji Islands, 12 fathoms.

The transverse yellow bands are so very pale as to be scarcely visible ; in one example they are quite obsolete.

Pleurotoma (Drillia) dejecta.

Testa fusiformis, alba, circa peripheriam fusco obsolete unizonata ; anfract. 10, primi 2 læves, politi, cæteri supra concaviusculi infra convexi, costis inferne incrassatis (in anfr. ultimo 8 haud basi attingentibus, una validissima aliquanto pone labrum sita) instructi, liris tenuibus spiralibus ad 5 (in anfr. ultimo circiter 15, circa caudam 5–6 quam aliis majoribus) cincti ; apertura longitudinis totius $\frac{4}{13}$ adæquans ; canalis angustus, recurvus ; sinus profundus ; columella subrecta, callosa, superne tuberculata.
Long. 13 mill., diam. $4\frac{1}{2}$.

Hab. Philippine Islands.

The ribs on the body-whorl are terminated inferiorly by the spiral lirations around the cauda, which are rather thicker than those on the rest of the shell.

Pleurotoma (*Drillia*) *semipellucida.*

Testa breviter fusiformis, tenuis, alba; anfract. 10, primi 2 læves, politi, cæteri convexiusculi, costis leviter obliquis, flexuosis instructi (in anfr. penultimo 11, in ultimo 18 basi fere continuis, costis 5–6 ultimis supra tergum anfractus obsoletis), inter costas subdistanter punctato-striati; apertura longit. totius $\frac{8}{21}$ adæquans; columella callo crassiusculo superne incrassato suturæque juncto induta; labrum aliquanto expansum, extra leviter incrassatum; sinus mediocris; canalis angustus, leviter recurvus. Long. $10\frac{1}{2}$ mill., diam. $3\frac{1}{2}$.

Hab. ——?

The whorls are very slightly contracted above. On the back of the body-whorl there is one rib very much larger than the rest, and from it to the labrum is smooth. The punctured striation is very characteristic.

Pleurotoma (*Drillia*) *persica.*

Testa breviter fusiformis, nitens, alba, inter costas dilute fusco tincta; anfract. 8, primi 2 læves (secundo medio angulato), cæteri superne excavati, inferne convexiusculi, sutura undulata sejuncti, costis superne obsoletis (in anfr. ultimo 10 basi attenuantibus) instructi; anfr. ultimus circa caudam liris tenuibus 5–6 ornatus; apertura longit. totius $\frac{7}{18}$ adæquans; columella callo tenui ad suturam incrassato induta; sinus magnus; canalis brevis, recurvus. Long. 9 mill., diam. 3.

Hab. Persian Gulf (*Colonel Pelly*).

This species resembles *D. disjecta* considerably at first sight; however, the larger size and the difference of the ribs, which are not nodulous above, are characters at once distinguishing it. It is somewhat like *D. obliqui-costata*, Reeve, in miniature.

Pleurotoma (*Drillia*) *paucistriata.*

Testa elongata, breviter subulata, alba, inter costas prope suturam et supra tergum anfr. ultimi dilute fusco maculata; anfract. 9, primi 2 læves, cæteri stria spirali paululum infra suturam sita bipartiti, costis superne nodulosis, obliquis instructi (in anfr. penult. 11, in ultimo circiter 5, cæteris obsoletis), striis distantibus 2–3 (in anfr. ultimo ad 9) insculpti; apertura brevis, longit.

totius $\frac{3}{10}$ adæquans; columella callosa, superne tuberculata; labrum extus incrassatum; canalis brevissimus, recurvus.
Long. 10 mill., diam. 3.

Hab. California.

On the back of the body-whorl there is a kind of swollen rib and the spiral striation has a semipunctate appearance.

Pleurotoma (*Drillia*) *disjecta.*

Testa breviter fusiformis, nitens, alba, inter costas dilute fusco tincta; anfract. 8, primi 2 convexi, læves, cæteri convexiusculi, paululum infra suturam undulatam sulco angusto bipartiti, longitudinaliter costati, costis superne supra sulcum nodulosis, inferne crassis (in anfr. ultimo 10 versus basim attenuantibus); anfr. ultimus pone labrum haud costatus circa caudam albam liris ad 6 cinctus, in tergum fuscescenti maculatus; apertura parva, longitudinis totius $\frac{5}{14}$ adæquans; columella callo juxta suturam incrassato labroque juncto induta; sinus magnus, profundus; canalis brevis, fuscescens, recurvus.
Long. $7\frac{1}{2}$ mill., diam. $2\frac{1}{2}$.

Hab. Persian Gulf (*Colonel Pelly*), China Sea, and Ovalau, Fiji.

In one specimen the furrow or depression a little below the suture is well defined, producing an undulating keel above it.

Pleurotoma (*Drillia*) *Cookei.*

Testa fusiformis, nitens, rubescens, circa medium anfractuum obscure pallide zonata; anfract. 7, primus magnus, lævis, cæteri convexiusculi, longitudinaliter costati, costis crassis, flexuosis, in anfr. ultimo 10 versus basim attenuatis sed subito liris gracilibus ad 8 circa caudam abruptis; anfr. ultimus zona secunda pallida infra medium indistincte ornatus; apertura superne ovata, inferne contracta, longit. totius $\frac{5}{13}$ adæquans; sinus magnus, profundiusculus; canalis subelongatus, recurvus, dextrorsum inclinatus; columella callo tenui superne labro juncto induta.
Long. $6\frac{1}{2}$ mill., diam. 2.

Hab. Jamaica.

This little species is unlike any other in the family. I have named it after the Rev. A. H. Cooke, who, besides other valuable work, has done much to clear up the errors which occur in the collection of the late R. MacAndrew, and who kindly presented the six specimens of this species in the Museum.

Pleurotoma (*Crassispira*) *bifurca.*

Testa elongata, pyramidalis, lutescens, inter tuberculas nigro tincta;

anfract. 12, superne juxta suturam carinati, infra carinam concavi et spiraliter exiliter striati, inferne tuberculorum magnorum 10 seriebus instructi, a tuberculis singulis decurrunt costæ duo nodosæ; anfr. ultimus supra costas tenues nodulis flavis 4 (qui series spirales 4 formant) ornatus, striis spiralibus tenuibus incrementique lineis insculptus, longe pone labrum incrassatus; apertura parva, intus fuscescens, longit. totius $\frac{3}{8}$ adæquans; columella callo crassiusculo fuscescenti juxta suturam valde tuberculosa induta; labrum supra nodulas mediocriter sinuatum; canalis brevissimus.

Long. 21 mill., diam. 7.

Hab. ——?

The general colour of this shell is dirty yellowish, the lower half of the upper whorls between the nodules being black, as is also the middle portion of the body-whorl. The four spiral series of little tubercles on the fine ribs of the last whorl are bright yellow. That two riblets bifurcate from each of the large tubercles is very remarkable.

Pleurotoma (Mangilia) fulgens.

Testa ovata, subturrita, nitens, alba, supra costam ultimam anfr. ultimi macula parva, pallide fusca notata; anfractus 6, primi 2 læves, convexi, cæteri paululum minus convexi, aliquanto supra medium obsolete angulati, costis fere rectis 11–12 (in anfr. ultimo fere ad basim continuis, ultima pone labrum quam cæteris valde majore) instructi, et liris spiralibus 3–4 supra costas leviter incrassatis, et supra angulum obsoletum liris aliis duabus tenuioribus cincti; anfr. ultimus liris 16–18, quarum circiter 8 circa caudam quam superioribus confertiores sunt, ornatus; apertura anguste ovata, longit. totius $\frac{1}{2}$ æquans; labrum extra incrassatum, superne satis distincte sinuatum, intus infra sinum unidentatum; columella tenuiter callosa; canalis brevis, angustus.

Long. 5 mill., diam. 2.

Hab. ——?

The pale dot on the last rib is so small and indistinct that it might easily be overlooked. The uppermost of the three or four chief spiral lirations is situated a little above the middle of the whorls, and it is at this point that they appear to be slightly angulated.

Pleurotoma (Mangilia) notabilis.

Testa ovata, turrita, alba, transversim flavescenti fasciata; anfractus 6, supremi duo læves, convexi, cæteri convexiusculi, costis paululum obliquis circiter 11 (in anfr. ultimo basi continuis) instructi, ubique spiraliter conspicue (præcipue inter costas) striati; anfr.

ultimus fasciis quatuor cinctus, quarum una juxta suturam, unaque circa medium versus labrum castaneo tinctæ sunt; apertura angusta, longitudinis totius $\frac{1}{2}$ paulo superans; labrum extus valde incrassatum, superne leviter sed distincte sinuatum; canalis brevissimus, truncatus.

Long. $4\frac{1}{3}$ mill., diam. $1\frac{2}{3}$.

Hab. ——?

The spiral striations are deep and are placed in pairs. The yellowish bands are not very conspicuous, but on the back of the body-whorl one of them at the suture and one in the middle of the labrum become of a deep brown or chestnut colour.

Pleurotoma (*Mangilia*?) *recta.*

Testa ovato-fusiformis, albida, inter costas pallide olivacco tincta, et circa medium anfr. ultimi zona alba angusta ornata; anfract. 7, primi 2 læves, politi, tertius spiraliter minute granulatus, cæteri superne leviter excavati, deinde convexiusculi, costis 8–9 medio exigue angulati (in anfr. ultimo basim versus attenuantibus) instructi, ubique spiraliter tenuissime striati, striis paucis quam cæteris majoribus, et incrementi lineis minute decussati; apertura longit. testæ totius $\frac{9}{19}$ adæquans; columella rectiuscula, callo tenui induta; labrum costa ultima munitum, paululum infra suturam parum sinuatum; canalis subelongatus, latiusculus.

Long. 8 mill., diam. fere 3.

Hab. Persian Gulf (*Colonel Pelly*).

This species is remarkable for the granular aspect of the third whorl. Between the ribs, which are white and scarcely reach to the suture above, it is of a pale olive-brown colour; the cauda also is white, and a narrow white stripe encircles the last whorl, interrupting the olive-brown colour of the interstices.

Pleurotoma (*Mangilia*) *Fordii.*

Testa fusiformi-ovata, alba; anfractus 6, primi duo læves, convexi, politi, cæteri convexiusculi, costis rotundatis circiter 8, superne versus suturam leviter attenuatis (ad basim anfr. ultimi evanidis) instructi, ubique striis confertis minutis quarum 2–3 (et in anfr. ultimo plures) quam cæteris crassiores sunt, spiraliter insculpti; apertura parva, angusta, longitudinis totius $\frac{3}{7}$ adæquans; labrum extra costam ultimam incrassatum, superne leviter sinuatum, intus incrassatum et unidentatum; columella tenuiter callosa; canalis brevissimus.

Long. $4\frac{1}{3}$ mill., diam. $1\frac{1}{2}$.

Hab. ——?

This unpretending little shell has for its chief distinctive characters the rounded ribs and fine spiral striation, and the lip is thickened within at a little distance from the acute margin.

Pleurotoma (Mangilia) parilis.

Testa oblonga, subturrita, alba, inter costas prope sed infra suturam rufo maculata, et supra costas punctorum ruforum seriebus spiralibus 2–3 (in anfr. ultimo 3–4) ornata; anfract. 7, supremi duo læves, convexi, cæteri paululum convexi, inferne leviter angustiores quam supra, costis subobliquis 9–10 (in anfr. ultimo ad basim attingentibus) instructi, ubique tenuissime denseque spiraliter striati; apertura angusta, longit. totius $\frac{1}{2}$ vix æquans; labrum incrassatum, superne semicirculariter sinuatum; canalis brevis, angustus.

Long. $7\frac{1}{2}$ mill., diam. $2\frac{2}{3}$.

Hab. Gulf of California.

This species possesses some affinity with *P. Goodingii*, but the ribs are not regularly continuous, less prominent, and thicker; it is differently coloured, and the form is less acuminated at both ends. Three specimens placed as varieties are a little shorter in the spire and their outer lips are somewhat thicker.

Pleurotoma (Mangilia) lata.

Testa brevis, lata, turrita, alba, supra labrum rufo unimaculata; anfractus 5–6, primi 2 convexi, læves, nitentes, cæteri superne decliviter tabulati, deinde angulati, infra angulum plani, sed versus suturam obliqui, costis 12, subrectis (in anfr. ultimo ad basim continuis) instructi, et liris spiralibus 3–4, suprema circa angulum sita, cæteris infra illum, succincti; anfr. ultimus liris circiter 15 ornatus; apertura longit. totius $\frac{1}{2}$ æquans; labrum incrassatum superne valde sinuatum; columella tenue callosa; canalis brevissimus.

Long. $4\frac{1}{3}$ mill., diam. 2.

Hab. China seas.

The broadest part of the whorls is at the angle, and they are contracted below it. This species is remarkable for its short broad form and its tabulated spire. Faint brown spots are occasionally traceable below the suture between the ribs, and above the angle two or three spiral lirations much finer than those below sometimes occur.

Pleurotoma (*Mangilia*) *decipiens.*

Testa oblongo-ovata, alba; anfractus 7, primi 3 læves, politi, convexi, cæteri leviter convexiusculi, costis 8–9 (in anfr. ultimo fere ad basim continuis) instructi, et spiraliter crebre fortiterque, præcipue inter costas, striati; apertura parva, longit. totius $\frac{1}{2}$ paulo minor; labrum costa ultima incrassatum, superne valde semicirculariter sinuatum; canalis brevissimus, truncatus.
Long. 6 mill., diam. 2.

Hab. ——?

This species has no very marked distinctive character. The spiral striations are generally rather coarse, but some are finer than the others, and the ribs on the body-whorl become more remote from each other as they approach the labrum.

Pleurotoma (*Mangilia*) *Lischkei.*

Testa ovato-fusiformis, turrita, sordide albida, lineis tribus rufis obscuris ornata; anfractus 6, supremi tres perconvexi fere læves, cæteri medio subangulati, costis tenuibus circiter 12 instructi, et lira unica obsoleta circa angulum cincti, ubique spiraliter obsolete striati; anfr. ultimus costis paululum ante basim liris spiraliter 8–10 circa caudam interruptis; apertura longit. totius $\frac{1}{2}$ adæquans; labrum extus incrassatum, superne leviter sinuatum; canalis angustus, brevis.
Long. $6\frac{1}{2}$ mill., diam. $2\frac{1}{2}$.

Hab. Japan.

The third whorl is seen to be finely, longitudinally, arcuately lirated in some specimens, and the spiral striation is very faintly developed. In the specimens before me, which are not in good condition, the spiral reddish lines, of which there appear to be three on the body-whorl, are very indistinct.

Pleurotoma (*Mangilia*) *castellata.*

Testa oblonga, turrita, alba; anfract. 6–7, primi 2 læves, convexi, cæteri tabulati et angulati, ad latera plani, inferne versus suturam angustati, costis pliciformibus tenuibus, valde prominentibus, superne ad suturam subrotunde angulatis (in anfr. penult. 8, in ultimo 7 basi continuis) instructi, ubique dense minuteque spiraliter striati; apertura angusta, longit. totius $\frac{1}{2}$ fere æquans; labrum costa ultima fortiter incrassatum, superne semicirculariter sinuatum; canalis brevis, angustus, truncatus.
Long. $6\frac{1}{2}$ mill., diam. $2\frac{1}{2}$.

Hab. ——?

This is a very elegantly formed shell. The whorls are narrower at the base than above, thus producing the turreted aspect. The plicate ribs are very prominent and the penultimate on the body-whorl is considerably remote from that which forms the labrum. As they are rather produced at the upper end the whorls have a somewhat castellated appearance, and in all the four examples which I have examined they are continuous up the spire.

Pleurotoma (Mangilia) fortistriata.

Testa ovata, albida; anfractus 7, primi 2 læves, politi, cæteri convexi, costis crassis 7 (super spiram plerumque continuis) in anfr. ultimo basi continuis instructi, et striis spiralibus fortibus ubique insculpti; apertura parva, longit. totius $\frac{5}{13}$ adæquans; labrum validissime incrassatum, intus dentibus 4–5 parvis munitum, et paululum infra suturam leviter sinuatum; canalis angustus, brevis.

Long. $6\frac{1}{2}$ mill., diam. $2\frac{1}{2}$.

Hab. Bombay.

This is a strong solid species with seven stout rounded ribs continuous up the spire and extending to the base of the body-whorl.

Pleurotoma (Mangilia) mamillata.

Testa subovata, lutescens; anfractus 5, primi duo magni, læves, convexi, papillosi, cæteri convexi, costis 7–8 supra spiram subcontinuis (in anfr. ultimo ad basim productis) instructi, ubique tenuissime spiraliter striati, et liris spiralibus 2–3 parum prominentibus sed supra costas leviter incrassatis prope medium cincti; anfract. ultimus liris circiter 8 ornatus; apertura longitudinis totius quam $\frac{1}{2}$ paulo minor; labrum valde incrassatum, levissime sinuatum; columella callo tenuissimo induta; canalis brevis, angustus.

Long. $5\frac{1}{3}$ mill., diam. 2.

Hab. ——?

This shell is very remarkable on account of the large size of its nuclear whorls. When more specimens are examined this may prove to be but an individual peculiarity.

Pleurotoma (Mangilia) subquadrata.

Testa ovata, turrita, cornea, superne ad suturas inter costas rufo tincta et circa anfract. ultimum paulo infra medium rufo zonata; anfract. 7, apicales pallidi, cæteri superne decliviter tabulati et angulati, infra angulum planiusculi, costis tenuibus 12–14 et liris spiralibus gracilibus 2–3 (in anfr. ultimo circiter 10) cancellati, et in interstitiis striis spiralibus squamulatis incrementique lineis minute decussati; apertura parva, longit. totius $\frac{6}{13}$ adæquans; labrum pallidum, valde incrassatum, intus superne inferneque tuberculo parvo munitum; sinus levis, subsemicircularis; canalis brevis, angustus, ad basim truncatus.

Long. $5\frac{2}{3}$ mill., diam. $2\frac{1}{3}$.

Hab. St. Helena.

This very pretty little species has very much the form of *P. quadrata*, Reeve, but is very different in sculpture and colour. The three apical whorls, the labrum, and usually the lower extremity of the body-whorl are whiter than the rest of the shell, which is of a pale yellowish horn-colour. The reddish zone encircling the body-whorl a trifle below the middle defines the whitish extremity and extends to the labrum, upon which in fresh specimens it is darker than elsewhere. The minute, microscopic, squamose cancellation which generally is chiefly observable in the interstices between the coarser sculpture is a good distinguishing feature. This is a smaller and stouter species than *P. gemma*, has more sharply angled whorls, rather stronger sculpture, and is different in form, the body-whorl being more contracted and slender below the middle.

Pleurotoma (*Mangilia*?) *granilirata.*

Testa elongato-subpyramidalis, sordide albida; anfract. 7–8, primi duo læves, convexi, cæteri convexiusculi, costis subrectis 8 (in anfr. ultimo fere ad basim continuis) instructi, et liris tenuibus confertis granosis (quarum 2–3 in anfr. superioribus, et circiter 12 in ultimo quam cæteris majores sunt) ubique cincti; apertura parva, pallide fuscescens, longit. totius $\frac{1}{3}$ paulo superans; columella lævis, labrum extra incrassatum, superne leviter sinuatum, intus dentibus parvis 4–5 munitum; canalis angustus, brevis.

Long. $5\frac{2}{3}$ mill., diam. 2.

Hab. ——?

The spiral lirations which cover the entire surface are beautifully minutely granulous. Of the four or five little teeth within the labrum the upper one, which is situated just below the slight sinus, is the largest.

Pleurotoma (*Clathurella*) *scabrata.*

Testa fusiformi-ovata, lutescenti-fusca, circa anfractuum medium lineis lacteis 1–2 cincta; anfract. 9, supremi 2–3 minute oblique reticulati, cæteri mediocriter convexi, costis circiter 16 (in anfr. ultimo fere ad basim continuis) instructi, incrementique lineis

striati, et liris spiralibus tenuibus 6–7 (in anfr. ultimo ad 27) et striis aliis interpositis succincti; apertura fuscescens, longitudinis totius $\frac{1}{2}$ adæquans; labrum leviter incrassatum, superne juxta suturam sinu parvo semicirculari ornatum; columella tortuosa; canalis breviusculus, angustus.
Long. 15 mill., diam. $5\frac{1}{2}$.

Hab. ——?

The few opaque lacteous lines encircling the whorls, chiefly near their middle, are not very distinct. The lines of growth are rather strongly developed, and on crossing the transverse lirations give them a roughened or subgranose appearance. The labrum in the three specimens examined is scarcely perfect, and possibly therefore it may be lirate within.

Pleurotoma (*Clathurella*) *crassilirata.*

Testa oblonga, turrita, alba; anfractus 7, sutura profunda sejuncti, primus lævis, sequentes duo tenuiter arcuate costati, cæteri convexiusculi, costis crassiusculis 9–10 (in anfr. ultimo ad basim continuis) instructi, liris spiralibus 5 (in anfr. ult. circiter 16) super costas incrassatis cincti, et inter liras tenuiter spiraliter striati; apertura angusta, longit. totius $\frac{1}{2}$ adæquans; labrum extus valde incrassatum, intus denticulis 7 armatum, superne leviter sed distincte sinuatum; columella tenuiter callosa, liris transversis 8–9 munita; canalis brevis, truncatus.
Long. $7\frac{1}{3}$ mill., diam. $2\frac{2}{3}$.

Hab. ——?

The lirations on the columella are rather strongly developed. The uppermost spiral lira on the whorls is slender and situated close to the one adjacent below it.

Pleurotoma (*Clathurella*) *pachychila.*

Testa elongato-subovata, alba, nitens; anfract. 7–8? (apice abrupto), reliqui 4 convexiusculi, costis rotundatis circiter 11 (in anfr. ultimo fere ad basim continuis) instructi, et liris spiralibus validis 4–5 (in anfr. ult. ad 12) supra costas leviter incrassatis cincti; apertura ovata, longit. totius $\frac{2}{5}$ adæquans; labrum costa ultima validissima maxime incrassatum, superne levissime sinuatum; columella arcuata, callo tenui induta; canalis perbrevis, angustus.
Long. 4 mill., diam. $1\frac{1}{2}$.

Hab. ——?

This species is remarkable for the immense thickening of the labrum; the liration at the top of the whorls is rather thicker than the rest.

Pleurotoma (*Clathurella*) *munda.*

Testa anguste ovata, alba; anfractus 7, supremi duo læves, cæteri convexiusculi, costis crassis circiter 9 instructi, et liris spiralibus tribus tenuibus sed maxime elevatis cincti, sutura filiformi sejuncti; anfractus ultimus costis paululum ante basim evanidis, et liris 11–12 ornatus; apertura parva, longitudinis totius $\frac{1}{3}$ paulo superans; labrum extus incrassatum, superne levissime sinuatum, intus denticulis 2–3 armatum; columella callo tenui induta, in medio liris duobus transversis munita; canalis angustus, brevis.
Long. $4\frac{1}{2}$ mill., diam. $1\frac{2}{3}$.

Hab. Persian Gulf and China Sea?

This species is especially remarkable for the fine yet very prominent thread-like lirations encircling the whorls. The longitudinal ribs are stout, rounded, and equalling in width the interstices between them.

Pleurotoma (—— ?) *contempta.*

Testa elongata, angusta, subfusiformis, albida, ad apicem fuscescens; anfractus 10, perconvexi, superne juxta suturam sulco angustiusculo sulcati, costis rotundis 9–10 superne ad sulcum terminatis (in anfr. ultimo paululum infra medium evanidis) instructi, transversim confertim lirati, liris circiter 8 inæqualibus supra costas leviter incrassatis; anfr. ultimus infra medium constrictus, in caudam brevem productus; apertura parva, longitudinis totius $\frac{1}{3}$ adæquans; labrum tenue, ad suturam leviter incisum; canalis obliquus, angustus, leviter recurvus.
Long. 9 mill., diam. 3.

Hab. —— ?

The whorls are very convex, and at the upper part close to the suture there is a spiral furrow or concavity striated faintly in a longitudinal direction. The spiral lirations are about twenty-four in number on the body-whorl.

Pleurotoma (*Bela*?) *incondita.*

Testa elongata, ovato-fusiformis, sordide albida; anfract. 6–7, supremi duo læves, magni, cæteri medio convexi, longitudinaliter costati, costis vel plicis circiter 15 parum prominentibus (in anfr. ultimo minus conspicuis et versus medium fere obsoletis) et transversim subdistanter maxime profunde sulcati; apertura elongata, longitudinis totius $\frac{1}{2}$ fere æquans; labrum tenue, prope suturam leviter sinuatum; columella rectiuscula, simplex; canalis brevis, latiusculus.
Long. 11 mill., diam. $3\frac{1}{2}$.

Hab. —— ?

The nuclear whorls in this species are rather large in proportion to the size of the shell. The longitudinal ribs are but slightly developed, and at the first glance the surface appears nearly smooth.

XXXIX.—*On a new Species of* Diphyphyllum, *and on a remarkable Form of the Genus* Lithostrotion. By James Thomson, F.G.S.

The object of the present communication is to describe a new species of the genus *Diphyphyllum*, Lonsdale, and a remarkable form of the genus *Lithostrotion*, Luidius. The discovery of the former is due to His Grace the Duke of Argyll, whose attention was directed to a remarkable boulder that was exhumed by a farmer while digging a drain in the boulder-drift on the farm of Carskey, near the south end of Kintyre, Argyllshire. Notably, amongst other erratics, there are numerous fragments and boulders of granite, traceable to the island of Arran, situated to the east. This boulder, so unlike the others, when more carefully examined, was found to be a mass of Carboniferous coralline limestone. This species of *Diphyphyllum* * was noticed in my paper on that genus published in the 'Quarterly Journal of the Geological Society,' February 1887; it was not, however, included for reasons that will be noted further on.

The species of *Lithostrotion* I discovered at Blackridge, Dumfriesshire, since the publication of my paper on that genus ('Transactions of the Edinburgh Geological Society,' February 1887).

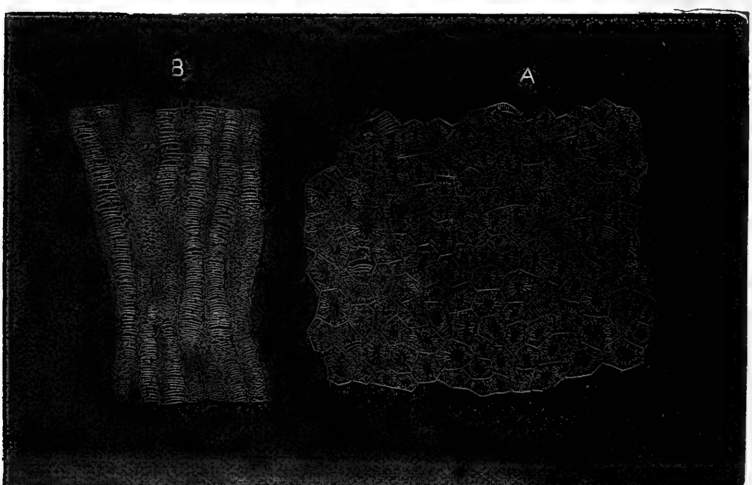
The genus *Diphyphyllum* was defined by Lonsdale in Murchison, Keyserling and de Verneuil's 'Geology of Russia and the Urals' (Appendix, p. 622). Lonsdale's definition was fully reviewed in the above-mentioned communication, and therefore need not be recapitulated. Briefly, he rests his definition of the genus principally upon the mode of reproduction, *i. e.* fissiparity, and the dichotomous branches. In the present species the mode of reproduction is by calicular gemmation, and the corallites are in dense masses and united —characters unlike those of any of the then-known species of the genus; consequently its publication was deferred, and the

* To His Grace I offer my thanks for permitting me to add it to the list of Carboniferous corals.

creation of a new genus for its reception was suggested. This, however, seems to be unnecessary. Subsequent investigations have revealed that reproduction in this and the accompanying genus *Lithostrotion*, Luidius, may be either by calicular gemmation or by fissiparity. Indeed, I hope by-and-by to demonstrate that we cannot restrict generic identity, not only in this but also in several other genera, by the mode of development. While the union of the corallites and consequent prismatic aspect is new to the genus, yet we cannot overlook the fact that our knowledge of the Carboniferous fauna is fragmentary and imperfect; but when more complete other forms will no doubt be discovered showing even a closer relation to its nearest ally *Lithostrotion*. A similar objection to the union of the cylindrical and prismatic varieties in the genus *Lithostrotion* was long accepted; but the generalization of those great masters Milne-Edwards and Jules Haime showed that external aspects so dissimilar were not incompatible with generic identity, and that we can define genera only from the internal structural characters—a decision which, from the enormous amount of evidence in my hands, I cordially endorse. All the other structural details being similar to those characteristic of the other species of the genus, we are justified in believing that the creation of a new genus on the union of the corallites would be adding an unwarranted synonym to the list of Carboniferous corals.

Diphyphyllum Argyllii, sp. nov.

Fig. 1.

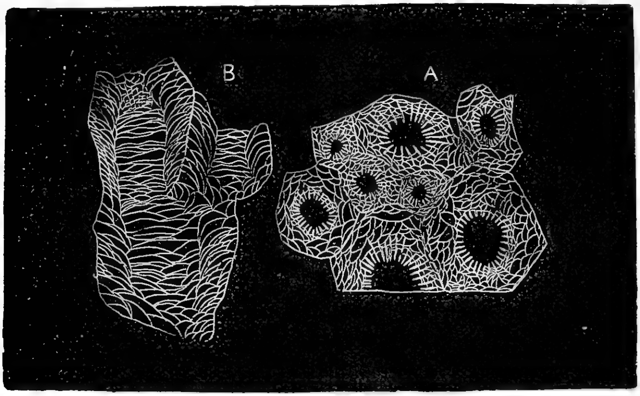


The corallum is in dense masses, prismatic from mutual pressure, and closely aggregated, with corallites of various sizes. Diameter of corallites from 3 to 5 millim. (fig. 1, A). Epitheca delicate; the calice is moderately deep, and the floor is occupied by broad flat tabulæ. The septa are of two orders, and their inner ends rest upon the superior face of the tabulæ. In a corallite 5 millim. in diameter there are thirteen primary septa, converging inwards for 1½ millim., and these alternate with an equal number of secondary septa, which extend inwards fully half the length of the primary, and they are united by endothecal dissepiments. The septa are bilaminate, and there are minute interlamellar plates ("stereoplasm") inclining inwards and downwards. A fossula is indicated. In the longitudinal section (fig. 1, B) the tabulæ are numerous and broad; they occupy two thirds of the total diameter of the corallum, and are sometimes bent upwards in the centre, as in those species in which development is by fissiparity. Vesicular structure is present near the wall, in the interseptal loculi. Acicular plates are rare.

Locality. Found at Carskey, south end of Kintyre, Argyllshire, in boulder-drift, associated with boulders of Arran granite.

As regards the affinities of the genus *Diphyphyllum* as defined by Lonsdale, it presents characters of a distinct and fundamental nature, and is surrounded by genera which possess structural details and external resemblances which are combined and represented in it. In the type, *D. concinnum*, Lonsd., there is no columella; there are, however, occasional acicular plates, which here and there bisect the tabulæ. If such corallites were sectioned transversely, the plane of those acicular points would induce such to be regarded as belonging to the genus *Lithostrotion*, Luid., and in this respect this species indicates a transitionary tendency and near relationship to the latter genus. There is another interesting character in *D. Argyllii*. In all the other species of the genus the septa extend inwards from the wall more or less into the centre of the corallum; there is, however, in some of the corallites of *D. Argyllii* a departure from that condition, as the septa are interrupted by vesicular tissue, and therefore do not reach the wall, in this respect indicating a transitional tendency in an opposite direction, and towards the genus *Thysanophyllum*, Thoms. & Nich. (fig. 2): in the latter the septa are intercepted and never reach the wall; in other respects the structural details are similar to those of the genus *Diphyphyllum*. The question presents itself, How are we to consider these modifications?—whether they are of sufficient value to warrant this species being raised to the rank of a separate genus, or whether we should regard such modifi-

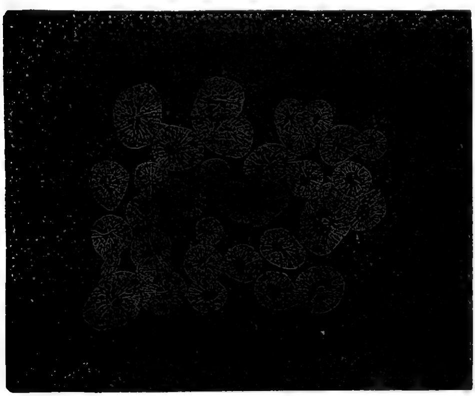
Fig. 2.—*Thysanophyllum orientale.*



cations as simply indicating an evolutionary tendency. With the latter view I cordially sympathize, and, as formerly stated, I hope at no distant date to show that other species occur in which there are structural characters equally distinct and differing as widely from the parent type, but which I do not feel warranted in raising to generic distinction.

Lithostrotion paradoxicum, sp. nov.

Fig. 3.



Corallum compound, cylindrical, and dichotomous. Development by fission and latero-calicular gemmation; the latter in the proportion of one to ten of the former. The epitheca is thin, and there are delicate encircling lines and shallow annulations of growth. The calice is moderately deep and its centre is occupied by a styliform columella in some corallites; in others a portion of the septa coalesce and extend inwards to the centre; there they unite with septa similarly arranged from the opposite side, and form a pseudo-columella, which is alone developed between each of the tabulæ, whilst in several of the corallites the columella is cylindrical. The septa are bilaminate and of two orders; the primary are variable in their inward extension, the secondary extend inwards half the length of the primary, and they are united by rectangular interseptal dissepiments. The corallites are unequal in diameter and the septa are variable in number. In a corallite 5 millim. in diameter there are nineteen primary alternating with an equal number of secondary septa. The tabulæ are slightly inclined upwards and occupy about half the total diameter of the corallum. A fossula is present, but is hardly recognizable.

Formation. Lower Carboniferous.

Locality. Blackridge, Dumfriesshire.

As regards the structural characters of the genus *Lithostrotion*, these are so varied and the vicissitudes which it has undergone are so numerous that it is desirable I should briefly refer to a few of the characteristics upon which generic identity is established. The name *Lithostrotion* was originally given by Luidius, 'Ichnographia' (1760), to a group of corallites figured on plate 23 of his work, and designated "*Lithostrotion* sive Basaltes minimus striatus et stellatus." There is, however, nothing to indicate its identity further than the excellent delineation of the external aspect.

In 1827 Dr. Fleming, in his 'History of British Animals,' adopted the generic name for three species of Carboniferous corals; as I have elsewhere shown *, two of his species cannot be identified as belonging to the genus. His *Lithostrotion floriforme* has been correctly referred to M'Coy's genus *Lonsdalia*.

Lithostrotion marginatum is not now in the collection; a reference to his description induces me to regard the two fragments referred to as belonging to the genus *Heterophyllum*, M'Coy. *Lithostrotion striatum* is still in the collection, and referred to by M.-Edwards and J. Haime as belonging to the same genus as Luidius's coral.

* 'Transactions of Edinburgh Geological Society,' 1887.

In 1836 Prof. Phillips, in his 'Geology of Yorkshire' (vol. ii. p. 2), noticed several species of corals. *Cyathophyllum basaltiforme*, which M.-Edwards and J. Haime subsequently relegated to the genus *Lithostrotion*, and the fasciculate species are referred to the genus *Lithodendron*.

Mr. Lonsdale in 1845 applied the name of *Lithostrotion* to four species; a reference to his figures and descriptions leaves no doubt that they belong to the genus *Lonsdalia*, M'Coy.

In 1849 M'Coy (Ann. & Mag. Nat. Hist. ser. 2, vol. ii.) described various corals and created several genera for their reception, but which cannot be separated from *Lithostrotion*.

In 1852 M.-Edwards and J. Haime still further expanded their definition of *Lithostrotion*, to which they then referred the genus *Stylaxis*, M'Coy (Brit. Foss. Corals, p. 191), and at the same time founded the genus *Petalaxis* for the corals which they had formerly described under the names of *Stylaxis M'Coyanum* and *S. Portlockii*.

In 1861 De Fromentel ('Polypiers Fossiles') restricted the name of *Lithostrotion* to those species of the genus which have an astræiform corallum, whilst he placed the fasciculate varieties under the genus *Diphyphyllum*, and further separated some of the astræiform species of *Lithostrotion*, together with the two species of *Petalaxis*, Edwards and Haime, and placed them under the revived genus *Stylaxis*, M'Coy, upon the mistaken ground that the septa are not continued into the external vesicular area, a condition which I have elsewhere suggested was probably due to the endemic tendency to variation *.

In 1872 Prof. de Koninck (Anim. Foss. Nouv. Rech. p. 26) defined the genus *Lithostrotion* in all the external points as done by Edwards and Haime. He correctly shows, however, that *Diphyphyllum*, Lonsdale, is to be separated from *Lithostrotion*.

The great diversity of generic names that have been applied to this group of corals, in which specific distinction is even sometimes difficult to define, is highly suggestive, inducing us to realize that the genus includes a series of varieties of an extremely varied character. Many of them are so dissimilar in their external aspects, and in their structural details approach so closely their nearest allies, that it becomes difficult to define the boundary of specific distinction. Some of the structural characters upon which specific identity has been accepted for several of the species are represented in different corallites in this little group at present under con-

* 'Transactions Phil. Soc. of Glasgow,' 1883, p. 404.

sideration. There are those in which the typical styliform columella is present; others in which the septa stop short and expose a broad tabulate area in the centre; in others the septa extend inwards along the superior face of the tabulæ, a portion of the septa coalesce and assume a more or less fasciculate aspect, and the central septum of each fascicle extends to the centre and unites with similarly arranged septa from the opposite side of the corallum to form a pseudo-columella, similar to the septal arrangement of *Lithostrotion junceum*, Ure. If the section exposed is on the plane of the tabulæ, the columella is not observable, demonstrating that the septa and columella are developed between the tabulæ in this variety. In some of the corallites on the same slab the columella is tubular, somewhat similar to the tubular columella which characterizes some of the species of the genus *Cyathaxonia*. Thus we have three distinct characteristics exemplified in the structural details of the central area in this group of corallites, each of which, if sectioned singly, would demonstrate structural characters which have been regarded as having specific distinction. In the type of the genus the compound corallum, the styliform columella, the tabulæ forming the floor in the central area, and the sparse vesicular tissue in the outer area are the distinguishing characteristics by which the genus can at all times be recognized.

In some of the corallites development is by fission, whilst in others it is by calicular gemmation, demonstrating that it is not only difficult to define specific distinction, but that we are not in a position to dogmatize as to specific identity, unless all the varieties can be examined and compared.

XL.—*Descriptions of new Species of Oriental* Cicadidæ. By W. L. Distant.

All the species here described will be figured in my monograph of Oriental Cicadidæ.

Tosena depicta, n. sp.

Head and thorax above black; head with a spot at apex of front and a spot at each anterior angle of vertex, two central spots on anterior margin of pronotum, the posterior margin of pronotum, four spots in transverse series on mesonotum, and the posterior margin of mesonotum ochraceous; the centre of basal cruciform elevation black. Abdomen above reddish ochraceous, with a central, longitudinal, narrow, dorsal, fuscous fascia. Head beneath, sternum, a lateral fascia to opercula, and legs black; a spot at apex and one on each side of apex of face; coxæ, apices of femora and tibiæ, tarsi (excluding base), rostrum (excluding apex) ochraceous. Body beneath ochraceous, the basal segment blackish.

Tegmina dark olivaceous, the costal membrane and the venation reddish ochraceous, with a transverse and slightly oblique greyish-white fascia near centre, not extending above the base of the second ulnar area; posterior basal margin narrowly reddish ochraceous. Wings black, the basal area reddish ochraceous, with its posterior margin black.

The rostrum reaches the apex of the basal abdominal segment and the tegmina have their apices considerably attenuated.

Long. excl. tegm. 36 millim., exp. tegm. 90 millim.

Hab. Borneo.

The smallest species of *Tosena* hitherto described.

Cosmopsaltria albostriata, n. sp.

♂. Head and thorax above ochraceous; head with the anterior margin of front, the area of the ocelli, a small central spot on anterior and posterior margins of pronotum, and a small spot behind each eye black; mesonotum with two obconical linear basal spots, which have a broken linear fascia on each side, and a spot near apex of each anterior angle of the basal cruciform elevation black. Abdomen above pale castaneous, with the posterior segmental margins ochraceous, and with two dorsal sublateral white fasciæ extending from base to about two thirds of the abdominal length. Body beneath and legs ochraceous. Tegmina and wings pale hyaline, the venation ochraceous inclining to fuscous; tegmina with the costal membrane ochraceous and the transverse veins at the bases of the second and third apical areas very narrowly infuscated.

The opercula are short and somewhat broad, concave a little beyond base, their apices broadly rounded and about reaching the apex of the second abdominal segment.

Long. excl. tegm., ♂ 30 millim., exp. tegm. 80 millim.

Hab. Philippine Islands.

This species has the elongated and posteriorly attenuated abdomen so strongly represented in some of the Polynesian and Australian species of the genus, such as *C. distans*, Walk., and *C. Stuarti*, Dist.

Cryptotympana epithesia, n. sp.

Allied to *C. diomedea*, Walk., from which it differs by its smaller size and more hyaline tegmina and wings, but principally by the totally different structure of the opercula, which in the male of *C. epithesia* are narrowed posteriorly and are obliquely wide apart at apices, which about reach the penultimate segment of the abdomen.

Long. excl. tegm., ♂ 44 millim., exp. tegm. 134 millim.

Hab. Borneo.

Prasia princeps, n. sp.

♀. Pale olivaceous green. Head with the apex of the front and the eyes infuscated; ocelli and lateral margins of pronotum more or less ochraceous; anterior tibiæ and tarsi brownish.

Tegmina very pale ochraceous or olivaceous and subhyaline; the costal membrane and the venation ochraceous. Wings pale hyaline.

Allied to *P. faticina*, Stål, but differs by its much greater size and distinct coloration, and also by the different arrangement of the venation in the tegmina.

Long. excl. tegm., ♀ 28 millim., exp. tegm. 90 millim.

Hab. North-eastern Celebes.

Tibicen tigrinus, n. sp.

Ochraceous; a transverse fascia between the eyes, a broad marginal fascia to pro- and mesonotum, a spot on each side of basal cruciform elevation, and two longitudinal dorsal fasciæ on abdomen dark castaneous or blackish. Tegmina and wings pale hyaline, the first with the costal membrane and basal area of venation ochraceous, remaining venation and an apical spot fuscous; wings with the venation fuscous. Body beneath and legs ochraceous; apex of abdomen spotted with black.

The rostrum just passes the intermediate coxæ; the anterior femora are armed beneath with four spines—two central long and prominent, one short and obscure near base, and one short placed just in front of the apical longest spine.

Long. excl. tegm., ♂ 13 millim., exp. tegm. 31 millim.

Hab. Kulluur. Calc. Mus.

XLI.—*On a new Species of* Loncheres *from British Guiana.* By Oldfield Thomas.

I am indebted to my friend and former colleague Mr. J. J. Quelch, Director of the British-Guiana Museum, Demerara, for the opportunity of examining a small collection of Mammalia from that country, and among them I find two specimens of the following new species of spiny rat.

Loncheres guianæ, sp. n.

Fur thickly spinous, the hairs between the spines scarcely perceptible. Muzzle rich rufous; crown of the head, fore back, flanks, and outer sides of limbs coarsely grizzled black and pale yellow, both hairs and spines slaty grey for four fifths their length, the former with a subterminal band of pale yellow, the latter black-tipped. Spines on posterior back with a narrow orange tip, which gradually broadens and deepens in colour until the rump is a bright rufous. Whiskers long and numerous, black. Chin, chest, belly, and inner sides of limbs pale buff, the line of demarcation from the colour of the sides fairly well defined. Tail murine in character, thinly haired and scaly throughout, the scales large, averaging about eight or nine to the centimetre; the thinly scattered hairs brown above, yellowish beneath.

Measurements of an adult skin:—

Head and body (c.) 190 millim.; tail 167; hind foot 36·2; ear (contracted) 5·5.

Skull, basal length (c.) 47, greatest breadth 26; nasals, length 15·5, interorbital breadth 13; diastema 11·8; length of upper molar series 11·2.

This species is readily distinguishable by its peculiar coloration from all the known species of *Loncheres* with one exception. This is "*Isothrix*" *pagurus*, Wagn.*, from Borba, Brazil, which has much the same coloration, but differs from *L. guianæ* by having wholly soft fur. That this absence of spines in *L. pagurus* is not due to youth is shown not only by the fact that the type specimen is slightly larger than that of *L. guianæ*, but also by the marked spininess of Mr. Quelch's second specimen, which is only about two-thirds grown. Nor is the difference a seasonal one, since the type of *L. pagurus* was captured in July and the smaller Demeraran specimen in June. The larger specimen is unfortunately not dated.

* Arch. f. Nat. 1845, p. 146; Abh. Ak. Münch v. p. 288 (1847).

XLII.—*Objections to the Genera* Pseudopygaulus, *Coquand,* Trachyaster, *Pomel, and* Ditremaster, *Munier-Chalmas: their Species restored to* Eolampas, *Dunc. & Sladen, and* Hemiaster, *Desor.* By Prof. P. MARTIN DUNCAN, F.R.S., and W. PERCY SLADEN, F.G.S., Sec. Linn. Soc.

CONTENTS.

WE regret that we cannot agree to some alterations in the classification of the Echinoidea which have lately been made by our much respected friend and fellow-worker in the group, M. Cotteau.

M. Cotteau, without giving us the opportunity of debating the subject, has altered the generic position of some of the species of Echinoidea which we described in the 'Palæontologia Indica,' ser. xiv., Foss. Ech. of W. Sind and of Kach and Kattywar, 1882–85, has placed our names after the species in brackets, has introduced his own without that objectionable enclosure, and has published the alterations in the Pal. Franç. Éch. terr. Éocène, 1887.

I.

One of the most important of the alterations has been made in consequence of a misinterpretation of the law of priority of description and publication on the part of M. Cotteau, who, in his evident desire to do what he thought correct, has done us a wrong.

During the study of the Echinoidea of W. Sind we found some very remarkable species, which could not be placed in any genus which had been published up to that date, and the genus *Eolampas* was founded and published to receive them. A typical species was described and figured, besides others, and the work including them was published in 1882 and circulated widely (Pal. Ind. ser. xiv., Foss. Ech. W. Sind, p. 61).

In 1884 a genus *Petalaster* was diagnosed and published by M. Cotteau, with a typical species, in "Éch. nouv. ou peu connus," Bull. Soc. Zool. France, 1884, fasc. 3, p. 39. In the author's remarks upon the genus it is evident that, although *Eolampas* covered the same ground, he was not aware of it.

In 1885 (Éch. Foss. de l'Algér. fasc. 9, p. 69) MM. Cotteau, Peron, and Gauthier admitted a genus *Pseudopygaulus*, Coquand, 1862, Mém. de la Soc. Emul. de la Prov. v. ii. Atlas, pl. xxxi. figs. 14–16, 1862, and *Petalaster*, Cotteau, 1884, was placed as a synonym. As we were aware by that time that *Petalaster* was a synonym of our *Eolampas*, although the fact had not become patent to the authors of the Algerian work, we naturally were anxious to know why *Petalaster* had been sacrificed, and especially as our researches had failed to find a definition of *Pseudopygaulus* anywhere. In the notice of the history of the genus *Pseudopygaulus* given by MM. Cotteau, Peron, and Gauthier (*op. cit.* p. 70) it turns out that up to the date of the publication of their work in 1885 there was no definition of the genus published! It is carefully stated that M. Coquand described the only species under the name *Catopygus Trigeri* (Coquand, *loc. cit.* p. 274). After the printing of the work was finished M. Coquand became aware that the species could not be placed in *Catopygus*, "et il se contenta, dans l'Atlas, à la légende de la planche, d'indiquer le nom générique de *Pseudopygaulus*. Il n'en a donné aucune diagnose, et n'a pas même consigné le fait dans un erratum." Although it was admitted that no diagnosis had been published and only the name had been appended to the plate of a species, the authors of the 'Éch. Foss. de l'Algérie' thought it their duty to respect "ce titre de priorité."

In the Pal. Franç. Éch. terr. Éocène, 1887, p. 467 (livr. 12) the following is found:—

> *Pseudopygaulus*, Coquand, 1862; Peron et Gauthier, 1885.
> *Eolampas*, Duncan & Sladen, 1882.
> *Petalaster*, Cott., 1884.

And M. Cotteau considers that *Eolampas* "doit être abandonné, comme le genre *Petalaster*, à cause de sa date plus récente." We demur to this proceeding, and decline most decidedly to give way. There is no instance on record where a "genus" has stood its ground without having been diagnosed and published; and it is a rule not to permit either species or genera to be considered of any value unless publication has occurred. MS. names and titles to species and genera do not carry weight or priority.

M. Coquand did not publish or diagnose *Pseudopygaulus* in 1862, and the genus was really published in 1885 in the work of MM. Cotteau, Peron, and Gauthier, and therefore it ought to be abandoned together with *Petalaster*, because they have dates later than *Eolampas*.

EOLAMPAS, Duncan & Sladen (*op. cit.* p. 61), 1882.

Syn. *Petalaster*, Cotteau, 1884.
Pseudopygaulus, named by Coquand in 'Atlas,' 1862, published Cott., Peron, et Gauthier, 1885.

The species we published will therefore remain as we printed them, without our names in brackets and without the addition of the honoured name of M. Cotteau, who had nothing whatever to do with their description. The other species will be named *Eolampas Toucasi*, Cott. sp., *E. Trigeri*, Coquand sp., *E. buccalis*, Peron et Gauthier sp., and *E. Gauthieri*, Cott. sp. The terms *Pseudopygaulus* and *Petalaster* are of necessity extinct.

II.

M. Cotteau has changed the generic position of *Hemiaster Branderianus*, Forbes, *H. princeps*, Bittner, *H. Archiaci*, de Loriol, and *H. decipiens*, *H. apicalis*, *H. nobilis*, and *H. carinatus*, Duncan & Sladen, from Sind. All these species now stand in the genus *Trachyaster*, Pomel, and the names of the original describers are placed in brackets and the name of M. Cotteau follows. Two other species are also noticed. In the Pal. Franç. Éch. 1887, p. 400, it will be found that the following is the synonymy given :—

TRACHYASTER, Pomel, 1883.

Syn. *Hemiaster*, pars, Desor, 1847, 1858.
Periaster, pars, Desor, 1858.

M. Cotteau gives no other references, but remarks that *Trachyaster* is distinguished from *Hemiaster* of the Cretaceous epoch by the madreporite separating the posterior genital plates and the posterior ocular plates, and that it has four genital pores.

In the "Note sur la famille des Brissidées," Bull. de la Soc. Zool. de France, 1887, vol. xii. p. 561, M. Cotteau gives a short diagnosis of *Trachyaster*, but he does not mention as a type any one of the species noticed by M. Pomel in the work where the genus was first diagnosed. We are not informed how *Periaster*, Desor, is connected with *Trachyaster*;

but the connexion of this genus with *Hemiaster*, Desor, is impressed upon the reader.

Inasmuch as *Trachyaster* is a genus which was not foreseen by Forbes, Bittner, de Loriol, and Desor, which is said to be allied to *Hemiaster* and *Periaster*, while part of it forms a genus *Ditremaster*, and considering that not one species of it properly bears the name of M. Pomel after it, and that we are not informed concerning the typical species of the genus according to M. Pomel, the whole history of the genus requires, in our opinion, very decided criticism.

The genus will be found in Pomel, 'Thèses présentées à la faculté des Sciences de Paris,' 1883 (published at Algiers), p. 38. The first thing which strikes the student of this work is that *Trachyaster* is placed just before *Abatus*, Lovén, and *Palæostoma*, Lovén, and that it follows a new genus *Opissaster*, Pomel, which has two genital pores. Preceding the genus are *Moira*, *Schizaster*, &c., but there is no sign of *Hemiaster*, Desor. After the "Brissiens," which contain these genera, come the "Philobathidés," with *Aceste*; then come the Pourtalesiadæ, and then the "Progonastérides," and in a division of these—the "Pycnastérides"—we find *Pericosmus*, *Periaster*, a genus *Mecaster*, Pomel, and then *Hemiaster*. These Progonastérides form a subfamily differing from that in which *Trachyaster* occurs. It is clear, then, that according to M. Pomel there is a greater classificatory gap between that genus and *Hemiaster* than M. Cotteau supposes. On examining the diagnosis of *Trachyaster* and on comparing it with that of *Mecaster*, Pomel (*op. cit.* p. 42), their superfluity is evident.

The diagnosis is as follows:—"*Trachyaster*, Pomel. Globular, with the apex excentric behind; four pores (genital). Anterior ambulacrum simple, in a shallow groove, lost in front, and notching or not the test at the ambitus; petals depressed, unequal, oval or oblong, the anterior sometimes slightly flexuous at the summit. Peripetalous fasciole angular; peristome labiate, not very close to the margin. Periproct at the top of the posterior part, above a more or less marked depression. Tubercles close."

A very important statement is then made:—"The type is a fossil of the Upper Miocene [no name is given]; it is necessary to unite with this the greater part of the Tertiary *Hemiasters*, such as *H. nux*, *H. digonus*, *H. rotundus*, &c., which have the madreporite prolonged between the posterior ocular plates, and, probably, *H. gibbosus* and *H. zonatus* of the recent fauna."

We remark:—1. That a genus without a described type species is good for nothing, and there is no type species to this one. 2. That the species mentioned as types do *not present* the generic characters of *Trachyaster*. *Hemiaster nux* has not four genital pores with the posterior basals separated by the madreporite; it has only two. It belongs, according to the method of M. Pomel, to the genus *Opissaster*, Pomel (*op. cit.* p. 37), and its synonym, *Ditremaster*, Munier-Chalmas, of which we shall write presently. *Hemiaster digonus* is well known to us, as it is a common species in Sind, and it has not four genital pores, so as to be a *Trachyaster*. The madreporite, moreover, does not always project between the ocular plates. Extraordinary as are these mistakes, those which follow are still more so, and simple want of observation will hardly explain the assertion that the madreporite is probably prolonged between the posterior ocular plates in *H. gibbosus* and *H. zonatus*. (M. Pomel forgets to place the name of A. Agassiz after these species.)

It is a positive fact that in *Hemiaster gibbosus*, A. Agassiz, the madreporite is restricted to the right anterior genital plate, and that it in no way passes between the posterior genital plates. It is a perfectly Ethmophract *Hemiaster*. The drawing of the apical system in the Report on the 'Challenger' Echini, pl. xx. *a* fig. 11, sets this matter beyond dispute. *Hemiaster zonatus*, A. Agassiz, is also drawn upon plate xx. *a* of the 'Challenger' Report, and there is absolutely no warrant for M. Pomel's doubt as to the nature of the apical system; the specimens are figured covered with their spines, and it is only the distinguished naturalist who has remarked upon the species that is in a position to know anything about it. But A. Agassiz remarks that the species only differs from *H. expergitus*, Lovén, in characters which are to be referred to age, and Lovén's species has most definitely the madreporite restricted as in *H. gibbosus*. A. Agassiz compares *H. zonatus* with *H. gibbosus*, and says nothing about an unusual extension of the madreporite.

It is indeed to be regretted that M. Pomel did not study the variations in the numbers of genital pores and the variable extension of the madreporite in individuals of some common recent species of Echinoidea. Had he done this he would have seen that no satisfactory generic characters are to be obtained from the number of pores and the size of the madreporite, all other structural characters being the same.

Neither M. Cotteau, M. Pomel, nor M. Munier-Chalmas, whose work we have to criticize shortly, appear to have studied the admirable work of Lovén, in his 'Etudes' and in his 'Pourtalesia' (Kongl. Svenska Vet.-Akad. Handl. Bd. x.

no. 7, 1883), regarding the variations in the apical system of Echinoidea, so we give a few extracts which may be readily verified.

The delineations are wonderfully correct and artistic in Lovén's 'Pourtalesia,' 1883, pl. xviii. Take first of all a specimen of *Spatangus purpureus* as large as many fossil *Hemiasters*, 16 : 15 millim., it has no genital pores; a slightly smaller one, 15 : 14 millim., has two genital pores and a madreporite; a specimen 24 : 21 millim. has only two genital pores; and one slightly smaller has one pore only and the madreporite has openings in the posterior basal (genital) plates besides along its course which separates the basals and posterior ocular (radial) plates. A specimen 23 : 22 millim. has four genital pores and the madreporite even extends into the posterior interradium. In *Brissopsis lyrifera* (Lovén, pl. xix.) a specimen 15 : 12 has two genital pores, but both are in the plates of the left side; a specimen 15 : 13 millim. has but one genital pore and that in the left posterior basal; a specimen 16 : 13 millim. has four genital pores, and one 42 : 28 millim. has only three genital openings, and there are isolated madreporic pores in the posterior interradium.

One of our species, *H. decipiens*, which we described in 1883 in the Ech. from Kach and Kattywar, Pal. Ind. ser. xiv. p. 34 (we give the reference because it was omitted by M. Cotteau), is now determined by M. Cotteau to be a *Trachyaster*, although he admits that the apical system is not visible! It so closely resembles *Linthia* in shape that we called it "*decipiens*;" but there is no lateral fasciole. The Trachyasterian characters are absolutely absent. We must confess that all this lax taxonomy does not appear scientific; but before leaving this part of the subject it is necessary to examine *Mecaster*, Pomel (*op. cit.* p. 42).

This genus is placed by M. Pomel immediately before *Hemiaster*, Desor, and in a different subfamily from *Trachyaster*, the sole difference between these so-called genera being that in *Mecaster* the madreporite separates the posterior ocular plates as well as the posterior genital plates!

It appears from M. Cotteau's article in the Pal. Franç. Éch. 1887, that he was aware of M. Gauthier's excellent article upon the impropriety of forming genera upon the position of the madreporite (Assoc. Franç. 1886, published 1887, p. 406) before altering the *Hemiasters* into *Trachyasters*. M. Gauthier's reasoning is incontrovertible as regards the genus *Hemiaster*, and he showed and delineated specimens of the same species in which the position of the madreporite was exceedingly variable. Yet this cogent reasoning is passed by.

We do not consider either *Trachyaster* or *Mecaster* in the light of genera or subgenera, and as we have noticed the errors associated with the first-named we place it out of the zoological pale. The whole of the species associated by M. Cotteau with *Trachyaster* must return into the genus *Hemiaster*, and therefore *Hemiaster decipiens*, Dunc. & Slad., *H. apicalis*, Dunc. & Slad., *H. nobilis*, Dunc. & Slad., and *H. carinatus*, Dunc. & Slad., 1884, *op. cit.* p. 198, are the correct generic and specific names.

III.

A considerable number of species of *Hemiaster* which were described by de Loriol, E. Forbes, Taramelli, Talavigne, Bouvé, Desor, and ourselves have been relegated to a genus *Ditremaster*, Munier-Chalmas, 1885, by M. Cotteau in the Pal. Franç. Éch. terr. Éocène, 1887, p. 411, and Bull. Soc. Zool. de France, 1887, p. 10. M. Cotteau has also placed two species which he had described as *Hemiaster* in this genus. One would have thought that a new genus which was to alter the classificatory position of some of the best known species of *Hemiaster*, and which by so doing conveyed a kind of stigma upon some experienced echinodermatists, would have been well placed before the biological world, published and fully illustrated, and that the essay would be accompanied by remarks explanatory of the reasons for antagonizing the opinions of Forbes and de Loriol. Moreover one would have thought that the description and argument would have been so well circulated that the students of the recent fauna might be informed concerning the new genus. We had much search after the new genus, and at last found it in Comptes Rendus Acad. Sci. 2 semestre, 1885, p. 1076, under the heading of "Distribution of genital openings":—"Genera with only two genital pores.—*Ditremaster*. *Hemiaster nux*, which occurs in the Middle Eocene of the Alps, and which has always been accorded four pores, has really only two, situated in the posterior genital plates. *H. Covazii*, from the same formation in Istria, has the same number. It is probable that a great part, if not the whole, of the Eocene *Hemiasters* should be referred to *Ditremaster*." This is all.

There is not a single word of reference added upon the very considerable literature upon the subject of the species of *Hemiaster* with three and two genital pores, and *Tripylus* and *Abatus* are left out. There is no reference made to the *Palæostoma*-question or to that of the *Hemiasters* with two pores, by de Loriol and ourselves (see 'Palæontographica,' xxx. 1881, and Ann. & Mag. Nat. Hist. 1884, xiv. p. 225). There is no reference to A. Agassiz's work in the 'Challenger' Report, and even M. Pomel is not noticed and his *Hemiaster*-genus with only two pores—*Opissaster* (*op. cit.* p. 37)—is passed by.

M. Cotteau, in Pal. Franç. 1887, Éch. terr. Éocène, p. 411, accepted this genus *Ditremaster* and attempted to improve it. It will be found that it is not such a simple genus as one might have expected, and M. Cotteau places as synonyms *Hemiaster* (pars) and *Trachyaster* (pars).

It appears that the reason of *Trachyaster* being in relation to *Ditremaster* must be from M. Pomel having jumbled up species of *Hemiaster* with two pores with those which have four, the madreporite in both instances passing backwards and separating the posterior ocular (radial) plates. This is satisfactory, because it indicates that *Trachyaster*, Pomel, is of no value. Having enlarged the diagnosis of *Ditremaster*, M. Cotteau altered the generic titles of the *Hemiasters* already referred to. The recent species appear to have escaped the memory of the distinguished palæontologist, and he has also neglected to refer to previous writers upon the subject. Otherwise he would not have altered the generic title of de Loriol's species; and we must believe that had he read our essay upon *Hemiaster elongatus*, which has two genital pores, he would have paid us the compliment of debating the matter. M. Cotteau must be aware of Prof. Sven Lovén's work upon the Ethmolysian *Hemiasters*, and it is inconceivable that with all M. Cotteau's great experience, unequalled we might say, he should alter the generic title of species upon such slight foundation. In his first definition of *Hemiaster*, 1847, Desor made no reference to the number of genital pores or to the extension of the madreporite; and in our "Fossil Echinoidea of Sind, Kach, and Kattywar," in Pal. Ind. ser. xiv., we followed his example, and for the same reason that made that authority neglect the very variable characters—the number of pores and the extension of the madreporite. We have enlarged upon the distribution of these structures in other genera in a former page, and it is only necessary to refer to de Loriol, who considers that these species of *Hemiaster* with a smaller number of genital pores than the old Cretaceous types are members of a group of the genus. No one would classify these neonomous Ethmolysii, to use Lovén's terminology, with the archæonomous ethmophract species; but they are still *Hemiasters*, for all the other characters are the same. To that opinion we adhere. It is necessary to point out that in the recent species *Hemi-*

aster cavernosus, A. Agassiz has described and drawn female specimens with two genital pores and an extended madreporite, the males having three pores ('Challenger' Report, 1881, pl. xx. *a.* fig. 19). According to the proposed generic changes females and males will be in different genera! It is difficult to understand how *H. Branderianus*, Forbes, can be a *Trachyaster* and also a *Ditremaster*, according to M. Cotteau. We cannot agree to the change of generic title of these species, and therefore we restore them to their previous position in *Hemiaster*.

IV.

The following is, in our opinion, the correct synonymy of the forms which we have considered in this communication:—

Genus Eolampas, Dunc. & Sladen, 1882.

Syn. *Petalaster*, Cotteau, 1884.
Pseudopygaulus, Coquand (name without definition), 1862; Cott. 1885.

Eolampas Trigeri, Coquand, sp., 1862.

Eolampas buccalis, Peron et Gauthier, sp.

Eolampas Gauthieri, Cotteau, sp.

Eolampas Toucani, Cotteau, sp.

Eolampas antecursor, Dunc. & Sladen.

Eolampas excentricus, Dunc. & Sladen.

Genus Hemiaster, Desor, 1847, et auctorum.

Syn. *Trachyaster*, Pomel, 1883.
Mecaster, Pomel, 1883.
Opissaster, Pomel.
Ditremaster, Munier-Chalmas.

Hemiaster Branderianus, Forbes.

Hemiaster princeps, Bittner.

Hemiaster Archiaci, de Loriol.

Hemiaster decipiens, Dunc. & Sladen.

Hemiaster apicalis, Dunc. & Sladen.

Hemiaster nobilis, Dunc. & Sladen.
Hemiaster gibbosus, A. Agassiz.
Hemiaster zonatus, A. Agassiz.
Hemiaster Bowerbanki, Forbes.
Hemiaster Prestwichi, Forbes.
Hemiaster digonus, d'Archiac.
Hemiaster elongatus, Dunc. & Sladen.
Hemiaster carinatus, Dunc. & Sladen.
Hemiaster cavernosus, Phil.

We have purposely omitted the subgenera *Abatus* and *Tripylus*.

September 1888.

XLIII.—*On some Remains of the Extinct Selachian* Asteracanthus *from the Oxford Clay of Peterborough, preserved in the Collection of Alfred N. Leeds, Esq., of Eyebury.* By A. Smith Woodward, F.G.S., F.Z.S., of the British Museum (Natural History).

[Plate XII.]

Since the elaborate researches of Agassiz it has always been suspected that the dorsal fin-spines named *Asteracanthus* and the teeth named *Strophodus* originally pertained to one and the same fish; but no proof of the circumstance has been made known during the forty years that have elapsed since the publication of the 'Poissons fossiles,' and one of the commonest of Mesozoic fossils has thus remained undetermined among the miscellaneous group of "Ichthyodorulites." At last, however, it is satisfactory to be able to bring forward the requisite proof of this long-maintained surmise; and not only that, but also to make known some other important features in the anatomy of *Asteracanthus* which definitely decide its systematic position. Ample materials are furnished by the fine series of fossils from the Oxford Clay of Fletton, near Peterborough, in the collection of Alfred N. Leeds, Esq., of Eyebury; and I am indebted to the kindness of my friend for the pleasurable opportunity of studying these interesting specimens.

Five series of associated remains are of especial importance, and form the basis of the descriptions given below. They may be enumerated as follows, under Mr. Leeds's catalogue numbers:—

1. Two dorsal fin-spines, with two cephalic spines.
2. Two fragmentary dorsal fin-spines, with one fragmentary cephalic spine.
3. One dorsal fin-spine, with twenty teeth.
4. Two dorsal fin-spines, with numerous portions of cartilage and ninety-seven teeth.
5. Remains of the cartilages of the head, with eleven teeth.

Nos. 4 and 5 afford some slight information concerning the cartilages of the fish; no. 1 makes known the singular cephalic spines; while some differences between both the dorsal fin-spines and the teeth in nos. 3 and 4 render these also interesting from a systematist's point of view.

Cartilage.—The cartilages are only superficially calcified, though the film of fine granular material is thick compared with that of many living Selachians. Only one fragment (no. 5) seems worthy of description and illustration, namely the right mandibular ramus, which is shown from the outer aspect, of one third the natural size, in Pl. XII. fig. 1. This is much crushed and broken; but it is interesting as showing the extremely robust character of the jaw. When complete the element must have had a length of about 0·27 m., being obtusely rounded in front, measuring about 0·085 in depth at the position occupied by the first series of lateral teeth, and gradually widening behind, until it attained a maximum depth of 0·14 at the condyle. On the inner side there is distinct evidence of a thickening of the cartilage of the lower margin immediately beneath the inferior limit of the tooth-bearing membrane; and on the outer side a singular feature may be noticed, in the form of a protuberance slightly in advance of a point halfway between the condyle and the anterior extremity. Much of the external surface of the cartilage has a coarsely fibrous appearance, and at the point just mentioned several of these fibres curve upwards and backwards from the inferior margin in front, producing a large roughened boss (*t*), in which their abrupt upper extremities have the appearance of terminating. I have not been able to discover a similar protuberance in any other Selachian, living or extinct, and its exact meaning seems at present inexplicable. That it is a normal feature is proved by its occurrence in both rami of two other mandibles in Mr. Leeds's collection; and the only explanation suggesting itself is that it relates to some attachment of ligaments or muscles specially adapted for the successful wielding of the unusually powerful dentition.

Dentition.—The teeth, most completely preserved in no. 4, are all detached, and those of both jaws mingled together in such a manner that the task of restoring the original dentition is somewhat difficult. Two or three definite facts, however, seem to form a satisfactory basis for a plausible attempt at a solution of the problem. In the first place, Sir Richard Owen has already determined the exact number and characters of the dental series in one jaw of the so-called *Strophodus medius* *; and the homologous teeth can easily be recognized in the present collection. Secondly, in the jaw just mentioned there is no median symphysial series, whereas among the Oxford Clay teeth there are five examples which must have undoubtedly occupied such a position; and it thus becomes probable that, as often in *Cestracion* †, one jaw had a median symphysial row of teeth, while the opposing jaw possessed none. Thirdly, upon a fragment of the right mandibular ramus a few teeth of series 1 and 2 are actually preserved in position; so that these rows can be identified with complete certainty and by inference also their opposing series. And, lastly, placing the median row of teeth in the lower jaw the teeth of series 3 and 4 can readily be arranged to make the dentition of both jaws thus far of precisely the same extent. The intercalation of the median series and the greater relative length of the teeth of series 4 in the lower jaw precisely compensate for the greater relative length of the first three paired series in the upper jaw; and on this account I venture to think that the following determinations will prove for the most part well founded. Examples of the several teeth of the upper jaw are shown in Pl. XII. fig. 2, and a corresponding set from the lower jaw in fig. 3.

Commencing with the upper jaw, six teeth of series 1 are preserved upon the left side and seven upon the right. Each measures 0·025 m. in length and is much elevated, and the high arched crown is longitudinally keeled, narrowest anteriorly, and broadest at the point of its maximum elevation, nearer

* Geol. Mag. vol. vi. 1869, p. 194, pl. vii.

† Sir Richard Owen (Geol. Mag. vol. vi. 1869, p. 196) has remarked that in the lower jaw of *Cestracion* a median symphysial row of teeth is present, while in the upper jaw it is absent. So far, however, as the present writer has had the opportunity of observing, the character is not constant.

the posterior than the anterior extremity. Of the teeth of series 2 five remain upon the left side and six upon the right. Each of these measures 0·037 in length and differs from a corresponding tooth of series 1 in its relatively less elevation and the almost complete absence of the longitudinal keel upon the crown. The teeth assigned to series 3 are very different from the foregoing; they measure 0·04 in length, and six of the left side and five of the right are available for study. The anterior extremity is still less truncated than the posterior; but the contour of the low crown is only gently sinuous, the posterior end being slightly upturned, and a more or less rounded elevation occurring somewhat in advance of the middle of the tooth. Series 4 is only preserved upon the left side, where it is represented by seven teeth, each measuring 0·048 in length, and differing from those of series 3 in the considerable forward flexure at the point of maximum coronal elevation. To series 5, 6, or 7, either of this or the opposing dentition, may also be referred two small elliptical teeth, of which one is shown in Pl. XII. fig. 4.

The five symmetrical median teeth assigned to the symphysis of the mandible have a much elevated, arched, longitudinally-keeled crown, and measure 0·023 in the longer transverse diameter. Those of series 1 only differ from the median teeth in their unsymmetrical character, being very similar to the corresponding opposing teeth; they measure 0·024 in length, and six of each side are preserved in addition to one incomplete germ on the right. The supposed teeth of series 2 are perplexing on account of their number, which at first sight leads to the suspicion of an error. No less than twelve teeth of each side can be identified, in addition to a germ on the right; and this number is equalled by no other known Cestraciont except *Cestracion*. Each tooth measures 0·029 in length and chiefly differs from a tooth of the opposing series 1 in its less elevation and the generally more truncated character of the posterior extremity. The teeth of series 3 much resemble those of series 2 of the upper jaw, but are relatively shorter, measuring only 0·034 in length; and of these four remain upon the left and six upon the right. The teeth assigned to series 4 are only preserved, to the number of five, upon the left; and their difference from those of the homologous upper series consists merely in their narrowness and great relative length, the latter measurement being at least 0·053.

Dorsal Fin-spines.—The two dorsal fin-spines associated with the dentition just described are shown, of two thirds the natural size, in Pl XII. figs. 5, 6. They are nearly of equal dimensions; but the posterior (fig. 6) can readily be distinguished by the evidence it bears of relatively deep and oblique insertion. Both spines are considerably crushed and abraded, and incomplete distally; but they appear to have been much compressed laterally, with a sharp anterior border. A very characteristic ornament is also preserved, consisting of small elongated tubercles, more or less arranged in series, and often fused above into delicate continuous ribs, which begin to prevail at a considerable distance from the upper extremity. The posterior face is slightly ridged, but the double series of denticles is almost destroyed. Measured from the extreme proximal limit of the ornament, the base of insertion of the first dorsal spine is almost precisely equal to that of the second; but the posterior opening of the central cavity is only 0·205 in length in the former, while in the latter it measures 0·235.

Cephalic Spines.—The cephalic spines of *Asteracanthus* are very similar to those of *Hybodus* and *Acrodus*, originally described by Agassiz under the name of *Sphenonchus* *; but, as indicated by specimens nos. 1 and 2, these dermal weapons are relatively larger. One of them is shown, from the upper and lateral aspects, two thirds nat. size, in figs. 7 and 8. Two pairs of such spines occur upon the sides of the head of *Hybodus* and *Acrodus*; and the fossil now under discussion shows that there was also a paired arrangement in *Asteracanthus*. The base of insertion of the spine is very robust and somewhat saddle-shaped, but with one side-lobe much more developed than the other. The exserted portion is slender, gradually arched, rising backwards (or downwards) from the broader anterior (or upper) extremity, and terminating in a barbed point. At the base it is oval in section, being somewhat laterally compressed; and the only keels proceed, one from the point to the large inferior barb, thence diverging and disappearing, and the other from the point to the small lateral barb, from whence it is continued but also rapidly vanishes. The shining exposed surface is smooth, except superiorly upon the proximal half, where a few large longitudinal rugæ are to be observed.

Specific Determination.—On comparing the dorsal fin-spines described above with typical examples of *A. ornatissimus* striking differences will at once be observed. If, indeed, these were isolated spines they might well receive a distinct specific name; and there are some peculiarities in the associated teeth which also might appear to justify the

* See E. Charlesworth, Mag. Nat. Hist. n. s. vol. iii. (1839), p. 245, with fig.; also E. C. H. Day, Geol. Mag. vol. ii. (1865), p. 565.

founding of a new species. Mr. Leeds's collection, however, comprises so large a series of dorsal spines from the Oxford Clay, and these exhibit so many variations in ornament—graduating from the type shown in figs. 5 and 6 to that of the most characteristic *A. ornatissimus*—that it seems quite impossible to discover any line of specific separation in the series. Indeed, the more the dorsal fin-spines of sharks are studied, the more impossible does it appear to employ variations in their surface-ornament for specific diagnosis; and it yet remains—at least in *Asteracanthus*—to determine what are the precise characters in the dentition to be counted as of real value. The teeth of series 3 and 4 in group no. 4 are relatively narrower and exhibit a more prominent coronal eminence than the corresponding teeth associated with the typical spine of *A. ornatissimus* in group no. 3. Fig. 9 represents a tooth, probably of series 3, of the latter, and fig. 10 two abnormal transversely-divided teeth, evidently of series 4 of the same fossil, and these agree more closely with the typical Kimmeridgian teeth from Shotover than those of the fish with finely ornamented fin-spines from Fletton. The general *facies* of the dentition, however, is identical in the two forms, and it thus seems most reasonable at present to describe the new one merely as a hitherto unrecognized variety under the name of *Asteracanthus ornatissimus*, var. *flettonensis*.

Conclusion.—From a study of the fossils just described it may be inferred, with much probability of correctness, that all the "species" of teeth named *Strophodus* are referable to the Selachian *Asteracanthus*. The spines and the teeth are often found together upon certain horizons; and the few cases in which they have not been thus discovered are worthless for consideration, being mere negative evidence. *Asteracanthus verrucosus*, for example, is common in the Purbeck Beds of Swanage, while not one tooth of "*Strophodus*" appears yet to have been discovered there; but spines of *Hybodus* are still more abundant in those beds, and it is scarcely minimizing to state that in all the public collections of Britain not more than a dozen teeth of this shark are to be seen from the same horizon.

The zoological result of this brief study is also interesting, demonstrating a still more close relationship between *Asteracanthus* and *Hybodus* and *Acrodus* than has hitherto been suspected. No vertebræ have been discovered with the remains of the Oxfordian genus, and it thus probably possessed a persistent notochord, like *Hybodus* and *Acrodus*. The dentition is fundamentally the same, only distinguished by the reticulate ornamentation of the teeth and the absence of lateral cusps; the cephalic spines agree; and the dorsal fin-spines merely differ in the prevailing replacement of a ribbed ornament by series of stellate tubercles.

EXPLANATION OF PLATE XII.

Asteracanthus ornatissimus, var. *flettonensis*, A. S. Woodw., Oxford Clay, Fletton, near Peterborough.

Fig. 1. Right ramus of mandible, outer aspect, $\frac{1}{3}$ nat. size. *t*, tuberosity. [No. 5.]
Fig. 2. Teeth of upper jaw, series I–IV, upper aspect, nat. size. [No. 4.]
Fig. 3. Teeth of lower jaw, series O–IV, upper aspect, nat. size. [No. 4.]
Fig. 4. Hinder tooth, upper aspect, nat. size. [No. 4.]
Fig. 5. Anterior dorsal fin-spine, lateral aspect, $\frac{2}{3}$ nat. size. [No. 4.]
Fig. 6. Posterior ditto, lateral aspect, $\frac{2}{3}$ nat. size. [No. 4.]
Fig. 7. Cephalic spine, lateral aspect, $\frac{2}{3}$ nat. size. [No. 1.]
Fig. 8. Ditto, upper aspect, $\frac{2}{3}$ nat. size. [No. 1.]
Fig. 9. Tooth of (?) series III, upper aspect, nat. size. [No. 3.]
Fig. 10. Two transversely-divided teeth of series IV, upper aspect, nat. size. [No. 3.]
Fig. 11. Hinder tooth, upper aspect, nat. size. [No. 3.]

(The numbers refer to the Catalogue of the Leeds Collection.)

XLIV.—*Description of a Large Variety of* Orbitolites Mantelli, *Cart., from the West Bank of the River Irrawadi, in the Province of Pegu, Burma, about* 36 *miles above Prome.* By H. J. Carter, F.R.S. &c.

Orbitolites Mantelli, var. *Theobaldi*, n. var.

Discoid, slightly undulous, flat, thin. Consisting of a well-marked central plane of ?-spheroidal cells in juxtaposition, bordered on each side by several layers of vertically compressed ones presenting a more or less columnar arrangement. Central plane thinnest in the centre (where it generally commences around one or more comparatively large "primary cells" in conjunction, by which the centre, when thus exposed, is easily ascertained), increasing slightly in vertical diameter towards the circumference; structure of the central plane, when viewed in a vertical section, passing through the "primary cells" or centre of the fossil, presenting, for the most part, quadrangular spaces. Disk of the largest specimen exposed about $3\frac{4}{8}$ inches in horizontal diameter by $\frac{1}{8}$ inch vertically in the centre, from which point it gradually and uniformly diminishes to the thinness of a wafer at the circumference. Layers of compressed cells on each side of the central plane, amounting in the centre of a vertical section to about sixteen, diminishing in this respect towards the circumference, presenting in the horizontal section the same cells under a circular or hexagonal form, in juxtaposition but for the intervention of a thin line of translucent shell-substance, through which, in specimens infiltrated with red or yellow oxide of iron, the intercellular canals of communication, by their opaque yellow colour, may be seen to pass, but no columns of the opaque white, shelly substance which especially characterize this structure in *Orbitoides dispansa.* These layers of vertically compressed cells present, in the horizontal planes, a similar arrangement to the centrifugal lines of an engine-turned watch-case, and are covered in on both sides by a very thin superficial or terminal layer, in which the cells markedly differ from those of the subjacent planes in the irregularity of their outline and their variability in size, although, under the microscope, they also may be seen to be separated by the thin line of intercellular translucent shell-substance, like that which, in the infiltrated specimens, is traversed by the canals of intercellular communication as in those of *Orbitoides dispansa*, but none of the "conical columns of non-tubular substance" of the late Dr. Carpenter ('Introduction to the Study of the Foraminifera,' p. 302), that is, of our opaque white, shelly substance which so essentially distinguishes this species from *Orbitolites Mantelli*, Cart., as before mentioned. General appearance of the "hand-specimens" under examination, which indicates that of the stratum from which they were taken, sandy; the matrix consisting of a combination of microscopic grains of quartz and a small quantity of argil together with a considerable portion of microscopic Foraminifera, in the proportion of 2 of the former to 1 of the latter, in which the specimens of *Orbitolites Mantelli*, var. *Theobaldi*, which are composed of apparently homogeneous, semitranslucent calcite, in a compact or crystalline state, lie, like a collection of large leaves, thus contrasting forcibly in their homogeneity and general appearance with the gritty character of the matrix. Colour of the matrix grey when fresh, rusty brown after exposure, tough, breaking with a rough fracture; structure laminar from the presence of the leaf-like fossils. Microscopic Foraminifera consisting chiefly of Discoids and *Textulariæ.* Although the hand-specimens, which altogether present about 150 square inches of surface, were carefully examined all over with a strong lens, I could not discover even a trace of any other foraminiferal test beyond those mentioned; this is the opposite to those from Upper Sind, which are in the midst of a mass of middle-sized Nummulites.

Loc. Village of Peitating (? Pinthaling), on the western bank of the river Irrawadi, about 36 miles above Prome, or 6 miles below Thayetmyo, in the Province of Pegu, Burma.

Obs. Of the stratum from which the two hand-specimens above mentioned were obtained, Mr. W. Theobald (who submitted them to me for examination and after whom the variety of *Orbitolites Mantelli* contained in them has been named) states, in his published "Report on the Geology of Pegu" (Memoirs of the Geological Survey of India, vol. x. p. 87), as follows:—

"Except in the Kama shale, Foraminifera are scarce throughout the beds of this group. A single specimen of an Orbitolite was found in the *Cythereamensis* bed, opposite Prome, which, when perfect, might have been the size of a shilling, but with a thickness no greater than cardboard. A careful search, however, failed to discover a second specimen. Another species of Orbitolite forms the characteristic fossil in a hardish sandstone on the banks of the Irrawadi, a little above the Lime Hill; but unfortunately the position of the bed is not very clear, neither does the fossil occur anywhere else that I know of. A perfect specimen must have measured five or six inches across, with a thickness of not more than the tenth of an inch, and these organisms are, in parts of the rock, packed together so closely that the section of them on the surface suggests the idea of a cross-cut through a bundle of little pancakes."

As regards the largest size that this fossil may attain, it will be observed that Mr. Theobald's measurements much exceed my own in horizontal diameter, that is "across;" but then it should be remembered that mine were taken from the largest specimen exposed in the "hand-specimens," while Mr. Theobald's were made on the spot, that is, where the stratum charged with them in the bank of the Irrawadi existed; at the same time my own measurement in horizontal diameter exceeds that of any discoid species of Foraminifera on record. And as regards the geological position of the stratum, I must refer the reader to that part of Mr. Theobald's report bearing upon the subject, merely observing that the "Lime Hill" (so called from the lime-kilns supplying Thayetmyo being situated on it) to which he again alludes further on, at p. 92, &c., consists of "a mass of nummulitic strata, forced up through the newer Tertiaries, and forming a conspicuous landmark for the district." This, which is also marked on his map, is less than a mile in length by half a mile broad, stated by Mr. Theobald from memory to be about "400 feet high," and separated from the river by a "narrow strip" of his "Newer Tertiaries," about 32 miles above the town of Prome, which "Tertiaries" on the other side also separate it again from the *main* area of nummulitic strata whose vertical section is especially well seen in a small stream at the village of Thambola, about 34 miles nearly due west of the "Lime Hill," and of which section, at p. 98 &c. of his Report, a detailed statement is given, condensed at p. 100 into the following generalized one :—

	feet.
1. Nummulitic Limestone	10
2. Shales and Sandstones; Shales occasionally Nummulitic	658
3. Massive Sandstone with some Shales and much soda-efflorescence in places	328
4. Shales and Sandstones; the Shale with some Carbonaceous markings	227
Total	1,223

So much for this variety of *Orbitolites Mantelli*, and the assumed geological position of the stratum charged with it, which is contained in Mr. Theobald's "Report." I have now, in conclusion, to offer a few explanatory remarks on the name "*Orbitolites Mantelli*" which I adopted in 1853 (Journ. Bombay Asiatic Society, vol. v. p. 138), as my kind friend the late Dr. Carpenter, in his excellent 'Introduction to the Study of the Foraminifera' of 1862, p. 298, considered it, viz. the term "*Orbitolites*," to have been adopted on "fallacious grounds."

In 1834, S. G. Morton (Synopsis of the Organic Remains of the Cretaceous Group. 8°. Philadelphia, U.S.) mentioned the occurrence, in the Claiborne Beds of Alabama, of a discoid fossil which he called *Nummulites Mantelli*; and 13 years afterwards, viz. in 1847, D'Orbigny ('Cours de Géologie,' vol. i. p. 194, and 'Prodrôme,' 1850, vol. ii. p. 406, respectively) used the name "*Orbitoides*" for this and similar fossils under the following diagnosis, accompanied in the preceding page by a typical illustration :—

"Coquille discoïdale, convexe des deux côtes, formée d'une seule rangée de loges autour du disque, très fortement encroûté extérieurement au milieu, et montrant soit des linéoles rayonnantes, soit des granulations" (Cours, vol. i. p. 194). Thus he includes under this generic heading not only the Alabama fossil (Prodrôme, vol. ii. p. 406), but the *Nummulites papyracea* of Boubée, 1832 = *Orbitolites Pratii* of Michelin, 1846 (*ib.* p. 334) = *Lycophrys dispansus* of Sowerby, 1837 (see Carpenter's 'Introduction,' p. 298), and therefore my *Orbitolites dispansa* of 1853 (Journ. Bombay Asiatic Society, vol. v. p. 136)—that is, the Alabama fossil, whose structural type is depicted in the "Parisien" species *Orbitoides media* on the page preceding D'Orbigny's diagnosis; and *Orbitoides dispansa*, previously called *Lycophrys dispansus* by Sowerby, whose structure, which is totally different, was depicted ten years previously in the illustrations to Captain Grant's Memoir on the Geology of Cutch, published in 1837 in the Transactions of the Geological Society of London (vol. v. p. 289, pl. xviii. figs. 16, 16 *a*, and 16 *b*).

In 1861 my paper on the "Foraminifera of Sind, with Observations on their Internal Structure," was republished, with additions, in the Ann. & Mag. Nat. Hist. for that year (vol. viii. p. 309), and at page 328 the genus *Orbitoides* is thus alluded to:—

"*Orbitoides*, d'Orb.

"In this family two distinct genera have been included, viz. *Orbitoides dispansa* and *Orbitoides Mantelli*, D'Orb. (*Orbitolites Mantelli*, Cart.), as will be seen by their descriptions hereafter under their respective heads. Moreover, it will also be seen there that they are so different that they can hardly be included even in the same family: at least, while the former is closely allied to *Cycloclypeus*, Carp., the latter is so closely allied to *Orbitolites* that I proposed the name of '*Orbitolites Mantelli*' for it, instead of '*Orbitoides*.'"

Following this is a detailed description of *Orbitoides dispansa* and of *Orbitolites Mantelli* respectively, whose differences, to make them more clear, are delineated in plate xvi. of the illustrations, in two columns side by side, which thus occupy the whole of the plate, together with separate and still more detailed descriptions of them at pp. 446 and 452 respectively of the same volume, wherein again their distinctive characters are repeated.

Dr. Carpenter has stated at p. 302 (*op. cit.*) that:—"In both forms of *Orbitoides*, and not (as stated by Mr. Carter) in *O. Fortisii* [= *Orbitoides dispansa*], we often find the superficial layers traversed by columns of non-tubular substance, which are of a conical form" (Dr. Carpenter's name for "Discolithus IV. *a* of Fortis" appears to be *Orbitoides Fortisii* = *Lycophrys dispansus* = my *Orbitoides dispansa*, 'Introduction,' p. 298).

This I have never seen in any of my specimens of *Orbitolites Mantelli*, either from Arabia, Kelat, or Sind, nor in that from Burma above described, while Dr. Carpenter himself adds just afterwards:—"in the American variety of *O. Mantelli* I have not met with any indication of the presence of these columns."

Sometimes the columns of cells in *Orbitolites Mantelli* do, in the vertical section, present a white appearance like the "columns of non-tubular substance" in *Orbitoides dispansa*, especially where the rest of the fossil is composed of dark grey calcite; but, then, the lighter-coloured correct the darker specimens in this respect; and if this does not suffice, we have only to turn to the specimens of *Orbitoides dispansa* and *Orbitolites Mantelli*, whose cavities respectively have been infiltrated with red or yellow oxide of iron, to see that the cells in the former are accompanied by the opaque white "columns of non-tubular substance;" while in the latter they are *not* so, but merely surrounded by the thin layer of translucent shell-substance, through which, as before stated, the "canals"—now rendered visible by being filled with the oxide of iron—may be seen to connect the contiguous cell-cavities.

After all, Dr. Carpenter states at p. 299 (*op. cit.*) that "There is so decided and constant a difference as regards the form of the chambers between *O. Mantelli* and *O. Fortisii*, that until such a gradational series of connecting links shall be discovered as unites the similarly diversified varieties of *Orbitolites*, they must be retained as distinct species." The distinctive differences of *Orbitoides Fortisii*, Carp., = *Orbitoides dispansa*, Cart., and *Orbitoides Mantelli* = *Orbitolites Mantelli*, Cart., are as clearly given in his twentieth plate as they are in my own, to which I have before alluded; and Gümbel, in 1869, makes the same distinction, proposing for the latter the name "*Lepidocyclina*," of which he states:—"Mediankammern auf dem Horizontalschnitt peripherisch halbkreisförmig abgerundet. (Bei den vorhergehenden Untergattungen [that is, *Orbitoides dispansa* &c.] dagegen rectangulär.)"—Bütschli, in Bronn's Klass. u. Ord. des Thierreichs, 1880, Rhizopoda, p. 216.

To sum up, the central plane of *Nummulites* corresponds to the form and arrangement of the plane of chambers in *Operculina*; that of *Orbitoides dispansa* to the form and arrangement of the plane of chambers in *Cycloclypeus*, Carp., together with the initiative "cones of non-tubular substance" as delineated in Dr. Carpenter's fig. 5, pl. xix.; and that of *Orbitolites Mantelli* to the form and arrangement of the single plane of cells presented by the most simple form of the existing species, viz. *Orbitolites marginalis*, Lamarck (1816, vol. ii. p. 196), which is almost ubiquitous between the shores of the Mediterranean and those of the south coast of Australia, if not elsewhere in these latitudes.

The identity of structure, although not exactly of form, in all the specimens of *Orbitolites Mantelli*, var. *Theobaldi*, compels me to consider the latter only a "variety;" while, as before stated, it is by far the largest discoid specimen of the Foraminifera on record.

XLV.—*Note on the Bib and the Poor- or Power-Cod.* By Prof. M'Intosh, M.D., LL.D., F.R.S., &c.

I regret that a little delay has occurred in the performance of my duty in regard to Surgeon-General Day's remarks on these fishes; but constant occupation in other departments prevented attention to the subject till now.

In my 'Catalogue of the Fishes of St. Andrews' (1875) the bib (*Gadus luscus*) and the poor-cod (*Gadus minutus*) were, as the author just mentioned truly says, entered as separate species, and it was only recently that the confusion in the descriptions of these forms struck me, as it probably also did Winther. A reexamination, however, shows that the earlier view (and Mr. Day's) is correct. In the 'British Fishes' of the latter author the distinctions rest on the proportions of the depth to the length of the body and the larger barbel of the bib *. The first dorsal is stated to have the same number of rays in both; the second to have a larger range and a few more rays in the poor-cod than in the bib. The first anal has more rays in the bib and arises nearer the vent than in the poor-cod; while the second has somewhat fewer rays than in the latter, and the fin in the former also arises further forward. Moreover, in his recent paper † Mr. Day correctly points out that these two fins have a more evident interval than in the bib. The lateral line in the latter is stated to curve very gently to the last half of the second dorsal, and then goes straight to the caudal, whereas in the poor-cod it is very slightly bent, becoming straight beneath the second third of the dorsal fin. In Mr. Day's figure of the latter, however, the curvature is less marked than in any example hitherto observed. The vent lies beneath the anterior portion of the dorsal fin in the bib, whereas in the poor-

* In a bib $13\frac{1}{4}$ inches long the barbel was about $\frac{3}{4}$ inch long and proportionally thick.

† Ann. & Mag. Nat. Hist., Feb. 1888.

cod it comes below the last rays of the first dorsal. The coloration of the bib is of a beautiful bronze during life, with a black spot at the base of the pectoral fin. The fins are bluish black, darker at their outer edges. In the poor-cod, on the other hand, the coloration is greenish grey along the back, becoming lighter at the sides, and in some large examples, Mr. Day adds, a trace of grey occurs at the base of the pectoral fin.

The main point contended for in my note * was the confusion on the subject and the apparent uncertainty of the author of the 'British Fishes.'

To my former remarks the following may be added:—The coloration of the poor-cod increases with age, and a blackish spot occasionally occurs at the base of the pectoral, as, for instance, in a specimen courteously sent by Mr. Dunn, of Mevagissey, and which he thought might be a hybrid; moreover, it becomes deeper in the body, so as to resemble the bib. The dull greenish hue along the dorsum laterally is also evident in spirit-preparations. As Mr. Day says, its eye is nearer the tip of the snout; but he does not mention the cutaneous bleb so characteristic of both species. The number of rays in the first dorsal is stated to be the same in both, viz. 12; but, as shown in the subsequent tables of those specially examined, the range is from 12 to 15 in the bib and from 12 to 14 in the poor-cod, the smallest specimens in both species, moreover, having most rays. The range in the second dorsal is from 22 to 26 in the bib, the larger specimen having most, while in the poor-cod the range is from 21 to 25. Mr. Day gives 19 to 20 in the bib and 19 to 25 in the poor-cod. In the bib the third dorsal shows from 18 to 20 rays, while in the poor-cod the range is from 19 to 22, the latter also occurring in the smallest example. In the first anal fin the range in the bib is from 31 to 33, while in the poor-cod it is from 26 to 28. The second anal presents from 20 to 21 in the bib and from 19 to 22 in the poor-cod.

In regard to the characters derived from the gill-rakers, as indicated by Mr. Day in his recent paper in this journal, it is found that in the bib the left outer gill has from 18 to 20, whereas in the poor-cod the number ranges from 26 to 29. The second gill in the bib has from 14 to 16, in the poor-cod from 18 to 20. The third has from 11 to 15 in the bib, 14 to 17 in the poor-cod. The fourth presents from 9 to 12 in the bib, 11 to 14 in the poor-cod. It will thus be noticed that this character is fully as important as any mentioned in the 'British Fishes.'

* Ann. & Mag. Nat. Hist., May 1886.

Bib.

No.	Dorsal. I.	Dorsal. II.	Dorsal. III.	Anal. I.	Anal. II.	Gill-rakers, Left. I.	Gill-rakers, Left. II.	Gill-rakers, Left. III.	Gill-rakers, Left. IV.	Line from anus strikes
(1) St. Andrews, $13\frac{1}{2}$ inches long.	12	24	18	33	21	18	14	13	11	Between 5th and 6th dorsal ray from front.
(2) Mevagissey, $10\frac{3}{8}$ inches	13	22	18	31	21	18	15	14	11	„ 2nd dorsal ray from front.
(3) Aberdeen, 11 inches........	14	26	20	31	20	20	16	15	12	„ „ „ „ „
(4) Thames, $4\frac{1}{4}$ inches	15	23	19	32	20	19	14	11	9	„ „ „ „ „

Poor-Cod.

No.	Dorsal. I.	Dorsal. II.	Dorsal. III.	Anal. I.	Anal. II.	Gill-rakers, Left. I.	Gill-rakers, Left. II.	Gill-rakers, Left. III.	Gill-rakers, Left. IV.	Line from anus strikes
(5) St. Andrews, $9\frac{3}{4}$ inches	13	22	19	27	19	27	19	16	12	5th ray, 1st dorsal, from behind.
(6) „ $6\frac{3}{4}$ „	13	22	22	27	21	26	19	14	13	„ „ „ „ „ „
(7) „ $8\frac{7}{8}$ „	13	21	20	27	20	26	19	15	14	„ „ „ „ „ „
(8) Mevagissey, $9\frac{1}{2}$ inches	12	23	21	27	22	29	20	17	13	„ „ „ „ „ „
(9) „ $7\frac{1}{2}$ „	13	24	22	27	21	27	18	17	13	„ „ „ „ „ „
(10) „ $7\frac{3}{4}$ „	13	25	21	28	21	26	19	17	11	Between 5th and 6th ray, 1st dorsal, from behind.
(11) Thames, $4\frac{6}{8}$ inches	13	23	20	27	19	27	18	16	12	5th ray, 1st dorsal, from behind.
(12) „ $3\frac{15}{16}$ „	14	21	22	26	22	26	19	17	11	„ „ „ „ „ „

The coloration of the bib is well marked, and the iridescence resembles that of the bronze-winged pigeon, the paler streaks on the sides occurring in broad blotches between the darker pigment-bands. The median fins are dark brownish. The edges of the second and third dorsal and the two anal fins, however, are whitish. Mr. Day observes that they are darkest at their outer edges. The margin of the tail, however, is bounded by a blackish belt. A blackish touch occurs in front of the first dorsal. The inner region of the ventrals is greyish, but the two anterior or outer rays are pale, indeed whitish towards the tip, and with two free filaments distally.

By the aid of the gill-rakers and other points the differences between the forms are now more apparent. In this connexion it is possible that a mistake has occurred, it may be without Mr. Day's knowledge, in labelling the specimen presented by him to the Edinburgh Museum of Science and Art, for in that collection a poor-cod $9\frac{1}{2}$ inches long is termed "*Gadus luscus.*"

XLVI.—*Notes on Pigeons collected by Mr. A. H. Everett in Mantanani and Banguey, off the North-west Coast of Borneo.* By W. R. Ogilvie Grant.

Carpophaga Everetti, sp. n.

This species is most nearly allied to *C. Pickeringi*, Cassin, from Mangsi, Sooloo Islands, but may be at once distinguished by the colour of the back, rump, and wings, which are dark grey slightly glossed with dull violet-copper, instead of being "ashy brown, with a green metallic lustre." Head, neck, and breast pale purplish grey, gradually melting into pale pearly grey on the mantle and sides of the neck. Throat pale pinkish white; abdomen, sides of the body, and flanks pale grey. Feathers round the eyes and the base of the bill whitish. Back, rump, and wings dark grey, slightly glossed with dark violet-copper, and mingling gradually with the mantle. Upper tail-coverts and tail dark ashy brown, with a dark green metallic lustre. Under wing-coverts pale grey. Under tail-coverts and outer web of under surface of primaries pale reddish brown; rest of under surface of primaries and tail-feathers brownish grey.

No frontal knob. The third primary is rather longer than the second and fourth and half an inch longer than the first. Tail with fourteen feathers.

Measurements in inches.

Total length	14
Culmen	1·1
Tarsus	1·2
Middle toe (sine ung.)	1·4
Wing	9·1
Tail	6

"♀. Mantanani. Iris crimson; bill light-lead grey; feet dull crimson. 17th Dec., 1887."—*A. H. E.*

Treron nasica, Schl.

Two specimens of this bird were obtained by Mr. Everett at Banguey, off the north coast of Borneo. One is a fully adult bird, and the other probably a somewhat immature female; but unfortunately no particulars are given on the collector's labels except the locality. This species may be easily distinguished from the nearly allied forms *T. nipalensis*, Hodgs., and *T. griseicauda*, G. R. Gr., not only by its smaller size, but by the difference in the colour of the lesser wing-coverts. The various differences may be tabulated as follows:—

Lesser wing-coverts pale grey. Cheeks green. Head darker grey on the top. Mantle uniform dull green. W. 5·3 in. .... *T. nasica.*

Lesser wing-coverts dark blackish grey. Cheeks grey. Head uniform light grey, like cheeks. Sides of mantle washed with buffy orange. W. 6·1 in. .... *T. griseicauda.*

Lesser wing-coverts dull vinous red, same as back. Cheeks green. Head darker grey on the top. Mantle uniform greyish green. W. 5·6 in. .... *T. nipalensis.*

MISCELLANEOUS.

Remarks on a Note by Dr. G. Baur on the Pleurodiran Chelonians. By G. A. Boulenger.

A recent number of the 'Zoologischer Anzeiger' (no. 285, 6th August, 1888) contains a note by Dr. Baur in which he contradicts me as to the existence of some of the characters which I have indicated as diagnostic of the Pleurodiran Chelonians.

First, my statement that "The mandible articulates with the skull by a condyle fitting into a concavity of the quadrate" is followed by the remark that "Dasselbe ist der Fall bei den Chelydridæ und Cinosternidæ und anderen." This is evidently due to my critic not having understood my meaning; but it shows how very superficial a knowledge he must have of the Chelonian skulls not to have noticed the great difference in the articulatory region of the mandible of a Pleurodiran as compared with any other Chelonian. Secondly, my statement that "The outer border of the tympanic cavity is completely encircled by the quadrate" is contradicted thus:—"Dies ist nicht volkommen der Fall bei *Chelymys victoriæ*, während dieselbe Eigenschaft auch den Chelydridæ und Trionychidæ zukommt." Here, again, Dr. Baur misunderstands me; had he referred to the publication he quotes he would have found that I do not include the Trionychidæ either among the Cryptodira or among the Pleurodira; and had he taken the trouble of comparing a skull of a Chelydroid with that of a Chelydoid he would have seen that in the latter the ear-chambers are closed posteriorly precisely where they are open in the former, and *vice versâ*.

I think it desirable to make this reply, because the accuracy of my statements is called into question in a most offhand manner by a zoologist who evidently writes on these matters without specimens before him: and I seize this opportunity for expressing an opinion on that author's recent publications on the Chelonia.

His views as to the relationships of the Sphargidæ, which have, in his own writings, already undergone various modifications *, have been most ably refuted by Dollo, whose criticisms have not yet been answered. For my part, I have to say that the statement that *Dermochelys* differs from the Chelonidæ only in the configuration and isolation of the carapace is simply monstrous, and that Dr. Baur could not have been acquainted with *Dermochelys* at the time he published his note. What! he actually states that the head and limbs are fundamentally the same in *Dermochelys* and in the Chelonidæ! The skull of the former bears a general resemblance to that of the true turtles; but this is limited to the shape and, to a certain extent, the general constitution of the temporal roof; in the absence of the column-like processes of the parietals, descending to the pterygoids in front of the supraoccipital and the prootics, it differs from that of all other Chelonians. As to the limbs, in spite of adaptive similarity, they differ in most important points. Thus, in addition to the shape of the humerus and the proportions of the phalanges, the fore limb differs in the radius and ulna being subequal in length and placed side by side in a horizontal plane, and in the fifth metacarpal, instead of the first, being the shortest.

The mosaic-like dorsal plates of *Eretmochelys* are now admitted

* *Cf.* Zool. Anz. 1886, p. 687; Amer. Nat. 1887, p. 89; Zool. Anz. 1888, p. 423.

by Dr. Baur himself not to be constant; and I presume it will ultimately be found that his observation was made on an injured specimen.

In his latest paper on the classification of the Pleurodira Dr. Baur gives as one of the characters of the family Chelydidæ the presence of a nuchal shield, and includes *Elseya*, overlooking that that genus was established on the absence of a nuchal.

So much for Dr. Baur's accuracy in dealing with facts. His want of judgment as to what constitute family characters is best shown in his classification of the Pleurodira, where one neural plate more or less (often merely an individual peculiarity) is regarded as a family character, except in the Chelydidæ, where, better informed, he admits their variation from 7 to 0! *Pelomedusa*, which is placed by him with *Podocnemis* in the family Pelomedusidæ, is beyond question much more nearly related to *Sternothærus*, which, in his system, forms another family. As there is not at present the slightest reason for splitting the Pelomedusidæ, or Pleurodira with mesoplastra, into several families, the new terms Mesoplastralia and Amesoplastralia were uncalled for, and only show, together with the proposal of a new name (*Erymnochelys*) to replace *Dumerilia*, preoccupied and a synonym of *Podocnemis*, the unfortunate fondness of the author for coining names whenever the slightest opportunity offers.

A Comparison of the Cretaceous Fish-fauna of Mount Lebanon with that of the English Chalk *. By A. Smith Woodward, F.G.S., F.Z.S.

No detailed comparison having hitherto been instituted between the Cretaceous fish-fauna of Mount Lebanon and that of the English Chalk, which belongs to a well-determined horizon, the author has undertaken a general survey of the genera, with the result that the two faunas are proved to have more forms in common than hitherto supposed. The Selachian fishes are scarcely comparable, *Notidanus* and *Squatina* being the only genera as yet recognized in the two formations, although the English teeth named *Lamna rhaphiodon* seem to belong to the Syrian shark named *Rhinognathus*; on the whole, those of Mount Lebanon exhibit the most modern facies, all traces of Hybodont Sharks and of *Ptychodus* being wanting. Chimæroids are unknown at Mount Lebanon, but abundantly met with in the English Chalk. Among Ganoids there are representatives of the Pycnodonts both in the Lebanon (*Palæobalistum*, *Coccodus*, *Xenopholis*) and in England (*Cœlodus*), but no identical genera can yet be recognized. Rhombic-scaled Ganoids are rare in the English Chalk (*Lophiostomus, Neorhombolepis*), and unknown in Mount Lebanon; traces of Acipenseroids also occur in the former, but have not been discovered in the latter; and at least one Crossopterygian genus occurs plentifully in England (*Macropo-*

* Abstract of paper read before Section C, British Association, Bath, September 1888.

ma), while no certain remains have been detected in the Syrian beds. *Belonostomus*, however, is common to the two formations, one species having been described from Mount Lebanon under the name of *Rhinellus laniatus*.

Of Physostomous Teleosteans, the great early families represented in the Chalk of England and the Upper Cretaceous of North America by *Portheus*, *Ichthyodectes*, *Protosphyræna*, and *Pachyrhizodus* are quite unknown in the deposits of Mount Lebanon; but in the latter locality *Enchodus* is abundant, having been described under the synonym of *Eurygnathus*, and this is accompanied by a closely-allied genus, *Eurypholis*, only differing in the possession of a few dermal scutes. The English *Pomognathus* may also be regarded as represented at Mount Lebanon, for the so-called *Phylactocephalus* merely differs in the presence of extremely delicate minute scales, which would not be preserved in a matrix of the nature of the Chalk; and *Aspidopleurus* (Mount Lebanon) possesses scutes undistinguishable from the detached examples long known in the English Chalk under the name of *Prionolepis*. *Dercetis*, also, is met with abundantly in the Syrian beds, being described under the synonym of *Leptotrachelus*. Among Elopine Clupeoids, some undescribed forms occur in the English Chalk, and one from Mount Lebanon has been erroneously assigned to the genus *Clupea* ('*C. Lewisii*'); and the supposed Salmonoid, *Osmeroides*, is common to the two formations, though inferior in size at the last-named locality. In the Syrian deposits, however, there are many more specialized Physostomi, such as *Cheirothrix*, *Spaniodon*, *Opistopteryx*, *Rhinellus*, *Scombroclupea*, *Diplomystus*, and *Clupea*, of which no traces appear to be discoverable in collections of English Chalk fossils. Among Physoclystous Teleosteans but few genera are common to the two formations under comparison. *Hoplopteryx*, with perhaps *Beryx*, represents the Berycidæ in both localities; but only a single imperfect specimen from the English Chalk can yet be assigned to any higher type, namely, *Platax* (?) *nuchalis*. At Mount Lebanon more specialized Physoclysti are numerous, as *Platax*, *Imogaster*, and *Pycnosterinx*; although to the latter have been erroneously assigned certain extraneous forms, including at least one well-marked Berycoid, the so-called *Pycnosterinx Lewisii*.

The conclusion is thus arrived at, that in those respects in which the Lebanon fish-fauna differs from that of the English Chalk, it exhibits greater specialization. Considered alone, therefore, it is distinctly of a more modern type than the latter, although the beds in which it occurs are regarded, from other evidence, as being of Senonian or even Turonian age.

On Bucklandium diluvii, *König, a Siluroid Fish from the London Clay of Sheppey**. By A. SMITH WOODWARD, F.G.S., F.Z.S.

In his well-known 'Icones Fossilium Sectiles,' pl. viii., No. 91,

* Abstract of paper read before Section C, British Association, Bath, September 1888.

König figures a remarkable fossil from the London Clay of Sheppey, which is mentioned in the text as not certainly determinable, but generally regarded, by the anatomists who have examined it, as pertaining to some type of lizard. This specimen is preserved in the British Museum, and the author has determined that it is truly the imperfect head and pectoral arch of a Siluroid. The roof of the skull is preserved almost as far forwards as the middle of the frontals; the pectoral arch is in position, though slightly bent backwards; and the mass of anchylosed anterior vertebræ, with the basioccipital, is displaced downwards and thrown beneath the clavicles. All the bones are remarkably strong, and the exposed surfaces are ornamented with large tubercles. The head must have been originally somewhat deeper than broad, and the roof exhibits no flattening but is strongly arched from side to side. Posteriorly, the supraoccipital projects in the usual manner, probably to meet a dermal plate upon the nape; and the post-temporal element seems to be merged with the bones of the postero-lateral angles of the cranium. It is impossible to determine the family position of the genus in the usual manner, but the skulls of the West-African *Auchenoglanis* and *Synodontis* appear to approach the fossil most closely. The provisional name of *Bucklandium diluvii* may be retained; and the fish is interesting as being the earliest undoubted Siluroid hitherto discovered.

On the Generic Name of the Tunny. By DAVID STARR JORDAN.

In the first edition of the 'Règne Animal,' 1817, pp. 313, 314, the generic names *Thynnus* and *Orcynus* were proposed for the Tunnies. The former name was given to the short-finned tunnies, type *Scomber thynnus*, L., and the latter to the species with long, ribbon-shaped pectorals, type *Scomber germo*, Lac.,=*Scomber alatunga* (*alalonga*), Gmelin.

It has been generally agreed that these two groups are generically identical. Many European writers have continued to use the name *Thynnus* for both, although this name was much earlier preempted by Fabricius for a genus of insects.

The name *Orcynus* is, however, also preoccupied, having been proposed by Rafinesque in 1815 in his worthless 'Analyse de la Nature' as a substitute for *Scombroides*, Lacépède.

According to current rules of nomenclature the group of Tunnies is left without a tenable generic name. I therefore propose the name *Albacora* for the group of which *Scomber thynnus* is the type, this species being with others widely known as *Albacore*. The subgenus or genus distinguished by the elongate pectorals may be called *Germo*, its type being *Sc. alalonga*, Gmelin.—*Proc. Acad. Nat. Sci. Philad.* 1888, p. 180.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 11. NOVEMBER 1888.

XLVII.—*On a new Species of the Genus* Atya (A. Wyckii) *from Celebes.* By SYDNEY J. HICKSON, M.A. (Cantab.), D.Sc. (Lond.), Hon. M.A. (Oxon.), Fellow of Downing College, Cambridge, Deputy Linacre Professor at Oxford.

[Plates XIII. & XIV.]

IN the mountain districts of Minahassa, in North Celebes, a favourite dish at the midday meal or "rijst tafel" is made by boiling a large number of the small "garneelen" which are caught in Lake Tondano. I first saw these small prawns when I was staying some 6 or 7 miles from the lake at a small mountain settlement called Kelelonde; but as they were at the time prepared rather for use than for observation, I trusted to a future visit to the lake to obtain some specimens for examination. Unfortunately I was unable to revisit the lake; but since my return home I have received a large consignment of these interesting forms from the Resident of Menado, the Jonkheer van der Wyck. As I at all times received much kindness and assistance from the Resident of Menado during my stay in Celebes, and am deeply indebted to him for the trouble he took to obtain specimens and information whenever I required them, I propose as a slight acknowledgement of my indebtedness to name this prawn (which turns out to be a new species of the genus *Atya*) *Atya Wyckii*.

Many species of this remarkable freshwater genus are now known. Species are found in Mexico, the West Indies, the Cape-Verde Islands, Java, Batjan, Bali, Celebes, the Philippines, Tahiti, Samoa, and New Caledonia.

In most cases they are found in rivers and brooks running into the sea, frequently accompanied by freshwater species of the genus *Palæmon*. In only one case do we find it mentioned that its habitat lies much above the sea-level, namely *A. sulcatipes*, 300 feet above the level of the sea at San Nicolao, Cape-Verde Islands (6, p. 49). The species I am about to describe lives in Lake Tondano, at a height of 2000 feet above the sea-level.

In many respects it is a much more slender and delicate form than any of its nearly allied species, and the three posterior pairs of walking-legs are equal in length and covered with a very sparse covering of fine hairs and a very few thick thorn-like hairs.

In most of the species of *Atya* the most remarkable feature is the mode of attachment of the chelæ of the first two walking-legs. The propodos is not attached at its proximal extremity to the carpos, but is prolonged nearly as far behind the articulation as it is in front. Moreover, the carpos has usually a most extraordinary shape, being either irregularly triangular or crescent-shaped, with the propodos articulating with the lower angle or horn. This is not the case with *A. Wyckii*. In the posterior chelate limb the carpos is long and cylindrical, as it is in the nearly allied genus *Caridina* and in *Palæmon* and other typical genera of the family. In the anterior chelate limb, however, the carpos is shorter and much wider at the distal than at the proximal extremity. In both the propodos is not prolonged behind the articulation with the carpos.

The tuft of hairs which is found at the ends of the chelæ in all species of *Atya* is also present in this one, and hidden among the dense hairs of each tuft is a hook. This hook is not seen at first, as it is completely hidden by the hairs; but it may readily be seen by soaking the claw in oil of cloves and examining it as a transparent object with the microscope. It may be that these hooks are present in other or all species of *Atya*; but they have never yet been figured.

We have, unfortunately, no precise information as to the size of many of the species; but this one seems to be, if not the smallest, at any rate one of the smallest known. Thus, of the species brought back by the 'Challenger,' *A. sulcatipes* is 68 millim. long, *A. serrata* 37 millim., *A. bisulcata*, ♂ 23 millim., ♀ 35 millim. The species from Lake Tondano is never more than 25 millim. in length. The largest females were 25 millim., but the average size of the females bearing ova was only 20 millim. The males are a little smaller and average 18 millim. in length. With these preliminary remarks, which justify the step I have taken in making a new species for it, I will proceed to describe its characters in detail.

The carapace is smooth and is not carinated dorsally until near the rostrum. The rostrum is sharp, laterally compressed, and bears on the dorsal side from twelve to seventeen serrations and on the ventral side very constantly nine. Occasionally there are a few hairs between the serrations, but more generally they are absent. The rostrum does not extend so far forward as the anterior end of the antennary plate. Just above the antennary termination of the branchiocardiac furrow the carapace bears a small tooth.

The pleon is smooth dorsally, compressed laterally, and the sixth somite is always considerably longer than the fifth (from once and a half to twice as long). The telson is long and pointed, reaching very nearly as far as the ends of the swimmerets; it bears four little hairy patches on each side and is terminated by a row of seven or eight short coarse hairs.

The eye-stalks are short and the eyes are but little larger in diameter than the stalk.

The three basal joints of the first pair of antennæ are fringed with long stiff hairs standing out at right angles to the joints; the first joint is provided with a long stylocerite almost as long as the second joint, and the second joint is also provided with a stylocerite, but a short one. The two long slender flagella are approximately equal in length and about as long as the carapace, *i. e.* 7 millim. The second antenna bears a broad ovate scapocerite, which is fringed internally with stiff-jointed hairs and extends forwards just beyond the anterior termination of the rostrum. The flagellum is about the same length as the body, *i. e.* 20 millim.

The mandibles (fig. 3) bear no palps. The free edge consists of a molar process (*a*), a short portion bearing coarse feathered hairs (*b*), a longer portion bearing much finer hairs (*c*), and a grinding-process (*d*) marked with very fine parallel ridges.

The first pair of maxillæ (fig. 4) are small, foliaceous, and divided into three branches. The outer branch or endopodite (*end.*) is tipped with one or two stiff feathered hairs.

The middle branch is more oval in shape and bears on its inner margin a dense row of short thorn-like hairs. The inner branch is semicircular in outline and bears a number of stiff, finely feathered hairs, one row arranged directly on the margin and one or two smaller rows on the under surface.

The second maxillæ (fig. 5) are also thin, delicate, foliaceous appendages. The protopodite is trilobed and bears a large number of long, delicate, but at the same time stiff hairs. The ovoid anterior end of the scaphognathite bears at its margin a few thick feathered hairs. The posterior end of the scaphognathite bears a tuft of remarkably long setæ terminated by a small hook. These long setæ are found in this position in all the species of the genus *Atya*. It is usually supposed that they are for the purpose of keeping the gill-chamber clean.

The first maxillipedes (fig. 6) are almost identical with those of *Atya bisulcata*. The inner margin is fringed with very long delicate hairs.

The second maxillipedes (fig. 7) also do not offer any very remarkable peculiarities. The outer border of the terminal joint being bent through an angle of 180° comes to face inwards, and is covered with a dense brush of very fine delicate hairs. The other joints are sparsely covered with stiff hairs. There is a broad mastigobranchial plume supporting a gill and a well-marked podobranch as well.

The third maxillipedes (fig. 8) are long and pediform. The basal and first joints of the endopodite are sparsely covered with long delicate hairs, the second joint bears a few short stiff bristles, the last joint bears a brush at the proximal end of fine close-set hairs, but more distally they become shorter and stiffer, until they become almost tooth-like at the extremity. The exopodite has a number of long delicate hairs towards its distal extremity.

On the basal joint there is a rudimentary mastigobranch and a well-developed arthrobranch.

Of the ambulatory limbs (pereiopods) the first two are chelate, the second pair being somewhat longer than the first pair. The carpos of the first pair is short and shaped like an elongated heart. The articulation with the propodos lies on the inner side of the lower angle of the distal extremity of the carpos. The propodos does not extend behind as well as in front of the articulations. The tuft of hairs at the extremity of the dactylos and propodos is very dense, and protects a sharp curved hook. Each of the hairs of these tufts bears a number of fine recurved hairlets, so that each tuft is capable of retaining a very considerable quantity of foreign material (fig. 14).

The carpos of the second pereiopod (fig. 10) is much longer than that of the first; it is almost uniformly cylindrical in shape, but swollen into a joint at its distal extremity. The chelæ are similar to those of the first pair.

The posterior three pairs of pereiopods are approximately equal in size and terminated by sharp pointed claws armed with short thorn-like hairs; they are covered only with a very sparse covering of hairs. The basal joint of each pereiopod except the last bears one or two very fine hairs, the somewhat reduced mastigobranchs.

The branchial formula appears to be

Pleurobranchiæ	0 . 0 . 1 . 1 . 1 . 1 . 1
Arthrobranchiæ	0 . 1 . 0 . 0 . 0 . 0 . 0
Podobranchiæ	1 . 0 . 0 . 0 . 0 . 0 . 0
Mastigobranchiæ	1 . 1 . 1 . 1 . 1 . 1 . 0

but as the specimens are very small and the gills not very well preserved in all cases, too much reliance should not be placed upon it. I examined a great many specimens very carefully, and the above represents the conclusions I came to. After a large number of careful measurements I drew up the following as the average measurements of the adults:—

	♂. millim.	♀. millim.
Entire length	19	22
Length of carapace............	7	8·5
Length of first antennæ........	7·5	9
,, second ,, ...	18	20
,, first pereiopod	5	5·5
,, second ,, ...	6·5	7
,, third ,, ...	6·25	6·5
,, fourth ,, ...	6	6·25
,, fifth ,, ...	5·5	6

For other species of the genus *Atya* see:—

(1) Leach.—Trans. Linn. Soc. Lond. vol. xi. 1815, p. 345.

(2) Randall.—"Crustacea of the Sandwich Islands," Journ. Acad. Nat. Sci. Philadelphia, viii. pt. i. p. 140 (1839).

(3) Newport.—"Species of *Atya* from New Zealand &c.," Ann. & Mag. Nat. Hist. vol. xix. 1847, p. 158.

(4) De Haan.—Fauna Japonica, Crustacea, 1850, p. 186, pl. O.

(5) Dana.—Crustacea, 1852, vol. i. p. 540.

(6) v. Martens.—"Ueber einige ostasiatische Süsswasserthiere," Archiv f. Naturgeschichte, vol. xxxiv. 1868, p. 47.

(7) Miers.—"Malaysian Crustacea," Ann. & Mag. Nat. Hist. ser. 5, vol. v. 1880, p. 382, pl. xv. figs. 3 and 4.

(8) Spence Bate.—"Crustacea Macrura," 'Challenger' Reports, vol. xxiv. pp. 691–702, pls. cxviii.-cxx.

EXPLANATION OF PLATES XIII. & XIV.

Fig. 1. *Atya Wyckii*, × 5 diameters.
Fig. 2. The same, natural size.
Fig. 3. Mandible. *a*, molar process; *b*, edge, bearing a few coarse feathered hairs; *c*, edge, bearing numerous fine hairs; *d*, triturating surface.
Fig. 4. First maxilla. *end.*, endopodite.
Fig. 5. Second maxilla. *a*, protopodite; *b*, anterior end of scaphognathite; *c*, posterior end of scaphognathite bearing long hooked hairs.
Fig. 6. First maxillipede.
Fig. 7. Second maxillipede. *a*, endopodite; *b*, exopodite; *c*, podobranch; *d*, mastigobranch.
Fig. 8. Third maxillipede. *a*, endopodite; *b*, exopodite; *c*, rudimentary mastigobranch; *d*, arthrobranch.
Fig. 9. First pereiopod. *d*, mastigobranch.
Fig. 10. Second pereiopod. *d*, mastigobranch.
Fig. 11. Third pereiopod.
Fig. 12. Chela of first pereiopod, showing the terminal hooks and brushes.
Fig. 13. Chela of second pereiopod.
Fig. 14. One of the hairs of the terminal brushes of a chela, showing the recurved hooks with which it is provided.

(I am indebted for figs. 1 and 2 to the skill and accuracy of my sister, Miss A. W. Hickson.)

XLVIII.—*Notes on Reptiles and Frogs from Dominica, West Indies.* By Dr. A. Günther, F.R.S., Keeper of the Department of Zoology, British Museum.

Two small collections made in the island of Dominica by Mr. Ramage, a gentleman engaged by the West-Indies Exploration Committee, contain a very interesting series of the reptiles and frogs of that island. Mr. Ramage has been working in the island for a short period only, so that we may expect further additions to this present list, which consists of five species of lizards, three of snakes, and two of frogs. Of particular interest would be observations on the mode of propagation of the *Hylodes*.

Thecadactylus rapicauda (Houtt.).

Two specimens, from Laudat and Laion. Generally distributed in the neotropical region.

Sphærodactylus Copii (Steind.).

Three specimens from Laion agree in the technical characters with this obscure species.

Ameiva fuscata.

Ameiva fuscata, Garman, Bull. Ess. Inst. xix. 1887, p. 5.

Closely allied to *A. surinamensis*; the Dominica form may be kept distinct on account of the modified scutellation of the fore and hind feet. The large scutes of the forearm are separated from the rows of scutella of the toes by broad areas of very minute scales.

Anolis alliaceus.

Anolis alliaceus, Cope, Proc. Ac. Sci. Philad. 1864, p. 168.
Xiphosurus oculatus, Cope, Proc. Am. Phil. Soc. xviii. 1879, p. 274. (Dominica.)
Anolis oculatus, Garman, Bull. Ess. Inst. xix. 1887, p. 30. (Dominica.)
Anolis lividus, Garman, *l. c.* p. 43. (Montserrat.)
Anolis sabanus, Garman, *l. c.* p. 39. (Saba.)
Anolis Leachii, part., Boul. Lizards, ii. p. 29.

Sixteen specimens of both sexes and all sizes.

Mr. Boulenger has not without reason referred the Dominica *Anolis* to *A. Leachii*. However, Dominica specimens can be recognized at a glance, on account of their extremely minute scutellation, resembling in this, as well as the other points, specimens from Montserrat and Saba, and differing widely from those from Guadeloupe (*Xiphosurus ferreus*, Cope, =*Anolis Leachii*, D. B., Bocourt). The difference in the size of the scales is conspicuous on every part of the head and body, and particularly on the temple. However, it must be admitted that some specimens in the Museum, for instance the type of Gray's *Anolis reticulatus*, whose origin is not known, are intermediate between the small- and large-scaled forms.

Having the type of *Anolis alliaceus* in the Museum, and having received from the museum at Harvard College specimens of Cope's *A. oculatus* and Garman's *A. lividus* and *A. sabanus*, I cannot entertain any doubt as to their identity.

The latter only might be kept distinct on account of its singular coloration; structurally it does not differ from the others.

Mabuia agilis (Radde).

Mabuia agilis, Boul. Liz. iii. p. 190; Günth. Biol. C.-Amer., Rept. p. 33.
Mabuia dominicana, Garman, Bull. Ess. Inst. xix. 1887, p. 52.

Eight adult specimens from Laudat and Laion.

Other well-authenticated localities are:—Mexico, Yucatan, Guatemala, Vera Paz, Salvador, Panama, Veragua, Venezuela, Ecuador, British Guiana, Rio Janeiro, Martinique, Island of Grenada.

Mr. Garman describes specimens from Dominica as a distinct species, said to be distinguished from *M. agilis* by having the supranasals separate from each other, and possessing from 68 to 72 scales in a series between the chin and vent. His *M. agilis* is stated to have the supranasals in contact with each other and only 54 or 56 scales between chin and vent.

The eight adult specimens from Dominica before me vary in both these respects; some have the supranasals in contact, others not. Between chin and vent there are 60 scales in two, 62 in one, 63 in two, and 64, 65, and 67 severally in single specimens. Therefore the characters on which Mr. Garman based his distinction are in these specimens so obviously variable that no herpetologist will place any reliance upon them.

But to prove the variability of these characters in this species beyond further dispute I took from a gravid female six embryos, all fully developed and about half the length of the mother. The mother had the supranasals in contact with each other and 62 scales between chin and vent. Of her progeny two had the supranasals as in the mother, in three they were separate from each other, whilst one might be assigned to either category. The scales on the abdomen are in 57 rows in two of these embryos and in 61, 62, 65, and 66 rows severally in their brothers.

Specific distinctions in these days are held to be, and often may be, matter of individual opinion, and, as a rule, I abstain from entering into any discussion about them; but they sometimes have a direct bearing upon wider and more important questions. In this case any one studying the distribution of reptiles over the West Indies would, by relying upon statements such as are propounded by Mr. Garman in his recent publications on West-Indian reptiles, be misled into the view of a more complete isolation and specialization of the faunas of the various islands than obtains in reality. He states in fact in this instance that the widely distributed *Mabuia agilis* has been sufficiently differentiated in Dominica to form a distinct species or whatever it may be called, whilst the examination of even a small number of examples disproves this statement. Distinctive characters, no matter how trivial they appear to be, become important enough to the systematic zoologist if they be found constant in a number of specimens and correlated to some other point of the life of an animal; but unless this has been ascertained to be the fact, their indiscriminate use impedes rather than advances zoology.

Liophis juliæ.

Acrophis juliæ, Cope, Proc. Am. Phil. Soc. xviii. 1879, p. 274.
Dromicus juliæ, Garman, *ibid.* xxiv. 1887, p. 281.

Eight specimens from Laudat and Laion.

This snake might be taken for one of the numerous variations of *L. cobella* or *L. Merremii*, but differs in having a larger eye and in its peculiar coloration, which is constant in all the specimens collected by Mr. Ramage.

In its physiognomy it reminds us much of some of the smaller species of *Dromicus*; but the subquadrangular black spots of the abdomen are very characteristic of snakes of the genus *Liophis*.

Habit moderately slender; head a little wider than the neck; orbit rather large, as wide as its distance from the nostril. Scales in seventeen rows, without apical groove. Ventral shields 159–168; anal divided; subcaudals 64–86 *.

Eight upper labials, the fourth and fifth entering the orbit. The single præorbital reaching to the upper surface of the head, but not extending to the vertical; two postoculars. Loreal square; temporals 1+2. Six of the lower labials are in contact with the chin-shields. Ground-colour slaty black, nearly every scale has a large bluish-white spot at the base. These spots are, however, irregular in size and also in

* Specimen	*a*:	V. 159,	SC. 85.
„	*b*:	V. 161,	SC. 84.
„	*c*:	V. 162,	SC. 76.
„	*d*:	V. 162,	SC. 81.
„	*e*:	V. 165,	SC. 64.
„	*f*:	V. 165,	SC. 86.
„	*g*:	V. 168,	SC. 81 (end broken off).
„	*h*:	V. 168,	SC. 81.

position, so that the pattern of coloration shows on the whole an irregular band of arrangement. Head above black, nearly all the shields with a light margin in front, a portion of the suture between the occipitals white or whitish. Lower parts white, either uniform or with scattered subquadrangular black spots. A very young specimen $7\frac{1}{2}$ inches long has the upper parts of a nearly uniform slate-colour.

The largest of the specimens measures 22 inches, of which the tail takes $6\frac{1}{2}$.

Dromicus leucomelas (D. & B.).

Alsophis sibonius, Cope, *l. c.* p. 275; Garman, *l. c.* p. 283.

Four specimens from Laudat.

This species occurs also in Guadeloupe and San Domingo, and, according to Duméril and Bibron, in Marie-Galante.

Boa diviniloqua (Laur.).

An adult and young specimen from Laion.

At present I am not prepared to give an opinion as to whether this snake should be specifically separated from *Boa constrictor*.

Cystignathus pentadactylus (Laur.).

Six adult specimens from Laudat.

This frog is widely distributed in Brazil and the Guianas. There is a distinct indication of the digital fringe, which induced me to refer the first specimen I saw from Dominica (Cat. Batr. Sal. p. 27) to *C. ocellatus*.

Hylodes martinicensis (Tsch.).

A great number of specimens of many colour-varieties from Laudat and Laion.

Occurs also in San Domingo, St. Vincent, and Barbadoes.

XLIX.—*A new Fossil Spider* (Eoatypus Woodwardii). By Henry C. McCook, D.D.*

While visiting the British Museum of Natural History at South Kensington, London, in the summer of 1887 I was

* From the 'Proceedings of the Academy of Natural Sciences of Philadelphia,' 1888, pp. 200–202.

permitted to examine some fossil insects and fossil spiders therein contained, under the kind direction of Dr. Henry Woodward, the Keeper of the Geological Department. Among the Aranead fossils I observed one which appeared to me to be new to science and closely related to the genus *Atypus*. The fossil is a tolerably well-preserved impression taken from the Eocene Tertiary at Garnet Bay, Isle of Wight.

After my return to America, Dr. Woodward sent me casts both in wax and plaster, from which the appended description has been made. These impressions somewhat shook the view which I was at first inclined to take as to the systematic place of the specimen. But on the whole I am inclined to adhere, though with some qualification, to my original judgment.

The only hesitation that an araneologist would feel in placing the species would be as to whether it belongs to the Saltigrades or jumping spiders, among the Attidæ perhaps, or to the Territelariæ, among the Atypinæ. Those who have examined fossils of insects and other small Arthropods, especially of the order Araneæ, will understand the difficulty of determining with absolute accuracy their generic and specific rank, and will therefore not be surprised at this hesitation concerning the above-named specimen.

The shape of the cephalothorax to some extent, especially as viewed in the original fossil in the British Museum, and more particularly the character of the falces, as noted in a side view of the specimen shown in fig. 1, indicate that the fossil may belong to the family Atypinæ and be closely related to *Atypus*. The name *Eoatypus Woodwardii* is therefore suggested for the species. If this inference is correct, we may possibly have in this new fossil the distant progenitor of the present British species of *Atypus* (*Atypus piceus*).

Order ARANEÆ.

Family **Atypinæ**.

EOATYPUS, nov. gen.

Eoatypus Woodwardii.

The total length of the body, including mandibles, is 8 millim.; length of abdomen 4 millim.; length of cephalothorax 3 millim.; of mandibles 1 millim.; width of abdomen at the apex 3·5 millim.; width of abdomen at the base 1·75;

width of the cephalothorax at the caput 2·25; width of cephalothorax from margin to margin across the middle 3·5 millim.; length of palps 2 millim. Both palps are represented by rather thin lines, showing slight marks of joints, and on one palp is a suggestion of a terminal bulb which might indicate it to be a young male.

The caput and median part of the cephalothorax as viewed from the cast are well elevated and defined; the cephalothorax narrows towards the abdomen. But in the original

Fig. 1. Fig. 2.

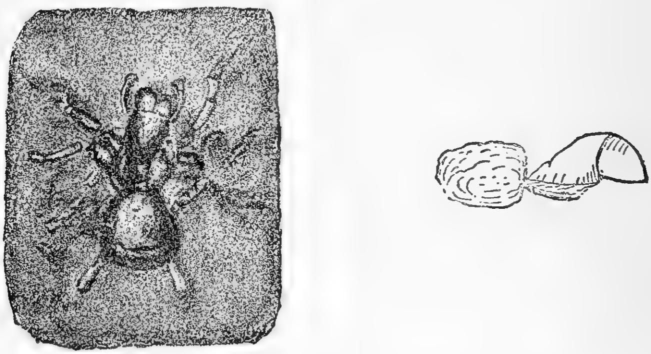


Fig. 1.—*Eoatypus Woodwardii*, × 4.
Fig. 2.—Ditto, × 4. Outline side view of body.

impression in the rock and less distinctly on the casts there appear outlines on either side of the margin of the cephalothorax, as though by pressure those parts had been flattened, and only the caput and a part of the dorsum of the cephalothorax along the median line had withstood the pressure and had been pushed upward into the matrix by the same. These outlines are visible, but not so distinct in the plaster cast. It is at this point that one experiences difficulty in determining whether the specimen is related to *Attus* or to *Atypus*. If the broader marginal markings are impressions of the original cephalothorax, the inference would be that the spider represented by this fossil belonged to the Atypinæ. That such is the case I am strongly inclined to believe, both on the ground just named and the characteristics of the mandibles, as well as the general facies of the impression and cast (see fig. 1) *. In the absence of the characteristic eyes

* This figure has been drawn from the cast and compared carefully with one kindly made for me in the Geological Department of the British Museum, and furnished by the Keeper, Dr. Woodward.

and long, jointed, superior spinners it would be impossible to relegate the specimen to the genus *Atypus* with absolute authority. Neither would one be warranted in characterizing a new genus by the absence of eyes and spinners, since these organs were doubtless present, but have simply failed to impress themselves upon the matrix. I have therefore felt compelled on the one hand to propose a new generic place for this fossil, and on the other to present no sharply defined generic characteristics. Indeed, it must be admitted that besides expressing the general facies of the fossil, as above described, the generic value of the name *Eoatypus* consists largely in assigning the specimen rank as a fossil spider.

On one side portions of all the four legs are preserved, the first three showing the articulations at the trochanter, femur, and patella. The second leg shows also the patella entire, indicating the articulation with the metatarsus. On the other side a portion of the femur of the first leg is shown with the patella and its articulations. Both hind legs are represented by the apical parts of the femora.

The horizon from which this new fossil was obtained is that from which most European fossil spiders have been taken, viz. the Eocene Tertiary. It is also that from which have come our American Aranead fossils as recently studied by Mr. S. H. Scudder from specimens collected at Florissant, Colorado.

L.—*The* Staphylinidæ *of Japan.* By Dr. D. Sharp.

[Continued from p. 295.]

Tachyusa coarctata.

Tachyusa coarctata, Er. Käf. Mark-Brand. i. p. 308.

Apparently a common species in the Japanese archipelago, and found by Mr. Lewis as far north as Hakodate. The species is very variable in Japan as well as in Europe.

Xenusa rufescens.

Tachyusa rufescens, Sharp. Trans. Ent. Soc. Lond. 1874, p. 11.

The genus *Xenusa,* recently established by Rey for a part of *Tachyusa*, appears to be a valid one, and we have two species of it in Japan. Fauvel thinks it the same as *Myrmecopora*, Saulcy, but this appears to me very doubtful. *T. algarum* is also a *Xenusa*.

Ectolabrus, nov. gen.

Corpus sat latum, posterius acuminatum, fortiter punctatum, pubescens, thorace transverso, anterius rotundato, posterius bisinuato. Antennæ sat graciles, laxe articulatæ. Palpi maxillares articulo ultimo sat elongato, gracillimo, præcedente gracili, latitudine plus duplo longiore. Genæ marginatæ. Prosternum brevissimum. Coxæ intermediæ subcontiguæ, mesosterno inter eas processum elongatum tenue, tenuiter carinatum formante. Pedes graciles; tarsi anteriores 4-articulati, intermedii et posteriores 5-articulati; posteriorum articulo basali secundo haud duplo longiore.

The insect for which I establish this genus is in appearance somewhat intermediate between *Homœusa* and *Dinarda*. None of the examples brought back by Mr. Lewis are in good preservation, and the structure of the tarsi has not been very clearly perceived by me; but I feel pretty sure that the intermediate feet are five-jointed.

Ectolabrus laticollis, n. sp.

Fusco-niger, haud nitidus, prothoracis marginibus elytrisque ferrugineis; antennarum basi pedibusque rufis; fortiter punctatus; thorace valde transverso, elytris paulo latiore, angulis posterioribus acutis.

Long. 4 millim.

Antennæ with the three basal joints yellow, the others darker; third joint a little longer than second, fourth to tenth each a little broader than its predecessor, the fourth longer than broad, seventh to tenth each transverse. Head broad and short, scarcely half as broad as the thorax, closely and coarsely punctate. Thorax twice as broad as long, sides rounded and narrowed in front, the base rounded in the middle, nearly concealing the scutellum, the hind angles slightly acute, the surface closely and coarsely punctate, with a vague depression in front of the base in the middle. Elytra a little longer than the thorax, roughly punctate, hind margin deeply sinuate on each side. Hind body acuminate behind, moderately closely punctate and pubescent, beneath densely pubescent.

Miyanoshita and Nikko; main island.

Group Bolitocharina.

Autalia rufula, n. sp.

Rufula, tenuiter pubescens ; abdomine ante apicem nigro ; thorace tricanaliculato.
Long. $2\frac{1}{2}$ millim.

Antennæ rather slender, third joint shorter than the second, penultimate joints slightly transverse. Head almost impunctate, neck slender. Thorax small, only half as broad as the elytra, about as long as broad, with a deep channel on the middle in front and with a lateral channel or depression on each side, these latter convergent behind. Elytra elongate, deeply marked at the base with four depressions.

Nagasaki, in March ; four examples.

This minute insect is not one half the size of its European congener *A. impressa*, to which, however, it appears to be rather closely allied in other respects.

Bolitochara varipes, n. sp.

Nitida, picea, abdomine basi rufo, nigro-variegato; antennis basi pedibusque testaceis, femoribus fuscis; subtiliter punctulata, elytris crebrius fortiusque punctatis.
Long. 4 millim.

Antennæ thicker externally, second and third joints equal in length, fourth and fifth each about as long as broad, sixth to tenth transverse, terminal joint stout, obtuse, longer than the two preceding together, its extremity paler. Head very feebly punctate. Thorax considerably narrower than the elytra, not quite so long as broad, feebly punctate, shining, with a very distinct fovea in front of the base in the middle. Elytra much longer than the thorax, closely and coarsely punctate, the humeral angle reddish. Hind body shining, almost impunctate, varied with red and black, the red predominating on the basal, the black on the apical segments. Legs yellow, the middle and hind femora infuscate.

Kashiwagi, June 22nd, 1881 ; two specimens.

Leptusa impressicollis, n. sp.

Minus elongata, subdepressa, rufo-ferruginea, capite fusco, pedibus testaceis; prothorace fortiter transverso, basin versus longitudinaliter biimpresso.
Long. $2\frac{1}{4}$ millim.

Antennæ short, thicker externally, fourth joint small, fifth to tenth transverse, the last of them strongly so. Head nearly black, dull, obsoletely, moderately closely, rather coarsely punctate. Thorax rather narrower than the elytra, twice as broad as long, rather coarsely punctate, with two rather indefinite impressions on the middle near the base. Elytra short, a little broader and a little longer than the elytra, moderately closely granulose-punctate, somewhat shining. Hind body shining, the basal segments sparingly punctate, the apical nearly impunctate.

Yokohama and Nagasaki in early spring; found under the bark of fir-trees.

Tachyusida velox, n. sp.

Elongata, angustula, rufo-brunnea; abdomine ante apicem picescente; antennis pedibusque rufis; opaca, densissime subtiliter punctata; prothorace vix transverso, basin versus angustato.

Long. 5 millim.

Antennæ elongate, rather stout, third joint slightly longer than the second, fourth to tenth each slightly longer than its predecessor, the tenth slightly transverse, terminal joint acuminate, not so long as the two preceding together; palpi slender. Head elongate, narrowed behind, much narrower than the thorax, extremely densely and finely punctured, quite dull. Thorax about as broad as the elytra, nearly as long as broad, very densely and extremely finely punctured, quite dull, much narrower at the base than in the middle. Elytra scarcely longer than the thorax, densely and finely punctured, dull. Hind body elongate and slender, rather shining, finely punctate. Legs elongate. Tarsi long and slender, the basal and the apical joint each very long. Male with a short carina or elongate tubercle on each of the terminal and penultimate dorsal plates.

Kashiwagi, June 1881; two specimens.

Silusa rugosa, n. sp.

Rufa, opaca, fortiter dense punctata; abdomine nitido, ante apicem nigro; elytris fortiter granulatis.

Long. 3 millim.

Antennæ rather short, thicker externally, third joint slightly shorter than the second, sixth to tenth joints transverse. Head extremely densely punctured, quite dull. Thorax strongly transverse, slightly narrower than the elytra, the sides rounded in front, considerably narrowed behind, coarsely, extremely densely punctured, quite dull. Elytra short, but distinctly longer than the thorax, very coarsely and densely punctured, so that the surface appears to be granulate. Hind body with the basal segments rather closely punctured, the apical nearly impunctate. Legs rather short. Male with a fine carina on the middle of the terminal and penultimate dorsal plates.

Nagasaki, in early spring.

I have not been able to see the labial palpi in this and the allied insects, all of which appear to be rare, and I cannot say whether they are two-jointed or three-jointed ; if the latter be the case, this insect would be placed in *Bolitochara* ; but I think it will prove to be more nearly allied to *Silusa* (*Stenusa*) *rubra*.

Silusa rorida, n. sp.

Rufo-nigra, opaca, densissime punctata, abdomine basi rufo ; antennis fusco-testaceis, tarsis testaceis ; pube albida vestita, præsertim in capite densa.

Long. $2\frac{1}{4}$ millim.

Antennæ rather short and slender, first joint infuscate yellow, second and third paler, fourth to tenth fuscous, terminal joint short, a little paler than the preceding, tenth transverse. Head extremely densely punctured, quite dull. Thorax a little narrower than the elytra, rather strongly transverse, much narrowed behind, like the head excessively densely punctate and quite dull. Elytra a good deal longer than the thorax, quite dull, densely covered with finely rugose-granular sculpture. Hind body very sparingly punctured, shining. Legs nearly black, with the tarsi pale.

Oyama ; one specimen.

Closely allied to *S. rugosa*, but smaller, darker in colour, with more slender antennæ and less coarse sculpture.

Silusa punctipennis, n. sp.

Rufo-nigra, capite thoraceque densissime punctatis, opacis ; elytris fortiter punctatis, subnitidis ; abdomine basi sanguineo ; antennis rufis, pedibus piceis.

Long. 3 millim.

Antennæ rather short and slender, thicker externally. Head much narrower than the thorax, extremely densely punctured, quite dull. Thorax rather strongly transverse, distinctly narrowed behind, very densely rugose-punctate, quite dull. Elytra rather longer than the thorax, densely and coarsely punctate. Hind body shining, rather closely punctate.

Nikko; one specimen.

Though allied to the preceding two species by the sculpture of the head and thorax, this differs by the more normal sculpture of the elytra; it is more like a *Bolitochara* in appearance than are the other two species.

Silusa conferta, n. sp.

Subdepressa, fusco-rufa, densissimo subtiliter punctata; abdomine parce punctato, nitido; antennarum basi, elytrorum marginibus pedibusque rufo-testaceis, abdomine ante apicem nigro.

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

Antennæ short, moderately stout, thicker externally, fifth to tenth joints transverse. Head a little narrower than the thorax, extremely densely punctured, dull. Thorax rather strongly transverse, a little narrowed behind, extremely densely, rather finely punctate, quite dull. Elytra considerably longer than the thorax, densely punctate, not quite dull, the punctuation being coarser than that of the head and thorax; the hind margins and shoulders are more distinctly rufescent than the other parts. Hind body very sparingly punctured, basal segments rufescent, the others black; legs sordid yellow.

Miyanoshita; two specimens, in bad preservation.

In this species I have been able to get a rather unsatisfactory view of the labial palpi; they are apparently slender and elongate, only two-jointed. *S. conferta* is distinguished from the preceding species by the more depressed form and finer sculpture.

Silusa crassicornis, n. sp.

Minus depressa, rufo-testacea, abdomine ante apicem fuscescente; antennis articulis 4^{o}–10^{m} fuscescentibus; capite thoraceque densissime punctatis, opacis, hoc fortiter transverso, basin versus angustato.

Long. $2\frac{1}{3}$ millim.

Antennæ rather stout, second and third joints equal, sixth to tenth transverse, terminal joint elongate and paler in colour than those preceding it. Head much narrower than the elytra, very densely punctate. Thorax twice as broad as long, its punctuation like that of the head. Elytra short and broad, rather longer than the thorax, rather roughly and coarsely punctate. Hind body convex and setose beneath, flat and shining above, sparingly punctate.

Yokohama; two specimens.

In this species the basal joint of the hind tarsus is as long as the two following together and the middle coxæ are rather more distant than in the previous species; the labial palpi, so far as I can gather from an imperfect view, are of the *Silusa* type of construction.

Silusa lanuginosa, n. sp.

Nigra, pubescens; antennis, pedibus, elytris abdominisque basi et apice rufis; thorace transverso, basi in medio impresso; abdomine parce punctato.

Long. 4 millim.

Antennæ moderately long and stout, third joint equal to second, fifth to tenth differing little from one another, each transverse, terminal joint quite twice as long as the tenth. Head finely punctate. Thorax slightly narrower than the elytra, twice as broad as long, not narrowed behind, closely and rather finely punctate, very distinctly pubescent, with a transverse impression in front of the base in the middle; in colour red suffused with black. Elytra a good deal longer than the thorax, closely and somewhat coarsely punctate. Hind body finely and sparingly punctate. Male with an extremely fine crenulation of the hind margin of the last dorsal plate.

Nagasaki, 16th February, 1881; three specimens.

This is a true *Silusa* with the labial palpi elongate and rigid.

Placusa infima.

Placusa infima, Er. Gen. et Spec. Staph. p. 196.

Nagasaki, in March and April.

The specimens are in very bad condition, and there is no male in which the characters can be seen, so that the determination is doubtful; if not *P. infima*, the species is no doubt new.

Epipeda granigera, n. sp.

Piceo-ferruginea, capite, thorace elytrisque densissime punctatis, opacis, abdomine punctato, nitido, pedibus flavis; prothorace subquadrato, medio vage depresso.

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

Antennæ short and stout, red at the base, darker beyond, third joint a little shorter than the second, fifth to tenth joints strongly transverse, terminal joint elongate, acuminate, nearly three times as long as the tenth. Head much narrowed behind the prominent eyes, densely punctate, quite dull. Thorax narrower than the elytra, not so long as broad, very densely covered with a granular sculpture, and broadly vaguely depressed along the middle. Elytra scarcely longer than the thorax, sculptured like it, but not quite so dull. Hind body finely punctate, the terminal segments almost impunctate.

Nagasaki, 16th March, 1881; one specimen.

Epipeda fraterna, n. sp.

Valde depressa, nigra; elytris fuscis, pedibus sordide testaceis; subtiliter punctata, subopaca; prothorace plano, medio vix perspicue impresso.

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

This obscure little insect is in all respects very similar to the common European *E. plana*, but is apparently a little smaller and narrower, and the male characters are not sufficiently similar to allow it to be considered a mere variety. In this sex the raised processes on the last dorsal plate are more distinct and enclose a much wider space, and each projects beyond the hind margin, so as to form a short, acute, free spine; the hind margin in the middle is rounded, and there is a slight emargination on each side close to the spine.

Miyanoshita, December 22nd, 1880; five specimens.

Epipeda Lewisa.

Homalota Lewisa, Sharp, Trans. Ent. Soc. Lond. 1874, p. 14.

Brachida clara.

Homalota (*Brachida*) *clara*, Weise, Deutsche ent. Zeitschr. xxi. 1877, p. 90.

Hagi (*Hiller*); Yokohama, Nagasaki, and Hitoyoshi, in spring, rare (*Lewis*).

Gyrophæna triquetra.

Gyrophæna triquetra, Weise, Deutsche ent. Zeitschr. xxi. 1887, p. 91.

Gyrophæna sapporensis, n. sp.

Brevis, subdepressa, fusca, capite abdomineque nigricantibus; an-

tennis pedibusque flavis; elytris fulvis, margine exteriore nigro; thorace parcissime punctato, elytris parce subtiliterque granulatis.
Long. $2\frac{1}{2}$ millim.

Antennæ short, clear yellow, fourth joint small, fifth to tenth similar to one another, each transverse. Head broad and short, almost impunctate. Thorax strongly transverse, narrower than the elytra, with three or four punctures on each side of the middle, forming an irregular series. Elytra a little longer than the thorax, bearing distant, minute, flattened granules. Hind body very finely and distantly punctate. In the male there is a series of very minute granules extending across the penultimate dorsal plate just in front of the hind margin; the terminal plate bears some coarser flat granulations irregularly placed, and its hind margin forms a triangular prominence.

Sapporo; three specimens.

In addition to these two species Mr. Lewis's collection contains a third *Gyrophæna* of very pallid colour; but the examples are not in a fit condition for examination.

Myllæna japonica, n. sp.

Elongata, angusta, omnino subtilissime punctulata, opaca, fusco-ferruginea; antennis palpis pedibusque testaceis; thorace transverso, basi utrinque leviter sinuato; elytris illo paulo longioribus.
Long. $3\frac{1}{2}$ millim.

Antennæ very slender, scarcely any thicker externally, tenth joint much longer than broad. Head about half as broad as the elytra. Thorax nearly twice as broad as long, convex transversely, much narrowed in front, the punctuation excessively minute, the base a little sinuate on each side near the hind angles, these rectangular.

Nagasaki and Miyanoshita, in April and May.

This is similar in size and colour to the European *M. elongata*, Rey, but has more slender antennæ, and its thorax more transverse and distinctly sinuate at the base on each side.

Group Oligotina.

Protinodes, nov. gen.

Tarsi omnes breves, quadriarticulati, posteriores articulo basali brevissimo; antennæ 11-articulatæ; coxæ intermediæ fere contiguæ.

The number of genera of Aleocharidæ with only four joints to the posterior tarsi is so small that the above characters are sufficient at present for the identification of the insect from which they are taken. It is of short convex form, somewhat intermediate in appearance between *Brachida* and *Oligota*. The maxillary palpi are small and short, the sides of the prothorax are very acutely inflexed, and the front coxæ are oblique, rather perpendicular in direction; the mesosternum is produced between the middle coxæ, forming a process very slender at the extremity and touching the raised margin on the front of the metasternum, which forms an angle immediately behind the coxæ without being produced between them. The basal joint of the hind tarsus is extremely short, projecting but little beyond the apex of the tibia; the second and third joints are short and equal, the fourth joint is longer than the other three together, and has beneath an excision giving rise in certain positions to an appearance of its forming two joints.

In an arrangement of the Aleocharidæ where predominance is given to the tarsal structure, the genus will be placed at the commencement of the Oligotina.

Protinodes puncticollis, n. sp.

Brevis, convexus, dilute rufus, brevissime pubescens; thorace elytrisque fortiter punctatis, abdomine subtiliter punctato.
Long. $2\frac{1}{2}$ millim.

Antennæ rather short, not stout, fourth joint small, very much smaller than the fifth, fifth to tenth differing little from one another in length, each a little broader than its predecessor, tenth about as long as broad, terminal joint longer than the tenth. Head small, with convex eyes, densely and coarsely punctate. Thorax strongly transverse, short at the sides, the base greatly rounded, the surface closely and coarsely punctured. Elytra rather longer than the thorax, coarsely punctate, rather shining. Hind body short, convex beneath, the upper surface finely and rather indistinctly punctured, the penultimate segments vaguely darker in colour.

Tokio; three very mutilated specimens.

Subfam. *Tachyporinæ*.

This subfamily proves to be extremely well represented in Japan, and the fauna is in this respect more similar to that of North America than to that of Europe.

Tachinus obesus.

Tachinus obesus, Weise, Deutsche ent. Zeitschr. xxi. 1887, p. 92.

A unique female; Hagi (*Hiller*). Not found by Lewis.

Tachinus japonicus, n. sp.

Major, nigricans, nitidus; antennarum basi et articulo ultimo, palpis pedibusque testaceis; prothorace picescente, marginibus dilutioribus; elytris fuscescentibus, subrufis; prothorace fere impunctato, evidenter striguloso, elytris parce sat fortiter punctatis. Long. 9–11 millim.

Antennæ with the four basal joints red, the terminal joint also pale, the intermediates darker, the penultimate joints not so long as broad. Thorax only excessively finely and sparingly punctate, but with the fine reticulation dense and evident. Hind body shining, moderately closely and distinctly punctate.

In the male the terminal dorsal plate is slender, little produced in the middle, with the apex of this short broad lobe emarginate; the lateral angles form each a broad, extremely short prominence; the corresponding ventral plate is produced into two very long laciniæ, which are not widely separated, are curved downwards, and nearly contiguous at their apices; the preceding ventral plate is very deeply and broadly emarginate, with the sides of the emargination twisted so as to be perpendicular at the angles; in front of the emargination the surface is depressed, the posterior part of the depression being broadly asperate.

In the female the last dorsal plate is trilobed, the three lobes being of one length and the middle one separated by a narrow space from the lateral; the middle lobe is the broadest and is obtuse behind, the lateral lobes are also obtuse; the last ventral plate is truncate in the middle behind, the margin of the truncation being setulose; each side of this middle lobe is armed with a short, slender, but truncate spine, and each lateral angle is produced to form a longer truncate spine, which does not, however, extend so far back as the intermediate spine, this latter itself extending considerably less backward than does the middle lobe.

A distinct species, somewhat allied to *T. humeralis*, but the individuals are larger, with very different punctuation, and strongly marked distinctions exist in the sexual characters.

The species is probably abundant in the northern parts of the archipelago; it was found at Awomori, at Chiuzenji in August, and at Nikko in June.

Tachinus trifidus, n. sp.

Niger, nitidus; antennarum basi pedibusque testaceis; elytris ad basin late vageque rufis, prothoracis lateribus angustissime piceis; prothorace subtilissime parce punctulato, elytris crebrius fortiusque punctatis.
Long. 6 millim.

Antennæ rather short and moderately stout, the two basal joints yellow, the others dark, tenth joint about as long as broad. Thorax and elytra finely strigulose, the former only finely punctate, the latter red about the base and shoulders. Hind body shining, finely and moderately closely punctate.

This species closely resembles *T. basalis*, Er., but the female characters are totally different. In this sex the last dorsal plate ends in four acuminate spines, the lateral interspace being nearly twice as long as the middle one; the lateral spines project slightly further backwards than do the middle pair. The last ventral plate is six-toothed, the lateral tooth and the intermediate on each side being elongate and slender; the lateral tooth is in fact considerably longer than the median pair.

In the male the last dorsal plate terminates in two rather short distant teeth; the external angle of the plate is not dentate and only projects as far back as the base of the notch separating the two middle teeth; the last ventral plate forms two extremely large laciniæ, a little incurved at their apices; the hind margin of the preceding segment is broadly but slightly emarginate and somewhat deflexed, the surface in front of it being flat and smooth; there is also a corresponding smooth space on the preceding segment.

This has only been met with in the main island, six individuals having been found at Kiga, Miyanoshita in May, and Nikko.

Tachinus bidens, n. sp.

Angustulus, niger, nitidus, antennarum basi, pedibus prothoracisque lateribus testaceis; elytris ad humeros rufis; abdomine crebrius subtiliter punctulato.
Long. 6 millim.

Antennæ slender, the four basal joints yellowish, the rest darker, tenth joint distinctly longer than broad. Thorax black, broadly, especially at the posterior angles, reddish or yellowish at the sides, finely and not closely punctate, and finely strigulose. Punctuation of elytra fine, though a good deal coarser than that of the thorax; their colour is dark, but a large vague red mark exists at the shoulder. The punctuation of the hind body is close and fine, and the hind margins of the segments are yellowish.

In the male the last dorsal plate forms in the middle an angular projection, the apex of the projection being divided by an angular notch that is evidently longer than broad, and each outer angle of the plate projects as a short but quite distinct tooth; the corresponding ventral plate terminates in two slender, parallel, linear, widely separated laciniæ, and each outer angle forms a rather long tooth; the hinder part of the preceding plate is deeply and rather broadly circularly emarginate, and the posterior part of the emargination is set with asperities; at each side of the emargination behind the surface is elevated in a plicate manner.

This species resembles *T. bipustulatus*, but is more slender and has longer and thinner antennæ and very distinct male characters; the slender, parallel, distant laciniæ of the last ventral plate are remarkable, as is also the fact that the sides of the emargination of the preceding segment are plicate in such a manner as to form the rudiments of laciniæ. The female is unknown.

Three specimens have been found; Nikko, 25th August, 1881, and Sapporo.

Tachinus luridus, n. sp.

Niger, nitidus; elytris ex parte majore luride rufescentibus, antennarum basi piceo, pedibus rufis; thorace elytrisque subtilius punctatis, dense strigulosis; abdomine sat crebre vix subtiliter punctato, tenuiter sed perspicue pubescente.

Long. 6 millim.

Antennæ black, with the basal joints rather paler, tenth joint about as long as broad. Thorax entirely black, only very finely and sparingly punctate, but very evidently strigose. Elytra more closely and coarsely punctate, but still only finely; they are of a rufescent colour, becoming darker behind and about the suture.

In the male the middle part of the last dorsal plate is only a little prolonged and forms in the middle two short teeth, which project only slightly further back than do the short, broad, lateral teeth. The last ventral plate is divided in the middle by a deep, narrowly oval excision; the sides of the excision are not prolonged into laciniæ, and there is only an extremely short lateral tooth on each side; the posterior part of the preceding plate has in the middle behind a narrow deep depression, the anterior part of which is furnished with coarse granules. In the female the last dorsal plate is divided into three lobes by two incisions, but the lobes are not separated from one another and the last ventral plate is nearly simple, it being scarcely produced in the middle; but its hind margin is for a considerable breadth finely ciliate.

Though very similar to *T. trifidus* and *T. bidens* this species is very distinct; it will, apart from the sexual characters, be easily recognized by the entirely black thorax and the more distant pubescence of the hind body. Only two individuals have been found.

Hakone and Kiga.

Tachinus nigrinus, n. sp.

Niger, subnitidus; antennarum basi rufo, pedibus piceo-rufis; capite, thorace elytrisque subtiliter punctulatis, minus subtiliter strigulosis; abdomine dense subtiliter punctato.

Long. 7 millim.

Antennæ short and stout, four basal joints red, the others dark, third joint only a little longer than the second, tenth a good deal broader than long; palpi red. Thorax and elytra with their punctuation fine, but the reticulate strigulosity rather coarser and more evident than usual. Legs short and rather stout.

In the male the last dorsal plate is but little produced in the middle, and is divided in the middle by a short angular notch; the lateral teeth are quite short and extend about as far back as the middle notch; the last ventral plate is very deeply divided and the sides are prolonged into laciniæ, which are much curved downwards; the preceding plate has the hind margin broadly emarginate in the middle and the hind margin of the emargination set with a narrow band of asperities. In the female the last dorsal plate is quadrispinose, the two middle teeth are rather slender and are widely separated by a deep and rounded notch, the lateral teeth are very elongate and reach slightly further back than do the middle ones; the last ventral plate is sexdentate, the intermediate and external teeth being of about equal length and longer than the middle teeth, the latter, however, projecting rather farther backwards.

Kiga and Miyanoshita, but only two specimens. The species is quite different from any other I am acquainted with.

Tachinus sibiricus, n. sp.

Niger, nitidus; antennarum basi pedibusque rufis; thorace elytrisque subtiliter strigulosis, illo parce subtiliter, his crebrius et magis fortiter, punctatis; abdomine subtiliter fere dense punctato.
Long. 6 millim.

Antennæ moderately long and stout, the four basal joints red, the others darker, tenth about as long as broad. Thorax scarcely at all picescent at the sides.

This is similar to the common European species of *Tachinus*, especially to *T. pallipes*, but the individuals are only about half the size of those of that species, so that the resemblance to *T. laticollis* is still greater: but from that species it differs by the sexual characters, which, however, are sufficiently similar to warrant the two species being really allied.

In the male the middle lobe of the last dorsal plate is divided by a rather deep narrow notch, and each outer angle forms a rather stout, not very short tooth; the last ventral terminates in two rather long, slender, widely separated laciniæ, the space separating the laciniæ being continued backwards as a narrow excision; external to the laciniæ on each side there is a long slender tooth; the preceding plate has a very deep excision, the margin of which is broadly set with asperities; at the hind margin on each side of this excision there is a slight additional cavity, also asperate, and forming as it were an adjunct or continuation of the excision, and outside of this the surface is a little plicate, elevated and prolonged backwards; in the female the last dorsal plate ends in four long acuminate spines of about equal length, the middle notch being quite narrow; the last ventral is sexdentate, the external tooth on each side being rather long.

This species is described from individuals found at Lake Baikal, in Eastern Siberia; a single female found by Mr. Lewis at Chiuzenji, 22nd July, 1881, apparently agrees with the Siberian individuals except in slight details; but it would be proper to examine Japanese individuals of the other sex before positively coming to a decision on this point.

Tachinus mimulus.

Tachinus mimulus, Sharp, Trans. Ent. Soc. Lond. 1874, p. 16.

Only four or five individuals have been brought this time. Nagasaki, Tokio, Nikko.

Tachinus nigriceps, n. sp.

Piceus, nitidus; capite nigro; antennis, palpis, thorace pedibusque flavis; thorace breviore, parce subtilissime punctulato; elytris abdomineque crebrius minus subtiliter punctatis.
Long. 4 millim.

Antennæ rather long and slender, entirely yellow, third joint much longer than second, tenth about as long as broad. Head quite black, very shining, broad and short. Thorax strongly transverse, shining yellow, broadly rounded at the hind angles. Elytra and hind body shining, very distinctly, not altogether finely, punctate.

In the female the last dorsal plate is trifid, the middle lobe being broad, parallel-sided, and terminated behind by a broad short emargination, so that each angle of the lobe is slightly acute; this central lobe is separated by only a small notch from the short broad lateral tooth, which projects just as far back as the middle lobe. The last ventral is sexdentate, the two middle teeth being broad and very short, the external tooth longer and slender.

This distinct species is somewhat similar to *T. collaris*. Only a single example has been found.

Tachinus impunctatus, n. sp.

Nitidus, niger; antennarum basi, palpis, thorace pedibusque testaceis; fere impunctatus; abdomine nitidiore; antennis gracillimis.
Long. 7–8 millim.

Antennæ elongate, very slender, one or two of the basal joints yellow, the others dark, tenth joint three times as long as broad; palpi elongate. Head narrow, impunctate, black. Thorax quite shining, impunctate, yellow, the hind angles much rounded. Elytra nearly black, pitchy at the hind margin, without punctuation, and only very obsoletely strigulose. Hind body shining black, almost impunctate. Legs long and slender.

In the male the last dorsal plate terminates in four nearly similar and equidistant teeth, like those of a saw; the last ventral plate is divided by a deep, not broad, nearly parallel-sided fissure; the lateral portion on each side would be rounded, except that there is an extremely slight production of its hind part; the preceding ventral plate is very peculiar, it has in the middle behind a very large triangular depression, the surface of which is coarsely asperate; this part of the segment projects further back than the lateral portions, and its hind margin is pectinate with coarse rigid cilia. The female has the central part of the last ventral plate prominent and split in the middle, but the two divided portions are not separated at all from one another, except that each is separately rounded at the apex, and each rounded part bears about three cilia; on each side there is a short broad tooth, and the outer angle forms also a short slender tooth; the last dorsal plate ends in four elongate spines, the external of which, though slender, is broader than the middle spines; the elongate middle notch is not quite so broad as the rather longer lateral notch.

Of this remarkably distinct species four individuals have been found.

Junsai Lake, under reeds, also at Sapporo.

Tachinus diminutus, n. sp.

Minimus, niger, nitidus; antennis fuscis, basi pedibusque rufis; prothorace lævigato; elytris crebre fortiter punctatis.
Long. 3 millim.

The antennæ are rather small and slender, the penultimate joint about as long as broad. The thorax is strongly transverse, broader than the elytra, its hind margin piceous. The elytra are much longer than the thorax, unicolorous.

Although I am not able fully to describe this species, owing to two examples only having been found and to their bad preservation, yet it cannot fail to be recognized owing to its small size, which is far less than that of any other species of the genus. The terminal dorsal plate in the male is almost unarmed, and the last ventral ends in two elongate, slender, extremely widely separated laciniæ. In the female the last dorsal has in the middle two very short obtuse processes, and on each side a slender tooth projecting quite as far back as the median processes; while the terminal ventral plate has behind four short, nearly equidistant teeth, of which the middle two are ciliated.

Kiga and Sendai.

Tachinus punctiventris, n. sp.

Nigerrimus, antennis crassiusculis, fulvis, pedibus piceo-rufis; prothorace nitidissimo, sublævigato; elytris sparsim profunde punctatis, nitidis; abdomine minus nitido, fortiter profundeque punctato, tenuiter pubescente.
Long. 10 millim.

Antennæ largely developed, being both elongate and stout, third joint elongate, greatly longer than the second, fifth to eleventh extremely dull, tenth a good deal longer than broad; palpi yellow. Head small, very shining. Thorax large, rather broader than the elytra, remarkably polished, and with only a few distant very fine punctures; the hind angles project very slightly backwards. Elytra longer than the thorax, the hind margin at the outer angle oblique, not rounded, the surface very shining, with deep and distinct punctuation. Hind body with coarse, close, elongate, deep punctures, from each of which springs a fine rather elongate hair.

In the female the last dorsal plate is trifid, the central lobe being small and minutely emarginate at the extremity, and separated by a rather broad interval on each side from the lateral teeth, which are broad and short and project a little further back than the central lobe; the last ventral plate is rounded in the middle and very slightly notched, the hind margin being set with very coarse setæ; on each side of the notch the lateral angles form on each side only an extremely short projection.

The above description is made from two females, one from Oyayama, one from Nikko, agreeing closely; besides these I have five other individuals before me which may be either varieties of this remarkable species or may represent two or more closely allied distinct species, viz. a female from Nikko, which has the punctuation of the hind body and also of the elytra less coarse, the prolongations of the last dorsal plate slightly longer, the lateral teeth of the last ventral a good deal longer; in other respects this agrees with the type. Another female from Nikko is considerably smaller (8 millim. long) and narrower, and has the punctuation of the hind body much finer; the prolongations of the last dorsal plate are evidently shorter than in the type, but the lateral tooth of the last ventral is slightly longer. Another female, from Subashiri, is still smaller (only 6½ millim. long), and has the punctuation of the hind body a good deal coarser, the prolongations of the last dorsal plate evidently shorter than in the type, and the tooth of the side of the last ventral very obscure. There are also two males present from Nikko, one similar in size and form to the type female, but with the hind body more densely punctate; the last dorsal plate is at the hind margin a little prolonged in the middle, so as to form a well-marked prominence, rounded behind, but minutely emarginate in the middle of the rounding; the last ventral plate is very deeply cleft, the sides, however, not being prolonged as laciniæ, the sides of the fissure within its margin deeply and broadly impressed;

the preceding plate is simply emarginate in the middle, and in front of this has a rather small space covered with minute asperities. The second male is considerably smaller than the first and has the hind body coarsely punctate; the prominences of the last dorsal plate are rather longer, the central lobe being comparatively narrower, less rounded, and more emarginate; the ventral structure is nearly the same as in the other individual, except that the lateral portions of the last plate are rather more prolonged and less obtuse. In neither of these males are the front tarsi dilated. My impression is that these seven specimens represent three or four distinct species, in which the specific sexual characters are much more feebly differentiated than in the normal *Tachini*; but without further material or evidence as to the cohabitation of the sexes I cannot venture to attempt to characterize more than one species. In any case, however, *T. punctiventris* is at once distinguished by the polished surface of head, thorax, and elytra, and the punctuation of the hind body, the largely developed antennæ, and the very short metasternum. It will probably be found that it should be generically separated from the normal *Tachini*.

Erchomus scitulus.

Erchomus scitulus, Weise, Deutsche ent. Zeitschr. xxi. 1877, p. 91.

Mitzudake, near Nagasaki; Hitoyoshi, in Higo.

[To be continued.]

LI.—*On the Bib and Poor-Cod.* By Francis Day, C.I.E., F.L.S., &c.

Professor M'Intosh, in your last issue, admits that he was in error in having stated in the Ann. & Mag. Nat. Hist. for May 1886 that the bib and poor-cod were the same species; but as he also, possibly in error, misquotes some of my statements, or observes upon omissions made by me, but which do not exist, I beg for a short space in order to reply.

He says that "the main point contended for in my note was the confusion on the subject and the apparent uncertainty of the author of the 'British Fishes'" (p. 349)—an uncertainty which I think no one would have discovered but Dr.

M'Intosh, as I not only gave them as separate and distinct species but also figured them as such. I fail to see how Dr. M'Intosh explains his assertion that "a large series from the various parts of the British seas leaves little doubt of the identity of the two forms" (Ann. & Mag. Nat. Hist. 1886, xvii. p. 443).

"Moreover, in his recent paper Mr. Day correctly points out that these two fins have a more evident interval (in the poor-cod) than in the bib" (p. 348). This would seem as if I had omitted such in my work, whereas it is distinctly shown on comparing the figures on plates lxxx. and lxxxi. As to the lateral line in my figure of the poor-cod not being sufficiently curved, I may say I merely followed what existed in the specimen.

"Mr. Day does not mention the cutaneous bleb so characteristic of both species" (p. 349). If my work is referred to (vol. i. p. 287) it will be seen that under the head of *names* I observe "*blens* or *blinds* in Cornwall; these last names are doubtless due to a sort of loose bag capable of inflation existing in front of the eye and formed by an outer layer passing from the cheeks over the eye, and a second layer over the eyeball, thus forming a sac-like cavity well designated by the local words *bleb* or *blain*, terms for a bubble in the water or a blister."

"The number of rays in the first dorsal is stated to be the same in both, viz. 12." This is another misstatement, for in the synopsis of species pertaining to the genus *Gadus* (vol. i. p. 275) I give the first dorsal at 12 in the *G. luscus* and from 12 to 15 in the *G. minutus*; those numbers are also repeated when describing the species in detail at pages 287 and 289. That Professor M'Intosh has found this fin in the bib with from 12 to 14 spines in 1888 does not affect the accuracy of my statement in March 1882 that I had found 12, for no one else has, until now, recorded more. The number of fin-rays in the Gadidæ, as in the Pleuronectidæ, is subject to very great variation.

Professor M'Intosh also observes: "In regard to the characters derived from the gill-rakers, as indicated by Mr. Day in his recent paper in this journal . . . it is fully as important as any mentioned in the 'British Fishes.'" Admitting this to be so, as I only obtained specimens on which to make these investigations in February 1888, I could not have recorded the results in 1882. So far as I know, this fact had not been previously observed; and Professor M'Intosh might have investigated it himself in the large series of specimens he referred to in 1886, and prior to so authoritatively asserting that other authors had been in error in considering these two species as distinct. As to my description in the 'British Fishes,' which he now accuses of being too meagre, he formerly termed it elaborate. Anyhow it and my figures have been sufficient for fishermen to recognize them by and send me the two forms. I can merely record zoological facts as they come under my notice, and if readers skip or cannot understand my descriptions I can scarcely consider the fault is always to be laid at my door.

Dr. M'Intosh says a poor-cod from my collection is in the Edinburgh Museum of Science and Art labelled *Gadus luscus*. This may be so, as my fish were sent to the Edinburgh Fisheries Exhibition in 1882, and subsequently transferred to the museum. During the interval they were in the show-case which had Professor M'Intosh's name on it, and were, I believe, under his charge, while I have not had an opportunity of rectifying any error. But however this may be, we are all aware of how transpositions of labels occur among specimens in our best regulated museums, while the merest tyro in ichthyology ought to be able to see in my figures and descriptions of the two forms quite sufficient evidence by which to recognize them.

Cheltenham,
October 8, 1888.

LII.—*On new Lamiide Coleoptera belonging to the* Monohammus *Group*. By C. J. Gahan, M.A., Assistant, Zoological Department, British Museum.

Leprodera lecta, n. sp.

Capitis fronte, pedibus et corpore subtus fulvo-brunneis, supra griseis; elytris basi plaga triangulari, communi, subfusca; singulo ad latus plaga magna et postice macula fuscis; illa antice albo marginata et lateraliter in medio albo unimaculata; antennis (♂) corpore tertia parte longioribus, scapo ad apicem intus subangulariter producto, (♀) corpore vix longioribus.
Long. 25–33 mm.

Hab. Siam.

Head sparsely and minutely punctured on the front, on the vertex, and on the cheeks, the latter dull white, as also is a line on each side of the prothorax below the lateral spines, which extends from the anterior margin to the outer angle of the coxal cavity. The prothorax is minutely and sparsely punctured on the disk; the transverse grooves are very indistinct, and there is just behind the middle a very faint and feebly bifid process. The elytra are minutely and rather sparsely granular at the base, the remainder being very minutely and sparsely punctate. They are of a light grey colour, with a basal, triangular, more or less dark brown patch, which is less distinct than the lateral markings; these consist of a subsemicircular marginal patch near the middle of each and a much smaller spot towards the apex, both dark brown and velvety in appearance. The large lateral patch is bordered along its anterior inner side with white, and has a white spot in its middle close to the outer margin. The first six joints of the antennæ are in both sexes shortly fringed with hairs on the underside, and the first three or four joints in the male are slightly rugose. The anterior tibiæ in the male armed towards their tarsal extremity with a strong tooth, and the anterior tarsi fringed with black hairs. The mesosternal process feebly tubercled in the middle. The prosternal process * with its sides parallel, its posterior extremity arcuate. Though that portion of the scape which bears the cicatrice is, in the male, angularly produced on its inner ventral side—a character of the genus *Archidice*—the species must be associated with *Leprodera* (*Lamia*) *crucifera*, Fabr., with which it has very strong affinities and in which the scape is not so produced.

The last-mentioned species—*Phryneta crucifera*, Fabr., of the Munich Catalogue—was placed by Von Harold in the genus *Leprodera* and a doubtful habitat attributed to it, viz. Ins. Bourbon. Of the five specimens in our Museum collection four are from Ceylon and one from Pondicherry.

* I think it well to note this character of the prosternum, because in one species at least of the genus *Leprodera* the form is different. In *L. verrucosa*, Pasc., the prosternal process is angularly dilated on each side a little behind its middle, the angles fitting into a corresponding notch or depression in each coxa. This form of prosternum is, I find, constant in the following genera of Monohammids:—*Pelargoderus*, *Epepeotes*, *Diochares*, *Mecotagus*, *Ptychodes*, and *Tæniotes*. In *Tæniotes* it is most strongly marked, each angle at the sides of the prosternal process fitting, in some cases, into a kind of sheathing-notch in the coxæ.

It is probable that the same form of prosternum which is found in *verrucosa* occurs also in *L. elongata*, Thoms., and *L. equestris*, Pasc.; it is, in fact, doubtful whether these two species are not identical and whether they are not both females of *verrucosa*. If this is so, it may become necessary to dissociate most of the remaining species of the genus from the type *L. elongata*.

Leprodera insidiosa (Chevr. MS.), n. sp.

Capitis fronte punctata, fulvo-brunneo pubescente, vertice brunneo, fere impunctato, postice ferrugineo-maculato; prothoracis disco punctato et in medio leviter ruguloso, obscure ferrugineo-vittato; scutello fulvo; elytris griseis, minute granulosis ad basin, deinde punctatis, fascia fusca obscura, literæ V persimili; singulo macula magna, submedia, nigro-velutina, albido marginata.
Long. 22–30 mm.

Hab. N. India and Penang.

The prothorax is dark brown above, with an obscure ferruginous or tawny band on each side of the middle; the sides of the prothorax at the base of the lateral tubercles as well as the tubercles themselves are also ferruginous. The rugosity on the middle of the disk is in some specimens scarcely apparent, in others plainly visible. The V-shaped band on the anterior part of the elytra is somewhat obscure and in old or rubbed specimens is liable to be overlooked The large spot on each elytron is placed for the most part behind the middle and is generally somewhat irregular in form. The apices of the elytra are rounded. The legs and underside of the body have a short fulvous-brown pubescence, in which numerous minute white bristles are scattered. The anterior legs in the male are long, with their tibiæ armed with a strong tooth and their tarsi fringed with black hairs.

The antennæ in the male are about twice as long as the body and their first three joints are slightly rugose; in the female they are a little longer than the body, with the scape, and sometimes also the base of the third joint, slightly rugose,

The mesosternal process is feebly tubercled in the middle; the prosternal has the moderately broad simple form which is found in the last species and in *L. crucifera.*

Monohammus modicus, n. sp.

Brunneo-griseo dense pubescens; prothorace supra inæquali; elytris ad basin minute et sparsissime granulosis, singulo ad medium macula fusca antice distincte, postice indistincte marginata, apicibus truncatis; antennis griseis, articulis a tertio apicibus brunneis.
Long. 18–19 mm., lat. 6½–7 mm.

Hab. Madras.

With a dense drab pubescence covering the head, thorax, legs, and underside of the body. The head impunctate; the lower lobes of the eyes rather large. Prothorax very feebly tubercled on the disk, impunctate, and with a few very minute scattered black granules on each side of the middle. Elytra minutely and sparsely granular near the base and with minute and scattered punctures, which are almost entirely concealed by the close pubescence; the latter at the base is of a greyish-brown colour, which passes behind without any definite limit into a pale grey with a pinkish tint. About the middle of each elytron is a dark brown pubescent spot, which is obtusely pointed and definitely limited in front, and passes gradually behind into the pale pinkish grey which surrounds it. The apices of the elytra are truncate. Antennæ about twice as long as the body in the male, scarcely half as long again as the body in the female; the scape with a completely margined and pubescent cicatrice. The middle tibiæ very feebly and indistinctly emarginate. The mesosternal process tubercled in the middle.

Monohammus distinctus, n. sp.

Capitis fronte dense brunneo-griseo pubescente, vertice maculis duabus nigro-velutinis; prothorace supra subfusco; postice cum maculis ellipticis duabus nigro-velutinis; scutello fusco, griseo marginato; elytris brunneo-griseis, ad basin subfuscis, singuloque ad medium macula magna fusca; antennis (♂) ad basin griseis, articulis a tertio fusco-testaceis griseo annulatis; tibiis griseis, fusco annulatis.

Long. 13 mm.

Hab. Assam.

Head with the front convex and densely pubescent, the lower lobes of the eyes small, the vertex with two velvety black spots—one behind the superior lobe of each eye. Prothorax even on the disk, with a dark brown pubescence somewhat mixed with brownish grey, and with two very distinct velvety black spots on the posterior half, placed obliquely, so that while posteriorly they come close together near the middle line, anteriorly they are widely separated; each is narrowly margined with greyish except on its posterior border. Elytra with a brownish-grey pubescence, which towards the base is replaced by a darker brown, and with a large irregular dark brown patch on the middle of each and smaller fuscous spots towards the apex; the latter rounded. Antennæ more than twice the length of the body, with the scape rather short, this and the second joint greyish, the remaining joints brown ringed with grey, each ring comprising the slightly externally swollen apex of one joint and the base of the succeeding joint. The underside of the body has a mixed pubescence of grey and brown. The legs are greyish, with the tibiæ ringed in the middle with brown; the femora incrassate towards the middle, where they are almost bare of pubescence; the tibiæ are entire. The sternal processes simple.

Monohammus perplexus, n. sp.

M. bifasciato simillimus, sed elytris nec fasciatis nec maculatis.

Hab. N. India.

Two male specimens in the collection, agreeing remarkably well in other respects with the figure and description of *M. bifasciatus*, Westw., but wanting the fasciæ of that species. The underside of the body has a greyish-yellow pubescence, similar to that on the upper side and on the elytra. The femora have a pubescence partly yellowish and partly greyish. There is a black vitta covered with a thin greyish pile on each side of the prothorax; the vitta passing over the lateral spine. The shoulders and the outer margins of the elytra are also black, with a similar feeble grey pubescence. The scutellum is greyish, and not distinctly black as in the figure of Westwood's species.

Notwithstanding these differences, I am inclined to think that the form is at most but a variety of *M. bifasciatus*, and the suggestion even occurs to me that possibly the type of Mr. Westwood's species was a specimen in which the fasciæ were artificially produced by rubbing. The existence, however, of a closely allied species—*M. sulphurifer*, Hope—in which there is a distinct black *pubescent* spot on the middle of each elytron is against this suggestion.

Monohammus vagus, n. sp.

Breviter brunneo-pubescens; capite, fronte, vertice genisque sparse punctatis; prothoracis disco lateribusque punctatis; elytris ad basin minute granulosis, deinde usque apicem punctulatis, utrinque macula fusca pone medium, apicibus rotundatis; antennis (♂) corpore plus quam duplo longioribus, articulo tertio incrassato leviter arcuato, (♀) corpore paullo longioribus.

Long. 25–29 mm., lat. 8–9½ mm.

Hab. Gaboon?

Head with the mandibles black, the palpi ferruginous brown, with a short yellowish-brown pubescence and sparse punctures on the front, vertex, and cheeks. Prothorax with a rather sparse fulvous pubescence, with three feeble tubercles on the disk; the latter, as well as the sides of the prothorax, with numerous somewhat scattered punctures. The scutellum is fulvous. The elytra have at their base numerous small, black, shiny granules, which posteriorly are replaced by punctures; the latter, gradually becoming smaller, extend as far as the apex. The pubescence on the elytra is of a mixed colour, the prevailing tint being a light chocolate-brown, interspersed here and there with a pale grey; towards the base it is tawny, mixed around the scutellum with dark brown; of the latter colour there is a distinct but irregular patch on each elytron behind the middle. The legs and underside of the body have a uniform greyish-brown pubescence. In the male the antennæ are fuscous ferruginous, more than twice as long as the body, with the third joint thickened and slightly arcuate; in the female they are very little longer than the body and the joints from the third are paler coloured at their bases. The sternal processes are simple.

Of the three specimens in the Museum two from Chevrolat's collection are ticketed India, the third is referred to Gaboon. The latter locality is more probably the correct one.

In structure and *facies* the species agrees best with African forms of *Monohammus*; its thorax is punctured, tubercled, and clothed with pubescence almost exactly as in some specimens of *M. ruspator*, Fabr.

Monohammus murinus (Dej. Cat.), n. sp.

Niger; capite, thorace, antennis, pedibus et corpore subtus omnino murino-pubescentibus; capite et prothorace disperse punctatis; hoc disco leviter quinque-noduloso; elytris nigris, nitidis, subseriatim punctatis, disperse murino-pubescentibus, apicibus truncatis; antennis (♂) corpore sesquilongioribus, articulis tertio quartoque paullo incrassatis.

Long. 23 mm., lat. $7\frac{1}{2}$ mm.

Hab. Senegal.

The pubescence of a mouse-grey colour, uniformly covering all parts except the elytra; on the latter it is scattered, with a somewhat larger patch on each behind the middle. The punctures on the head and thorax are small and scattered, those on the elytra, slightly granular at the base, are somewhat larger and seriately arranged along the middle of each, and extend up to the apex.

Monohammus plumbeus, n. sp.

M. murino simillimus, sed differt elytris omnino pubescentibus, singuloque macula fusca pone medium.

Hab. Congo.

In size, structure, and general appearance this has a very close resemblance to the last species, of which it may possibly prove to be only a variety. The elytra are, however, uniformly pubescent, and each has a small, transverse, fuscous, pubescent spot on the deflexed part of the base at the sides of the scutellum, as well as a larger spot of similar colour behind the middle.

Monohammus fulvisparsus, n. sp.

Æneo-niger, subnitidus, sparse pubescens; capitis fronte et scapo antennarum dense punctatis; prothorace supra leviter griseo pubescente, fulvo trivittato, vitta media angustissima, sparse punctato pone medium; scutello fulvo; elytris punctatis, fulvo vage pubescentibus, apicibus subtruncatis vel rotundatis; corpore subtus uniformiter griseo-fulvo pubescente.

Long. 30 mm.

Hab. Congo.

The front of the head thickly and somewhat rugosely punctured, the cheeks with a few scattered punctures, the vertex almost impunctate. Prothorax with the disk somewhat convex and almost quite smooth, with a median longitudinal tawny line and a wider tawny band or spot on each side close to the base of the lateral spines. There are a few punctures on each side of the disk behind the middle as well as on the bases of the lateral spines. The elytra are rather thickly and irregularly punctured, the punctures being larger and somewhat asperate towards the base; behind the latter there is on the middle of each elytron a feeble but broad and obtuse hump or swelling. The fulvous pubescence on the elytra is broken up into minute patches scattered everywhere, but closer together on some parts than on others. The underside of the body and the legs have a slight uniform greyish tawny pubescence. In the male the anterior tibiæ are armed each with a tooth at about one third of its length from the distal extremity, and the first joint of the anterior tarsus is almost as long as the two succeeding taken together. The antennæ are damaged in the single specimen in the collection, but the few joints that remain are shortly and rather thickly fringed with hairs beneath.

Monohammus nyassensis, n. sp.

Capite et prothorace brunneo-griseo pubescentibus, sparse punctatis; prothoracis disco trituberculato; scutello fulvo; elytris

punctatis, fulvo-pubescentibus nigro adspersis, basi plaga transversa communi nigro-fusca; humeris acutis, minute dentatis, quoque elytro in medio ad basin leviter cristato; corpore subtus pedibusque uniformiter brunneo-griseo pubescentibus; antennis (♀) corpore paullo longioribus, articulis a tertio apicibus fuscis.
Long. 20 mm.

Hab. Nyassa.

The head and the sides and disk of the prothorax are sparsely but distinctly punctured. There are really five tubercles on the latter, but the two postero-lateral are very feeble and scarcely noticeable; the median tubercle is the most distinct. The nearly black transverse patch at the base of the elytra is broadest along the suture, and gradually narrows towards the sides, where it stops short just above the shoulder; it has a faintly granular and somewhat velvety appearance. The remainder of the elytra has a scattered brownish tawny pubescence and is somewhat strongly and irregularly punctured, the punctures being especially visible on those spots where the black and shiny derm is almost bare of pubescence. The apices rounded.

It is doubtful whether this species should not rather enter into the genus *Lophoptera*, with which it agrees in the sharp and faintly toothed shoulders and in the crested base of the elytra. The crest in the present species is, however, very feeble, and consists of a row of three or four granules, of which the most anterior and strongest forms a small vertical ridge on the deflexed portion of the base. On the whole the species can scarcely, I think, be separated from the genus *Monohammus*, and amongst described species comes nearest perhaps in structural characters to *M. Thomsoni*, Chevr.

Tæniotes simplex, n. sp.

Niger, nitidus; capitis fronte et scapo antennarum rugoso-granulosis, capitis vertice et lateribus punctatis; prothoracis disco leviter rugoso; elytris basi albo bipunctatis, leviter rugulosis, deinde punctatis, punctis evanescentibus versus apicem; apicibus singulatim rotundatis, nec dentatis.
Long. 31–33 mm.

Hab. South or Central America.

A very distinct species, easily recognized by the almost entire absence of pubescence and by the presence of two small white pubescent spots, one on the depressed basal portion of each elytron a little removed from the scutellum, the latter also bearing traces of a white pubescence behind. Another minute linear white spot is to be found on each side of the prothorax in front of and below the lateral spine.

Although the species has a superficial resemblance to some of the typical species of *Monohammus*, its structural characters are distinctly those of the genus *Tæniotes*; it has the form of head and eyes, the form of prosternum, the tuberculation of mesosternum, and the broadly truncate and laterally toothed last abdominal ventral segment which are characteristic of this genus. Each elytron is narrowly rounded at the apex, but wants the terminal tooth which is present in many species of the genus. The front of the head is slightly broader than in the majority of its congeners.

The two female specimens in the Museum collection were presented many years ago by Sir E. Belcher and were collected during the voyage of H.M.S. 'Sulphur' around the world. No indication of locality is attached to the specimens, but it may, I think, be safely asserted that they are South or Central American.

Tæniotes singularis, n. sp.

Æneo-niger, nitidus; subtus maculatus et supra obscure vittatus pube ferrugineo-brunnea; capitis fronte, scapo antennarum prothoracisque disco rugoso-granulosis; elytris basi granulosis, fere impunctatis, plagis dilaceratis et maculis parvis albis.

Long. 34 mm.

Hab. Ecuador.

Head with the front minutely and reticulately ridged, the eyes bordered with a reddish-brown pubescence; the vertex punctured behind and with a glossy black, somewhat raised, longitudinal line in the depression between the antennal tubercles. The prothorax with the lateral spines acute, the disk minutely and irregularly ridged, with a distinct feeble tubercle or callosity in the middle; the pubescence sparse, of a reddish-brown colour, and arranged somewhat in longitudinal lines—three on the disk and one on each side below the lateral spines. Elytra granular at the base, with a reddish-brown pubescence, almost limited to two longitudinal bands on each elytron, one narrow sutural, the other broader and fainter, lateral, but not reaching the margin. In addition there are three larger torn patches and some smaller spots of white pubescence on each elytron; the first patch is just behind the middle of the base, the second antemedian, and the third postmedian. The apex is rounded and appears not to be armed with teeth. (In the single specimen the apex is slightly damaged.) The underside of the body and the legs have a faint greyish pile, and there is a rust-brown pubescent spot on the side of each abdominal segment, as well as a few spots of the same kind on the breast.

The style of marking in this species reminds one more of species of *Hammoderus*, a closely allied genus, than of *Tæniotes*. The structural characters, however, leave no room for doubt, and it may be here remarked that the form of prosternum is one of the best characters for distinguishing the two genera; in *Hammoderus* the prosternum is simple, in *Tæniotes* it is of the form described above in a footnote.

Deliathis Batesi, n. sp.

D. niveæ similis, sed differt pube flava, oculis minoribus, capitis fronte latiore, capite supra flavo univittato, mesosterno minus valde producto.

Long. (♂) 30, (♀) 40 mm.

Hab. Mexico.

In style of marking and arrangement of pubescence closely resembles *D. nivea*, Bates. The pubescence is yellowish in colour, not white, the pubescent vittæ on the front of the head are broader, and the latter is itself distinctly wider than in *D. nivea*. The upper part of the head wants the lateral pubescent vittæ which are present in that species. The mesosternal process is horizontal below and is produced in front but very little beyond the anterior vertical wall of the mesosternum; in *D. nivea*, on the other hand, it is very strongly and obliquely produced downwards and forwards.

Deliathis Buquetii, Taslé, var.

Deliathis mira, Chevr. MS.

♀. Prothorace lateribus obtuse tuberculatis nec spinosis.

Hab. Mexico (*Palenque*).

In this variety, of which there is a single female specimen in the Museum collection, the lateral spines of the thorax are wanting and are replaced by obtuse tubercles. The longitudinal white and ochraceous bands on the elytra are all very much interrupted.

The absence of the lateral spines on the prothorax is the more noteworthy since in some females of another species of the genus (*D. nivea*), as mentioned by Bates, the same kind of variation occurs.

THERMONOTUS, n. g.

♀. Head triangularly concave between the antennal tubercles, the latter prominent and, at their base, approximated. Lower lobes of the eyes small.

Antennæ scarcely reaching to the apex of the elytra, with the scape long and gradually and slightly thickened towards its apex, the latter with a distinct and completely margined cicatrice, the third joint a little shorter than the scape, the fourth distinctly shorter than the third, the fifth and following gradually decreasing in length.

Prothorax with a strong median spine on each side; the disk somewhat raised across the middle between the lateral spines, the raised portion bounded anteriorly by a very distinct transverse groove and posteriorly by a somewhat irregular ridge.

Elytra rather short, slightly expanded behind the middle, and broadly rounded at the apex.

Legs of equal length, the middle tibiæ without notch or tubercle.

Prosternal process raised in the middle to a level with the coxæ and broadly canaliculate throughout nearly its whole length. Mesosternal process horizontal behind, slightly obtusely produced and vertical in front.

This genus must be placed near *Cereopsius*, with which it has many characters in common, but from which it is readily distinguished by the form of its elytra.

Thermonotus nigripes, n. sp.

Rufo-testaceus; antennis, mandibulorum apicibus pedibusque nigris; scutello dense elytrisque leviter ochraceo squamoso-pubescentibus.

Long. 16–19 mm., lat. 7–8½ mm.

Hab. N. India (and Penang?).

The whole body, including the head, thorax, and elytra, is of a reddish testaceous colour, which is somewhat paler and inclined to flavous on the posterior part of the elytra. Legs, antennæ, and apices of the mandibles black. Front of the head with a narrow, mesial, raised black line, which extends on to the vertex. The lateral spines of the thorax have a slight backward curvature, their anterior border being convex, their posterior slightly concave. The raised middle portion of the disk has a somewhat uneven surface and is slightly punctured on each side of a median, posterior, feebly bifid process. The scutellum is ochraceously pubescent; a similar short, somewhat scaly pubescence appears in places on the elytra. (The specimens are more or less rubbed.) The latter are sparsely and irregularly punctured on their anterior half, and each at its base projects forwards in the middle, so as to form a hump on each side of the scutellum. The apex rounded.

Two female specimens, one ticketed N. India, the other Penang.

Synonymical and other Notes.

Archidice quadrinotata, Thoms., is synonymous with the previously described *Monohammus officinator*, White. The species is not strictly referable to either genus. Its short metasternum brings it into relation with the "true Lamiidæ." It belongs nevertheless to the *Monohammus*-group, and may be placed in the genus *Lamiomimus*, Kolbe, from which it structurally differs only in the more prominent antennal tubercles and in the feebly tubercled mesosternum.

Psacothea (*Monohammus*) *hilaris*, Pasc. (Trans. Ent. Soc. London, ser. 2, vol. iv. p. 103), is synonymous with *P.* (*Diochares*) *flavoguttata*, Fairm. (Ann. Soc. Ent. de Belgique, 1887, p. 133).

The genus *Psacothea*, though never characterized, seems to be good. Its name, first, I believe, used in manuscript by Pascoe, was subsequently employed by Bates (Ann. & Mag. Nat. Hist. ser. 4, vol. xii. p. 311). In the Munich Catalogue the genus is placed as a synonym of *Monohammus*. It is, however, much more nearly related to *Epepeotes*, especially to the North-Indian species of that genus. The following characters may serve to fix it:—Head narrowly and triangularly concave between the antennal tubercles, the latter prominent, divergent, approximated at their base; lateral spines of thorax short and feeble; prosternal process dilated on each side behind the middle; anterior coxal cavities incompletely closed in behind; mesosternum tubercled; anterior legs in the male with the tibiæ unarmed, with the first joint of tarsus simple, nearly as long as the two succeeding joints.

Epepeotes (*Leprodera*) *spinosa*, Thoms., is synonymous with the later described *Epepeotes meridianus*, Pasc. (= *lateralis*, Guér.).

Pelargoderus rugosus, Waterh., appears to be synonymous with *Paragnoma acuminipennis*, Blanchard. The type of Waterhouse's species is a large male from Larat, in which the apices of the elytra are obliquely truncate. In two specimens associated with it—one a female from Thursday Island, the other a small male from Torres Straits—the apices are obliquely truncate, with the outer angles produced, especially in the male. The female agrees very well with the figure and description of *Paragnoma acuminipennis.* The genus *Paragnoma* was therefore, as Pascoe and Lacordaire correctly surmised, founded upon the female of a species of *Pelargoderus*, and cannot stand.

(*Monohammus*) *marcipor*, Newm., belongs to the genus *Anammus*; it is intermediate in size and structure between *A. conspersus* and *A. Daleni.*

Monohammus melanostictus, White, is synonymous with *M. beryllinus*, Hope. This species and *Monohammus Bowringii*, White, belong rather to the genus *Melanauster.*

To the genus *Domitia*, Thoms., must be added *D.* (*Monohammus*) *viridipennis*, Chevr. This species is possibly identical with the type species *D. lupanaria*, Thoms.; it differs from the description of the latter only in being smaller and in a few other minor particulars. To the same genus doubtless belongs the *Lamia œnea* of Parry, which in the Munich Catalogue is placed in the genus *Sternotomis.* It is uncertain whether this species also is not synonymous with one or both of the species just mentioned.

Agnoderus, Thoms.—This genus is known only from the female sex, which was described by Thomson and Lacordaire, the latter wrongly regarding it as the male. In the male the antennæ are twice as long as the body, and the third, fourth, and fifth joints are almost normal, being slightly and gradually thickened towards their apices, but not so markedly so as in the female. In other respects the two sexes scarcely differ.

There are in the Museum collection five specimens of the type species *A. gnomoides*, Thoms., two males, and three females, all from North India.

In this genus also might be placed *Monohammus desperatus*, Thoms. (=*Fredericus*, White).

LIII.—*Notes on Echinoderms collected at Port Phillip by Mr. J. Bracebridge Wilson.* By Prof. F. Jeffrey Bell, M.A.

During the last few years Mr. J. Bracebridge Wilson has from time to time been so good as to present to the Trustees of the British Museum interesting examples of the Echinoderm-fauna of Port Phillip. The region investigated by Mr. Wilson seems to be one of much promise; unfortunately many of his specimens are young or solitary examples; I trust therefore that the publication of this list will induce him and perhaps others also to make larger collections in the Victorian waters, and especially to obtain good series of the species collected.

What follows must only be considered as a preliminary notice of the Echinoderm-fauna of Port Phillip, as in many cases the existence of new or incompletely known species is merely indicated. As there is, however, no reason to suppose that we shall not receive more examples from the locality, I think it more advantageous to science to abstain from naming or describing such specimens till we have a more complete series. In the case of two new species of *Antedon* there is, happily, quite sufficient material for description; with the Holothurians this is unfortunately not the case.

List of the Species.

I. Crinoidea.

1. Antedon Wilsoni.
2. —— incommoda.
3. Actinometra trichoptera, *J. Müller*.

II. Asteroidea.

4. Asterias calamaria, *Gray*.
5. Plectaster decanus, *M. Tr.*
6. Nectria ocellata, *Perrier*.
7. Tosia grandis, *Gray*.
8. Palmipes, sp.
9. Asterina Gunni, *Gray*.
10. Patiria crassa, *Gray*.
11. Astropecten pectinatus, *Sladen*.

III. Ophiuroidea.

12. Pectinura arenosa, *Lyman*.
13. Ophiothrix, sp.
14. Ophiomyxa australis, *Lütk*.

IV. Echinoidea.

15. Goniocidaris geranoides, *Lamk*.
16. Amblypneustes ovum, *Lamk*.
17. ——, sp.
18. Microcyphus zigzag, *Ag*.
19. Strongylocentrotus tuberculatus, *Lamk*.
20. ——, sp. (juv.).
21. Lovenia elongata, *Gray*.

V. Holothurioidea.

22. Molpadia, sp.
23. Cucumaria inconspicua, *Bell*.
24. Colochirus australis, *Ludw*.
25. Holothuria (2 or 3 species).

Notes and Descriptions.

Antedon Wilsoni.

General formula A_b^b.

This belongs to the *Basicurva*-group of Dr. Herbert Carpenter *, and is the first of the group which I have as yet had the opportunity of examining; it goes in the second division, or that in which the pinnule-ambulacra are not plated, and has the same general formula as the two species in the 'Challenger' collection. From *A. denticulata* it may be distinguished at once not only by the abundance of sacculi but by the first pinnule being the longest; with *A. pusilla* it has many more points of resemblance. The first radials are evident and the numbers of the cirri and cirrus-joints are much the same; but the form of the joints is different; syzygies are much more numerous, the radials have no tubercles, and the basal joints of the later pinnules have not the same form.

Centrodorsal slightly convex, with marginal cirri, in two rows, about fifteen in number; cirrus-joints about thirty, outer cirri longer than inner, owing chiefly to the greater length of the basal joints; the basal joints are much longer than broad; this character gradually diminishes in the more distal joints; the outer cirri are also stouter than the inner.

First radial just visible, the second broader than long, with straight edges but no tubercle, the third radial with a nearly straight proximal edge and two distal axillary curves.

Ten arms; a notch between second and third brachial, the succeeding joints overlap a little from side to side; syzygies in the third, sixth, and ninth brachials, then generally in every second.

Pinnules short, the first is the longest, has ten (or more) joints, the third and fourth of which are very elongated, but it is not at all stout; the later pinnules are not unlike those of *A. pusilla*, as figured by Dr. H. Carpenter.

Pinnule-ambulacra not plated; sacculi numerous.

Colour in spirit white.

Spread about 60 millim., but none of the arms are quite complete.

Hab. Port Phillip.

It is quite clear that this is the representative on the south coast of Australia of *A. pusilla* of Torres Straits; it is not often that one gets such obvious signs of relationship.

* Chall. Reports, part lx. p. 102.

Antedon incommoda.

This species, like *A. bidens*, does not fall into the groups proposed by Dr. H. Carpenter. It appears to be common at Port Phillip, as several specimens have been sent. Like *A. bidens* it has pinnules on the second and third brachials and the first pinnule is the longest; but it is distinguished from *A. bidens* by the much greater slenderness of the pinnules, the want of stiffness in the arms, which are not markedly compressed, the greater number of syzygies, and the smaller number of cirrus-joints.

General formula $A\frac{b}{a}$.

Centrodorsal flat, central part free of cirri; cirri about thirty in number, with about twelve joints; the dorsal side of the joints indented much as in *A. bidens*; most of the joints are longer than broad and have the distal edge projecting and overlapping.

First radials hidden, second broader than long, not in contact, third irregularly triangular, not protuberant.

Ten arms; first brachials in contact, longer without than within; second also longer without than within, but not protuberant; the third, which are syzygial, are longer within than without. The next two or three are more regularly quadrate, the successors alternately wider on outer and inner sides; but there is not the pronounced overlap that there is in *A. bidens*.

Syzygies 3, 8, 12, then every third.

The first pinnule is the longest, but is not very long; the rest are rather short and are not so stiff and well marked as in *A. bidens*.

Colour white, brownish with two dark bands or dark with central lighter band on dorsal surface; cirri light in colour.

Spread about 70 millim.

Here again we have a species which curiously resembles in many points a form from Torres Straits.

Actinometra trichoptera.

This is obviously a very abundant species at Port Phillip and is as yet the only member of the genus that has been sent by Mr. Wilson. I look forward with interest to the arrival of fully grown individuals, as I suspect, from what I have seen of the small specimens that have reached us, that the cirri will exhibit an interesting dimorphism.

Plectaster decanus.

I was able last year to note the presence of *Echinaster decanus* in the waters of Port Jackson (Proc. Linn. Soc. N. S. W. [2] ii. p. 1074) ; the affinities of the species will be discussed by Mr. Sladen in his forthcoming 'Challenger' Report; he informs me that he has instituted a new genus, which he calls *Plectaster*, for its reception; this is quite in accordance with the expectation of Dr. E. P. Ramsay, who is reported (*loc. cit.*) to have expressed his opinion as follows :—"although closely allied to *Echinaster*, I believe it will eventually find its way into a new genus."

Palmipes, sp.

Here we have a small specimen too young to be definitely determined. I cannot think it to be the young of *Palmipes inflatus*, Hutton, though, like it, it has the adambulacral spines imbedded in the integument. It is probably an immature example of an undescribed species.

Microcyphus zigzag.

A small specimen of this species, with a diameter of less than 10 millim., has the test of a most beautiful rosy colour, which does not appear to be lost by preservation in alcohol.

Strongylocentrotus, sp.

There is a single small specimen which, with a little hesitation, I refer to this genus; it is remarkable for the thick covering of scales found on the buccal membrane. Mr. A. Agassiz defines the genus as having the membrane bare. As, however, the specimen is young, and bearing in mind the variations presented by different specimens of *Echinus*, I think we may regard this as an immature example of what will probably be found to be a new species of *Strongylocentrotus*. The spines are white, rather short, and rather stout.

Molpadia, sp.

There is, unfortunately, only one example of a species of this genus ; it is not, I think, the same as *Molpadia australis*, Semper, for its spicules are much more regular ; a more complete judgment on the matter had better be postponed till a larger series of specimens is available.

Cucumaria inconspicua.

It may be convenient to reprint the description of this species from the 'Proceedings of the Zoological Society,' 1887, p. 532:—

"Small, stout, a little rough to the touch, with the suckers not quite definitely limited to the ambulacra, though very often nearly so; the trivial suckers are in four and the bivial in two fairly regular rows. No anal teeth. The pharyngeal ring large, the muscles stout and inserted at once into the body-wall; the ring appears to be made up of five * sets of equal pieces, formed probably by the equal radial and inter-radial calcifications; the Polian vesicle is large.

"The genital tubes are long, simple, and not numerous.

"The spicules are rare and are only in the form of large deposits of the shape shown in plate xlv. fig. 3.

"Colour, varying shades of dark slate or brown.

"Average length 17 millim., average greatest breadth 6 millim.

"Port Phillip Heads. Collected by J. B. Wilson, Esq.

"The irregularity of the arrangement of the suckers of this species appears to afford a strong argument against the division of the genus *Cucumaria* into *Cucumaria* s. str. and *Semperia*, which has been proposed by Lampert."

It will give a little more completeness to these notes if I add the names of the species collected by the 'Challenger,' but not included in Mr. Wilson's collections, from shallow water near Port Phillip. Mr. Sladen has kindly given me the names of the Asteroidea; the additional species are *Asterias polyplax* and *Nectria ocellifera*.

The Ophiuroids, as reported by Mr. Lyman, were

Ophioglypha Kinbergi, Lym.
Ophiobyrsa rudis, Lym.
Ophiocnida pilosa, Lym.
Ophionereis Schayeri, M. Tr.
Ophiothrix aristulata, var., Lym.

* "Fine" in the original is a misprint for "five;" as a matter of fact the pieces are rather stout.

Mr. A. Agassiz found the following Echinoids :—

Goniocidaris tubaria, Lamk.
Amblypneustes formosus, Val.
—— *pallidus*, Lamk.
Sphærechinus australiæ, A. Ag.
Echinanthus testudinarius, Gray.
Laganum Peroni, Ag.

There were no additional Crinoids or Holothurians.

LIV.—*Diagnoses of four new Mammals from the Malayan Region.* By Oldfield Thomas.

1. *Hylomys suillus dorsalis*, var. nov.

Essential characters as in the typical variety, but with a more or less distinct black line running from between the eyes down the neck to the middle of the back.

Head and body (c.) 116 millim.; tail 16; hind foot 25.

Hab. Mount Kina Balu, North Borneo (*Mr. J. Whitehead*).

2. *Sciurus concinnus*, sp. n.

Very similar to *S. exilis*, Müll., but rather larger, and with the colour of the back a deeper and more uniform rufous, the general colour being almost as rufous as in the common bank-vole (*Evotomys glareolus*, Schr.). The hind feet are larger and heavier than in *S. exilis*, and their hairy part is of much less extent, the posterior part being covered for less than 8 millim., as compared to more than 9 millim. in the other and smaller species. This hairy part is grizzled olive in *S. concinnus* and yellow in *S. exilis*. The posterior sole-pad is oval instead of circular, and is situated much further back on the foot, the distance from its front edge to that of the middle digital pad being about 7·0 millim., as compared to $3\frac{1}{2}$ millim. in *S. exilis*. The tail is longer and rather bushier in *S. concinnus* than in its Bornean ally.

Turning to the skull we find that the general shape is much the same in the two species, but that the muzzle in *S. con-*

cinnus is shorter and broader anteriorly, the nasals especially being much broader, so that their greatest breadth is more than half their length.

In the dentition the minute anterior premolar (p^3) of *S. exilis*, present in all the specimens as yet observed (at least seven in number), is wholly absent in the type of *S. concinnus.* The molars again are markedly broader and heavier, the actual breadth of m^2 being 1·4 millim., as compared to 1·0 millim. in *S. exilis.*

Dimensions of the type, an adult female (skin):—

Head and body (apparently rather stretched) 85 millim.; tail, without hairs, 59; hind foot 25·5; heel to front of last foot-pad 11·4, to front of anterior digital pad 18·4; ear (contracted) 4·8.

Skull: basal length 19·6; greatest breadth 15; nasals, length 7·1, breadth 3·9; diastema 6·3; length of tooth-series (front of p^4 to back of m^3) 3·8.

Hab. Isabella, Basilan, Philippines (*Prof. J. B. Steere*).

This species is the fourth known member of the beautiful little Malayan group of pigmy squirrels, the other three being *S. melanotis*, Müll. & Schl., *S. Whiteheadi*, Thom., and *S. exilis*, Müll. From the first it is readily distinguishable by its uniformly coloured head and rufous back, from the second by its untufted ears, from the third by the many important although less obvious differences above detailed, and from all by its possession of only a single upper premolar.

3. *Mus alticola*, sp. n.

Fur mixed with spines both above and below. General colour above a peculiar uniform bluish grey, not speckled or grizzled. Hairs and spines creamy white basally, grey terminally. Underside pale yellowish white, the hairs uniformly of this colour to their bases. Line of demarcation on sides not sharply defined. Tail short-haired, sharply bicolor from base to tip, brown above, yellowish white below.

Dimensions:—Head and body (probably stretched) 177 millim.; tail 162; hind foot 32.

Skull: tip of nasals to "lambda" (junction of sagittal and lambdoid sutures) 34; nasals, length 15; interorbital breadth 7·4; palate, length 19; anterior palatine foramina 6; length of upper molar series 5·8.

Hab. Mount Kina Balu, North Borneo (*Mr. J. Whitehead*).

This species is allied to the Nepalese *M. niveiventer*, Hodgs., but may be distinguished by its unspeckled back, by the gradual passage of the upper into the lower colour, and by its larger size.

4. *Mus infraluteus*, sp. n.

Size large. Fur coarse and harsh, but not spinous. General colour dark greyish brown, the tips of the shorter hairs with a silvery lustre. The longer straighter hairs numerous, not markedly lengthened on the rump, uniformly black. Under surface a dirty yellowish brown, the tips of the straighter hairs dull orange, their bases and the whole of the underfur slaty grey. Hands and feet brown. Tail rather shorter than the head and body, thinly haired, dark brown or black above and below; rings of scales averaging about eight or nine to the centimetre. Skull and teeth large and powerful.

Dimensions:—Head and body (c.) 285 millim.; tail (extreme tip wanting) 235; hind foot 51.

Skull: tip of nasals to lambda 51; nasals, length 21·8; interorbital breadth 8·8; infraorbital foramen, length of outer wall 7; palate, length 32; anterior palatine foramen 8·4; length of upper molar series 10·7.

Hab. Mount Kina Balu, North Borneo (*Mr. J. Whitehead*).

LV.—*Descriptions of some new Genera and Species of Curculionidæ, mostly Asiatic.*—Part V. By Francis P. Pascoe, F.L.S. &c.

Brachyderinæ.

Eupholus cinnamomeus.

Hylobiinæ.

Hylobius Pipitzii.
—— distinctus.

Balanininæ.

Pimelata, n. g.
—— maculata.

Alcidinæ.

Alcides carbonarius.
—— obtusus.
—— gallarius.

? Metatyginæ.

Zantes, n. g.
—— limbatus.

Ithyporinæ.

Misynus, n. g.
—— dissimilis.
Desmidophorus lanosus.
—— maculatus.
—— funebris.
—— morbosus.

Tylodinæ.

Poropterus afflictus.
—— basiliscus.
—— irritus.

Eupholus cinnamomeus.

E. oblongo-ovatus; elytris cinnamomeis, humeris parteque posteriore nigricantibus; tibiis albidis, tarsis læte cæruleis. Long. 12 lin.

Hab. New Guinea.

Oblong-ovate; head and rostrum covered with greenish-ashy oblong scales; antennæ with numerous white setæ, scape golden green, funicle whitish, club black; prothorax brown, with scattered minute paler scales; scutellum small, black; elytra cinnamon-coloured, with very minute paler scales, the shoulders and posterior declival part dull blackish; legs pilose; femora brown; tibiæ yellowish; tarsi clear azure blue; body beneath brown, with short scattered hairs.

A true *Eupholus*, but very different in coloration from the other species, the tarsi alone showing the beautiful green or azure, which, with black bands or stripes, distinguishes its congeners.

Hylobius Pipitzii.

H. oblongo-ovatus, fuscus, pilis aureis adspersus; rostro rugoso-striato; antennis articulis quinque ultimis moniliformibus; prothorace confertim punctato; elytris prothorace vix latioribus. Long. 7 lin.

Hab. New Caledonia.

Oblong-ovate, dark brown, with scattered minute golden hairs; rostrum roughly striate-punctured; antennæ with the last five joints of the funicle moniliform; club distinct; prothorax flattish above, closely punctured; scutellum small, round; elytra slightly broader than the prothorax at the base, faintly striate, the interstices with transverse raised lines, the intervals with a few golden hairs; femora mutic; intercoxal process broadly rounded; suture between the first and second abdominal segments obliterated in the middle.

A broad dull-coloured species, the golden hairs only visible under a powerful lens. It belongs to the first "*Stirps*" of Schönherr. I owe my specimen to Dr. Pipitz, of Gratz.

Hylobius distinctus.

H. anguste ellipticus, nitide niger, plagis silaceo-pilosis decoratus; rostro haud striato; articulis 3^{o}–6^{m} funiculi moniliformibus, ultimo transverso. Long. 4 lin.

Hab. Kodikanel Mountains (India).

Narrowly elliptic, glossy black, with patches of pale silaceous hairs above; rostrum not striated, partially covered with long whitish hairs; funicle with the third to the sixth joints moniliform, the seventh transverse; prothorax not contracted at the base, finely punctured, the side with a broad silaceous stripe; scutellum rounded behind; elytra slightly broader than the prothorax, parallel at the sides for about two thirds their length, the apex of each pointed, several irregular patches of silaceous, principally at the sides; femora toothed beneath; tibiæ slender; abdominal segments as in the last.

A slender form which may be placed near *H. notatus.* The female has rather, although but slightly, rounded sides. My specimens came from M. Oberthür, of Rennes, whose collector, M. Castets, found them in India.

PIMELATA.

Rostrum teres, arcuatum; *scrobes* laterales. *Antennæ* breviusculæ, pone medium rostri insertæ; *funiculus* sex-articulatus; *clava* distincta. *Prothorax* latus, basi bisinuatus. *Elytra* subcordata, prothorace paulo latiora. *Pedes* validi; *femora* clavata, infra dentata; *tibiæ* apice calcaratæ; *tarsi* breviusculi; *unguiculi* basi connati. *Metasternum* breve. *Abdomen* segmentis duobus basalibus ampliatis.

Ergania, to which this genus is allied, has a seven-jointed funicle and small approximate claws; but it differs considerably in *facies* owing to its being uniformly covered by close-set pale grey scales. Both genera I refer to Balanininæ, although, as in many species of *Balaninus*, the elytra completely cover the pygidium.

Pimelata maculata.

P. breviter elliptica, nigra, maculatim albido-squamosa; antennis piceis; rostro nitide nigro, leviter punctato. Long. 3 lin.

Hab. India.

Shortly elliptic, black, spotted above with close-set whitish scales; antennæ pitchy, first two joints of the funicle as long as the rest together; club shortly ovate, distinct; prothorax much broader than long, minutely punctured, not contracted at the base; scutellum punctiform; elytra convex, slightly broader than the prothorax and not much longer than broad, seriate-punctate, the punctures large but shallow and approximate, the apex round; body beneath and tarsi closely covered with whitish scales; femora stout, with a small tooth beneath.

Alcides carbonarius.

A. elongatus, subcylindricus, niger, nitidus; elytris parte basali depressis, in medio convexis, striato-punctatis, punctis magnis contiguis, interstitiis convexis; femoribus tibiisque validis, breviusculis. Long. $5\frac{1}{2}$ lin.

Hab. Rangoon.

Elongate, subcylindrical, glossy black; rostrum scarcely longer than the prothorax, the latter about as broad as long, with granules varying in size and approximation; scutellum punctiform; elytra gradually narrowing to the apex, with the base depressed but conspicuously rising in the middle, striate-punctate, punctures large, contiguous, interstices convex; femora and tibiæ stout and comparatively short, the former with a well-marked tooth beneath.

This species is differentiated by the conspicuously raised middle of the elytra and, in a less degree, by its comparatively short stout femora and tibiæ.

Alcides obtusus.

A. sat breviter oblongus, niger, subnitidus; antennis piceis; capite rostroque omnino confertim punctatis; prothorace granulato; elytris lateribus parallelis, rude seriatim impresso-punctatis; femoribus tibiisque anticis et intermediis elongatis. Long. 5 lin.

Hab. Sarawak.

Somewhat shortly oblong, black; antennæ pitchy; head and rostrum closely punctured throughout; prothorax coarsely granulate; scutellum obcordate; elytra parallel at the sides, flattish at the base, roughly striate-punctate, punctures large, impressed, the interstices convex; fore and intermediate legs elongate and slender; sterna covered with silaceous hairs; three middle segments of the abdomen nearly equal in length.

Shorter and less cylindrical than the preceding, with much larger and more slender fore and intermediate legs.

Alcides gallarius.

A. anguste oblongus, castaneus, nitidus, prothorace fusco; rostro elongato; prothorace in medio linea elevata instructo; elytris subparallelis, lineatim punctatis; femoribus anticis dente magno armatis. Long. 4 lin.

Hab. Saylee.

Narrowly oblong, glossy castaneous; prothorax brown; rostrum nearly twice as long as the prothorax; second joint of the funicle as long as the two next together; prothorax transverse, closely granulate, the middle with a well-marked raised line extending from the apex to the base; scutellum transverse, longitudinally incised; elytra very gradually narrowed to the apex, linearly punctate, the punctures narrowly oblong, the interstices with nearly obsolete punctiform impressions; anterior femora with a large triangular tooth beneath; sterna and abdomen with minute more or less approximate scales.

The strongly raised line on the prothorax, the scutellum formed, as it were, of two transversely placed points, and the coloration are the leading characters of this species; as in the two preceding, the claws are fissile. The six-jointed funicle, the prolonged scutellar lobe of the prothorax, and the salient base of each elytron are characters that stamp the genus *Alcides* as one of the most trenchant of the Apostasimerous Curculionidæ. Yet there is hardly any other genus of Coleoptera where the *facies* of its numerous species (I have over 140) is so dissimilar. According to Lacordaire it should be divided into several genera; but though it would not be difficult to isolate a number each with one or perhaps two species, the majority would remain with intermediate characters forming a genus as indeterminate as it is at present.

Zantes.

Caput deflexum, inter oculos latum; *rostrum* breve, robustum; *scrobes* laterales, arcuatæ, ante oculos desinentes. *Oculi* parvuli, rotundati. *Antennæ* breves, prope oculos insertæ; *scapus* medium oculi attingens; *funiculus* 7-articulatus, articuli quatuor ultimi in clavum gradatim transeuntes, hoc elongato-elliptico. *Prothorax* transversus, basi bisinuatus, ad latera abrupte declivis. *Elytra* rotundata, in medio alte elevata. *Propectus* breve, antice late sinuatum. *Mesosternum* latum. *Abdomen* segmentis tribus intermediis longitudine fere æqualibus, segmento basali inter coxas rotundato. *Pedes* breves; *coxæ* anticæ separatæ; *femora* valida, infra dentata; *tibiæ* arcuatæ; *tarsi* breves, articulo penultimo bilobo; *unguiculi* basi dilatati.

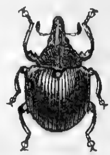
Allied to *Metatyges*—an African genus with no decided affinities—having straight scrobes, contiguous anterior coxæ, &c. There is a marked difference in the *facies*, although they have both the same short outline. The head is extended in the figure in order to show the rostrum; but naturally only a small part of it is seen from above.

Zantes limbatus.

Z. latissime ovatus, fulvus, pilis aureis adspersus; elytris nitide nigricantibus, margine exteriore fulva; clava antennarum nigra. Long. 3 lin.

Hab. Madagascar.

Very broadly ovate, fulvous, with scattered golden hairs; elytra glossy black, the external margin fulvous; head and rostrum finely punctured, the latter broader at the base, the scrobes passing obliquely in front of the eye, not receiving the whole of the scape; club of the antennæ and last three joints of the funicle black, the first joint stout and rather longer than the second; prothorax nearly twice as broad as long, the scutellar lobe truncate; scutellum hollowed in the middle, the two anterior angles tuberculiform; elytra about as broad as long, linearly sulcate, the shoulder and outer margin fulvous; body beneath and legs sparsely pubescent.



Misynus.

Rostrum tenuatum, arcuatum; *scrobes* laterales. *Oculi* ovati, infra approximati. *Antennæ* in medio rostri insertæ; *scapus* oculum haud attingens; *clava* cylindrica, elongata. *Prothorax* convexus, utrinque rotundatus, lobis ocularibus distinctis. *Elytra* prothorace vix latiora. *Coxæ* anticæ contiguæ; *femora* longe pedunculata, infra dentata. *Abdomen* segmentis tribus intermediis gradatim brevioribus.

I do not find the scrobes connivent beneath the rostrum, as stated by Lacordaire, in *Mecocorynus* or in *Ectatorhinus*, and in that respect they agree with the above. From the former this genus differs in the separation of the anterior coxæ, from the latter in the terete rostrum, and from both in the narrow elytra, scarcely broader than the prothorax at the base.

Misynus dissimilis.

M. oblongo-ellipticus, fuscus; prothorace apice angustiore, utrinque fortiter rotundato; elytris griseo-variegatis. Long. $5\frac{1}{2}$ lin.

Hab. Niam-niam.

Oblong-elliptic, brown, prothorax and elytra with obscure patches of greyish, the most conspicuous patch on the latter behind the middle and close to the suture surrounded by a blackish border (but coloration probably variable); rostrum slender throughout; scape long, slender, clavate, not quite reaching the eye; funicle gradually thicker from the first joint, the club not thicker than the last joint and about as long as the last five together; prothorax as long as broad, closely punctured, each puncture filled by a circular bright silaceous scale, the back with a longitudinal raised line; scutellum small, round; elytra seriate-punctate, the interstices raised and granulate; intermediate legs shortest and more slender than the posterior, which extend beyond the body, the anterior stouter and less pedunculate but nearly as long as the posterior; body beneath covered with dull silaceous scales.

Niam-niam is an island off the west coast of Sumatra.

Desmidophorus lanosus.

D. ovatus, haud ampliatus, pilis longissimis silaceis fasciculatim tectus; antennis tenuioribus, nitide nigris; scapo articulo ultimo a clava distincto; elytris humeris rotundatis. Long. 6 lin.

Hab. Madagascar.

Ovate, closely covered with long silaceous hairs, here and there on the elytra fasciculate; rostrum sparsely punctured; antennæ slender, glossy black; funicle with the second joint longest, first, third, and fourth shorter and about equal; club distinct; prothorax rounded at the sides, slightly contracted at the base; elytra broadest at the base, the shoulders rounded and not produced, fasciculi very marked, but their limits not definite; legs very hairy.

The long hair of this very distinct species completely hides the sculpture as well as the scutellum.

Desmidophorus maculatus.

D. sat breviter ovatus, obscure piceus, pilis silaceis albisque obsitus, fasciculis fuscis notatus; antennis nigricantibus, articulis duobus basalibus funiculi longioribus, æqualibus; prothorace fasciculis sex—*sc.* duobus apicalibus et quatuor in medio transversim sitis; elytris humeris productis. Long. 8 lin.

Hab. Batchian.

Rather shortly ovate, dull pitchy brown, the elytra closely covered with mixed yellowish and white setiform scales, the fasciculi of short dark brown scales; antennæ blackish; funicle with the first two joints equal and much the longest;

club distinct; prothorax slightly contracted at the base, somewhat closely punctured, a slender silaceous hair lying over each puncture, at the apex two projecting fasciculi, and four transversely placed in the middle; scutellum subquadrate; elytra very broad at the base, the shoulders produced, the apex of each truncate, with a small tubercle at the outer angle, on the back about twenty slightly raised fasciculi varying in size; femora with a small tooth beneath; third and fourth abdominal segments very short.

The nearest ally of this species is *D. Imhofii* (Java and Borneo), but, *inter alia*, the sculpture is more decided, there are fewer fasciculi, and the four basal joints of the funicle are nearly equal in length.

Desmidophorus funebris.

D. breviter ovatus, niger, opacus; antennis nigricantibus, articulis quatuor basalibus funiculi brevioribus et fere æqualibus; clava distincta; prothorace basi latiore; scutello angusto; elytris humeris productis. Long. 7 lin.

Hab. Waigiou.

Shortly ovate, black, opaque; antennæ black, the first four joints of the funicle nearly equal; club distinct, nearly as long as the last five joints of the funicle together; prothorax broadest at the base, closely punctured, a few curved setæ on the anterior half; scutellum very narrow; elytra strongly produced at the shoulders, seriate-punctate, punctures large, quadrate, apex of each truncate, on the back about twelve fasciculi, composed of very black setæ; legs with short stiff hairs; femora with a nearly obsolete tooth beneath, and with the tibiæ coarsely punctured.

A uniformly black-coloured species, remarkable for its very narrow scutellum. The prothorax spreads out at the base as in *D. ursus* and *D. encaustus.*

Desmidophorus morbosus.

D. breviter ovatus, fuscus, maculis fusco-griseis adspersus; antennis piceis, articulis duobus basalibus funiculi longioribus, tertio quartoque gradatim brevioribus; clava distincta, breviore; elytris humeris tuberculo instructis, singulo apice rotundato. Long. $6\frac{1}{2}$ lin.

Hab. Siam.

Shortly ovate, dark brown, the elytra with several irregular more or less approximate spots, composed of very short silaceous setæ; antennæ black; the first two joints of the funicle equal and longest, the third and fourth gradually shorter; club distinct, not longer than last four joints; prothorax contracted at the base, deeply and coarsely punctured, and with a slightly raised longitudinal line; scutellum subcordiform; elytra not produced at the shoulders, a small tubercle a little behind the angle, the apex of each rounded, seriate-punctate, punctures large, glossy, approximate; femora with a small tooth beneath and with the tibiæ coarsely punctured.

The spots on the elytra are not very conspicuous and they require a powerful lens to show that they are composed of very short setæ.

Poropterus afflictus.

P. ovatus, fuscus, opacus, ad latera pallidior, supra granulis parvis nitidis adspersus; prothorace pone apicem vix constricto; elytris in medio prothorace vix latioribus. Long. 5 lin.

Hab. Saylee.

Ovate, brown, opaque, the sides paler, with silaceous scales and small glossy granules irregularly scattered on the prothorax and elytra; rostrum coarsely and reticulately punctured; antennæ ferruginous; prothorax not broader than long, scarcely constricted behind the apex, the disk longitudinally hollowed in the middle and at the sides; elytra scarcely broader in the middle than the prothorax, slightly rounded at the side, covered with numerous small tubercles with glossy granules intermixed, and some crowning the tubercles; each elytron rounded at the apex; body beneath with greyish scales; second abdominal segment shorter than the first, the suture curved.

A rather narrow species comparatively, in outline resembling *P. approximatus*, but with different sculpture &c. The paler side—forming a sort of stripe in the individual here described—is nearly wanting in another.

Poropterus basiliscus.

P. obovatus, fuscus, opacus, supra granulis parvis nitidis adspersus; prothorace pone apicem constricto; elytris ampliato-rotundatis, tuberculatis, apicem rotundatis, singulo macula magna nigro-fusca basali, alterque mediana, notato. Long. 5 lin.

Hab. Kaioa.

Obovate, brown, opaque, with silaceous scales and small glossy black granules irregularly scattered on the prothorax and elytra; rostrum as in the preceding; antennæ ferruginous; prothorax constricted anteriorly, the side from the middle gradually narrowing to the base, the disk flattish but a little raised in the centre; elytra well rounded at the side, the base of each with a larger oblong tubercle, and on its outer side a large velvet, blackish-brown patch, on the middle another, along the suture a line of small granules, some of the lateral tubercles elevated, conical, and crowned with a glossy granule; body beneath with greyish scales and setæ; first abdominal segment as large as the three next together, the sutures straight.

Allied to the next, but, *inter alia*, with smaller tubercles, a broader prothorax, and dark patches on elytra, &c.

Poropterus irritus.

P. obovatus, fuscus, opacus, supra granulis nitidis adspersus; prothorace pone apicem constricto, disco bituberculato; elytris ampliato-rotundatis, tuberculis octo majoribus instructis. Long. 5 lin.

Hab. Ceram.

Compared with the preceding this species has a narrower and rougher prothorax, not so flat, and with two well-marked tubercles on the disk; the elytra have eight large rounded tubercles—four at the base and four on the back posteriorly, the outermost smallest, the sides and declivity with still smaller tubercles, all spotted more or less with glossy granules, the intervals covered with a scaly matter and many minute scales; body beneath with thickish non-contiguous scales, except that on the second abdominal segment they are close together, that segment itself being very little shorter than the first segment.

Mr. Wallace informs me that this species is found under rotten trees. As in the two preceding, the second joint of the funicle is longer than the first and there is no scutellum.

It is almost impossible to give an adequate idea of the complicated sculpture of these weevils, although to the eye there is no difficulty in detecting the characters differentiating the numerous species of the genus, which spreads as well over Australia, Tasmania, and New Guinea, but apparently not to the Celebes or Borneo. They are not mentioned by Mr. Tepper in his 'Common Native Insects of South Australia.'

LVI.—*On the Mollusca collected by Mr. G. A. Ramage at the Island of Dominica.*—Report II.* By EDGAR A. SMITH.

A SECOND consignment of specimens collected at Dominica by Mr. Ramage comprises eight species which were not contained in his first collection. They are as follows:—

1. *Hyalinia arborea*, Say, var.?

Helix arborea, Say, Reeve, Conch. Icon. fig. 733. [For further references see Gould, Invert. Mass. 1870, p. 396.]

Hab. North America, Cuba, Guadeloupe.

The single specimen from Dominica appears to be rather flatter than North-American examples with which I have compared it; the lines of growth seem to be slightly coarser and the colour darker. These differences, if constant in a series of specimens, would be sufficient to base a new species upon; but as only a single example is at hand, I consider it advisable to await more material before attempting a decision.

†2. *Helix* (*Dentellaria*) *denticus*, Férussac.

3. *Bulimus* (*Leiostracus*) *liliaceus*, Férussac.

4. *Bulimus* (*Leiostracus*) *multifasciatus*, var.

Three specimens from Dominica are very different in colouring from the type as figured by Delessert (Recueil. pl. xxvii. fig. 3). They are of a warm reddish-pink colour banded with purple-black. The upper whorls exhibit two bands, one just beneath the suture and the other, a trifle broader, rather below the middle. The body-whorl has a third zone beneath the centre somewhat narrower than the one above it. The fine spiral striæ correspond with those of the typical form and the minute pitting of the dark apical whorls is the same.

5. *Bulimus* (*Thaumastus*) *exilis*, Gmelin.

Three or four varieties in colour occur in the few shells sent by Mr. Ramage. The form also is equally variable.

* For Report I. see these 'Annals' for September 1888, pp. 227–234.

† References to this and the following species are given in my paper in these 'Annals,' September 1888, pp. 229–233.

6. *Succinea approximans*, Shuttleworth.
7. *Helicina fasciata*, Lamarck.
8. *Helicina Guppyi*, Pease.

In my list of terrestrial Mollusca from Dominica I accidentally omitted *Helicina Goldfussi*, Böttger (Jahrbuch deutsch. mal. Gesell. 1887, vol. xiv. p. 103, pl. iv. fig. 10).

This will raise the total number of species known to inhabit the island to thirty-four. No freshwater shells have hitherto been recorded from this locality. Mr. Guppy presented to the Museum some specimens of *Neritina punctulata*, Lamarck, which he had himself collected, and specimens of this species have also just been received from Mr. Ramage. This well-marked form occurs in many of the Greater and Lesser Antilles and has also been recorded from Mexico.

BIBLIOGRAPHICAL NOTICES.

Catalog der Conchylien-Sammlung. Von Fr. Paetel. 8vo. Berlin, 1887–1888.

The first volume of this work is now complete, and a few remarks upon it may therefore not be out of place. In the preface we are informed that the 'Catalogue' will consist of three parts: the *first*, that now before us, to contain lists of the Cephalopoda, Pteropoda, and marine Gastropoda, the *second* the land and freshwater * Gastropoda, and the *third* the Acephala and Brachiopoda.

The scope of the work is to give a list, not only of the species and varieties contained in Herr Paetel's own collection with their habitats, but also the names of all other recent species which have been described, and such synonyms as were known to the Author. A reference is also added to those species which are desiderata in his collection.

The great value of a Catalogue of this kind lies in its completeness and accuracy. Is it or is it not reliable? Unfortunately the two requisite qualities mentioned appear to be wanting in an eminent degree in the present work. One or two illustrations taken at random will suffice. On page 1 at least half a dozen synonyms and species are omitted in the list of *Argonauta*, and under Suborder I. Octopoda no list appears of the 70 or 80 known species of *Octopus*, and in

* The Melaniidæ, Ampullariidæ, and Viviparidæ, the largest freshwater groups, are given in vol. i.

fact all the other genera belonging to this suborder are wanting, although their absence is unexplained*.

Page 6. In looking at the catalogue of *Sepiola* we miss at least three names which have been proposed for so-called species of the genus, and three species are assigned to "*Pels*" (whoever that may be) which were described by Pfeffer.

Proceeding to the *Heteropoda*, p. 13, we find *Janthina*, *Recluzia*, and *Macgillivrayia* included in this group. The two former genera have long since been properly classed with the Ptenoglossa among the Gastropoda, and the species of *Macgillivrayia* are known to be merely the larval forms of Gastropods. None of the shell-less Heteropods are quoted, and the lists of the Atlantidæ and *Carinariæ* are full of omissions, both in the species and the synonymy. Five species, at least, of the latter are wanting, and about the same number of *Atlanta*, besides which the names of three species are wrongly spelt—namely, *gibba*, *heliconoides*, and *Quoyi*, which should be *gibbosa*, *helicinoides*, and *Quoyana* respectively.

Proceeding to the Gastropoda we may take as a test of accuracy the first page (p. 57) of the family *Pleurotomidæ*. This extensive group occupies no less than forty pages. In examining p. 47 we have noticed that ten names are omitted which should have been included in the alphabetical list of species between *abbreviata* and *alterum*; nor are they to be found under any of the other sections of the family on the subsequent pages.

Thinking that possibly the work might have improved in the later parts we have examined one genus, *Cylichna*, p. 621. Here again great omissions occur, over *thirty* described species being unrecorded!

The names of localities are greatly abbreviated, and in some instances almost beyond recognition; for instance, many might fail to guess what was meant by C. b. sp., Puert Porter, M. pers., Dieg. Srz., C. Espbg., &c.

With regard to the references which are given it may be pointed out that several of them are ridiculous and others are scarcely recognizable or only to be guessed at.

As a specimen of the ridiculous kind we would mention "Ad. gen." This abbreviation occurs throughout the volume and of course refers to the work by Messrs. H. and A. Adams on the Genera of Recent Mollusca. As, however, merely lists of the names of the species are given under their respective genera we gain no information by turning to the work mentioned.

Samples of those which are scarcely recognizable or only to be guessed at are, "Petit," "A. Ad. Moll. Jap."†, "Mrts. Beitr.," "Shell Afr. Sow.," "Proc." ‡, "Grdlr. Vz.," "Binn. Amer.," "Tapp. C.," "Brgt. Etud. Pal.," "Beau 17, G.," &c. &c.

* The fact of these forms possessing no shells may account for their omission.

† A. Adams has never published any work entitled 'Mollusca Japonica;' but some of his papers on Japanese shells in these 'Annals' are probably referred to.

‡ This reference is given to A. Adams, Forbes, Jeffreys, and may refer to the Proc. Zool. Soc., London.

Enough has been said to show the character of the work. The fact is patent that the Author's knowledge of conchological literature was very limited. It is to be regretted that this Catalogue, which must have occupied much time in preparation, is not more complete. Such a work if accurate and reliable would be of the greatest use to Conchologists.

The Fauna of British India, including Ceylon and Burma. Edited by W. T. Blanford.—Part I. *Mammalia,* by W. T. Blanford. 8vo. London: Taylor & Francis. 1888.

By the labours of professional and non-professional naturalists an enormous amount of information has been accumulated upon the zoology of our Eastern Empire. For many years, back indeed to a period which seems almost archaic to the present generation of naturalists, the love of field-sports innate in all true Britons, intensified no doubt by the *ennui* consequent upon frequent residence in places far removed from intercourse with those who could occupy the position of friends, led many civilians and military men to bestow more or less attention upon the natural objects, and especially the larger animals, surrounding them. The result, as is well known, has been the publication of a host of valuable books and memoirs, treating of the structural characters, habits, and mode of life of the principal vertebrate inhabitants of the country.

Without wishing to cast any doubt on the time-honoured precept that "in the multitude of counsellors there is wisdom," we may remark that one consequence of such a variety is usually for a time a considerable divergence of opinion upon certain points, and especially upon those matters which come under the domain of systematic zoology, the determination of the limits and alliances of species, and the recognition of the precise nature of an animal the habits and economy of which may have been under observation. Gradually, of course, the statements of older writers are tested by later observers, errors are eliminated, and the actual facts established. So much has now been done in this direction that the Indian Government has shown great wisdom in determining to bring out a work such as this proposed 'Fauna of British India,' in which all the more or less scattered materials may be brought together in a convenient form, and correlated and criticized by competent authorities, guided by the results of their own investigations.

At present, we notice, the intentions of the Government go no further than the production of a series of volumes upon the Vertebrata of the wide regions over which their dominion extends, and the portion of the work now before us is the first half of the volume on the Mammalia, the preparation of which has been confided to one of the best of Indian zoologists, Dr. W. T. Blanford, who has also been appointed the Editor of the whole work.

In this part the author has given a systematic description of the forms belonging to the orders Primates, Carnivora, and Insectivora which have been recorded as inhabiting the Indian Region as limited by British rule. This he divides into subregions as follows:—1. *Tibetan*, including the Upper Indus valley and the higher Himalaya, belonging to the Palæarctic region of Sclater; 2. *Himalayan*, the southern slopes of the great mountains; 3. *Indian*, from the base of the Himalayas to Cape Comorin, taking in the north of Ceylon, but omitting the Malabar coast; 4. *Malabar* or *Ceylonese*; 5. *Burmese*; 6. *South Tenasserim*, including the Malayan Peninsula. As a matter of course, any hard-and-fast lines of demarcation between such subregions as these must be more or less artificial, and the author is quite conscious that some of them may require modification, but the mere enumeration of them serves to indicate the interesting variety of forms with which it will be the privilege of the different writers to deal.

In a notice of such a book as this, any attempt at special criticism would be out of place. Our object is to indicate the general nature and scope of the work, and the mode in which the author has performed the task he has undertaken. The idea which he has set before him is evidently to produce what may be called a Manual of the Indian Mammalia, giving classified descriptions of all the known species with a compendious account of what has been ascertained with regard to the animals described. If this definition is too modest in its terms, we must ask Dr. Blanford to forgive us; the idea we have wished to convey to the reader is that of the most useful general treatise that one can wish to possess upon any group of animals, and it only remains to be seen how the fundamental idea has been carried out.

The classification adopted by Dr. Blanford is almost identical with that proposed by Prof. Flower, as given by that gentleman in his article on the Mammalia in the new edition of the 'Encyclopædia Britannica.' At the same time he indicates in various places that he is by no means a bigoted upholder of this particular system. The orders, suborders, families, subfamilies, genera, and species are tabulated throughout. The species are admirably described, and their characters, where necessary, discussed in some detail, and in the case of each the distribution is fully indicated; while upon the habits of the species we find an excellent compendium of what has been previously recorded (generally with quotations from the original treatises), often tested and supplemented by the author's own observations or by information furnished to him by reliable observers. The synonymy of the species given seems to us sometimes a little scanty; but this is a minor matter, and will hardly detract much from the usefulness of the book.

The illustrations, which consist of woodcuts and other blocks scattered through the text, are tolerably numerous, and for the most part good and characteristic. Some of the figures are borrowed from the 'Proceedings of the Zoological Society' and other sources; the remainder consist of reduced copies from drawings and published plates. A good many outline figures of skulls are given.

In conclusion we must congratulate Dr. Blanford upon the production of so valuable a work; and we can only hope that the execution of the other portions of the 'Fauna' will be equally satisfactory. The names of the gentlemen to whom the different classes have been entrusted, may, indeed, be taken as a guarantee for the good quality of the work. The volumes on Fishes have been undertaken by Mr. Francis Day, and those on Reptiles and Batrachia by Mr. G. A. Boulenger; while Dr. Blanford tells us that it is hoped the Birds will be taken charge of by Mr. E. W. Oates.

We shall look forward with great expectations to the completion of the series; and we cannot forbear expressing a hope that some means may be found of extending the scheme eventually so as to include the Invertebrate fauna, at any rate of the land and fresh waters, of the Indian district. That there is room for something of the kind is evidenced by the publication of a book which was noticed in this Journal some time ago; and, indeed, we understand that there is already a movement on foot for the systematic investigation of the Entomology of British India.

A Bibliography of the Foraminifera, Recent and Fossil, from 1565 *to* 1888. By C. Davies Sherborn, F.G.S. 8vo. Pp. i–viii and 1–152. Dulau and Co., London.

Foraminifera, both recent and fossil, have often been described and figured and their somewhat confused nomenclature treated of in the 'Annals and Magazine of Natural History.' We are much pleased to be now able to recommend to the notice of naturalists and geologists a complete bibliography of this group of Protozoa. They are mostly microscopic and interminably various in their often very elegant forms; hence their study has often been taken up by observers with enthusiasm, but without sufficient knowledge of what had been done by others before them in the same line of research.

Mr. C. D. Sherborn has collated all previously published catalogues (down to 1888), and, correcting many of their entries, has added not only the latest books and papers treating of this group of Microzoa, but many that had escaped notice, including especially some published in 1712, 1717, 1754, 1791, and 1803. These are mentioned in his preface; and notes are also given of rare and little-known memoirs. The very numerous papers on Foraminifera by C. G. Ehrenberg *, occupying five and a half pages, have never before been so carefully enumerated and annotated as at pp. 41–47. The many important memoirs published by Hungarian rhizopodists are now for the first time catalogued. These and all the other foreign titles are given with the same perfect literary accuracy as that with which the English books and papers are entered; and altogether very few (nine) *errata* have had to be noted at p. vii (with thirteen valuable *addenda*), and the reader can scarcely find a misprint in the type. The titles of papers are given

* See Ann. & Mag. Nat. Hist. 1872, vols. ix. and x.

in full, and a systematic abbreviation of the periodicals and a uniform plan of printing are carefully attended to throughout. Date, size, number of pages and plates of the paper, the pages and plates concerned with the subject-matter, and the place of publication (as in titlepage) are all given, and often a note as to special points of interest; and the dates of birth and death of deceased authors are entered where known. The very few papers that have not been read or examined by the author of the Bibliography are marked "not seen;" and the rarity of this remark (only twenty out of more than two thousand entries) is a striking proof of the persistent energy of the Author in studying the Foraminifera for several years with conscientious labour to the fullest extent.

Mr. Sherborn gratefully acknowledges in his Preface much aid from his many friends in every direction, including the libraries of public institutions and others who have freely helped him. The book is a perfect model of scientific bibliography, and will be of great use to every one working at Foraminifera.

Guide for Scientific Observations in Travelling, in separate memoirs, &c. Second Edition, revised and augmented. Edited by Dr. G. Neumayer, Director of the German Marine Observatory. *Anleitung zur wissenschaftlichen Beobachtungen &c.* 2 vols. 8vo. Berlin, 1888. With numerous woodcuts and two lithograph plates.

This work was originally produced in 1874 after the plan of the well-known British Admiralty 'Manual of Scientific Enquiry,' and, like that work, has received further improvements. The first volume (655 pages) of this second edition contains memoirs as follow:—1. Geographical determination of places, by F. Tietjen; 2. Topographic and geographic surveying, with tables, by W. Jordan; 3. Geology, with table of contents, by F. von Richthofen; 4. Determination of the elements of terrestrial magnetism on land, by H. Wild; 5. Meteorology, by J. Hann; 6. Instructions for observing the general phenomena of the heavens with the naked eye or with such instruments as travellers may have at their disposal; 7. Nautical surveying, by R. Hoffman; 8. Method of tidal observations, by C. Bœgen; 9. Determination of the waterway in unconfined rivers, by J. R. von Lorenz-Liburnau; 10. Some ocean problems: currents, waves, colour, transparency, by O. Krümmel (with a map); 11. Suggestions for observing the commerce of nations, by M. Lindeman; 12. Hydrographic and magnetic observations at sea, by G. Neumayer; 13. Appendix (with table of contents):—1. R. Assman's aspiration-psychrometer; 2. An improved mercury-barometer for travellers; 3. Determination of the snow-line and conditions of snow in mountains; 4. Ratzel's questions regarding snow in mountains; 5. Temperature of springs; 6. Hydrographic signs (plate); 7. Corrections for declination, inclination, and total-force in iron ships; 8. Useful tables (with list): thermometrical, metrical, barometrical, and of difference in longitude and time between Greenwich and ten important places; lastly, a useful index and a list of *corrigenda et addenda.*

The second volume (625 pages) contains:—1. General and political geography, and statistics, by A. Meitzen; 2. Hygiene, comprising remarks on anatomy, physiology, and medicine, by A. Gärtner; 3. Agriculture, by A. Ort; 4. Agricultural plant-culture, by L. Wittmack; 5. Geographical botany, by A. Grisebach and O. Drude; 6. Geographical distribution of the sea-grasses, by P. Ascherson; 7. Collecting and preserving phanerogamic plants, by G. Schweinfurth; 8. Ethnology, by A. Bastian; 9. Language, by H. Steinthal; 10. Counting, with a table of the development of writing numerals, by H. Schubert; 11. Anthropology and prehistoric research, by R. Virchow; 12. Mammalia, by R. Hartmann; 13. Cetacea, by H. Bolan; 14. Birds and Eggs, by G. Hartlaub; 15. Collecting Reptiles, Batrachians, and Fishes, by A. Günther; 16. Collecting Molluscs, by Ed. von Martens; 17. Invertebrata: Crustaceans, sea-spiders, worms, Tunicates, Echinoderms, Cœlenterates, Bryozoans, Sponges, Rhizopods, by K. Möbius; 18. Articulata: Insecta, Arachnoidea, Crustacea, Myriopoda; 19. Microscope and photographic apparatus, by G. Fritsch. A good index follows, also a list of *corrigenda et addenda.* There are lists of books relating to the respective subjects in many of the memoirs in each volume.

The care with which the memoirs have been prepared by their many experienced authors renders these volumes most trustworthy for travellers by land and sea, and indeed they contain considerable stores of information for the home-staying student and observer.

MISCELLANEOUS.

On a Ciliate Infusorian parasitic in the Blood of Carcinus mænas. By Dr. G. Cattaneo.

In 1852 Stein found a ciliated Infusorian of the family Opalinæ (*Anoplophrya branchiarum*) in the branchial lamellæ of *Gammarus pulex* (Zeitschr. f. wiss. Zool. Bd. iii. p. 486). In 1855 Balbiani found another species of *Anoplophrya* in the blood of *Asellus aquaticus*, and remarked that this was the first example of a parasitic ciliate Infusorian living in the blood of its host and travelling with the blood-corpuscles into all parts of the circulatory apparatus. He proposed for it the name of *Anoplophrya circulans* (Rec. Zool. Suisse, vol. ii.).

In May of the present year the author was engaged in the investigation of the amœboid cells of the blood of the Crustacea, and for this purpose examined many examples of *Carcinus mænas*, during which he found in one individual an extraordinary quantity of ciliate Infusoria, living and circulating in the blood like the *Anoplophryæ*, although not belonging to the same family. They were first met with in a large male which had lost its chelæ, and which had been in the aquarium for about a fortnight, and appeared much less vivacious than its companions. It was operated on with the others and with the same precautions, when the examination of the first two or three drops of blood showed very few amœbocytæ, while the preparation was full of large Infusoria which moved rapidly in all directions. The examination was extended to all parts of the body by squeezing the blood from the ends of the limbs, extracting it by means of a fine syringe, and piercing the dorsal vessel, and in all cases the same appearances were presented.

Lastly, the branchial lamellæ of the living Crustacean were examined under the microscope, and the same Infusoria were seen within them travelling in the circulation with the amœboid cells.

This is a case of blood-parasitism like that observed by Balbiani in *Asellus*; but the Infusorian is a Holotrichous one, furnished with a buccal aperture. The Infusoria are 35–45 μ in length, with a greatest breadth of 10–12 μ; they are attenuated anteriorly, rounded posteriorly. The body is entirely surrounded by cilia of equal length, except in the anterior part, where they are a little longer. The attenuated anterior part bends more or less to one side in the form of a flexible rostrum, and at some distance from the apex is the buccal cleft, furnished with long cilia. The body contains a nucleus in its median part, a rose-coloured contractile vesicle in the posterior part, and many granules scattered here and there. These characters show it to belong to the order Holotricha, family Enchelyidæ, Sav. K., and to the genus *Anophrys*, Cohn, which is very nearly allied to the Colpodini.

The genus *Anophrys* was established in 1866 by Ferdinand Cohn, who discovered it in an aquarium containing sea-water. He gives it the following characters:—

ANOPHRYS, gen. nov.

Body rigid, with fine longitudinal and transverse striations, furnished with cilia throughout the periphery, with a central nucleus and a terminal contractile vesicle, with a lateral buccal aperture surrounded by a circlet of vibratile cilia. The apex, which extends above the mouth, has the appearance of an acuminate and flexible rostrum *.

The two known species of this genus are *Anophrys carnium* (=*Leucophrys carnium*, Ehr.) and *A. sarcophaga*, which was found by Cohn in sea-water among putrifying fragments of flesh. The characters of the latter species as given by Cohn are as follows:—

* F. Cohn, Zeitschr. f. wiss. Zool. Bd. xvi. (1860). See also Saville Kent, 'Manual of the Infusoria,' pp. 511, 512.

Anophrys sarcophaga, nov. gen., nov. spec.

Body yellowish, oblong, rounded posteriorly, with the rostrum bent laterally into a hook, flexible, with longer cilia than those of the posterior part of the body (*Acineria incurvata*, Duj. ?). Length 60 μ, breadth 15 μ.

The form found by the author coincides with the generic characters, but differs somewhat from *A. sarcophaga* specifically, especially in its smaller size, the absence or extreme attenuation of the striation, and its parasitic nature. Hence the author is led to regard it as a new species, which he proposes to name in honour of Prof. Maggi. He characterizes it as follows:—

Order HOLOTRICHA.

Fam. Enchelyidæ, Sav. Kent.

Genus Anophrys, Cohn.

Anophrys Maggii, nov. spec.

Char. Body elongate-oval (μ 35–45 × 10–12), rounded posteriorly, with the anterior part pointed and recurved like a rostrum; anterior cilia longer than the lateral and posterior; nucleus median and contractile vesicle posterior; buccal aperture situated beneath the rostrum, and furnished with a circlet of cilia; the transverse and longitudinal striation not visible or very indistinct.

Loc. In the blood of *Carcinus mænas*.

Individual differences occur in the size and in the greater or less curvature of the anterior and expansion of the posterior part. From one to five vacuoles containing granules, besides isolated granules. The rostrum is very mobile. The motion of the Infusorian is rapid, continuous, and direct; occasionally some are seen to stop and rotate around the longitudinal axis. The adaptation to a parasitic existence in the blood of the Crustaceans is especially manifested in the aptitude to change its form, narrowing momentarily in order to pass through confined spaces (as is also done by *Anoplophrya circulans*, Balb.). While the *Anoplophrya* having no mouth is evidently nourished by the blood-plasma, the *Anophrys*, by the movements of the buccal cilia, devours the cells and granules scattered through the blood. Several individuals were seen in transverse segmentation.

The essentially carnivorous nature of the other known species of *Anophrys* explains the adaptation of *A. Maggii* to a parasitic existence. The invasion of the parasite most likely took place through wounds of its host, perhaps at the period of the change of skin; but the presence of the parasite in only one out of some three hundred *Carcini* examined, and that one showing injuries, would seem to indicate that the infection takes place only through occasional courses.

In the blood of the other *Carcini* examined there was a great abundance of little monads with an oval or reniform body, together with some Holotricha much smaller than the *Anophrys.*—*Zoologischer Anzeiger*, no. 286, August 20, 1888, p. 456.

Contribution towards the Knowledge of the Freshwater Fauna of the Vosges. By Dr. O. E. Imhof.

Of the basins upon the chain of the Vosges, the Lake of Gerardmer, 600 metres above the sea, is as yet the only one that has been investigated with regard to its fauna, and, indeed, for its Entomostraca and Hydrachnida. The determination of the material there collected in July 1887 gave 16 Cladocera, 7 Copepoda, and 16 Hydrachnida. Of forms living at the bottom the genera *Planaria* and *Pisidium* also were named *.

The following results of investigations may be ranged with those previously made known from this geographical region (the Mittersheimer-, Niederstein-, and Zummingen-Weiher in Lorraine) †.

1. *Lake of Gerardmer.*

Pelagic fauna: Rotatoria:—*Synchæta pectinata*, Ehr.
Anuræa longispina, Kellie.

2. *Lake of Longemer.*

760 metres above the sea; length 2 kilom.; surface 75 hectares; depth 30–35 metres.

Pelagic fauna: Protozoa:—*Dinobryon sertularia*, var. *alpinum*, Imh.
Podophrya cyclopum, C. & L.
Rotatoria:—*Conochilus volvox*, Ehr.
Triarthra longiseta, Ehr.
Polyarthra platyptera, Ehr.
Synchæta pectinata, Ehr.
Anuræa aculeata, Ehr.
—— *cochlearia*, Gosse.
—— *longispina*, Kellie.

Bottom fauna: Protozoa:—*Difflugia spiralis*, Ehr.
—— *constricta*, Ehr.
Nebela collaris, Ehr.
Cyphoderia ampulla, Ehr.

* 'Feuille des jeunes naturalistes,' no. 204, pp. 162–164.
† 'Zoologischer Anzeiger,' no. 211.

Cladocera :—*Drepanothrix dentata*, Euren.
Copepoda :—*Canthocamptus*, sp.

The samples of the bottom contained a few spicules of a *Spongilla.*

3. *Lac Noir.*

950 metres above the sea; length 520 metres; surface 14 hectares.

Pelagic fauna: Rotatoria :—*Conochilus volvox*, Ehr.; very numerous.
Polyarthra platyptera, Ehr.
Anuræa aculeata, Ehr.
—— *cochlearis*, Gosse.
—— *longispina*, Kellie.
Asplanchna, sp.
Cladocera :—*Holopedium gibberum*, Zadd.
Bosmina, sp.
Copepoda :—*Nauplius*, abundant.

Bottom fauna: Protozoa :—*Difflugia acuminata*, Ehr.
—— *pyriformis*, Perty.
Centropyxis aculeata, Ehr.

4. *Lac Vert, or the Sulser- or Darensee.*

980 metres above the sea; length 320 metres; surface 4·23 hectares; depth 10–11 metres (since the raising of the dam above the natural outflow, 18 metres).

Pelagic fauna: Rotatoria :—*Triarthra longiseta*, Ehr.
Polyarthra platyptera, Ehr.
Synchæta pectinata, Ehr.
Anuræa cochlearis, Gosse.
—— *longispina*, Kellie.
Copepoda :—*Cyclops*, sp.

5. *Lac Blanc.*

Upon the Reisberg, 1054 metres above the sea; length 760 metres; width 380 metres; surface 24·86 hectares.

Pelagic fauna: Rotatoria :—*Anuræa longispina*, Kellie.
Asplanchna, sp.
Copepoda :—*Nauplius*, numerous.
Cyclops, sp.

Bottom fauna: Protozoa:—*Difflugia pyriformis*, Perty.
Centropyxis aculeata, Ehr.

Note.—*Anuræa longispina* is present in all basins.

Particularly noticeable are:—*Dinobryon sertularia*, var. *alpinum*, Imh., previously met with only in a small geographical region on the Bernina, and the occurrence of *Drepanothrix dentata*, Euren, characterized by the tooth about the middle of the dorsal ridge, which was quite recently discovered in France near Tulle.—*Zoologischer Anzeiger*, No. 290, October 8, 1888, p. 565.

On Ægyria oliva, *Clap. & Lachm.* By Dr. L. Plate.

In his memoir 'Ueber Infusorien des Golfes von Neapel,' Geza Entz remarks of *Ægyria oliva*:—"The nucleus is situated beneath the œsophagus. It is a large, clear, round or oval body with a transverse fissure; on various parts of its surface I was able to distinguish a nucleolus quite clearly, even without the employment of reagents." To this short description I would add something, as the nucleus of this Infusorian presents a somewhat unusual structure. It is, in fact, composed of two halves which behave differently with staining materials, in the same way as is known to be the case in *Spirochona gemmipara*, *Leptodiscus medusoides*, and some Rhizopoda. After the animal has been killed with osmic acid one half of the nucleus presents a darkly granular appearance, while the other looks nearly homogeneous and clear, only having a very slight granulation at its foremost pole. The two divisions lie close together, but are separated by a distinct line, so that the transverse fissure observed by Geza Entz must have been an artificial one. On the application of solution of carmine the clear half of the nucleus becomes intensely and the dark one very faintly coloured. The nucleus of *Ægyria oliva* therefore behaves with staining materials just in the opposite way to that of *Spirochona gemmipara*, in which the darkly granular part is the chromatic and the clear part the achromatic part. It would be interesting to ascertain whether in the one form the nuclear division is of so complicated a nature as in the other; for if this were the case we should be justified in regarding the separate arrangement of the chromatic and achromatic nuclear elements as the cause of such a mitosis.—*Zoologische Jahrbücher, Abtheil. für Anat. und Ontogenie*, Band iii. p. 173.

On Heliochona sessilis, *a new Vorticelline.* By Dr. L. Plate.

On the branchial plates of a *Gammarus* from the North Sea I have found a new Vorticelline, the nearest allies of which are to be sought in the genera *Spirochona* and *Stylochona*. As in the latter Infusoria the anterior extremity of the body is widened in the form of a funnel and beset within with numerous cilia which whirl in the food. The animal may bear the name given in the title, as its head-funnel is characterized by a sun-like border of thin rigid bacilli issuing from its margin.

Heliochona sessilis has the form of a flask of which the neck passes into the above-mentioned funnel. However, the transverse section both of the belly of the flask and of the funnel is not round, but oval, so that we can distinguish two narrow and two broad sides. With the lower transversely truncated pole of the body the Infusorian attaches itself to the branchial plate, and, indeed, generally to the surface rather than to the periphery. The length from the base to the beginning of the neck is about 0·034 millim., and from this to the margin of the funnel 0·02 millim. The transverse axis of the *Heliochona* seen from the broad side measures about 0·025 millim., while that of the narrow side is only 0·007 millim. in length. The body is covered throughout with a thin cuticle, which is particularly delicate at the point of attachment.

The only thing of some interest in this Infusorian is the funnel. One of the broad sides of it (which may be described as the back) is produced into two symmetrically placed lobes, which are bent over inwards and partially cover up the cavity of the funnel. Further, the whole margin of the funnel is furnished with a great number of rigid bacilli, which stand nearly at equal distances apart, and may be traced down, as faint ridges, for a short distance in the wall of the funnel. In some individuals I ascertained that some of these bacilli—about every fourth one—were twice as long as those standing between them; in others no such distinction could be recognized. The radii starting from the margin of the funnel are wanting only on the small space between the two overhanging lobes of the cup; on the latter, however, they are present and cause the access to the cavity of the funnel to be partly blocked. Only the smaller food-particles whirled by can pass the lattice-work formed by these bacilli and reach the short œsophagus situated at the bottom of the funnel, and in this circumstance evidently lies the advantage of the arrangement.

In the cell-plasma a rounded, finely granular nucleus is easily observed, but I have seen nothing of a paranucleus. Reproduction takes place, as in *Spirochona gemmipara*, by buds, which are constricted off at a particular spot on the ventral surface, at the base of the neck. The further details of this process I have been unable to trace from want of material.—*Zoologische Jahrbücher, Abtheil. für Anat. und Ontogenie*, Band iii. p. 172.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 12. DECEMBER 1888.

LVII.—*Remarks upon a Species of* Coccidium *infesting* Perichæta. By FRANK E. BEDDARD, M.A., Prosector to the Zoological Society of London, Lecturer on Biology at Guy's Hospital.

[Plate XV.]

THE notes which I publish in this paper are very incomplete, inasmuch as they are the outcome of a study of spirit-preserved material only. But as the material in question shows with perfect clearness certain characteristic features in the structure and development of this *Coccidium*, and as it is not at all likely that I shall have the opportunity of studying the living worms which are the host of the Gregarine, I think it better to publish such new facts as I have noted down. Moreover, this is, I believe, the first record of the presence of *Coccidia* in any Annelid, or at any rate in any earthworm; and it is always important to ascertain how far the range of certain genera of Gregarines is limited to certain groups of animals which are their hosts.

In the account of the Gregarines by Prof. Bütschli, in vol. i. of Bronn's 'Klassen und Ordnungen des Thierreichs,' a valuable summary is given of the distribution of Gregarines; it is there stated that *Coccidia* are only found parasitic in Vertebrates, Myriopods, Turbellaria, and Mollusks; I am able now to extend this statement, and to add earthworms to the list of animals which are known to harbour *Coccidia*. I have made a practice of examining all the earthworms which pass through my hands for Gregarines; I have never as yet detected *Coccidia* in any genus except *Perichæta*; in two species of that genus I have noticed these Gregarines, viz. in *Perichæta novæ-zelandiæ** and in *P. armata* †; in both species they occupied the same part of the body, viz. the perivisceral cavity.

In both cases the *Coccidium* differs in certain particulars from any *Coccidium* that has been hitherto described; it seems also possible that the *Coccidium* which infests *Perichæta novæ-zelandiæ* belongs to a different species from that which infests *Perichæta armata*; upon this point, however, I cannot be certain.

I could discover only a few examples of *Coccidium* in *Perichæta novæ-zelandiæ*, and therefore some stages may have been wanting which would, if present, have shown the species to be identical with that inhabiting the body of *Perichæta armata*. The characteristic Gregarine of the first-mentioned *Perichæta*‡ was so numerous that there was perhaps no room for the *Coccidium* to multiply very freely.

On the other hand, the *Coccidium* of *Perichæta armata*, when it occurred at all, which was very rarely, was extremely abundant; I have been able therefore to get together some drawings, which are reproduced in Pl. XV., and which illustrate some of the principal phases in the life-history of the *Coccidium*. The majority of the figures in the plate illustrate the *Coccidium* of *Perichæta armata*; fig. 16 refers to the *Coccidium* of *Perichæta novæ-zelandiæ*.

In both cases the parasite has the form which is characteristic of *Coccidium*, that is to say it is oval or rather egg-shaped, with slightly flattened sides. Certain individuals, for example those represented in figs. 10, 11, are hardly distinguishable from *Coccidium oviforme* §. The cell-contents are granular, with very coarse granules, and there is no differentiation into endo- and ectoplasm; the cyst-membrane is distinctly double in some cases (fig. 9), less distinctly double in others (fig. 10).

* I have not yet described this species, which I owe to the kindness of Mr. W. W. Smith, of Ashburton, New Zealand.

† The specimens of this worm, in which the *Coccidium* occurs, were kindly sent to me from Borneo by Mr. Everett.

‡ See P. Z. S. 1888, pt. iii.

§ For an account of this parasite see 'The Parasites of Man' (Leuckart), translated by W. E. Hoyle, Edinburgh: p. 203 *et seq.*

Micropyle.—At one end of the cyst in all individuals is a structure which I identify with what has been termed by Waldenberg* (its discoverer) and Leuckart† a "micropyle." The micropyle, however, in the *Coccidium* of *Perichæta armata* is rather different from that of *C. oviforme.*

In *C. oviforme* the micropyle is stated to be an extremely fine pore and to be situated at one pole of the cyst.

Schneider ‡ has described a structure in the cyst-membrane of *Orthospora propria* which appears to correspond to the micropyle; it does not, however, appear from Schneider's description to be a pore, but a slight bulging of the cyst-wall inwards at one extremity of the cyst.

Bütschli considers that probably this "*stigma*" upon the cyst of *Orthospora* corresponds to the so-called micropyle of *Coccidium.* I observed in one specimen of *Coccidium* (fig. 10) a slight thickening at one end of the cyst which projected into the interior, and which agrees very closely with Schneider's figures § of the "*stigma*" of *Orthospora*; but I never noticed any such relation between the "stigma" and the cell-contents as he has figured ‖ and described.

In *Coccidium* from *Perichæta armata* there is always, with very rare exceptions, such as that just mentioned, a micropyle which differs considerably from that of *C. oviforme* or of *Orthospora.* In the first place (*cf.* figs. 1, 2, 3, &c.) its position is not constant; it may be situated (fig. 1) at one pole, but as frequently it is placed at one side more (fig. 15) or less (fig. 2) remote from the pole. The appearance of this structure, which I have termed a micropyle because that is the generally received term, is such that I am inclined to agree with Schneider in believing it *not* to be a perforation of the cyst-membrane at all. My specimens of this *Coccidium* are mounted in glycerine, so that their position can be changed at will by pressing with a needle upon the cover-glass. When the position of the *Coccidium* upon the slide is such that the micropyle is seen in profile it presents the appearances represented in figs. 2, 8, 9, 15. These figures illustrate what the preparations seem to teach, viz. that the so-called micropyle is simply a bulging in of the cuticle, perhaps due to a separation of part of the internal cuticular lamella

* "Zur Entwickelungsgeschichte der Psorospermien," Arch. pathol. Anat. Bd. xl. (1867) p. 435.

† *Loc. cit.*

‡ "Sur les *Psorospermes oviformes* ou *Coccidies,*" Arch. Zool. Exp. t. ix. (1881) p. 387.

§ *Loc. cit.* pl. xxii. fig. 4 *b*, and figs. 5, 6, 7, 8, 10.

‖ *Loc. cit.* pl. xxii. fig. 4 *c*.

caused by reagents. The boundary-line of the micropyle is perfectly continuous with the inner margin of the cyst-membrane, and there is no appearance, at the point where the clear spherical body is in contact with the cyst-membrane, of any perforation of the latter. This structure is so very much larger in this species than in *Orthospora*, that this statement can be made with greater confidence, and it does not appear to me likely that the preservation of the specimens in alcohol is likely to have confused the relations of these parts, which are entirely chitinous. The appearance of such an individual as that represented in fig. 1 gives some colour to the view that the structure in question is a funnel-shaped invagination of the cyst-membrane which opens into the interior of the cyst; but it is simply due to the optical effects produced by the position of the *Coccidium*.

In other cases, where the micropyle is seen from above (fig. 12) it presents the appearance of a free oil-globule contained within the cyst. The second difference then between the so-called micropyle of *Orthospora* and *Coccidium perichætæ* (as I may term the species, perhaps both of them, which are described in the present paper), is its very much greater size in the latter.

The third difference is that there are frequently two of these structures present in a single cyst (see fig. 4); in these cases they are not placed at opposite poles; they may be occasionally so placed, but I have noticed plenty of instances where they are not. This fact will at once recall the apparently similar structure of *Eimeria falciformis*, in which Eimer* has noted the presence of two micropyles placed one at each pole of the somewhat oval cyst. These structures have not been described or figured by Schneider in his account † of *Eimeria nova*.

Cyst-membranes.—There are clearly two cyst-membranes present in *Coccidium perichætæ* ‡; the inner membrane is much thicker in young stages than the outer membrane, which is at that time very thin (fig. 9). Fig. 6 appears to show a third, innermost, membrane, but I believe this appearance to be due to the optical effect produced at a certain focus by the inner membrane.

The most remarkable difference, however, between the cyst-membranes in this species and in *Coccidium oviforme* is

* See Bütschli, Bronn's 'Thierreich,' Bd. i. Protozoa, pl. xxxviii. fig. 2 *b*.

† *Loc. cit.* p. 397.

‡ These statements, as well as those about the micropyle, refer only to the parasite of *Perichæta armata*.

that the outer cyst-membrane, instead of disappearing as the cyst ripens *, not only persists, but increases greatly in importance. I have observed various stages in the increase in thickness of this membrane, which are illustrated in figs. 9, 2, 5, 6, 12, 15; it finally comes to project beyond the two poles of the cyst for a very considerable distance (fig. 15), sometimes equal or nearly equal to the length of the cyst. Although this membrane increases so greatly in thickness, especially at the two poles, it remains of a very delicate consistency and is extremely transparent. It bears no little resemblance to the thick transparent outer cyst-membrane of *Gamocystis* and *Clepsidrina* †. Occasionally (fig. 15) concentric lines, perhaps indicating the deposition of successive layers, are visible.

It is important to observe (fig. 15) that in these advanced stages the micropyle has not any relation whatever to the outer cyst-membrane, which is a further argument against regarding this structure as an aperture.

It often happened that two cysts, each limited by its own inner membrane, were enclosed partly (fig. 8) or entirely (fig. 13) in a common outer membrane.

Sporulation.—In *Coccidium oviforme* the first preliminary to sporulation is the condensation of the protoplasmic contents of the cyst into a rounded mass. This I have not discovered in *Coccidium perichætæ*, or, rather, I have not observed any great differences in this particular between various individuals with a still undivided mass of protoplasm. The condition, however, of the material (preserved in alcohol) is probably responsible for this; but in any case there does not appear to be any formation of a membrane enclosing the spores, as in *Cyclospora* ‡.

Various stages in the division of the protoplasm are shown in figs. 4, 3, 8, 9, 13, 12, 15, and these stages are an almost unbroken series, showing *the division into a large number of sporoblasts.* The increase in number of the sporoblasts does not bear any definite relation to the increase of the outer cyst-membrane. In some individuals the outer cyst-membrane had attained to a high development, while the protoplasmic contents of the cyst were still undivided (fig. 7). On the other hand, figs. 8 and 9 illustrate two individuals in which the outer cyst-membrane was inconspicuous, while the cell-contents had already divided into several masses. I have not succeeded in tracing the formation of spores any further than to this point.

* Bütschli, *loc. cit.* pl. xxxvii. figs. 11 *a* and *b*.

† Schneider, "Contributions à l'histoire des Gregariens &c.," Arch. Zool. Exp. t. iv. (1875).

‡ Schneider, *loc. cit.* pl. xxii. figs. 23–38.

The division of the cell-contents into a large number of sporoblasts is a fact of some little importance with regard to the affinities of the *Coccidia*, to which group the present species seem without doubt to belong.

The oviform psorosperms, including *Coccidium* and Schneider's genus *Orthospora*, as well as *Eimeria* and *Cyclospora*, which differ in having a circular form, are distinguished from other Gregarines (1) in being intracellular parasites, for the greater part of their life and even in the latest stages parasitic in the tissues of their host; they are never free-living: (2) in the fact that they only produce a limited number of spores—one to four.

In *Klossia* and *Benedenia* (which Schneider does not regard as distinct from *Klossia*) the number of spores is much greater; but they agree with the other Coccidiidæ in their mode of life and are generally referred to that family. In the phenomenon of their sporulation, which may perhaps be related to their greater size, they agree with other Gregarines, and they form therefore an intermediate group between *Coccidium* &c. and the Monocystidæ.

This affinity between the Coccidiidæ and the Monocystidæ is rendered closer by the fact that Coccidium perichætæ, *which is a typical oviform* Coccidium, *produces a large number of spores like the free-living Gregarinidæ. It also resembles certain of the latter*, e. g. Gamocystis, *in the great development of the outer cyst-membrane.*

With regard to the *Coccidium* from *Perichæta novæ-zelandiæ* I have observed the formation of a large number of sporoblasts (fig. 16); but I have not noticed the thick outer cyst-membrane. As has been already stated, the formation of spores in the *Coccidium* from *Perichæta armata* does not advance *pari passu* with the development of the outer membrane; it may be therefore that I did not succeed in observing any individuals in which the outer cyst-membrane was developed, but that there were others not observed by me in which it was to be found.

I have stated at the commencement of this paper that in both species of *Perichæta* the *Coccidium* occurred in the body-cavity; I certainly met with the *Coccidium* from *Perichæta novæ-zelandiæ* in this situation in company with a large species of Gregarine which I have described elsewhere*. I cannot be so certain about *Perichæta armata*, as the intestine of the worm from which I obtained my specimens was ruptured. In both cases, however, the *Coccidia* may very

* "Note on a new Gregarine," Proc. Zool. Soc. 1888, pt. iii.

possibly have been contained in the tissues lining the cœlom; but of this fact I cannot be absolutely certain.

Summary.

The most important facts recorded in this paper are the following:—

(1) *Coccidium* occurs in the Oligochæt *Perichæta.*
(2) In two species of *Perichæta* from different parts of the world (i. e. *P. novæ-zelandiæ* from New Zealand and *P. armata* from Borneo) the same species, or at least closely allied species, occur which differ from other forms.
(3) The cyst-membrane is double and the outer membrane is of very great thickness, though extremely transparent.
(4) There is a conspicuous "micropyle" (often two) which does not appear to be a perforation of the cyst-membrane, but merely a local bulging, perhaps due to reagents.
(5) The protoplasm of the parasite breaks up into a large number of spores.

EXPLANATION OF PLATE XV.

Lettering:—*a*, inner cyst-membrane; *b*, outer cyst-membrane; *c*, micropyle; *d*, protoplasmic contents; *d'*, sporoblasts.

Figs. 1–13, 15. *Coccidium* from *Perichæta armata.*
Fig. 14. *Gregarina*, sp.?, found in company with *Coccidium* in *Perichæta armata.*
Fig. 16. *Coccidium* from *Perichæta novæ-zealandiæ.*

LVIII.—*On the Foraminiferal Genus* Orbitoides *of d'Orbigny.* By H. J. Carter, F.R.S. &c.

There are several discoid fossils among the Nummulites which, having a central plane covered in on each side by a more or less convex crust, look so much like Nummulites that, without close inspection, they would appear to present no difference; and these in totality have been named "*Orbitoides*" by d'Orbigny, whose diagnosis, together with typical illustrations of the structure of the genus, taken from *Orbitoides media*, d'Orb., of 1847, olim *Orbitolites media*, d'Archiac, of 1837, = *Orbitolites* of Faujas de Saint-Fond in 1799, may be found in his 'Cours de Paléontologie et de Géologie' (vol. ii. pp. 193, 194) and 'Prodrome' (vol. ii. p. 279), where he has also assigned to them as their existence in time the geological interval between his "Sénonien" and "Parisien" divisions, that is between the Upper Chalk and the Nummulitic series inclusively.

Now this would probably be quite sufficient if the structural type of *Orbitoides media* was the same as that of all the other species; but this is not the case, inasmuch as the structural type of *Orbitoides papyracea*, which d'Orbigny has placed in his "Suessonien" division of the Eocene Period (*op. cit.* vol. ii. p. 732), is markedly different.

The typical structure of *Orbitoides media*, d'Orb. (making allowance for the diagrammatic nature of his illustrations), is precisely like that of *Nummulites Mantelli*, Morton, of the Claiborne Beds in Alabama, saving the presence of the superficial layer in the latter and the difference in the marking of the surface in the former, as will be more particularly seen hereafter when I come to describe the type forms of these fossils respectively, while the structure of *Orbitoides papyracea* is almost precisely like that of *Lycophris ephippium* delineated by J. de C. Sowerby in his illustrations of Grant's "Memoir of the Geology of the State of Cutch, in Western India" (Trans. Geol. Soc. Lond. 1840, 2nd ser. vol. v. pl. xxiv. figs. 15 *a* and 15 *b*). D'Orbigny's genus, then, dates from 1847 and Sowerby's from 1840.

Here it should be remembered that Sowerby's illustrations of the structure of his *Lycophris ephippium* (viz. pl. xxiv. figs. 15 *a* and 15 *b*) are very different from those of his *Lycophris dispansus* close by (viz. 16 *a* and 16 *b*), as in his "fig. 16 *a*" there are none of the columns which are so characteristic of his *L. ephippium* in "fig. 15 *b*," and the columns indicated in the section of *L. dispansus*, fig. 16 *b* (since the chambers of the central plane are not shown), may or may not be those of the ephippial type, as will be seen hereafter, although I confess to a leaning towards the latter. Sowerby also, in adverting to his illustrations in the paragraph following his explanations, states that "possibly these two forms may be different stages of the growth of the same species." I mention this here to point out that, although the presence of the "columns" is a persistent character of those *Orbitoides* which present the structural type of *Lycophris ephippium*, it is by no means so in that of *Orbitoides media*, d'Orb. (*op. et loc. cit.*), and therefore to apply the term "*Orbitoides dispansa*" indiscriminately to the two fossils, viz. *Lycophris ephippium* and *L. dispansus*, may be a mistake; while if they really belonged to the types that I have mentioned respectively, it may be inferred that both are found together in the bed of Nummulites at Lukput, in Cutch, from which these fossils are stated by Captain Grant, in his "Memoir," to have come (*op. et loc. cit.*).

For excellent illustrations of the microscopical structure of *Orbitoides papyracea* and all the known species of this type brought together I must refer the reader to Gümbel's "Beiträge zur Foraminiferenfauna der Nordalpinen Eocängebilde," Taf. iii. n. iv. (Abhandl. k. bayer. Ak. Wiss. vol. x. p. 581, 1868), whereby he will become acquainted with this type. Thus the reader will observe here, no less than in Sowerby's delineations of his *Lycophris ephippium*, to which I have alluded, that horizontally the central plane is composed of more or less oblong rectangular chambers, and that vertically, that is on each side of the central plane, the crust-like structure is composed of columns of vertically compressed cells intermingled with conical columns (which columns consist of non-tubular, opaque, white shelly substance), whose obtuse ends project above the surface in the form of little knobs and whose pointed ones extend down to the central plane (Gümbel, *op. et loc. cit.* Taf. iii. fig. 21).

On the other hand, equally typical microscopical illustrations of Morton's *Nummulites Mantelli* from the Claiborne beds of Alabama, with the exceptions just stated, are represented in d'Orbigny's illustrations of the structure of his *Orbitoides media* (*op. et loc. cit.*), whereby the reader may become equally well acquainted with the prevailing type of *this* Orbitoid structure as with its differences from that of *Orbitoides papyracea*. Thus it will be observed here in *Nummulites Mantelli*, no less than in my own illustrations of the Sindian species of 1853 ('Annals,' vol. xi. pl. vii. figs. 40 *a*, *b*, *c*, and 41), that horizontally the central plane appears to be composed of circular, or, from their juxtaposition, slightly hexagonal cells, so arranged in the interstices of obliquely crossing lines that, radiating centrifugally from the centre to the circumference, they present the pattern of an "engine-turned" watch-case (see especially d'Orbigny's illustrations of his "Coupe horizontale" of *Orbitoides media*), and that vertically here the crust-like structure is composed of columns of vertically compressed cells, which are *not* intermingled with the "conical columns" before mentioned, but are separated from each other simply by the translucent substance of the fossilized test; while the whole, in the Sindian species as well as in the Alabama fossil, is covered in by a thin superficial layer of still more compressed cells, which are in juxtaposition, and in lieu of being "circular" are so irregular in outline that altogether they present a reticulated appearance ('Annals,' *l. c.* pl. vii. fig. 40, *a*, *b*), simulating a similar layer in the surface of *Nummulites lævigatus* from the Bracklesham beds in England.

Hence it will have been seen that the central plane in *Orbitoides papyracea* is composed of "chambers," and that these chambers are rectangular in form; whereas in *Nummulites Mantelli* it is composed of cells, and these cells circular or spheroidal in form (I call them "cells" because they are spheroidal in form and not rectangular): the former arranged in rows radiating centrifugally from the centre ('Annals,' *l. c.* pl. vii. fig. 26), and the latter circularly in the interstices of crossing lines also radiating from the centre, but in opposite directions, so as to intersect each other obliquely and thus present the "engine-turned" pattern to which I have alluded. Moreover, that in *Orbitoides papyracea* there *are* the conical columns of opaque, white, non-tubular shell-substance, and that in *Nummulites Mantelli* there are *none*. Further, that there is on the surface of the Sindian species a cortical portion possessing a reticulated structure, which is concealed in the Alabama fossil under a smooth structureless surface, and that in *Orbitoides papyracea* there is nothing of the kind.

Thus I was led in 1853 to adopt the name of *Orbitolites Mantelli* for Morton's *Nummulites Mantelli*, more especially because it appeared to me that this compound structure was but an evolutionary development of the more simple one of *Orbitolites marginalis* of Lamarck.

But to understand this more clearly it is desirable that *Orbitolites marginalis* (which is not only widely spread throughout the warmer regions of the earth, but also typical of the fossilized species, which at least date as far back as the Nummulitic series) should be particularly described. Thus, in general form it is circular, wavy, and concave on both sides, owing to the smallness of the central or first-formed cells and their increasing in size and number of layers towards the circumference. The largest specimens of the recent species that I possess are 5-12ths of an inch in diameter and were obtained from the Gulf of Suez, while the largest fossilized specimen that has come under my notice is from the Nummulitic series on the south-east coast of Arabia, and this measures 1 inch in diameter and about 1-12th of an inch in thickness (Geol. Papers of Western

India; Carter (reprint), Bombay, 1857, p. 587). The cells of which *Orbitolites marginalis* is composed are spheroidal and so arranged respectively in the interstices of obliquely intercrossing lines which radiate centrifugally from the centre to the circumference in opposite directions as to present the same "engine-turned" appearance as that of the central plane of *Nummulites Mantelli*; and not being accompanied by the conical "columns" of opaque shelly substance, incipient or otherwise, they thus altogether present precisely the same appearance as that of the central plane of *Nummulites Mantelli.* Hence by the evolutionary development of the collateral crusts of *Nummulites Mantelli* it so becomes allied to *Orbitolites marginalis* that I have been led to adopt the name of *Orbitolites Mantelli* for the former in contradistinction to that of "*Orbitoides*" in *O. papyracea* and its like, which, on the other hand, all together seem to be equally based upon another type of Foraminifera, viz. *Cycloclypeus.*

Thus *Cycloclypeus*, Carp. ('Introduction,' pl. xix.), consists horizontally of a thin discoid test, which is composed of a number of rows of rectangular chambers that radiate centrifugally from the centre, in the angles of which chambers are incipient conical pillars of opaque white shelly substance ("cones of non-tubular substance," Carp., see fig. 5, *op. et loc. cit.*), whose obtuse ends project beyond the surface in the form of little knobs, so as to give it a granular appearance, whereby the form is simply that of the central plane of *Orbitoides papyracea* and its like. Thus by the evolutionary development of the collateral crusts of the latter it so becomes allied to the former that *Orbitoides papyracea* (following the same reasoning) must be regarded as much a derivative from *Cycloclypeus* as *Orbitolites Mantelli* is from *Orbitolites marginalis*; and hence the difference in the structure of these fossils to which I have alluded.

The same with *Nummulites*, which, *mutatis mutandis*, appears to be an evolutionary development of *Operculina.*

It is evident that Gümbel must have seen this or he would not have proposed a subgenus of *Orbitoides*, d'Orb., viz. "*Lepidocyclina*," for species of the type of *Orbitolites Mantelli* = *Orbitoides Mantelli*, d'Orb. (Gümbel, *op. cit.* p. 139, separate copy).

All this I pointed out in 1861 ('Annals,' vol. viii. pl. xvi.); the plate then given is entirely devoted to parallel columns of structural illustrations, in order that the facts I have stated might be directly realized. Whether or not this has had the desired effect I cannot say, but at all events in de Lapparent's

'Traité de Géologie' of 1883, p. 1027, the name of *Orbitolites Mantelli* appears among the Alabama fossils.

With reference to the specific value of the "conical columns of non-tubular, opaque, white, shelly substance;" in distinguishing the two types of Orbitoid structure to which I have alluded, I now find that it is by no means so great as I had anticipated; for while this character appears to be persistent in the type of *Orbitoides papyracea*, it is only partially so in that of *Orbitolites Mantelli*, seeing that the columns are undoubtedly absent in the Alabama species, in that from Arabia, and that from Burma which I have lately described ('Annals,' 1888, vol. ii. p. 342), but not always so in the specimens from Sind. They are undoubtedly absent in the infiltrated specimen from Sind which I have figured in the 'Annals' (*l. c.*), while in the same ferruginous mass of Nummulites from which the latter came there is an *uninfiltrated* specimen about an inch in diameter in which the "columns" are so undoubtedly present that, but for the presence also of a portion of the characteristic central plane of this type, I should have set it down as belonging to *Orbitoides papyracea*. Again, in the specimens of *Orbitolites Mantelli* from Nal, in the province of Jhalawan, they are not only indicated by the presence of their obtuse ends among the reticulated structure of the surface, but in the section may be seen to have their pointed ends in the intervals between the cells of the central plane. While it will presently be seen that they are equally characteristic of d'Orbigny's *Orbitoides media* from Maestricht, although they are not represented in his illustrations of this species (*l. c.*), that is if it be the one which it is stated to be in his 'Cours de Géologie' (*l. c.*). Hence it becomes necessary to describe a genuine specimen of *Orbitoides media* from the Upper Chalk of Maestricht first, and then to compare it with d'Orbigny's illustrations afterwards; but before entering upon this it is desirable to premise what the references are which appear to justify d'Orbigny's identification, for which purpose the following extract is given from the 'Prodrome,' vol. ii. p. 279, viz.:—

"ORBITOIDES, d'Orb. 1847.

"1349. *media*, d'Orb. 1847. *Orbitolites media*, d'Archiac, 1837. Mém. Soc. Géol. de France, t. ii. p. 178. Faujas de Saint-Fond, pl. xxxiv. figs. 1, 2, 3, 4. Royan (Charente-Inférieure), Lanquais (Dordogne); Maestricht."

Fortunately, through the kindness of Dr. H. Woodward, of the British Museum, aided by sections made by Dr. G. J. Hinde, I am in a position to give the following description of a genuine specimen of *Orbitoides media* from the Upper Chalk of Maestricht:—

This is circular, slightly wavy, depressed, conical on one side, where it ends in a slight central papillary projection corresponding to a gentle depression on the opposite side, which is otherwise slightly convex, granular on both sides, the granules often presenting an indistinctly sinuous linear arrangement towards the circumference. Internal structure consisting of a central plane, in which the cells or chambers in a fresh state appear in a horizontal section to have been circular and situated respectively in the interstices of inter-crossing centrifugal lines, which, radiating from the centre in opposite directions, thus present the "engine-turned" pattern to which I have above alluded, and show how the first-formed or central cells become smallest and the circumferential ones the largest; while in the vertical section the same circumstances cause the central plane to be thinnest in the centre and widest at the circumference, where apparently the layers of cells, by running into each other, cause the divisions of the central plane to present a series of curved cylinders, whose convexities are directed outwards. Central plane covered in on each side by a convex crust composed of columns of vertically compressed cells, intermingled with conical columns of more consolidated whitish shell-substance, whose obtuse ends form the granules of the surface and whose pointed ones appear to reach the angles of the interstices in the central plane. Size of specimens varying a little under 8-24ths inch in diameter and 2-24ths in thickness in the centre, including the papillary projection.

Loc. Upper Chalk of Maestricht.

Obs. The above description is quite sufficient to recognize the fossil, but would have been more satisfactory if the fossilization had been more crystalline and compact. No. of specimens "P. 1490."

Such are the characters of the little discoid fossil from Maestricht, and they are fundamentally the same as those presented by the large specimens of *Orbitolites Mantelli* from Nal, in the province of Jhalawan, to which I have just alluded. Dr. Cook states, in his "Topographical and Geographical Sketch of a portion of the Province of Jhalawan &c., or northern part of the Tableland of Beloochistan" (Trans. Med. and Phys. Soc. Bombay, no. vi. new ser. 1861, p. 71; whence the subjoined diagrammatic figure is taken), that "this limestone in some places is crystalline and contains no fossils, but in others is almost *made up* of a large flat, thin fossil with an abruptly prominent centre closely resembling *Lycophris dispansus*. Its surface is covered with small tubercles (but they are not, I think, united by stellate lines). This fossil measured 2½ inches in diameter, 1-20th inch thick, and 2-10ths inch in the centre." Among the

specimens which Dr. Cook kindly sent me at the time the central inflation considerably differs in thickness, since in some instances it is so slight that it is hardly distinguishable. But whoever studies the Foraminifera must be prepared for such differences, and must therefore be correspondingly careful as to the value he attaches to them in specific distinction.

It will now be seen that d'Orbigny's illustrations do not entirely accord with what has been stated of the Maestricht fossil, which was first described and illustrated by Faujas de Saint-Fond in 1799 (' Histoire Naturelle de la Montagne de Saint-Pierre de Maestricht), in so far as there are no "columns" represented by d'Orbigny in the "Coupe verticale" of his *Orbitoides media* (*l. c.*) and no granulations on its surface, but in lieu thereof there are sinuous lines extending from the centre to the circumference and a central papillary projection on *each* side; while in the fossil from Maestricht the papillary projection is on one side *only*, as represented by Faujas de Saint-Fond in his fig. 3, as I learn from the tracing kindly made for me by Mr. Jones, of the Geological Society. Still, in other respects d'Orbigny's illustrations would suffice for the Orbitolitean type of the Maestricht fossil to which I have alluded.

What fossil, then, do d'Orbigny's illustrations in totality represent? Let us take his other reference, viz. that to *Orbitolites media*, d'Archiac, from the Chalk in the south-west of France, of which, as I have no specimen and there is no illustration to his description, the best thing that I can do is to append his own words in the following extract:—

" *Orbitolites media*, nob.

" Lenticulaire, déprimé. Du centre de chaque face partent de petits sillons nombreux, qui se croisent en se dirigeant vers la circonférence ; pores irréguliers à la surface ; souvent le polypier se divise en deux parties égales dans le sens de son épaisseur; l'intérieur présente alors des couches d'accroissement et des cercles qui, en se croisant, ornent ces lames de losanges disposés en quinconces circulaires. Diamètre des plus grands individus, 50 millim.; épaisseur, 3 millim.

"Les individus jeunes, dont on serrait tenté de faire une espèce, sont moins larges, plus elevés, proportion gardée, et ressemblent à deux cônes opposés base à base.

"Cette espèce est figurée dans Faujas de Saint-Fond ('Histoire de la Montagne de Saint-Pierre de Maestricht, pl. xxxiv. figs. 1, 2, 3, 4). Elle est aussi indiquée, mais non décrite dans le genre discholite de Fortis.

"*Loc. de S. Ouest.* Royan, Lanquais, Dordogne.

"*Etage* 4.

"*Loc. du Nord de la France et de l'Europe.* Maestricht.

"*Etage*, Craie tuffau.

"(Mém. Soc. Géol. de France, tome ii. 1837. 'Sur la Formation Crétacée du Sud-ouest de la France,' par M. le Vicomte d'Archiac, p. 178.)"

With reference, then, to d'Orbigny's illustrations of his *Orbitoides media*, it will be observed that d'Archiac does not mention the central papillary projection represented by d'Orbigny on each side of his specimen ("Profil," *l. c.*), even if his "sillons" be identifiable with the sinuous lines on the surface of d'Orbigny's *Orbitoides media*, which I much doubt. Nor do d'Archiac nor d'Orbigny notice any granulations on the surface, or the "columns" that extend therefrom to the central plane in the Maestricht fossil, although both the description of the interior by the former and d'Orbigny's "Coupe horizontale" indicate the structure that is typical of the Maestricht fossil (viz. the "engine-turned" pattern) which Faujas de Saint-Fond has represented in his fig. 4 (*l. c.*), as well as of *Orbitolites Mantelli*. Again, while Faujas de Saint-Fond's specimen was only 12 millim., that from the south-west of France described by d'Archiac was 50 millim. in diameter. Thus Faujas de Saint-Fond's species of 1799, d'Archiac's of 1837, and d'Orbigny's *Orbitoides media* all differ so far as has been above stated; but, as I have said, such differences in Foraminiferal species are of doubtful specific value, and the difference in size just mentioned need not be regarded as distinctive any more than the presence or absence of the "columns" in this type of Orbitoid structure, as I have above stated. Thus, after all, each of these three fossils might have been regarded by d'Orbigny as typical of his *Orbitoides media*, as each possesses the most persistent and typical structure in the central plane. D'Archiac's specimen was evidently a more or less symmetrical fossil with a central plane, since he states that it was susceptible of being split into "equal parts," which is not the case with *Orbitolites marginalis* &c., as they present *no* "central plane."

Further I cannot go. D'Archiac's fossil is stated to have come from Royan &c., and all seem to agree that the cliff at Royan on the northern side of the estuary of the Garonne presents the "Maestrichtien" of France, which is equivalent to the Upper Chalk of Maestricht in the Netherlands.

Lastly, I have to advert to the type of *Nummulites Mantelli*, Morton, of 1834, viz. the Alabama species = *Orbitolites Mantelli*, Cart. (1853), for the examination of which I am again indebted to my kind friend Dr. H. Woodward; and here, for comparison, it is best to follow the same course that I have taken with the Maestricht fossil. Thus:—

The Alabama fossil is circular, flat, and thin, slightly undulatory and *smooth* on the surface, presenting a small, more or less gentle elevation in the centre, which is papilliform. Internal structure consisting of a central plane, in which the cells or chambers in a horizontal section appear to have been circular and situated respectively in the interstices of intercrossing centrifugal lines, which, radiating from the centre to the circumference in opposite directions, thus present the "engine-turned" pattern to which I have alluded, and in like manner show how the first-formed or central cells become smaller and the circumferential ones largest, while in the vertical section the same circumstances cause the central plane to be thinnest in the centre and widest at the circumference, towards which apparently the layers of cells running into each other vertically cause the central plane in the vertical direction to assume a series of curved lines whose convexities are directed outwards. Central plane covered in on each side by a convex crust composed of vertically compressed cells separated only by fossilized shell-substance in which there are no "columns;" cells gradually losing their original circularity outwards and becoming even still more compressed, so as to present a reticulated appearance, in which the interstices are extremely irregular both in form and size; finally concealed under a thin *smooth* layer of amorphous substance which, where it has been chipped off, shows the subjacent reticulation.

Colour white, chalk-like, in accordance with the earthy granular composition of the matrix in the hand-specimen, which appears to consist chiefly of microscopic Foraminifera in which the specimens of *Nummulites Mantelli* of all sizes are abundantly and horizontally imbedded. Size of largest specimens 13½-12ths inch in diameter and 1-24th inch thick.

Loc. Claiborne beds of Alabama, United States North America.

No. of specimen "50515."

Obs. In all the *Orbitoides* there is a marked difference between the form of the chambers of the central plane and those of the crust, which consists in the increasing irregularity of the horizontal outline in the latter outwards; while the chambers in the central part of a vertical section of the central plane present a rectangular form, on account of the section of this part passing through them tangentially.

Thus it will be seen that the Alabama fossil has no "columns" and possesses a cortical layer, which *therefore* has a *smooth* surface, while that of the Maestricht fossil *has* "columns" with a granulated surface, where the granules represent the outer ends of the columns, which therefore more nearly allies it to, although it is not identical with, the much larger species, viz. *Orbitolites Mantelli*, Cart., from Nal, in Jhalawan, to which I have alluded, in which the distance between the knobs or granules on the surface and their indistinctness, together with the size, seem to ally this species more to Gümbel's "*Orbitoides dilata*" among his Lepidocyclina (*op. cit.* p. 139, Taf. iv. figs. 45–47) than any of the rest.

I cannot say more, however, of his figure representing part of the structure of the central plane of this fossil (viz. fig. 46) than that it is almost identical with that given by Carpenter of the Alabama species ('Introduction,' pl. xx. fig. 5); for according to the position of the cell and its surrounding lines I learn from my large infiltrated specimen from Sind that it may be at one time circular in outline and at another subcircular, as represented by Carpenter and Gümbel respectively, that is, according to the position of the section, while the cells in the *fresh state* would appear to be all spheroidal.

P.S.—I regret to say that in correcting the "proof" of my last paper in the 'Annals,' viz. that containing a description of the large variety of *Orbitolites Mantelli*, Cart., var. *Theobaldi*, from Burma (vol. ii. p. 342, Oct. 1888), there were several errors which, on account of illness at the time, were overlooked, but fortunately none which interfered with the descriptive part of the communication; still as it is desirable that they should be noticed, I append the following list:—

At page 344, 17th line from top, for *Cithereamensis* read *Citherea promensis*.
At page 346, 4th line from top, for *Orbitolites* read *Orbitoides*.
" " 7th " " *for* Parisien *read* Sénonien.
" " 10th " " *for* ten *read* seven.
" " 12th " " *for* 1837 *read* 1840.
" " 6th " bottom, insert "only" after the brackets.
" 348, 7th " top, insert "*Orbitolites Mantelli* that I have described ('Annals,' *loc. cit.*) with that of" after "all the specimens of."

In the month of June, 1864, I deposited in the museum of the Geological Society of London the type specimens of my *Conulites Cooki* and *Alveolina meandrina*, described and illustrated in the 'Annals' of 1861 (vol. iii. pp. 331 and 381, and pls. xv. and xvii. figs. 7 and 4 respectively). I mention this here because I know of no others of the same kind that have been found or publicly noticed.

Note.—Since this paper was written I have had the pleasure to receive (viz. on the 9th November) some beautiful specimens of the "Nummulitic Beds" of Alabama charged abundantly, as usual, with the *Nummulites Mantelli*, Morton, from Mr. Anthony Woodward, of New York, for whose great generosity and promptness in thus replying to my request I shall feel lastingly indebted to him.

LIX.—*Description of a new Species of the Longicorn Genus* Cyriocrates. By C. J. Gahan, M.A., Assistant, Zoological Department, British Museum.

Cyriocrates elegans, n. sp.

Niger, nitidus; capite minutissime et sparse punctulato, genis, vittis duabus frontis et mandibulorum basibus pallide cæruleis; prothorace antice (linea media excepta) pallide cæruleo, postice nigro, cum lobo mediano distincto; elytris nigris, chalybeatis, fere impunctatis, fasciis quatuor incompletis et macula rotunda utrinque ad apicem pallide cæruleis; corpore subtus lateraliter cæruleo-maculato; antennis cæruleo-griseo annulatis.
Long. 32 mm.

Hab. Ruby-Mines District, Upper Burmah.

Head very minutely and sparsely punctured; black, with a large spot on each cheek, the epistome, the base of the mandibles, and a short vitta on each side of the front pale blue. The sides of the prothorax in front of the lateral spines and the anterior part of the disk (the middle excepted) pale blue; the sides behind the lateral spines, the basal part of the disk, and a narrow, longitudinal, median space black and glossy. The scutellum pale blue. The elytra, without granules and impressed with only a few small punctures behind each shoulder, are of a deep dark blue which is almost black. They are crossed by four pale blue pubescent bands, of which the most anterior or basal is made up of three spots on each elytron—one below the shoulder, the second in the depression above the shoulder, the third smaller and confluent with the second nearer to the suture. The second band consists of a single large transverse spot on each elytron which reaches neither the suture nor the outer margin. The third band is similar to the second. The fourth is a row of four quadrate spots—two on each elytron. In addition there is a large rounded pale blue spot on each at the apex. A single broad spot on the side of each abdominal segment, the sides of the metasternum and the mesothoracic episternum are also coloured pale blue. The tarsi on their upperside, the tibiæ towards their middle, and the apices of the femora are bluish, the remaining parts of the legs black. The antennæ, rather stout and scarcely more than half as long again as the body, are ringed with bluish grey, each ring comprising the apex of one joint and the base of the succeeding joint; the intervening parts are of a dull pubescent black, the scape only being somewhat naked and glossy. The latter is provided with a distinct and complete cicatrice. The mesosternum is horizontal behind, vertical and strongly tubercled in front.

The spots and bands of pale blue pubescence on a shining ground of very dark blue give this insect a handsome appearance.

LX.—*The* Staphylinidæ *of Japan.* By Dr. D. Sharp.

[Continued from p. 387.]

Tachyporus terminalis, n. sp.

Testaceus; elytris circa scutellum nigricantibus, metasterno infuscato; abdomine rufo, apice nigro.

Long. 4 millim.

Antennæ elongate, evidently thicker externally, testaceous, the terminal joints scarcely more obscure. Head and thorax clear yellow. Elytra more reddish yellow, with a definite black patch about the scutellum; sparingly punctate. Hind body with first four segments red, the two terminal clear black. Mesosternum yellow; metasternum blackish.

A distinct species to be placed near *T. obtusus*.

A single male was found at the Shimonosuwa Lake, 31st July, 1881.

Tachyporus celatus.

Tachyporus celatus, Sharp, Trans. Ent. Soc. Lond. 1874, p. 17.

This is apparently one of the commoner species of Staphylinidæ in Japan, and though I have not seen very many specimens, is, I think, very variable in colour.

Yokohama, Nikko, Hakone, Miyanoshita, and Kamiichi.

Tachyporus suavis, n. sp.

Niger, nitidus; antennis, palpis, prothoracis lateribus pedibusque testaceis; elytrorum apice plus minusve evidenter pallido; antennis extrorsum evidenter crassioribus; prothorace elytris conspicue latiore.

Long. 5 millim.

Var. Antennis extrorsum fuscescentibus.

Antennæ rather stout, tenth joint about as long as broad. Prothorax curved at the sides and much narrowed in front, black, but yellow at the sides, the yellow colour being broadest near the hind angles. Elytra considerably longer than the thorax. Hind body with a sparing but distinctly impressed punctuation.

This is readily distinguished from the darker specimens of *T. celatus* by its thicker antennæ, as well as by the more elegant coloration; it is remarkable from the fact that the punctuation of the hind body is a true punctuation, consisting evidently of fine impressed punctures; this is best seen near the base of each segment, the punctures becoming quite obsolete on the hinder part of each plate.

Single individuals have been four times met with, at Yuyama in May, at Fukushima at the end of July, at Chiuzenji and at Nikko in August, 1881. Of the variety with darker antennæ single individuals were twice found, viz. at Shimonosuwa on the 31st July and at Nikko on the 18th August.

Tachyporus oculatus, n. sp.

Fusco-niger, abdomine nigro; antennis fuscis basi dilutiore, palpis

pedibusque testaceis; elytris thoracis longitudine, vix rufescentibus; abdomine parce obsoletissimeque punctato.
Long. $3\frac{1}{2}$ millim.

This species is of the size and form of *T. humerosus*, but is one of the most easily recognized species of the genus; the head is broader than usual, the eyes being larger and more distinctly faceted; the penultimate joint of the maxillary palpus is but little broader than the preceding. The thorax is but little curved at the sides and but little narrowed in front; its sides are more or less distinctly sordid yellow. The elytra are of a very dull and obscure red colour, only very sparingly punctured. The punctuation of the hind body is extremely indistinct. The tarsi are elongate and slender, the anterior of the male not dilated.

Five individuals were found at Miyanoshita and a single individual at Hakone, a few miles distant.

Tachyporus orthogrammus, n. sp.

Niger; prothorace margine laterali et basali, elytris margine apicali vittaque recta intra-laterali, pedibus antennisque testaceis, his extrorsum fuscescentibus.
Long. 3 millim.

Antennæ quite slender, a little thickened externally. Head broad, with large eyes. Thorax strongly transverse, not much narrowed in front. Elytra considerably longer than the thorax, feebly punctate and pubescent, and with a few erect, short, black setæ distributed over their surface; of a lurid black colour, at some distance from the outer margin but parallel with it, bearing a broad straight yellow stripe extending from front to hind margin. Hind body black, hind margin of each segment narrowly yellow.

This has longer elytra than *T. oculatus*, and cannot fail to be distinguished by the peculiar coloration of the wing-cases.

Kiga; a single example.

Conosoma pumilum.

Conurus pumilus, Sharp, Trans. Ent. Soc. Lond. 1874, p. 18.

Found near Nagasaki in March.

Conosoma germanum.

Conurus germanus, Sharp, Trans. Ent. Soc. Lond. 1874, p. 17.

About a dozen specimens have been found in various localities in Kiushiu and the main island, Hakone, Fukushima, and Nagasaki. The species is no doubt quite distinct from the European *C. pubescens.*

Conosoma fimbriatum, n. sp.

Majus, nigrum, subopacum, sat dense punctatum, pedibus rufis; antennis fuscis basi et articulo ultimo testaceis, hoc elongato; tibiis intermediis apice nigro-ciliatis, ciliis intus vix ascendentibus.

Long. 6 millim.

Antennæ elongate, the tenth joint quite as long as broad, the three or four basal joints pale, and the apical joint also pale, this latter elongate, a little longer than the ninth and tenth together. Thorax with the base truncate and the hind angles rounded, not at all produced, the hind margin more or less picescent. Elytra slightly longer than the thorax. Hind body entirely black. Mesosternum with a strong carina; epipleuræ at shoulders much developed in the perpendicular direction; middle tibiæ rather stout, the black fimbriæ with which they are armed at the extremity only just extending along the rounded angle.

Found in the main island, at Yokohama, and in fungi at Nikko.

Conosoma tibiale, n. sp.

Sat crassum, fusco-nigrum, subopacum; antennis pedibusque testaceis, illis in medio fuscis, articulo ultimo sat elongato, decimo latitudine fere longiore; elytris ad basin vage rufescentibus; abdomine ferrugineo-cingulato; tibiis intermediis apice nigro-ciliatis, ciliis ad marginem interiorem evidenter ascendentibus.

Long. $5\frac{1}{2}$ millim.

This insect is very similar to *C. fimbriatum*, but differs in the important fact that the black cilia of the apex of the middle tibiæ are conspicuously continued for a short distance upwards along the inner margin. The punctuation of the surface is not nearly so dense as in many species of the genus; when the hind body is extended it is seen that the segments are broadly cingulate with reddish colour, and that the hind part of the penultimate segment and the greater part of the terminal segment at the base are yellowish. In the strongly carinate mesosternum and the epipleural development at the shoulders *C. tibiale* and *C. fimbriatum* are similar.

Two individuals found in fungi at Nikko and one at Oyayama, April 26, 1881.

Conosoma tristiculum.

Conosoma tristiculum, Weise, Deutsche ent. Zeitschr. 1877, p. 92.

Mr. Lewis has brought back only a single specimen that I can consider to be this species; it has the middle tibiæ simple and the epipleuræ nearly simple at the shoulders, and is thus readily distinguished from *C. tibiale*, while from *C. varicorne*, which also it greatly resembles, the slender antennæ with elongate terminal joint conspicuously separate it.

The precise locality of this individual has not been recorded.

Conosoma varicorne, n. sp.

Sat crassum, nigro-fuscum, subopacum; antennis rufo-obscuris, basi et articulo ultimo pedibusque testaceis; antennis haud gracilibus, apicem versus incrassatis, articulis penultimis transversis, ultimo haud elongato; tibiis intermediis simplicibus, ad apicem flavo-ciliatis.

Long. 5 millim.

The punctuation is not very dense and usually there is no marked cingulation of the hind body in this species; it resembles *C. tristiculum* and *C. tibiale*, but is readily distinguished by the simple intermediate tibiæ; these when looked at from the inner face are not at all enlarged towards the extremity, which is simply truncate and armed with minute yellow cilia; the mesosternal carina is only moderately elevated and the epipleuræ are a little impressed at the shoulders. I have seen but few specimens, mostly in bad preservation; although the colour is in some individuals more variegate with red—somewhat as in *C. tibiale*—I see no characters for separating them specifically.

Found in several localities on the main island; and also one individual of a large dark variety from Sapporo.

Conosoma pedicularium.

Tachyporus pedicularius, Grav. Col. Micr. p. 133.

A few individuals were collected about Nagasaki in February 1881. I am not able to point out any satisfactory characters for separating the Japanese insect from the European species.

Conosoma armatum, n. sp.

Parvulum, ferrugineum; elytris abdomineque plus minusve nigrosignatis; antennis ante apicem sæpius fuscescentibus; elytris ad latera setis erectis majusculis armatis.

Long. 3 millim.

This little insect is extremely similar to *C. pedicularium*, but is readily distinguished by the large black setæ with which the sides of the elytra are armed; it is also more or less spotted with black, but apparently in a very variable manner. It is nearly allied to the Australian *C. personatum*, Fauv., but that insect is smaller and has the antennæ shorter and more clavate.

A few specimens were found on the main island at Kashiwagi, Nikko, and Oyama.

Bolitobius.

It appears probable that Eastern Siberia and Japan are the metropolitan regions for this genus. I am enabled to bring the number of species from the latter country up to nine, and in addition to these Mr. Lewis obtained single examples, not in a condition suitable for study, of five others.

Bolitobius principalis, n. sp.

Elongatus, capite præsertim elongato, angusto, nigerrimus; antennis basi flavescente articulis tribus ultimis pallide flavis; abdomine segmentis tertio quartoque rufis.

Long. 13 millim.

This remarkable *Bolitobius* is no doubt allied to the Siberian *B. prænobilis*, Kr., that species having, however, the hind body in greater part red and the antennæ different at the extremity. Here the three terminal joints are pale, almost white, and form an abrupt contrast to the preceding joints, which are quite black, the elongate and slender basal joint being flavescent, with a dusky streak above. The narrow head is conico-subcylindric. The thorax and elytra entirely black, the sutural and dorsal series of punctures on the latter each about nine in number. The hind body is coarsely punctate, with strong outstanding setæ. The legs black, becoming paler towards the extremity, so that the tarsi are reddish at any rate towards the extremity.

Nikko, Miyanoshita; seven examples.

Bolitobius daimio, n. sp.

Elongatus, capite præsertim elongato, niger, nitidus; antennarum

basi et articulo ultimo pedibusque testaceis; elytris margine apicali vittaque obliqua ad humerum extrorsum expansa flavis.
Long. 11 millim.

Antennæ rather elongate, ninth and tenth joints each about as long as broad, terminal joint rather longer, yellow, the elongate basal joint also yellow; palpi piceous, with the terminal joint flavescent. Head elongate and narrow, subcylindric. Thorax entirely black. Elytra not very long, in larger part black, but each with a yellow mark starting from the suture at the apex and extending to the shoulder, where it is much dilated, the hind margin also narrowly yellow; the sutural and discoidal series of punctures each about eleven or twelve in number. Hind body rather coarsely punctate, with distinct erect setæ. Legs flavescent, with the tips of femora and tibiæ infuscate.

One of the two examples has the base of the hind body obscurely rufescent, due, I expect, to its being a little immature.

Nikko.

Bolitobius irregularis.

Bolitobius irregularis, Weise, Deutsche ent. Zeitschr. xxi. (1877) p. 93.

Yokohama, Miyanoshita, and Kumakuni in Higo (*Lewis*); Hagi (*Hiller*).

Bolitobius semirufus, n. sp.

Elongatus, angustulus, antice et postice acuminatus; antennarum basi et articulo ultimo, palpis pedibusque testaceis; capite thoraceque nigris, hoc ad latera et ad basin, illo antice, testaceis; elytris testaceis, circa scutellum et late ad angulos posteriores nigris; abdomine rufo, apice nigro, segmento penultimo apice flavo-cingulato.
Long. 7 millim.

Antennæ slender, the three basal joints and the terminal joint yellow, the tenth joint about as long as broad. Head elongate, black, yellow in front of the antennæ. Thorax as long as broad, black, the sides yellow, more broadly so behind, the basal margin narrowly yellow. Elytra rather long, yellow, with a very large black mark on each behind; these marks nearly join at the suture, and leave the hind margin narrowly yellow; there is also a black triangular mark on the scutellar region; the sutural series of punctures is about seven in number, and the discoidal the same. The abdominal punctuation is scanty, being nearly absent on the two basal segments and only moderately close on the penultimate. The legs, including the front coxæ, are yellow; the breast is black. This is about the size of our European *B. trinotatus*, but has a much longer head and is differently coloured.

Nikko and Chiuzenji; five examples.

Bolitobius cinctiventris, n. sp.

Niger, antennarum basi, palpis, pedibus elytrisque testaceis, his ad angulos posteriores nigro-maculatis; abdomine fortiter punctato, segmentorum marginibus posterioribus testaceo-cingulatis.

Long. 7½ millim.

Antennæ rather short; fifth to tenth joints subequal, no one of them longer than broad; terminal joint short, pale at the tip. Head black, short. Thorax black, scarcely so long as broad. Elytra yellow, with a large diagonal black mark at each outer hind angle, and with a small dark mark round the scutellum extending backwards along the suture; the sutural and dorsal series consist each of about eight punctures. Hind body dark, each segment with the hind margin remarkably definitely testaceous, the basal segments very sparingly punctate, those behind rather coarsely though not densely so.

This may be placed near *B. trinotatus*, but is not very close to any species I know.

Oyama, Miyanoshita; only three ill-preserved examples were obtained.

Bolitobius breviceps, n. sp.

Niger, antennarum basi, palpis, pedibus elytrisque testaceis, thorace ad latera flavescente; elytris ad angulos posteriores nigris, seriebus dorsalibus et suturalibus circiter 9-punctatis.

Long. 6 millim.

Antennæ with the four basal joints pale, tenth joint about as long as broad, terminal joint elongate, about twice as long as the tenth. Head black, very short, eyes but little distant from the thorax. Thorax not so long as broad, black, with the sides yellow, this colour rather broader behind. Elytra yellow, not marked with black round the scutellum, but with each outer angle diagonally black, the dark colour extending quite to the hind margin, scarcely reaching the suture, but at the outer margin extending far forwards. Hind body black, with the penultimate segment broadly ringed with yellow, rather finely punctate.

Nikko, June 1880; two ill-preserved examples.

Bolitobius pallidiceps, n. sp.

Niger, antennarum basi et articulo ultimo, palpis, pedibus capiteque testaceis, hoc vertice fuscescente; elytris ad humeros flavescentibus, serie dorsali circiter 8-punctato.
Long. $5\frac{1}{2}$ millim.

Antennæ rather short, the penultimate joints not quite so long as broad, terminal joint also quite short, pallid. Head moderately long and acuminate. Thorax as long as broad, the base and hind angles very rounded, entirely black. Elytra rather short, in greater part black, but with a rather large ill-defined pale mark at each shoulder, the punctures of the dorsal series unusually coarse. Hind body black, rather sparingly and finely punctate, each segment ringed with yellow behind.

Kashiwagi, 16th June, 1881; unique.

Bolitobius simplex, n. sp.

Elongatus, angustulus, rufo-testaceus, capite nigro; antennis (basi excepta), elytris versus apicem abdominisque apice fuscescentibus.
Long. $5\frac{1}{2}$ millim.

Antennæ rather slender, the three basal joints pale, the penultimate joint rather longer than broad, terminal joint elongate, yellow at its extremity. Head quite short, black. Thorax clear yellow, about as long as broad. Elytra elongate, yellow, vaguely fuscescent towards the extremity, the sutural and dorsal series consisting each of about twelve fine punctures. Hind body slender, sparingly punctate, basal half of penultimate segment fuscescent, the other half reddish, apical segment blackish.

Nagasaki and Bukenji; one example from each locality.

Not closely allied to any other species, and in appearance perhaps more similar to *Mycetoporus splendidus* than to the typical *Bolitobii.*

Bolitobius felix, n. sp.

Major, latus, rufo-testaceus, abdomine, elytrorum apice antennisque nigris, harum basi pedibusque testaceis; prothorace basi subtiliter marginato; elytrorum seriebus circiter 10-punctatis.
Long. 9–13 millim.

Antennæ rather stout, four basal joints yellow, the next six blackish, terminal joint rather long, fuscous yellow, each of fifth to tenth joints about as long as broad. Head rather broad, not acuminate. Thorax not quite so long as broad, much narrowed in front, like the head bright reddish yellow. Elytra rather longer than the thorax, the apical margin black, the black colour broader towards the outer angle and along the outer margin extending far forwards, but not reaching the shoulder, the dorsal series of punctures placed in a well-marked depression, the epipleural line very closely and coarsely punctate. Hind body black, coarsely and rather closely punctate, the two basal segments impunctate on the middle. Anterior coxæ scabrous. The male has the hind margin of the penultimate ventral plate produced somewhat in the middle, and in front of this there is a carina becoming behind gradually more elevated. The hind margin of the terminal plate is densely hispid.

Although the characters of the scabrous front coxæ and the margined base to the thorax in conjunction with the rather slender sublinear palpi are sufficient to make this a distinct genus, I do not propose a name for it, as much discrepancy of opinion prevails concerning the allied genera.

Nikko, Yuyama, Kashiwagi, and Nara, in the early summer, ten examples; also in Eastern Siberia.

Megacronus.

Under this name I unite for the present purpose the genera distinguished by Rey under the names *Bryocharis*, *Megacronus*, and *Bryoporus*, feeling that in the present early and extremely incomplete state of our knowledge of the insects of this family it is not advisable to make use of more generic names than are necessary.

Megacronus prolongatus, n. sp.

Elongatus, subdepressus, rufus; abdomine rufo-obscuro; elytris crebre fortiter irregulariter punctatis.

Long. 8 millim.

Antennæ elongate, third joint very long, of fourth to tenth each is shorter than its predecessor, the fourth being greatly longer than broad, the tenth about as long as broad, terminal joint a little longer than the tenth; the middle joints are a little infuscate. Head rather small, concolorous with the thorax; this latter with two punctures on the disk in front of the middle. Elytra longer than the thorax, rather coarsely punctate, the punctuation not serial. Hind body elongate and slender, of a dusky red colour, with the apex clearer red, rather coarsely punctate.

This is allied to the European *M. inclinans*, and belongs to the subgenus *Bryocharis* of Thomson and Rey.

Nara, 1st July, Chiuzenji, 19th August, 1881; one example from each, both apparently females.

Megacronus princeps.

Megacronus princeps, Sharp, Trans. Ent. Soc. Lond. 1874, p. 19.

Mr. Lewis has now found the male of this species; it possesses on the penultimate plate two series of cilia separated by a moderately broad space; the cilia are so arranged and so densely packed as to appear like a solid carina. The species belongs to the subgenus *Bryocharis.*

Hitoyoshi and Miyanoshita; a single example in May from each locality.

Megacronus setiger.

Megacronus setiger, Sharp, Trans. Ent. Soc. Lond. 1874, p. 18.

The characters previously given by me as those of the male are, I presume, really those of the female, as Mr. Lewis has brought back two examples, one of which, by extraction of the œdeagus, I find to be certainly a male; it has the terminal ventral plate provided in the middle behind with a large broad depression, and terminated behind by a large, peculiar, ligular prolongation.

Ichiuchi and Kiga; one example from each place.

Megacronus striatus.

Staphylinus striatus, Oliv. Ent. no. 42, pl. v. fig. 47.

In Europe this species has not been found to be variable; but in Japan, to judge from the few examples obtained by Mr. Lewis, it is quite the contrary. The eight Japanese examples represent four forms, viz.:—1, similar to our European type; 2, similar to the European type, but with more densely punctured hind body; 3, rather smaller and more slender than the European type, and with the elytra entirely black; 4, considerably smaller than the European type, and thorax and elytra red, the latter with a black spot behind. It is far from improbable that these may prove to be four distinct species.

1. Nikko; 2. Oyama and Nikko; 3. Nikko; 4. Nikko and Sapporo.

Megacronus optatus, n. sp.

Niger, nitidus; elytris sordide rufis, antennarum basi, palpis pedibusque testaceis; abdomine parce punctato, segmentorum marginibus rufo-cingulatis.
Long. $5\frac{1}{2}$ millim.

Antennæ rather slender, thickened externally, four basal joints yellow, fifth joint as long as broad, penultimate joints slightly transverse, hind margin picescent. Elytra slightly longer than the thorax, the dorsal series consisting of four or five subobsolete punctures. Hind body sparingly punctate, distinctly though scantily pubescent.

This is readily distinguished from *M. striatus* by the comparatively slender antennæ and the red immaculate elytra. It is more like our European *B. rugipennis*, from which it is distinguished by the colour of the head and thorax and the absence of any rugæ on the elytra. It is a member of the genus or subgenus *Bryoporus*, Rey, which, however, is scarcely sufficiently distinct from *Megacronus* as defined by the French systematist.

Kiga; unique.

Megacronus gracilis, n. sp.

Angustulus, rufus, capite nigricante, antennarum basi, palpis pedibusque testaceis; elytris regulariter multiseriatim punctatis.
Long. 5 millim.

This also from the structure of its palpi must be assigned to the subgenus *Bryoporus*; but it is very distinct by the regular coarse punctuation of the elytra, which is arranged in seven or eight series, somewhat as it is in the Central-American species of the genus. The antennæ are short, thickened externally, with the penultimate joints rather strongly transverse; the middle joints are infuscate. The head is small and narrow, black. The thorax is slightly transverse, and is remarkable from possessing along the middle three pairs of setigerous punctures, one near the front, one near the base, and one behind the middle; there are also a few lateral punctures irregularly placed, and in addition a scanty very minute punctuation. The elongate and narrow elytra are much longer than the thorax. The hind body is elongate and slender, rather closely punctate.

Otsu, Kobé, Fukushima, in June and July; one example from each locality.

MYCETOPORUS.

The Japanese species of this genus are better placed in the subgenus *Ischnosoma*, Rey: *Mycetoporus*, i. sp., which contains all the European species of the genus except two, not being represented in the Japanese fauna so far as we know it at present.

Mycetoporus convexus, n. sp.

Angustulus, nitidus; antennis crassiusculis, testaceis; capite thoraceque fusco-testaceis, pernitidis; elytris sordide testaceis, seriebus dorsalibus et discoidalibus remote punctatis; abdomine fusco, segmento penultimo late testaceo-cingulato.

Long. 4 millim.

Antennæ stout, clear yellow, the penultimate joint about as long as broad. Thorax very convex, about as long as broad. Elytra rather longer than the thorax, the dorsal series consisting of four or five indistinct punctures, the sutural series of about six rather more distinct. Hind body slender, its setæ very largely developed and conspicuous; the colour is nearly black, the hind margins of the segments being reddish, that of the penultimate segment very broadly so.

Hitoyoshi and Hosokuté; one example from each locality.

Mycetoporus discoidalis, n. sp.

Angustus, fusculus; antennis, palpis, thorace, pedibus elytrisque testaceis, his disco late fuscescente; abdomine segmentis posterius testaceo-marginatis, dense punctato; elytris seriebus dorsalibus et suturalibus crebre punctatis.

Long. 5 millim.

Antennæ only moderately long and not stout, penultimate joints hardly so long as broad, the middle joints a little infuscate. Head narrow, infuscate yellow. Thorax rather small, scarcely so long as broad, clear yellow. Elytra longer than the thorax, infuscate on the middle, so as to leave the hind margin broadly yellow and a yellow mark at each shoulder; the punctures of the dorsal and sutural series, though fine, are very distinct and numerous, there being from twelve to fifteen in each series. The slender hind body is densely punctate; the hind margins of the segments are broadly yellow, that of the penultimate segment very broadly. The male has the middle of the last ventral plate deeply depressed behind, the depression surrounded by a scabrous margin, and a tuft of setæ on each side projecting backwards beyond the hind margin. The hind margin of the preceding segment is feebly emarginate in the middle and set with fine pale pubescence, on either side of which are black setæ.

This is nearer than any other of the Japanese species to our European *M. splendidus*, but is not very close to it.

Yokohama, Kiga, Miyanoshita.

Mycetoporus duplicatus, n. sp.

Rufo-testaceus; elytris nigricantibus, basi late rufo-testaceo, serie suturali multipunctato, serie dorsali duplicato.

Long. 5 millim.

Antennæ moderately long, penultimate joints scarcely so long as broad. Head yellow, slightly infuscate. Thorax clear yellow, broader than long. Elytra rather elongate, more than half of their surface black, the base being clear yellow; the punctures of the sutural series are numerous and distinct, about fifteen in number; the dorsal series is duplicate. The hind body is clear pale red, rather closely punctate. The legs are yellow.

Chiuzenji, 21st August, 1881; two examples.

Mycetoporus Lewisius.

Bryoporus Lewisius, Sharp, Trans. Ent. Soc. Lond. 1874, p. 19.

Mr. Lewis has now obtained other specimens of this insect, and it is clear from the structure of the palpi that the species would be better placed in the subgenus *Ischnosoma* of *Mycetoporus* than in *Bryoporus*. This species and *M. duplicatus* connect, however, *Mycetoporus* rather closely with *Bryoporus*.

Nagasaki in April; four examples.

[To be continued.]

LXI.—*Notes from the St. Andrews Marine Laboratory* (*under the Fishery Board for Scotland*).—No. IX. By Prof. M'Intosh, M.D., LL.D., F.R.S., &c.

1. On *Lesueuria*, a Ctenophore new to Britain.
2. On the Development of Mussels (*Mytilus edulis*).
3. On a Post-larval Pleuronectid (Turbot?).
4. On a Post-larval *Cottus* contrasted with the Gadoids.
5. On the appearance and disappearance of *Lucernaria* and other Forms.

1. *On* Lesueuria vitrea, *M.-Edwards.*

Comparatively little attention has been given by British naturalists to the Ctenophores, though at least two species have long been known as inhabitants of our seas, viz. *Pleurobrachia* and the ordinary *Beroë* (termed *Idyia cucumis* by Dr. Merle Norman). The former is perhaps the most abundant and ubiquitous Cœlenterate in inshore waters in all stages of growth and at all seasons of the year, from January to December—not, as formerly pointed out, always near the surface, but often for long periods in our changeable climate towards the lower regions of the water. The latter again is more characteristic of the warmer months of the year, from July till September, and the adults are often in vast masses at the surface, especially in such regions as the voes of Shetland and the Frith of Forth, though it is of course met with almost everywhere round our coasts.

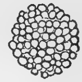
In using the large mid-water net in St. Andrews Bay at a depth of 3 fathoms on the 19th May this year considerable numbers of a form agreeing with *Lesueuria vitrea*, M.-Edwards, were found amongst hosts of *Pleurobrachiæ* and Hydromedusæ. They were recognized by their great translucency, powerful locomotive flappers, and characteristic shape; moreover, on further examination their extreme delicacy was conspicuous; indeed, they are the most fragile of a fragile group, and yet at this time the specimens were not large—only from $\frac{3}{4}$ to $1\frac{1}{2}$ in. in long diameter. From this period onward to September they presented themselves almost daily in great abundance in the mid-water net, and throughout the bay generally, so that it was as common to meet with them as with *Pleurobrachia*. In respect to novelty they took the place of *Clione* of the previous year.

They varied in size from the period just mentioned onwards, that is, both large and small forms were present throughout, the maximum of $3\frac{1}{2}$ in. or rather more being reached, however, on August 4th. The reproductive organs appeared to attain maturity towards the end of June and in July. The capsule of the ovum measured ·016 in. and the ovum proper ·0083 in. in a specimen procured in the first week of July.

The genus *Lesueuria* was established in 1841 by Milne-Edwards in his description of the structure and functions of certain zoophytes &c. from the shores of France, the name being given in honour of the able fellow-worker of Péron in the description of the forms procured during the well-known voyage to the Australian seas. He had found this new Ctenophore (2 centimetres long) in great abundance in the Bay of Nice. The account * of *Lesueuria*, as given by the distinguished French zoologist, corresponds generally with

* Ann. des Sc. nat. 2e sér. tome xvi. p. 199, pls. ii., iii., and iv.

the specimens found at St. Andrews, so that it is unnecessary to repeat it. The contractile filaments, however, in connexion with the principal lobes are much more distinct than he figures them, and the concretions in the ctenocyst are minutely botryoidal or form a crystalline coarsely granular mass (see woodcut), and are perfectly colourless, instead of being reddish, as in the Mediterranean form. There are tinted granules (pinkish), however, at the bases of the water-vessels. It is also worthy of note that in July and August certain examples showed a much larger development of the principal lobes at the sides of the mouth than had been observed earlier in the season. They projected like two large flaps at the sides of the aperture, approaching in this respect the *Euramphæa* of Gegenbaur (*Mnemia* of M. Sars *). The species has since been found at Nice by Verany and at Naples by Sars and Spagnolini †.



Concretion in ctenocyst.

On the shores of North America (Massachusetts Bay and Newport, R. I.), again, Alex. Agassiz procured a species of the same genus, and described it in 1865 along with other Cœlenterates. This species grows to a large size, viz. 4 inches in polar diameter, and " is as transparent as *Bolina* and even more sluggish. It is exceedingly abundant during September, large numbers being visible during any clear hot day. Its phosphorescence is a very peculiar bluish light, of an exceedingly pale steel-colour, but very intense " ‡.

The examples at St. Andrews swam steadily in the water, and more actively than *Beroë*, as might be expected from their very powerful locomotive flappers. The mouth was generally uppermost. Nothing of moment was observed in the gastric chamber, and hence they formed a striking contrast with *Pleurobrachia*, which is so greedy that it engulfs post-larval fishes, and thus it is necessary to remove the latter from contact with the Cydippes the moment the net is brought on board. Like the American species, that at St. Andrews was beautifully phosphorescent, the light being intense and almost white. It is readily emitted by merely blowing on the water, and glances brightly along the ctenophores or locomotive flappers. Messrs. Pentland Smith and J. Walker, who examined the light with me in May, thought it faintly greenish; but though not pure white, the tinge of greenish or bluish was hardly distinguishable.

* 'Beskrivelser og Jagttagelser &c.,' p. 32, pl. vii. fig. 16.

† *Fide* 'Prodromus Faunæ Mediterraneæ,' i. p. 55.

‡ 'North-American Acalephæ,' p. 24.

2. *On the Development of* Mytilus edulis.

In the 'Annals' for February 1885 a few remarks on the reproduction of the common mussel were noted. Amongst other things it was shown that the development of the reproductive elements of well-grown mussels from the Eden had made considerable progress in January and February, so that ripe sperms and well-developed ova were present. In full maturity, as in April, the orange mantle further was richly arborescent from the racemose sperm-sacs and ducts, but less distinctly so in the female. The sexual elements diminished in May, June, and July, the general stroma of the mantle being vesicular and granular, so that the characters of the sexes were absent. It was thus apparent that there was a period of resolution aud rest as well as a period of functional activity in the reproductive organs. The ova again appear in the larger forms in September.

Since that period the development of the mussel has been the subject of a special research by Mr. John Wilson, B.Sc., who has published several papers—the last illustrated by three plates (4to) *. He found artificial impregnation of the ova—by tearing the mantle carefully to pieces—the best mode of procedure, and he was thus enabled to follow the early stages, that are not so readily procured in the sea as the later, in which the shell has attained considerable dimensions. As had formerly been pointed out †, he also found that comparatively small specimens were mature, and that many of those amongst the tidal rocks and elsewhere carried such reproductive elements till August; indeed, he partially succeeded in fertilizing ova on the first of the latter month.

The main point of the present note, however, is the fact that the older mussels in one part of the estuary of the Eden are covered with dense feathery masses of *Gonothyrœa,* upon which the young mussels settle as soon as they quit pelagic life, and thus an interesting phase in their history is determined. For many years it had been one of the ordinary features of the district to find very young mussels on zoophytes and seaweeds, especially on *Obelia* and *Gonothyrœa.* By watching the latter in the bed of the Eden and in the line of the pelagic young it was observed that the mollusks first settled on the zoophytes in July, the twigs being densely covered with young mussels varying from $\frac{1}{71}$ to $\frac{1}{21}$ of an inch, some showing three gill-papillæ, others thirteen, the larger,

* Fifth Ann. Report, Fishery Board for Scotland. This important paper has been overlooked by some recent writers on the subject.

† Ann. & Mag. Nat. Hist., Feb. 1885.

moreover, having the bluish tinge of the shell, which is also somewhat elongate. An almost inexhaustible stock of young mussels could thus be obtained at an early stage for transporting to any fresh site. Their attachment, moreover, is readily loosened (as in the older stages), for if the water in the vessel be impure, they leave the zoophytes and congregate at the margin of the water inside the vessel.

Before they are found in these dense masses on the zoophytes they often occur amongst the sandy débris around the older mussels, and of course are very abundant in the bay generally, as formerly mentioned *, indeed they constitute one of the most striking features of collections of pelagic organisms. While in May and June they are comparatively few, they increase vastly in number in July and August, both at the surface and towards the bottom. Moreover their size somewhat increases as the season progresses, especially towards the bottom of the water, those in the upper parts preserving perhaps greater uniformity in size throughout the season.

The duration of the existence of these young mussels on *Gonothyræa* and similar zoophytes is limited, for towards the end of September only the stumps of the former are found on the adult mussels, the rest having been swept away to other sites. Numerous young mussels, however, still cling to the stumps and to the rough surface of the adult shells. They have now grown considerably—varying as a rule from $\frac{1}{25}$ to $\frac{1}{10}$ of an inch. Successive crops of *Gonothyræa* thus serve as a nidus for the attachment of the young mussels, which thereafter seek new ground for further growth.

It is many years since I pointed out the peculiar sites sometimes chosen by the young mussels on quitting their pelagic existence. Thus, previous to 1860 † it was often observed that they attached themselves to the sockets of the eyes of *Carcinus mœnas*, and during growth caused evulsion of the ocular peduncles and injury to sight, and so with the antennules, while others fixed the abdomen of the crab to the cephalothorax by their byssi, so as to interfere with reproduction. Some time ago mussels of considerable size were found in more than one instance in perfect health on the gills of the haddock ‡, their growth causing the operculum to bulge outward and greatly to impede the functions of the parts. It has often been shown that the Gadoids in their young condition are very fond of feeding on the

* 'Report of H.M. Trawling Commissioners,' &c.

† Thesis Univ. Edinb. pp. 18 and 19.

‡ These specimens were lately in the Glasgow Exhibition, and are now in the University Museum, St. Andrews.

young mussels when they are settling in autumn on the blades of the seaweeds or on the rocks fringing St. Andrews Bay; and it is possible the minute young mollusks then attach themselves to the gills and grow apace with the young fish, the relative sizes of the two species being a feature of considerable interest. In these and other instances which need not at present be multiplied the young mussels fix themselves on sites well adapted for both aeration and food.

It is, again, an erroneous view (not altogether confined to the unscientific observer) to suppose that because mussels of considerable size are found on a particular site, *e. g.* a ship's bottom, this indicates that since last "cleaning" they have grown from their pelagic stage to the, it may be, very considerable size in question. As Mr. Wilson has shown, it is a well-known fact that mussels can leave their sites and fix themselves to new ones by a fresh secretion of the byssus. Indeed, in France they are often artificially torn off and placed in slender netted bags for attachment to poles or wattles. Before the meshes of the net give way they are again firmly fixed. All that is required therefore in the case mentioned is that the ship settle down on the mussels in the harbour, detach some, and for these again to fix themselves afresh to the ship's planks. If in addition to these the timbers are already coated with a series of small forms whose fixation dates from the pelagic period, a somewhat complex condition is presented.

3. *On a Post-larval Pleuronectid* (*Turbot?*).

In the large mid-water net at 3½ fathoms over sandy ground off the estuary of the Eden, on the 22nd August, a post-larval Pleuronectid measuring 5 millim. was obtained. Its coloration was so striking that at first sight it seemed to be provided with a series of dorsal papillæ or processes, the first of which projected from the occiput. This appearance, however, was only due to the boldness of the pigment and the extreme translucency of the marginal fin. The latter stretched from the tip of the snout to the tail, which was somewhat oblique from the dorsal bend of the notochord, and again along the ventral line forward to the abdominal projection.

The fish had reached the stage at which the Pleuronectid character was evidenced by the great ventral increase of the abdominal region and by the depth of the body generally, while the upward bend of the notochord and the slight development of the hypural elements were also noteworthy. The most conspicuous feature, however, was the presence of the deep ochre-pigment in the dorsal marginal fin. The first spot occurred at the occiput, and at first sight simulated the long process seen in the larval *Arnoglossus* *. The marginal fin was continuous and uniform. Behind were other five, very boldly marked, ramose pigment-areas, somewhat conical in shape, the base being at the margin of the muscle-plates of the body. Two less distinctly marked spots existed in the ventral marginal fin, each being somewhat behind the corresponding dorsal areas (last two). A series of small stellate chromatophores ran along the margin of the body dorsally and ventrally, commencing behind the occipital pigment-patch dorsally, and numbering about fifteen in that region, while ventrally about fourteen existed between the posterior border of the abdomen and the tip of the tail. Various chromatophores of the same hue extended over the abdominal surface and the head and cheeks, and many minute dark specks occurred on the same regions as well as on the sides of the body. Along the margin of the body, between the large and small chromatophores, similar pigment caused a series of serrations by transmitted light. The eyes are relatively small and of a bluish silvery aspect.

After immersion in spirit the body was marked all over with blackish pigment, indicating that perhaps the latter had formerly been obscured by the chrome.

So far as appearances and general structure go this little post-larval fish closely approaches the condition to be expected in the turbot, ripe ova of which were first procured in the trawling expeditions in July 1884.

4. *On a Post-larval* Cottus *contrasted with the Gadoids.*

In the mid-water net on the 28th May a post-larval *Cottus* 9 millim. in length occurred. It is easily distinguished from the young Gadoids of the same size, so plentiful at this period, by its shorter snout, smaller mouth, and smaller eye, as well as by the deeper greenish pigment, with a trace of yellow on the head and abdomen. Moreover, the latter is much more densely and somewhat regularly spotted with blackish pigment, the whole having a tesselated aspect. Further, from the greater tenacity of life in this species the body does not so soon assume the whitish opacity so characteristic of the Gadoids; indeed, though the specimen was perfectly motionless, the heart was still pulsating. The blackish pig-

* *Vide e. g.* Dr. F. Raffaele's figs. 12 and 18, pl. iii., 'Mittheilung a. d. Zool. Stat. zu Neapel, 8, Bd. i. Heft, 1888.

ment again is confined to the ventral edge instead of passing along both dorsal and ventral edges as well as some distance up the sides, as in the Gadoids.

Except in the tail the young Gadoid of the same size has only embryonic rays in the continuous marginal fin, while in *Cottus* a considerable number of rudimentary true rays occur both dorsally and ventrally (10 or 11 dorsally and 6 ventrally). In the ventral the true rays commence behind the anus. Those in the dorsal begin just above the latter, that is in the posterior division of the body. No permanent rays appear in the dorsal and ventral marginal fin, even though the example exceeds the Cottoid of this stage in length.

A very evident difference occurs in regard to the tail in those of equal length. Thus, the hypural and epiural elements are more or less equally developed dorsally and ventrally in the Gadoids, the ventral series, however, terminating in one or two larger cartilages. The tapering notochord is straight and extends considerably beyond both series. True caudal fin-rays, moreover, are developing both dorsally and ventrally—giving the tail a peculiarly symmetrical or "feathered" appearance.

On the other hand, the notochord in *Cottus* is somewhat less finely tapered, it has a thicker sheath, and the hypural elements alone are conspicuous in the form of a large inferior and two upper cartilages. The permanent caudal rays are developed only inferiorly, while the whole dorsal half and the region extending to the last ray of the dorsal fin have embryonic rays.

5. *On the Appearance and Disappearance of* Lucernaria *and other Forms.*

About thirty years ago shannies were extremely common in the rock-pools at St. Andrews and under moist seaweeds on ledges and elsewhere amongst the rocks. Now it is difficult to secure a few adults over a wide area of the same region. One of the most abundant Crustaceans on the beach at all seasons of the same period was the little *Portumnus variegatus,* dried specimens occurring here and there daily on the sands. This species is now one of the rarest of the group, no specimen having been procured for a long time. On the other hand, *Portunus holsatus* has apparently increased in numbers. Small examples of *Lucernaria* formerly occurred on seaweeds, especially *Fucus serratus,* both at the rocks near the mouth of the harbour (where they were first found by Miss Otté and Prof. G. E. Day) and in the extensive shallow pools about half tide-mark at the East Rocks. These, with others of the same size from various parts of the British shores, were considered fine specimens by Prof. Häckel *. For several years they have been extremely rare, only one or two having been secured after diligent search. A series of large and beautiful examples, however, somewhat suddenly made their appearance this autumn on the seaweeds on the rocks near the mouth of the harbour; indeed, they occurred in considerable abundance and all were several times as large as formerly. They were first noticed by my excellent assistant Mr. Pentland Smith; but a more detailed study of them has been undertaken by Mr. W. L. Calderwood, who will probably investigate the life-history as well as the structure of the species.

LXII.—*Contributions to our Knowledge of the Myriopoda of Dominica.* By R. I. Pocock, of the British Museum (Natural History).

[Plate XVI.]

Most of the specimens which form the subject-matter of the present paper were collected by Mr. G. A. Ramage under the superintendence of the West-Indies Exploration Committee. Those specimens, however, of which the names are marked with an asterisk were taken in 1883 by Mr. G. F. Angas.

I. CHILOPODA.

Fam. **Scolopendridæ.**

Scolopendra alternans (Leach).

Scolopendra alternans, Leach, Trans. Linn. Soc. xi. p. 383, et auctt.

Four specimens.

This species appears to be generally distributed throughout the West Indies; it occurs also in South America. The British Museum possesses specimens from St. Kitts, Antigua, Haiti, Colombia, and one from South Africa.

For additional localities and a list of synonyms for this species see Meinert, Proc. Amer. Phil. Soc. xxiii. p. 193.

* *Vide* 'Syst. d. Medusen, Vorwört,' p. xviii.

I take this opportunity of stating that from an examination of the types I am able to corroborate the view entertained by Dr. Meinert concerning the specific identity of the following forms :—*alternans*, Leach, *Grayii*, *complanata*, *multispinata*, Newport, Ann. & Mag. Nat. Hist. xiii. p. 98 (1844).

Otostigma cormocephalinum, sp. n.

Shining, with almost metallic lustre. Tergites, sternites, legs, and antennæ olivaceous; head-plate and maxillary feet and sternite castaneous.

Antennæ short, scarcely as long as the head-plate and the first two tergites, thicker at the base, composed of sixteen or seventeen segments, of which the proximal six are bare, the rest being densely hirsute.

Head-plate sparsely but somewhat deeply punctured, its posterior two thirds furnished with two conspicuous anteriorly diverging sulci.

Maxillary feet and *sternite* manifestly punctured, the latter marked in front with two deep sulci which, arising close together near the inner margins of the prosternal plates, extend nearly to the hind margin of the sternite and break up into branches which are arranged subsymmetrically upon the two sides; the anterior half of each of these sulci is united with that of the opposite side by two transverse branches. Prosternal plates well developed, widely separated, each being divided in front into two teeth, the internal of which is larger and bi- or tridenticulate. Basal tooth distinctly bidentate.

The *tergites, including the first*, but with the exception of the last, strongly bisulcate, with the exception of the first eight or nine marginate, the first three feebly punctured, all of them slightly rugose.

Sternites, with the exception of the first and the last, strongly bisulcate, all of them slightly rugose.

Anal tergite with a conspicuous median longitudinal sulcus; anal sternite wide, with gently converging lateral margins, rounded postero-lateral angles, and convex posterior margin; anal pleurites marked with remarkably large, interspersed with smaller punctures; the superior and posterior margins not punctured; the posterior inferior angle not elongated into a process of any kind, but simply armed with a small spine; there is a second small spine in or near the middle of the posterior margin.

Anal legs broken off.

All the *legs* are without tarsal spurs, but the claws are furnished at the base with two small spines.

Length 37 millim.

A single specimen.

This species is of peculiar interest, inasmuch as it appears to partake of the characters of the two genera *Otostigma* and *Cormocephalus* and in a measure to fill up the interval between them. Although by the form of its tracheal apertures it is undoubtedly referable to the former, as characterized by v. Porath, yet it differs from all the specimens of this genus that I have examined in the total absence of tarsal spurs and in the presence of the two conspicuous abbreviated cephalic sulci, features which are conspicuous for their constancy in *Cormocephalus*.

It is unfortunate that, owing to the absence of the anal legs, certain additional specific characters cannot be given; but the occurrence of the two conspicuous sulci upon the first tergite and the large size of the pleural pores serve to differentiate this species from all others with which I am acquainted.

Scolopocryptops Meinerti, sp. n.

? Syn. *Scolopocryptops Miersii*, Meinert, Proc. Amer. Phil. Soc. xxiii. p. 181 (1886).

Nec syn. *Scolopocryptops Miersii*, Newport, Trans. Linn. Soc. xix. p. 405 (1845).

Shining; tergites castaneous, sternites, legs, and antennæ paler.

Antennæ long, attenuate, composed of seventeen segments; proximal three segments sparsely hirsute, the rest thickly clothed with short hairs; segments cylindrical, ultimate segment about equal in length to the penultimate.

Head-plate almost circular, deeply but sparsely punctured, and scantily hirsute, without elevated margins.

Maxillary feet and *sternite* sparsely punctured; anterior margin of the sternite bearing four teeth, two in contact in the middle line and one on each side; basal tooth conspicuous but simple.

Tergites punctured, with the exception of the first seven and last two, with raised lateral margins; the first marked anteriorly with a conspicuous transverse groove; the last narrow, with lateral margins nearly parallel; posterior margin between the joints of the legs convexly produced.

Sternites punctured, not marked with two sulci; the last narrow, with gently rounded lateral margins and straight or slightly concave posterior margin.

Anal pleurites compressed, thickly and deeply punctured, below produced posteriorly into a simple sharp spine, which, like the posterior portion of the sclerite, is devoid of punctures; pleurites projecting considerably beyond the margin of the anal sternite, but not extending further posteriorly than the middle of the anal tergite; superior half of posterior margin vertical, inferior half gently sloping to the apex of the process.

Legs hirsute, more so distally than proximally; claws of all the legs furnished at the base with two spurs; tarsi of all the legs, the ultimate and penultimate pairs excepted, composed of a single segment; tibiæ of twenty-third, twenty-second, and twenty-first pairs of legs unarmed, tibiæ of twentieth pair armed beneath distally with a single spur, tibiæ of the rest of the legs each armed distally with two spurs, one above and in front, the other below; tarsi of the twenty-second and twenty-third pairs unarmed, tarsi of the rest of the legs armed distally beneath with a single spur (the superior tibial spine of the nineteenth pair may be absent). Femur of anal legs armed proximally with two spines, one larger beneath, the other smaller above.

Measurements in millimetres of the largest specimen.— Length (from anterior margin of head-plate to posterior margin of anal tergite) 49; width of twelfth tergite $4\frac{1}{2}$; width and length of head-plate $3\frac{1}{4}$; width of anal tergite $2\frac{1}{4}$; length of anal leg 14; length of antenna 13.

Five specimens.

This species differs from *S. Miersii*, Newp., inasmuch as in the latter the anterior margin of the maxillary sternite is not furnished on each side with two teeth.

Fam. **Geophilidæ.**

Geophilus tenuitarsis, sp. n.

No. of pairs of legs in male 85. Length about 35 millim.

Antennæ hirsute at base, pubescent at apex, composed of fourteen segments, which increase very slightly in length to the fourth, then progressively decrease in length to the thirteenth; the fourteenth conspicuously longer than the thirteenth; distal extremity of each segment wider than the proximal.

Head-plate about as wide as it is long, with rounded lateral borders and straight anterior and posterior borders; frontal lamina not distinct; prebasal lamina concealed by head-plate, which slightly overlaps the anterior portion of the basal lamina; basal lamina very wide.

Maxillary sternite large, considerably wider than it is long, feebly cut out into teeth in its anterior middle line, furnished with two patches of black colour in that region, and marked on each side with a distinct sulcus, which runs parallel to the long axis of the body from the middle of the joint of the maxillary feet to the posterior margin of the sternite. Maxillary feet, when closed, not reaching so far as the anterior border of the head-plate; coxæ and claw not armed on the inner side with teeth. Entire head hirsute.

Tergites strongly bisulcate, portion within the sulci slightly less smooth than the lateral portions.

Sternites oblong, not sulcate, and without conspicuous porous areas.

Anal tergite wider in front than behind; pleurites small, smooth, without pores; sternite wide, laterally covering the pleuræ, with rounded lateral margins and straight posterior margin. Anal legs hairy, very robust, proximal four segments compressed from side to side, but exceedingly thick from above downwards, increasing progressively in length towards the distal extremity; the inferior margin of the fourth segment behind produced into a small rounded process; the fifth and sixth segments small, cylindrical, the fifth articulating only with the upper portion of the distal extremity of the fourth; the sixth armed with a claw.

Anal pores not visible. All legs hirsute.

One specimen.

II. DIPLOPODA.

Fam. **Polydesmidæ.**

**Paradesmus gracilis* (C. Koch).

Fontaria gracilis, C. Koch, Syst. d. Myr. p. 142 (1847); Die Myriop. ii. p. 51, fig. 173 (1863).

Polydesmus coarctatus, Sauss. Mém. Mex. Myr. p. 39, pl. iii. fig. 18 (1860).

Paradesmus gracilis, Tömösvary, Termés. füz. iii. p. 246, pl. x. figs. 1–5 (1879).

Specimens of this species, which is tolerably commonly distributed throughout the tropical parts of both hemispheres, and has found its way into England and other European countries in connexion with exotic plants, were taken by Mr. G. F. Angas beneath a log in Dominica in 1883.

Strongylosoma semirugosum, sp. n.

? Syn. *Strongylosoma spilonotum*, Gerv. Ins. Apt. iv. p. 117.

Colour ochraceous above, with a faintly marked median, dorsal, paler band, testaceous beneath; legs and antennæ testaceous.

Tergites shining, the anterior half of each less so than the posterior, the latter feebly rugose; those of the posterior region of the body more rugose than those of the anterior; the posterior portion of each, with the exception of the first four and the last three, marked with a transverse groove, which extends almost from keel to keel; keel of the second somite appearing as a longitudinal ridge, keels of the third and fourth somewhat rounded and very small, those of the succeeding somites more rounded and larger; those keels that do not bear stigmata less conspicuous than those that are provided with them; first tergite without trace of keels, with rounded lateral margin; the lateral and antero-lateral margin with raised edge.

Head-plate marked above with a conspicuous median longitudinal groove, which extends from the area between the antennal sockets beneath the first tergite; lateral border of head-plate with raised margin; anterior margin beset with hairs, medianly excavated and laterally rounded. Distal four antennal segments thickly hirsute, the proximal three sparsely so.

Anal tergite produced behind into a rounded setiferous prominence, which considerably overlaps the anal valves, furnished with a transverse row of setæ; anal valves (pleurites) with elevated free margins; anal sternite evenly rounded.

Legs hirsute, the proximal segments less so than the distal; distal two segments in the male furnished beneath with a tuft of hairs.

Basal (internal) segment of copulatory foot of the male irregularly cylindrical; second segment small, projecting posteriorly, somewhat elliptical, with its long axis at right angles to that of the basal segment, densely hirsute; from its anterior surface springs a slightly twisted elongate lamina, distally bifid, and curled upon itself so that the bifid extremity is almost in contact with the proximal end of the segment.

Total length 28 millim., width $2\frac{1}{2}$ millim.

Five male specimens.

The descriptions of the American (and other) species of *Strongylosoma* are, with one or two exceptions, so brief that the task of identifying specimens from them is by no means an easy one. However, short though they be, I have (with one exception) found set forth in each case one or more characters which afford me sufficient grounds for concluding that these specimens from Dominica belong to a species which is now for the first time described.

The following is a list of the species. After each I have stated the character which leads me to consider the species to be different from *semirugosum*.

Str. concolor, Gervais, Aptères, iv. p. 117.—Chili. This species is smooth, with subbifid anal tergite and squared anal sternite.

Str. spilonotum, id. ibid.—S. America. *Cf.* infrà.

Str. coccineum, Saussure, Miss. Sci. Mex., Myriopodes, p. 50, pl. i. fig. 12.—Orizaba. There is no transverse sulcus on the hinder half of each tergite.

Str. vermiforme, id. Mém. Mex. Myriop. p. 40, pl. i. fig. 4.—Mexico. Tergites as in the preceding species.

Str. vermiculare, Peters, Monatsb. d. k. Akad. Berlin, 1864, p. 536.—Caraccas. The anal sternite is feebly tridentate.

Str. glabrum, id. ibid.—Columbia. This species is smooth.

Str. eruca, Wood, Journ. Acad. Nat. Sci. Phil. (1) ii. p. 106. —This species is said to be punctate.

Str. Poeyi, Bollman, Ent. Amer. iii. p. 82.—Havana. Tergites punctate.

Of the above species it is with *spilonotum* that *semirugosum* presents the greatest affinities; but Gervais's description, although applicable so far as it goes to the latter, is not sufficiently detailed to enable me to say with certainty that the two are identical.

Fam. **Iulidæ.**

Spirostreptus (*Nodopyge*) *dominicanus*, sp. n.

Species belonging to the Immucronate group of Brandt.

Shining, piceous, posterior border of somites paler; antennæ and legs testaceous.

Head-plate.—Superior portion not marked in the middle line by a longitudinal sulcus; margin of the labrum furnished with a row of somewhat close-set setæ, above which are three setiferous pores, one in the middle and one on each side about halfway between the middle and the lateral margin.

First tergite with anterior border sloping gradually away at the sides and not sharply marked off from the lateral margin; the lateral and antero-lateral border (as far as the ocular area) raised; lateral portion marked with a more or less complete sulcus, which runs from the anterior margin near the ocular region backwards and slightly downwards to the posterior margin; above the posterior end of this there are about six short sulci, which correspond with the longitudinal sulci marking the infero-lateral portions of the somites.

Each somite, except the last, divided into an anterior and a posterior half by a shallow depression, which in many species of the genus has the form merely of a streak; foramina repugnatoria situated in the middle of the sides of the somites a little behind this depression.

Anal tergite produced behind, so as to cover but not to pass beyond the superior angle of the anal valves; anal valves but little prominent, with simple unraised borders; anal sternite with rounded posterior margins.

Inferior surface of the legs sparsely hairy.

Four female specimens.

Length of adult not greater than 30 millim.

Unfortunately all the specimens obtained are in a fragmentary condition, and it is consequently impossible to estimate with exactness either the length of any one individual or the number of somites of which it is composed. And, further, the description is of necessity rendered additionally imperfect owing to the fact that the absence of a male has made it impossible to examine the copulatory apparatus of that sex and to determine whether the species is referable to the homomorphous or the heteromorphous group of the genus.

The species appears to be allied to *Sp. cinctus* (Humb. & Sauss.), but the latter is said to have a triangular subanal plate. It also presents affinities with *Sp. rotundanus* and *Sp. mellitus* (Karsch), but the descriptions of the latter do not satisfactorily apply to it in all particulars.

**Spirobolus paraensis*, Humb. & Sauss.

Spirobolus paraensis, Humb. & Sauss., Rev. et Mag. Zool. 1870, p. 176; Miss. Sci. Mex. (Myriopodes), p. 81, pl. iv. fig. 15.

Species without scobina.

Segments slate-coloured above and at the sides, paler beneath, each, the first two excepted, marked posteriorly in the dorsal middle line with a single pale spot, and on each side immediately in front of the foramen repugnatorium with a similar spot; legs, antennæ, labral region, anal valves, and posterior portion of anal tergite testaceous.

Body cylindrical; length 39, width 4 millim.; number of somites forty-three (adult).

Head-plate marked by a shallow median sulcus, which divides the labral region into two halves, and above is represented by a pale band of colour; labral region furnished on each side with two conspicuous setiferous punctures, one near the middle line, the other near the side margin. Eyes large, consisting of a somewhat quadrate mass of ocelli.

Antennæ short, not projecting laterally beyond the hind margin of the first tergite; proximal segments smooth and less narrowed proximally; distal segments scantily hirsute and more narrowed proximally.

First tergite not projecting below so far as the second, with rounded lateral margin, straight antero-lateral margin, and slightly raised antero-lateral border, the sulcus which marks the border extending from the ocular area almost to the posterior portion of the lateral margin.

Each somite, with the exception of the first and last, divided into a larger anterior and a smaller posterior portion by a complete transverse sulcus; laterally and inferiorly from this sulcus arise before and behind numerous secondary sulci, just as the webs of a feather arise from the shaft, those behind running longitudinally to the posterior margin of the somite, those in front running transversely towards the summit of the somite in a direction more or less parallel to the sulcus from which they originate; one of these, stronger than the rest, starting a little below the middle of the lateral surface, runs completely round the dorsum parallel with the main sulcus; in the space bounded by these sulci, but close to the posterior of the two, is, on each side, the foramen repugnatorium, which is situated within a loop of the last-named sulcus. Posterior (uncovered) portion of dorsal region of each somite (except the last) smooth and shining.

Anal somite.—Tergite produced behind into an apically rounded angular prominence, which covers the superior angle of the anal valves, but does not project beyond the valves; anterior portion of valves convex, posterior portion compressed, with prominent margins; posterior borders of valves conspicuously convex from above downwards; subanal plate with obtusely angled posterior margin.

Legs very smooth, the inferior surface of each segment being for the most part furnished distally with a single seta.

A single female specimen taken under a log by Mr. G. F. Angas.

**Spirobolus dominicæ*, sp. n.

Species without scobina.

Colour reddish, posterior portion of each somite shining.

Length of adult male about 49 millim., width 4 millim.; number of somites forty-seven; sixth and seventh somites in the male slightly dilated laterally and much produced below.

Head-plate.—Inferior portion divided by a median sulcus, which disappears above; on each side of this are two setiferous punctures, one near the middle, the other near the lateral margin; inferior border angularly excised, the excision being filled with an obscurely denticulated plate. *Eyes* consisting of an almost circular mass of ocelli. *Antennæ* stretching laterally as far as the hind margin of the second somite; proximal segments bare and slightly narrowed proximally, distal segments sparsely hirsute and more narrowed proximally.

The *first tergite* not projecting so far below as the second, much narrowed laterally, the lateral portion of the anterior border lightly concave and receding somewhat abruptly from the superior portion of the same border; the anterior and posterior margins meeting at an angle of about 50°; apex of the angle rounded, its border being marked by a conspicuous groove, which extends to the ocular area; upper surface irregularly and minutely punctured.

Somites not marked with a transverse circular sulcus, its position being occupied by a shallow depression. The lateral surface of each somite marked in front with very many close-set, interlacing, fine striæ, which behind pass into the usual longitudinal sulci; the dorsal surface of each is in front adorned with a fine network of ridges, the interspaces of which in the hinder portion of the somite become converted into irregularly shaped punctures. Foramina repugnatoria very minute, lodged just in front of the circular depression.

Anal somite.—Tergite produced behind into a broad angular process, the rounded angle of which covers and projects very slightly beyond the superior angles of the anal valves; anal valves convex in front, a little compressed behind, with borders not prominently convex from above downwards; subanal plate with rounded margin.

Legs almost smooth, each segment furnished beneath with a single seta; distal segment in male bearing pad beneath.

♂. Right and left portions of the copulatory apparatus united in front by a triangular plate, concave from side to side, two of the sides of which are slightly sinuous and converge below to a bifid point; the third and superior side is strongly concave; each of the upper angles of the plate is produced into a process which, at first slender, runs upwards and curls round the side of the anterior lamina, immediately dilates into a second triangular piece, which, abruptly narrowing behind, skirts the lateral superior margin of the anterior lamina and is continued inwards along that of the posterior lamina. Anterior aspect of anterior lamina narrower above, projecting for about a quarter of its length below the triangular plate; produced into two small blunt processes, one inner, the other outer, between which the inferior margin slopes obliquely upwards and outwards. Outer margin of front aspect of plate nearly straight and rounded; lateral aspect of plate somewhat heart-shaped, with the apex directed downwards; behind it meets the posterior lamina in a nearly vertical and straight suture. Posterior lamina irregularly oblong, about twice as high as it is wide; about the middle of the inner margin is a conspicuous notch, from which is continued inwards a deep groove, which quickly dilates into a wide depression occupying the greater part of the lower half of the lamina.

Attached on each side by a muscle to the upper part of the prolongation of the triangular plate is a slender rod, which, thicker in front and slightly curved, runs directly backwards to be articulated with the proximal end of the internal protrusible portion of the apparatus for which the anterior and posterior laminæ described above constitute a sheath.

This internal protrusible portion consisting of two segments, the proximal of which is short and about one third the length of the distal segment; distal segment curved from above downwards, more or less wrinkled at the sides, partially hollowed behind, wider above and bluntly pointed at its distal extremity. From the middle of its posterior margin there arises a downwardly directed, compressed, and somewhat oblong tooth; from the lower surface of the base of this tooth spring two small slender processes, one inner, the other outer, the former being sharp, needle-like, and almost straight, the latter sharp and twisted upon itself. From the posterior surface of the distal extremity of this segment arises a somewhat membranous piece, which bifurcates and runs up towards the above-mentioned oblong tooth.

Three specimens (one male, two females) taken under a log by Mr. G. F. Angas.

Perhaps most nearly allied to *Sp. nietanus* and *heteropygus* of de Saussure; but in these two species the anal valves are not compressed.

EXPLANATION OF PLATE XVI.

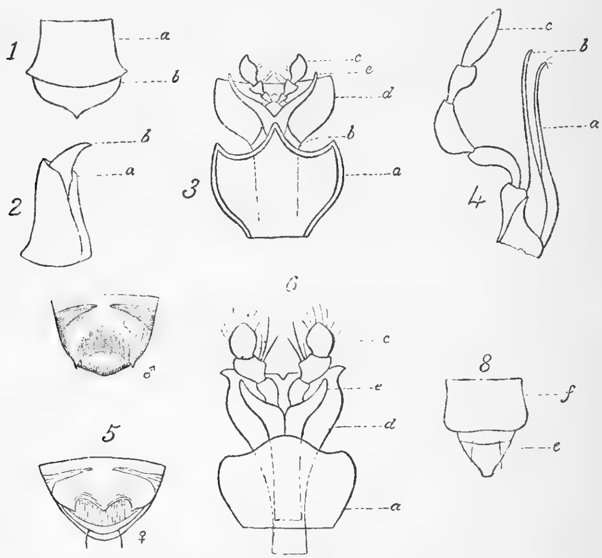
a. *Otostigma cormocephalinum*, anterior extremity from above.
a^1. Ditto, ditto, from below.
a^2. Ditto, posterior extremity from below.
b. *Scolopocryptops Meinerti*, from above (nat. size).
b^1. Ditto, head from below.
c. *Geophilus tenuitarsis*, anterior extremity from above.
c^1. Ditto, ditto, from below.
c^2. Ditto, posterior extremity from below.
c^3. Ditto, posterior leg from the side.
d. *Strongylosoma semirugosum*, 12th somite from above.
d^1. Ditto, anal somite from the side.
d^2. Ditto, copulatory foot.
e. *Spirostreptus dominicanus*, anterior extremity.
e^1. Ditto, posterior extremity.
f. *Spirobolus dominicæ*, anterior extremity.
f^1. Ditto, posterior extremity.
f^2. Ditto, copulatory organ from before.
f^3. Ditto, ditto, from behind.
f^4. Ditto, ditto, from the side.
f^5. Ditto, ditto, central portion.
f^6. Ditto, ditto, central portion (apex).

LXIII.—*On the Mouth-organs of two Species of* Rhysodidæ. By George Lewis, F.L.S.

By the kindness of the Rev. A. Matthews, who has dissected and drawn them, I am able to give outlines of the mouth-organs of *Rhysodes niponensis*, Lewis, and *Clinidium veneficum*, Lewis, of which descriptions appeared in the July number of this Magazine. Mr. Matthews found it exceedingly difficult to make the dissections, owing to the hardness of the chitinous parts; and it is solely due to Mr. Matthews's persistent industry and a sacrifice of a good many specimens that the results now given were obtained. Mr. Matthews considers he has been completely successful with the *Clinidium*, "although the dissection of the smallest *Trichopteryx* would have been more easily accomplished, for the maxilla, labium, &c. are exceedingly fragile, while the surrounding integument is almost as hard as iron, and cannot be penetrated without more or less danger to the finer parts;" and he also says: "The organs of the mouth are, without exception, the most extraordinary I have ever seen: the labrum is very small, the epistoma, or, rather, the clypeus and the mentum, are very large and of the hardest and most impenetrable horn;

the maxillary palpi are very long, and the maxillæ, labium, and lingua exceedingly fragile and minute. The labium appears to be extensile, like that of *Stenus*, and of the most complex character, and at rest it is so completely withdrawn behind the mentum that dissection is rendered supremely difficult. The lingua is very large and broad, and so thin as to be perfectly transparent. The mandibles are equally abnormal, being enclosed in a horny envelope open on the inside."

To Mr. Matthews's drawings I have added one which represents the curious tubercles on the last abdominal segment of the female of *Clinidium veneficum*, which will be useful for comparison with the drawing of the corresponding dissection of the male which is by the side of it.



EXPLANATION OF THE FIGURES.

Rhysodes niponensis.

1.—*a.* Epistoma.
b. Labrum.
2.—*a.* Shield.
b. Mandible.
3.—*a.* Mentum.
b. Labium.
c. Labial palpi.
d. Lingua.
e. Paraglossal processes.
4.—Maxilla.
a. Inner lobe.
b. Outer lobe.
c. Palpus.

Clinidium veneficum.

5.—Apex of abdomen, ♂ & ♀.
6.—*a.* Mentum.
b. Labium.
c. Labial palpi.
d. Lingua.
e. Paraglossal processes.
8.—*f.* Clypeus.
e. Labrum.

LXIV.—*On the Structure and Classification of the* Asterolepidæ. By R. H. Traquair, M.D., F.R.S.

[Plates XVII. & XVIII.]

Of this remarkable and problematic group of Palæozoic Vertebrata the genera with which I propose to deal in the present communication are *Asterolepis*, Eichwald, *Pterichthys*, Agassiz, *Bothriolepis*, Eichw., and *Microbrachius*, Traq. We shall commence with

Pterichthys, Agassiz, 1840.

(=*Asterolepis*, Pander, pars, non Eichw., non H. Miller.)

The structure of *Pterichthys*, sadly misunderstood by Agassiz, was more satisfactorily discussed by Egerton (8); but the writer who in former times knew most about it was Hugh Miller. It is, indeed, strange that though Miller published in 1841 (3) wonderfully accurate figures both of its upper and under surfaces, Agassiz should have mistaken the belly for the back and should have given in his "Old Red" such an utterly bizarre and incorrect restoration, which has, moreover, been copied and recopied into so many text-books, down even to the present day.

A brief account of *Pterichthys* was given by M'Coy in his 'Palæozoic Fossils,' in which Hugh Miller's ideas as to the number and arrangement of the plates of the carapace are corroborated. No attempt is, however, made to go into the structure of the pectoral appendages, while as to the head he says that it is "covered by several irregular polygonal pieces, the exact form of which is still doubtful." The fin observable on the tail was regarded by M'Coy as an anal (6, p. 598 *et seq.*).

Pander, in his classical 'Placodermen' (7), has given some figures of Scottish examples of *Pterichthys*, which, however, do not help us much with those details not already known. But assuming that *Asterolepis*, Eichwald, and *Pterichthys*, Agassiz, are synonymous terms, he added to his elaborate and valuable restoration of the Russian *Asterolepis ornatus* a tail and dorsal fin taken from the Scottish *Pterichthys* (pl. v. fig. 10); and I must agree with Lahusen (11) in protesting against this figure having been reproduced in various works not only as "*Pterichthys*" but even as one or other of the species of *Pterichthys* occurring in Scotland *.

* For instance as "*Pterichthys Milleri*" in Owen's 'Palæontology' (1860), p. 121, as "*Pterichthys cornutus*" in Prestwich's 'Geology' (1888), vol. ii. p. 80.

There is therefore abundant reason for going afresh into the anatomy of the organisms discovered by Hugh Miller, Malcolmson, and Stables, and named by Agassiz *Pterichthys*. The special structure of the head and limbs was hitherto almost unknown, and there is also room for rectification as regards the body-carapace and tail. And this investigation is also of great systematic importance as bearing on the question as to whether Pander was right in maintaining the identity of Agassiz's genus with Eichwald's *Asterolepis*; for as "*Asterolepis*" has the priority, the only ground for maintaining *Pterichthys*, were Pander right in his contention, would be the inadequacy of Eichwald's original description of *Asterolepis*, and then that name would have to be cancelled, as it cannot legitimately be applied to the great Coccostean, named *Homosteus* by Asmuss, and familiarly known to us as Hugh Miller's "*Asterolepis* of Stromness." With that question is also bound up that of the distinction of *Bothriolepis*, Eichwald, a genus also considered by Pander to be synonymous with *Asterolepis*; for although Lahusen (11) and Trautschold (12) have given good reasons for retaining it as valid, the latest writer on the subject, Whiteaves, treats the question as one concerning which certainty has not yet been attained (15).

Head.—The cephalic shield of *Pterichthys* (Pl. XVII. fig. 1) is of a semicircular or, rather, semielliptical shape, rounded in front and truncated behind, where it joins the body-carapace. In the centre it shows a transverse opening, distinctly represented in Hugh Miller's early drawing (3, pl. i. fig. 1), and which, though it was not mentioned by Agassiz, is nevertheless indicated in his figures both of *Pterichthys testudinarius* (4, tab. iv. fig. 2) and *Pamphractus hydrophilus* (*ib.* tab. iv. fig. 6 and tab. vi. fig. 2). This opening, slightly contracted in the middle and expanded on each side, I shall simply call the *median opening*, though it has usually been regarded as an "orbit," and more recently Cope has put forward the view that it represents the mouth in the Tunicata (17). It is entirely filled up by a small plate or system of plates rarely seen in *Pterichthys*, but, as we shall see further on, well displayed in many specimens of the allied genus *Bothriolepis*. The nuchal region is occupied by a plate, the *median occipital* (*m. o.*) shaped somewhat like the conventional royal "crown," but without the pinnacle in the centre. Marginally it shows six aspects or articulations—one posterior, straight, articulating with the median dorsal plate of the carapace; two lateral, each of which passes first forwards and then obliquely forwards and outwards, articulating with the lateral occipital (*l. o.*); two antero-lateral, passing at an angle forwards and inwards, articulating with the lateral plate on each side; and one anterior, retracted in the centre, so as to form a wide reentering angle in which the correspondingly angulated posterior aspect of the postmedian plate (*p. m.*) is received. On each side of the median occipital is the *lateral occipital* (*l. o.*), of an irregularly pentagonal shape and having one side internal, articulating with the median occipital; two posterior, articulating with the anterior dorso-lateral (*a. d. l.*) of the carapace; one anterior, articulating with the lateral plate of the head; and one external, joined to the *angular* (*ag.*). The latter (postmarginal, Owen) is a very small plate, also forming part of the cranial shield behind the lateral plate. In front of the median occipital, which it entirely separates from the median opening, is a transversely elongated plate, the *postmedian* (*pt. m.*), broadest in the middle, narrow at each end. Its gently convex anterior margin forms the posterior boundary of the median opening; its posterior margin, obtusely angulated, fills up the reentering angle of the front of the median occipital, while each narrow extremity or outer margin articulates with the lateral cranial plate.

Each *lateral plate* (*l.*) is of an antero-posteriorly elongated form and may be described as having four margins. The very irregular inner one articulates with the median occipital and postmedian, is then notched to form the outer margin of the median opening, in front of which it articulates with the *premedian* (*p. m.*); the outer margin, slightly concave, articulates with *extralateral* (*e. l.*), the posterior with the external occipital, while the short anterior one forms part of the front margin of the cranial shield.

The remaining plate (*e. l.*) of the cranial shield is that which in *Asterolepis* has been named "opercular" by Pander, "marginal" by Owen; but I prefer to call it *extralateral*. Forming the lateral margin of the buckler external to the lateral plate on each side, this element attains a large size in *Pterichthys*, and seems to have been only loosely articulated to the side of the head, as it so frequently occurs dislocated and removed from its position, while the other cranial plates still cohere together. In fig. 4 I have represented it in an isolated condition, where it will be seen that its inner margin, which must have been largely overlapped by the lateral plate, shows a peculiar notch a little in front of the middle. (Compare Pander's figure of the same plate in *Asterolepis* (7, tab. vi. fig. 1, no. 3).)

I have seen no trace in *Pterichthys* of the narrow plate which Pander figured in *Asterolepis* (7, tab. vi. fig. 1, no. 2) under the name of "os terminale," as forming the anterior margin of the cranial shield in front of the premedian and right and left laterals. This bone Pander admitted he had never found perfect in the Old Red Sandstone of Livonia, but thought that he found it *in situ* in Scottish examples of *Pterichthys* (*ib.* tab. vi. fig. 5). Nevertheless on comparing the figure here quoted with numerous examples of *Pterichthys* I am satisfied that the suture there indicated as marking off the "os terminale" is only the transverse groove, belonging to the lateral line system, which crosses the front part of the head.

Of the small, narrow, doubly curved ossicle designated by Pander "Oberkiefer" (7, tab. vi. fig. 1, no. 1) I know nothing; but the oblong plates which he named "Unterkinnlade" or "maxilla inferior" are preserved *in situ* in numerous examples of the Scottish *Pterichthys*. This supposed lower jaw (*mn.* Pl. XVII. fig. 2) consists of two somewhat narrow oblong plates, meeting each other in the middle line and placed transversely on the under surface of the head right in front of the semilunar plates (*s. l.*) of the ventral body-carapace. Each is narrower at the outer than at the inner end and somewhat concave above; frequently they occur displaced forwards, even to a position altogether in front of the head. These plates may indeed have formed the inferior (or posterior) boundary of the mouth; but it is clear that their mode of working must have been rather different from that of the mandible of ordinary Vertebrata.

Before leaving the head of *Pterichthys* it may be well to point out the distribution of the lateral line system on this part. In all the Asterolepidæ, as well as in the Coccosteidæ, this system consists of grooves, which are apt to be, and have often been, mistaken for sutures, actual or obsolete; but they do not occur on the inferior surfaces of the bones, and their connexion with a similar groove running along each side of the body amply demonstrates their true nature. In *Pterichthys* each cephalic groove (Pl. XVII. figs. 1 and 2, represented by the double dotted lines) passes from the dorso-lateral plate of the body on to the external occipital, where it at once bifurcates, a transverse branch passing across over the posterior part of the median occipital to join its fellow of the opposite side. The main groove then runs forward on the lateral cranial plate, and, arriving in front of the median opening, it bends inwards to join the opposite groove on the premedian plate, on which it forms a small backward flexure. This course is altogether similar to that in *Asterolepis*; but, as we shall see, it is in some particulars different from the arrangement seen in *Bothriolepis*.

Body-carapace.—This, as already shown by Sir Philip Egerton and Hugh Miller, is nearly quite flat below, high and vaulted above, the sides rising at right angles to the base; as the former author says, "the contour must have had considerable resemblance to a high-backed tortoise with the carapace culminating near the anterior margin," the transverse section being "not unlike the outline of a stirrup-iron." It is composed altogether of thirteen plates, being two more than the number given by Hugh Miller, but agreeing in this respect with *Asterolepis* as described by Pander.

The general form of these plates is already so well known from the descriptions of Hugh Miller and Egerton that I need here only allude to certain matters of detail which require correction, some of them, however, being of considerable importance. In Pl. XVII. figs. 1, 2, and 3, I have represented the outlines of the body-plates as seen from the back, belly, and side respectively, the thick black lines representing overlapping edges, as seen on the external surface, the thin ones those which are overlapped, and which consequently are concealed externally when the plates are *in situ.*

The first point of importance is the presence of two small narrow plates (*s. l.* fig. 2), each of which occupies a space cut out from the inner half of the anterior margin of the anterior ventro-lateral (*a. v. l.*) and is in contact mesially with its fellow of the opposite side. This is Pander's *semilunar* in *Asterolepis* (7, pl. vi. fig. 1), and though not mentioned in the descriptions of Hugh Miller and Sir Philip Egerton, the space which it occupied is distinctly seen in one of Sir Philip's figures (8, p. 305, fig. 2).

Next, as to the anterior ventro-lateral plate itself and the mode of articulation of the arms. Notwithstanding the contrary opinion of Hugh Miller and M'Coy, Sir Philip Egerton strongly maintained that the arms were articulated to separate "thoracic" plates, marked off by a distinct line of suture from the anterior ventro-lateral; and so confident was he in this opinion that he went so far as to say that he was "at a loss to conceive how Professor Pander can have been led to assign the attachment of the arms to the ventro-lateral plates as shown in the magnified figure on tab. vi. of his magnificent work on the Devonian fishes, although in the preceding plate these organs are correctly drawn as appended to the thoracic plate" (9, p. 105). Now in this matter Pander's accuracy cannot be impugned as far as *Asterolepis* is concerned, for the Russian plates of this genus were found isolated and uncompressed, and the place of articulation of the arm can easily be verified on a specimen of the anterior ventro-lateral plate of *A. ornatus* in the British-Museum collection. And as regards Sir Philip's appeal to Pander's figures 5 and 9 on tab. v. of his work, in which the "thoracic" plates seem to be represented in specimens of *Pterichthys* from Lethen, he could not surely have read the author's explanation of these figures, in which it is expressly stated that this appearance is due to fracture!

Nevertheless, accepting Pander's description of these parts to hold good for *Asterolepis* and Egerton's for *Pterichthys*, Beyrich (10), Lahusen (11), and Zittel (16) have sought herein to find a diagnostic mark between the two genera; but this idea I cannot corroborate. Careful study of a large series of Scottish examples of *Pterichthys* has convinced me beyond all doubt that Egerton was in error on this point and that his "thoracic" plates are simply parts of the anterior ventro-laterals, separated not by a *suture*, but by an internally projecting ridge, which, in crushed and decorticated specimens, gives the false impression of a division. I may add that the species *macrocephalus*, in connexion with which Sir Philip expressed his opinion so strongly, is not a *Pterichthys*, but a *Bothriolepis*, and that isolated plates of the larger species of the same genus demonstrate absolutely the unity of the anterior ventro-lateral and the position upon *it* of the pectoral articulation.

The articular fossa on the outer side of the anterior ventro-lateral in *Pterichthys*, with its contained helmet-process grasped by the articular plates of the arm, and the foramen for the passage of the vessels and nerves to the same, seems to be conformed exactly as in *Asterolepis*; and as these parts have been so well described by Pander from Russian specimens of the latter genus, it is needless at present to enter into detail respecting them. If the Scottish and Russian genera are distinct the diagnosis must be founded on something else than the articulation of the limbs.

Thirdly, as to the articulation of the body-plates with each other. Sir Philip Egerton states that "all the plates of the carapace, with the exception of the lozenge-shaped plate *g* (of the under surface), are united by simple sutures; this, on the contrary, is attached to its neighbours by broad squamous sutures, the lateral bones overlapping its margins on all sides" (8, p. 306); but in the same paper he quotes Hugh Miller to the effect that the two median dorsal plates overlapped some neighbouring ones and were themselves overlapped by others. Now my observations show that all the plates of the carapace were connected with each other by overlapping or squamous sutures, a marginal band along the internal surface of the overlapping plate being thinned off to fit on to a corresponding band along the margin of the outer surface of the one overlapped. The hexagonal *anterior dorsal plate* (*a. d.*) in this way overlaps the anterior dorso-laterals, but is itself overlapped along its postero-lateral margins by the posterior dorso-laterals, and also behind by the posterior median dorsal, though in this latter case the contrary is stated by Hugh Miller (*ib.* p. 309).

The *anterior dorso-lateral* (*a. d. l.*) overlaps the posterior dorso-lateral, but is itself overlapped by the anterior median dorsal and by the anterior ventro-lateral.

The *posterior dorso-lateral* (*p. d. l.*) overlaps the anterior median dorsal, but is itself overlapped by all the other plates with which it is in contact, viz. the posterior median dorsal, the anterior dorso-lateral, and the anterior and posterior ventro-laterals.

The anterior ventro-lateral overlaps the anterior and posterior dorso-laterals, the posterior ventro-lateral, and the median ventral, while the right one overlaps its fellow of the opposite side in the mesial line.

The posterior ventro-lateral overlaps the median ventral and the posterior dorso-lateral, but is in turn overlapped by the anterior ventro-lateral. In the middle line the plate of the left side overlaps its fellow.

The Arms.—These are comparatively short, as in *Asterolepis*, and I find their structure to be essentially similar to those in that genus as described and figured by Pander. They are hollow, divided by a transverse joint into two segments, proximal and distal, rather flattened above and below, especially towards the extremities, and composed of numerous plates, which have much the same contour above and below. In the proximal segment (Pl. XVII. figs. 1 and 2) we have the following plates:—two *articular* (*ar*), dorsal and ventral, which grasp the helmet-process of the anterior ventro-lateral plate; one *internal articular*, only visible from the inner side of the limb, and therefore not shown in the figures; one *external marginal* (*m*), extending nearly along the whole of the outer aspect of the segment; one shorter, *internal marginal*, and two *anconeal*, or elbow-pieces (*a*), dorsal and ventral, somewhat triangular in shape, their apices directed forwards to meet the posterior extremities of the articulars, their convexly rounded bases articulating with the central plates of the distal segment. The distal segment or "forearm" consists of two *centrals* (*c*), dorsal and ventral, rhombic in shape, with the acute angles truncated, one acutely pointed *terminal* (*t*), and four *marginals* (*m*), of which two follow each other on the outer aspect, and two are similarly placed on the inner aspect of the limb.

The Tail.—In most Scottish examples of *Pterichthys* more or less perfect remains occur of a tail, covered with small rounded or somewhat hexagonal, slightly imbricating scales, which are arranged in longitudinal rows and also in transverse bands, the scales of one band alternating with those of the next; on the dorsal aspect close behind the carapace is also a small fin (Pl. XVII. fig. 3). Along the dorsal margin the scales are different in shape from those on the sides; in front of the fin they seem to be in the form of a few narrow, longitudinal, median plates; behind it they are elongated and imbricating, the arrangement reminding us of the so-called fulcra or V-scales along the extremity of the tail of an Acipenseroid fish; but whether they are monostichous or distichous it is hard to determine. The external sculpture of the scales is rarely seen, and can therefore hardly be available as a specific character. (See Agassiz's figure of the scales of *Pt. cornutus* in 4, pl. ii. fig. 3.)

The *fin* is triangular-acuminate in shape and seems to have been covered with small scales, no distinct rays being seen. At least two specially prominent elongated scales are placed along its anterior margin, producing an appearance which has been mistaken for that of a spine. The position of this fin is undoubtedly *dorsal*, as held by Hugh Miller, and not anal, as supposed by M'Coy (6, p. 599). Sir Philip Egerton supposed that in addition to the dorsal two ventrals were also present (9 *a*, p. 127); but having examined the specimen, now in the British Museum, on which he founded this conclusion, I find that the two supposed ventrals are merely parts of the dorsal separated by a little fault or dislocation in the stone.

As regards the British species of *Pterichthys* I have already indicated my views in the 'Geological Magazine' of last month. Their characters, so far as I can see, are entirely dependent on slight differences in the shape of the carapace and of the terminal segment of the arm, so that I have often suspected that after all only one "good" species was really represented. Were this view to be adopted, then the name *Pterichthys Milleri*, Ag., would include all the others as varieties.

ASTEROLEPIS, Eichwald (published April 1840).

(= *Asterolepis*, Agassiz, pars, non Hugh Miller; *Pterichthys*, Owen, Whiteaves, et cet. auct. pars, non Agassiz.)

We have seen that Pander maintained the identity of

Asterolepis, Eichwald, with *Pterichthys*, Agassiz; and as the priority lay with *Asterolepis*, he proposed to abolish the latter name altogether, as being a mere synonym. We have also seen that the attempt to base a generic distinction on a supposed difference in the mode of articulation of the arms cannot hold good, as Egerton's "thoracic" plates exist no more in the one case than in the other.

There is certainly a very remarkable resemblance in the form and arrangement of the plates of the head and of the arms, though as regards the former I must make a few remarks. I have never in *Pterichthys* found any trace of the "*os terminale*" figured by Pander in his restoration of *Asterolepis*, and concerning which he admitted that he had never found it perfect in the Old Red Sandstone of Livonia; yet its existence in the Russian form seems probable enough if, as described by Pander, the anterior margin of the premedian shows a sutural surface indicating the apposition of another plate in front of it. I have seen nothing like the "*os dubium*" in *Pterichthys*, though it may be the central part of an arrangement like that which closes up the "orbit" in *Bothriolepis*. Lastly, although there is in *Pterichthys* an "angular" element in the same position as that shown in Pander's figure of *Asterolepis*, it does not seem to project backwards in the same way from the margin of the cephalic shield.

As the plates of the Russian *Asterolepis* have hitherto been found only in a disjointed condition, it is natural that no tail should have occurred in apposition with the body; Pander has, however, referred to the dermal covering of this part certain curious bodies found in the Old Red of Russia, and with which he considered the fragments known as *Psammolepis*, Ag., *Cheirolepis splendens* and *unilateralis*, Eichw., *Microlepis exilis* and *lepidus*, Eichw., and *Ctenacanthus serrulatus*, Ag., to be identical. I have never had the opportunity of examining any of these bodies, and can only say that, judging from Pander's descriptions and figures, there does not seem to me to be any reason for connecting them with *Asterolepis*, especially as he himself admitted that they differ in structure from the body-plates, being composed of vaso-dentine, while the latter are composed of true bone. It is therefore clear that no comparison can be instituted between *Pterichthys* and *Asterolepis* so far as the tail is concerned.

There remains the body-carapace. This is more depressed than in *Pterichthys*, but the number and general arrangement of the plates are the same. As regards their mode of articulation Pander does not enter into any great detail either in his figures or text; but he makes one important statement regarding the anterior median dorsal which demands attention, namely that its lateral margins have on the underside narrow squamous surfaces which overlap both the anterior and posterior dorso-laterals ("unter welche sich die beiden seitlichen Schilder 12 und 13 unterschieben"), a statement borne out also by his figures of the plates in question. Now we have seen that in *Pterichthys* the anterior median dorsal plate does not overlap the posterior dorso-lateral, but is certainly overlapped by it, so that we have in this circumstance a quite tangible mark of distinction between the two genera.

I have not seen the anterior dorso-median plate of *Asterolepis ornatus*; but in the Upper Old Red Sandstone of Nairnshire remains of a large Asterolepid are not uncommon in which this plate certainly had the same relations to the surrounding ones as Pander has described in the Russian form. This is the *Coccosteus maximus* of Agassiz (4, p. 137, tab. xxx *a*. figs. 17 and 18), who supposed the plate in question was a median ventral, while Hugh Miller, with a better conception of its real nature, wished to consider it the dorsal plate of "*Pterichthys*" *major*. Having now got together a very instructive set of its plates, I find that this creature is not *Pterichthys major*, which is in reality a *Bothriolepis*, but a species closely resembling the *Pterichthys* of the lower beds in all essential respects save its depressed form and the mode of articulation of its anterior median dorsal plate. In Pl. XVIII. figs. 1 and 2, I have given outlines of the upper and lower aspects of this plate, the articular surfaces being shaded by horizontal lines. There it will be observed that on the outer aspect (fig. 1) there is no articular surface but the one, *z*, at the posterior margin which is overlapped by the posterior median dorsal, while on the under surface (fig. 2) the antero- and postero-lateral margins show each a narrow surface, *x* and *y*, which overlap the anterior and posterior dorso-laterals respectively. Isolated specimens of the dorso-lateral plates show corresponding surfaces on their outer aspects. The rest of the creature, as I have said, resembles *Pterichthys*, but the carapace is more depressed, the anterior and posterior dorso-lateral plates being narrower. The limbs are short and are similar in construction to those of the last-named genus; and though I have seen little of the head, what I have seen appears to correspond. As regards the tail, as no really entire specimen of the creature has occurred, it is difficult to speculate; but numerous rounded scale-like bodies occurring in the same beds may possibly be referable to this part.

I therefore propose to refer this species to *Asterolepis* under the name of *A. maximus*, Ag., sp., the name being fortunately suited to its large size, as median dorsal plates sometimes attain a length of 6 inches.

Bothriolepis, Eichwald, 1840.

(*Pamphractus*, Agassiz; *Homothorax*, Ag.; *Asterolepis*, Pander, pars; *Pterichthys*, Ag. et cet. auct. pars; *Bothriolepis*, Ag., pars.)

Bothriolepis was founded by Eichwald upon certain plates or fragments of plates occurring in the Old Red Sandstone of Russia which differed from those of *Asterolepis* in having the surface pitted instead of tuberculated. From his very brief original description (1) it is evident that he had before him fragments of a creature allied to *Pterichthys*; but unfortunately he ascribed teeth to it and imagined its scutes to be arranged in longitudinal rows, like those of the sturgeons, with a rough shagreened skin or smooth enamelled scales between them. By Agassiz *Bothriolepis* was placed among the "Cœlacanthi," and though the plates figured by him as *B. ornatus*, Eichw., are Asterolepid (or Pterichthyid) in character, he gave the name of *Bothriolepis favosus* to an undoubted Rhizodont. In establishing the family of Placodermata to include the Cephalaspidæ of Agassiz except *Cephalaspis*, M'Coy (5) rightly included *Bothriolepis*, and Pander went so far as to assign to it a place among the synonyms of *Asterolepis*, Eichw., along with *Pterichthys*, Ag., and many other names.

However, the dorsal plate figured later on by Eichwald (2, pl. lvi. fig. 3) as belonging to his *B. ornatus* not only stamps it as Asterolepid, but leads us also to suspect that it is generically different both from *Asterolepis* and *Pterichthys*, and that this is the case was clearly shown by Lahusen (11). Describing a head with a portion of the body attached, as well as the two median dorsal plates and some other fragments of the body and arms of a species to which he gave the name of *B. Panderi*, Lahusen pointed out, first that the course of the cephalic furrows (lateral line system) was not the same as in *Asterolepis*; second, that the postmedian plate was different in shape; third, that there was no *os terminale*; fourth, that the articular plates of the arms were longer. But when he speaks of the arms being more simple in structure than those of *Asterolepis* and we compare his figures, it is quite clear that he had before him only the proximal segment of the limb; and it must also be noted that in some cases he regards the grooves of the cephalic lateral line system as sutures, or at least as former sutures, and so very considerably increases the number of bones which he allots to the cranial shield.

Trautschold's contribution to the structure of *Bothriolepis*, published shortly afterwards (12), consists largely of corrections of Lahusen's paper in matters of detail. He also formulates the differences between the heads of *Bothriolepis* and *Asterolepis*, laying stress on much the same points as Lahusen, but adding that the angular and opercular elements (Pander) found in the latter are wanting in the former genus, though, strangely enough, the angular is represented in the diagram which he gives of the head in *Bothriolepis*. Noteworthy it is that he mentions having found in one specimen a lid or cover to the "orbit," and accurately fitting it. As regards the arms, of which he had no complete specimens, he pointed out certain differences in the arrangement of their constituent plates and considers it doubtful whether the limb was divided into proximal and distal portions, as in *Asterolepis*.

The discovery by the officers of the Canadian Geological Survey of numerous well-preserved entire specimens of *Bothriolepis* in the Upper Devonian rocks of Scanmenac Bay enabled Mr. Whiteaves to give a description (13, 14, 15), accompanied by excellent figures, of a new species of the genus, to which he gave the name of *Pterichthys* (*Bothriolepis*) *canadensis*. These specimens are certainly the finest examples of Asterolepid remains yet discovered, and clearly show all the salient features of *Bothriolepis* in a manner never before exhibited. Unfortunately Mr. Whiteaves does not seem to have had complete access to the literature of the subject, as he makes no reference to the papers of Egerton and Beyrich on *Pterichthys* or to those of Lahusen and Trautschold on *Bothriolepis*, and consequently does not seem to be aware that the identity of *Asterolepis*, Eichwald and Pander, and *Pterichthys*, Agassiz, had ever been questioned, or that very tangible differences between *Bothriolepis* and *Asterolepis* had been already pointed out; for as regards the former he says, "It is still open to question, however, whether the geuus *Bothriolepis* is or is not a valid one, and sufficiently distinct from *Pterichthys*" (15, p. 106).

However, he bases his reference of the Canadian species to *Bothriolepis* on the sculpture of the plates, pointing out some discrepancies in the plates of the head compared with those in Pander's restoration of "*Pterichthys*" (=*Asterolepis*); and noticing the absence of a tail, he contents himself with saying "It seems therefore highly probable that *Bothriolepis* will prove to be distinct from *Pterichthys* proper." Even as regards the species he seems to be in doubt as to whether or not it is distinct from *B. ornatus* of Eichwald.

But if the generic distinctions between *Asterolepis* and

Pterichthys are but slight, nothing can be more salient than those which distinguish *Bothriolepis* from both, as will be seen from the following sketch.

Head.—The median occipital (*m.occ.* Pl. XVIII. fig. 6) has its lateral margins more perpendicular to the posterior one, the anterior margin shows not merely a shallow reentering angle for the postmedian plate, but a deep semielliptical notch or excavation. The postmedian is small, narrow, semielliptical in shape, and, except its anterior margin, is entirely received in the aforesaid notch of the median occipital, not extending on each side to join the laterals, as in *Pterichthys* and *Asterolepis*. The laterals (*l.*) are much broader, while the extra-laterals (*e. l.*, B in Whiteaves's figure) are very small and narrow; but I have not seen the still smaller plate which Whiteaves figures as A in front of the last-named.

The pattern of the cephalic lateral-line grooves is considerably different from that in *Asterolepis* and *Pterichthys*. No transverse commissure unites the lateral groove of each side across the occipital plates, as in those genera; but in front, just at its inward flexure on the lateral plate, a conspicuous branch is given off which runs forwards and outwards to the margin of the shield, while immediately behind the origin of this branch and on the inner side of the main groove a small ear-shaped mark is often, though not always, seen. On the median occipital two slighter grooves are seen, forming an angle with each other behind, whence, diverging obliquely forwards and outwards, they pass also over the lateral plates and terminate near the flexure of the great groove, close behind the origin of its small outer branch.

These grooves are only superficial and have nothing to do with sutures, either present or former; nevertheless their having been considered as such has, as in the case of *Coccosteus,* given rise to confusion in the enumeration of the plates of the cranial shield. Owing to this source of fallacy, Whiteaves, like Lahusen, has numbered, in his figure of the head of *B. canadensis,* no less than seven plates more than what really exist, namely his no. 2 in front and on each side his nos. 2 *a*, 3, and 9 *a*, though he owns that 9 *a* "may possibly be a part of the postlateral" (external occipital). That is undoubtedly the case, and in like manner 2 *a* and 3 are portions of his prelateral (lateral) and 2 of the premedian. Nos. 2 and 2 *a* he regards as equal to the "*os terminale*" in *Asterolepis*; but if we turn to Pander's figure (7, tab. vi. fig. 1) we shall find that similar divisions are marked off by a similar groove on the premedian and lateral plates altogether independently of the division between these plates and the *os terminale.*

The median or "orbital" opening is in perfect specimens of the head of *Bothriolepis* filled up by a system of plates, being the "Decke" already noted by Trautschold. Whiteaves describes the arrangement as consisting of four elements, one central, like Pander's "*os dubium*," one anterior, and two lateral, of a rounded form, stating besides that the anterior one shows a remarkable slender process passing from the middle of its anterior surface right down through the head. I have not seen these plates in *B. canadensis*, but the "lid" is well shown in two specimens of *B. hydrophilus* in the Edinburgh Museum, in which the rounded lateral parts are seen to be very convex above. I cannot in these specimens trace any separation into distinct plates; but this may be due to mode of preservation.

Whether this median opening represents morphologically the mouth of the Tunicata, as Prof. Cope has suggested (17, 18), or not, the lateral convexities of the lid distinctly indicate that it covered a paired organ or pair of organs; and what paired organs could we more readily suppose to occupy this position than the eyes? But of what use could the eyes be if covered above by an opaque bony roof? Here I would venture a suggestion. May not the slender descending process described by Whiteaves be for the attachment of muscles arising from the inner aspect of the shield, which, on contraction, would elevate the entire lid above the level of the surrounding cranial plates, and enable the eyes to see out from below its margins? I do not put forward this theory with any notion of infallibility, but it does seem to me more consistent with the actual arrangement of the parts than that which supposes the median opening to be a mouth, the position of which was, I think, more probably on the under surface of the front of the head.

On the under surface of the head Whiteaves figures two plates (13, pl. vii. fig. 1, no. 15), of which he says that they "no doubt correspond to the plates which Pander calls the lower maxillæ." Except that their anterior margins come too far forwards, these plates do remind us of the pair seen in *Pterichthys* immediately in front of the semilunars, and which Pander in *Asterolepis* has interpreted as "Unterkiefer." Is it not possible that the exceeding closeness of their anterior margins to the edge of the cranial shield in Whiteaves's figure may be due to a slight forward displacement, such as often occurs in *Pterichthys* to a much greater extent? In a specimen of *B. canadensis* in the Edinburgh Museum remains of these plates occur, which evidently are so displaced, as they are shoved forwards quite over the edge of the cranial shield.

I have not seen the small median plate which Whiteaves (same figure, no. 18) represents immediately behind the two last mentioned, and concerning which he remarks, "Judging by analogies with the *Asterolepis* of Hugh Miller, but not of Pander, this may have been the hyoid plate." Unfortunately for this comparison, the "hyoid" plate of Hugh Miller's *Asterolepis* (=*Homosteus*) was, thirty years ago, determined to be the *median dorsal* plate of its carapace (7, p. 76).

Body-carapace.—This is more depressed in *Bothriolepis* than in *Pterichthys*, has a dorso-lateral angulated margin as well as a ventro-lateral one, and the dorsal surface is broader than the ventral one. The median dorsal plates are not so acutely elevated mesially as in *Pterichthys*; in some species they are only gently convex on the upper aspect. The anterior median dorsal, usually rather wide in its shape, articulates as in *Pterichthys* (but not as in *Asterolepis*), its antero-lateral margin overlapping the anterior dorso-lateral, while the postero-lateral margin is, on the other hand, overlapped by the posterior dorso-lateral. The inner surface of this anterior median dorsal (Pl. XVIII. fig. 3) shows a sharp median ridge, from which anteriorly two short branches are seen to diverge at acute angles forwards and outwards. On the inferior surface of the body the anterior ventro-laterals (Pl. XVIII. fig. 5) show a peculiarity in shape which distinguishes them from the corresponding plates in *Pterichthys* and *Asterolepis* in not exhibiting in front the prominent emargination for the semilunar plates seen in those genera. In fact no precisely similar semilunar plates exist, though these seem to be represented by a single small triangular one occupying the median notch at the union of the two anterior ventro-laterals. This is figured by Whiteaves in *B. canadensis* (*tab. et fig. cit.* no. 17), and it is indicated, though obscurely, in many specimens of *B. hydrophilus* (Pl. XVIII. fig. 5).

The lateral-line groove is continued on the body-carapace from the external occipital along the dorso-lateral plates on each side immediately below their longitudinal flexure. In addition to this another groove in the form of an inverted V is seen on the dorsal surface, the apex of the V being a little in front of the middle of the anterior median dorsal plate, while its legs extend outwards and backwards over the posterior dorso-lateral (see Pl. XVIII. fig. 4).

Arms.—The pectoral limbs in *Bothriolepis* are distinguished from those of both *Pterichthys* and *Asterolepis* by their greater length, which usually equals or even exceeds that of the carapace, and this is due chiefly to the greater proportional extent of the proximal segment of each. Consequently the articular and marginal plates of that segment are of greater length than in those two genera; but what is more remarkable is that the anconeal element (Pl. XVIII. fig. 4, *a*) is reduced to a small rounded plate on the dorsal, and apparently entirely wanting on the ventral aspect of the limb; so that beyond the articulars the marginals are entirely in contact with each other on the ventral side, and only separated towards their extremities on the dorsal. In so far as the proximal joint is concerned the limb of *Bothriolepis* may be said to be simpler in construction than in *Pterichthys*; but this is not true of the distal part, in which both the central and marginal rows contain each at least one additional plate.

Tail.—It is remarkable that no tail is seen in *Bothriolepis*, although numerous specimens both of *B. canadensis* and *B. hydrophilus* seem perfect in every other respect. It is therefore perfectly plain that caudal scales were absent, though it does not seem to me quite so safe to assume that no caudal appendage was ever present; for the posterior aspect of the carapace shows a large opening just as in *Pterichthys*, out of which it is difficult to conceive that absolutely no body-prolongation ever proceeded, and it does seem quite possible that a tail might have existed, though unprovided with hard parts capable of preservation. Moreover, in a specimen of *B. canadensis* in the Edinburgh Museum there is to be seen, just at the place where the tail occurs in *Pterichthys*, a peculiar dark organic-looking film, which is strikingly suggestive of the remains of such an appendage.

British Species of Bothriolepis.

B. hydrophilus, Ag. sp. (=*Pamphractus hydrophilus* and *Andersoni*, Ag.; *Homothorax Flemingii*, Ag.; *Pterichthys hydrophilus*, Miller, Egerton).—This interesting form, remarkable for its occurrence in great numbers crowded together in the Dura-Den fish-bed, was elevated by Agassiz into a genus distinct from *Pterichthys*, but on mistaken grounds, as he compared what was in reality the *ventral* surface of that genus with the *dorsal* one of the present subject. The error of this diagnosis having been seen by Hugh Miller and Sir Philip Egerton, *hydrophilus* was restored by them to *Pterichthys*, to which, indeed, Agassiz himself had first of all referred it.

Recently, however, on carefully developing the specimens on a portion of Dr. Anderson's original slab, now in the Edinburgh Museum, I was interested to find that this species does not belong to *Pterichthys* after all, but is an unmistakable *Bothriolepis,* closely allied to *B. canadensis.* This is at once apparent from the restored figure of its upper surface which I have given on Pl. XVIII. fig. 4. It differs somewhat in the sculpture of the plates, which is delicately pitted-reticulate, while in *B. canadensis* it retains rather more of a confluent tubercular character over most parts of the carapace. The proximal joint of the arm seems also slightly longer in proportion to the distal, and the denticulation of its outer margin rather coarser.

It is quite obvious that, as Hugh Miller and Sir P. Egerton have already pointed out (8, pp. 311 and 314), *Homothorax Flemingii,* Ag. (4, tab. xxxi. fig. 6), is founded on a bad drawing of the under surface of the species under consideration.

B. major, Ag. sp. (=*Pterichthys major,* Ag.; *Placothorax paradoxus,* Ag.).—This has been already referred to *Bothriolepis* by Lahusen (11), whose opinion I can amply corroborate. Its remains, as they occur at Scat Craig, near Elgin, are very fragmentary; but I think they are identifiable with those which occur at Heads of Ayr in a more perfect state. Tubercles of the surface confluent, sometimes into tortuous ridges, more generally forming a reticulation, the stellation of their bases often observable; limbs with the proximal joint proportionally long and slender.

B. macrocephalus, Egert. sp. (=*Pterichthys macrocephalus,* Egert.).—The long arms and the shape of the anterior parts of the ventro-lateral plates clearly show that this minute species is a *Bothriolepis* and very closely allied to *B. hydrophilus,* Ag. sp. This is quite evident from a glance at Sir Philip Egerton's figures (9); but I have also carefully examined the type specimens in the British Museum. The body-plates are sculptured with a delicate reticulate pitting also resembling that of *B. hydrophilus.*

In the 'Geological Magazine' for last month (November) I have named and briefly defined two additional species, viz. *B. giganteus,* Traq., from the Upper Old Red of Alves, near Elgin, and *B. obesus,* Traq., from a similar horizon near Jedburgh.

Microbrachius, Traquair, 1888.

(=*Pterichthys,* pars, C. W. Peach; *Microbrachius,* Traq., Geol. Mag. Nov. 1888.)

The small species discovered by the late Mr. C. W. Peach in the Lower Old Red of John o' Groats, and named by him *Pterichthys Dickii* *, shows some peculiarities which seem to me to be decidedly of generic value.

It is small in size, head and carapace together measuring only about $1\frac{1}{4}$ inch in length. In shape it resembles *Bothriolepis*, having the carapace generally depressed and broader on the upper than on the under surface. On the upper surface the anterior margin of the carapace forms a deep reentering angle (see Pl. XVIII. fig. 8) or emargination, so that the antero-external angles of the anterior dorso-lateral plates project considerably in front.

The anterior dorso-median is peculiarly broad in shape. Its antero-lateral margin on each side first envelops the anterior dorso-lateral, and is then overlapped by it, this relation of the plates to each other being thus suddenly reversed. Behind this the postero-lateral and posterior margins of the plate are, as in *Pterichthys* and *Bothriolepis*, overlapped by the posterior dorso-lateral and the posterior dorso-median; the last-mentioned plate shows posteriorly a prominent angular point, projecting over the hinder opening of the carapace. On the underside the median ventral plate is extremely small. The arms are short, slender, and pointed; the plates of the head, which is large, are not well enough preserved to be readable. The outer surface of the body-plates is minutely tuberculated, the tubercles often tending to confluence in concentric lines.

In the form of the carapace *Microbrachius* resembles *Bothriolepis,* but the arms are short and the mode of articulation of the anterior dorso-median plate is altogether peculiar. Only the type species, *Microbrachius Dickii*, Peach sp., is known.

I have no material at present to enable me to enter into the discussion of *Actinolepis*, Ag., or *Chelyophorus*, Ag., of which the former at least is pretty certainly Asterolepid, as already noticed by Miller and Egerton; and the discussion of the general affinities of the group will form the subject of a subsequent communication.

List of Works referred to.

(1) Eichwald, E. von.—"Die Thier- und Pflanzenreste des alten rothen Sandsteins und Bergkalks im Novgorodschen Gouvernement," Bull. Sc. St. Pétersbourg, April 1840.

(2) Eichwald, E. von.—'Lethæa Rossica,' Stuttgart, 1860.

* British Assoc. Rep. 1867.

(3) Miller, Hugh.—'The Old Red Sandstone, or New Walks in an Old Field,' 1st edition, Edinburgh, 1841.

(4) Agassiz, L.—'Monographie des Poissons Fossiles du vieux grès rouge,' Neufchâtel, 1845.

(5) M'Coy, F.—"On some new Fossil Fish of the Carboniferous Period," Ann. & Mag. Nat. Hist. [2] vol. ii. 1848, pp. 1-10.

(6) M'Coy, F.—'Systematic Description of the British Palæozoic Fossils in the Geological Museum of the University of Cambridge,' London, 1851-55.

(7) Pander, C. H.—'Ueber die Placodermen des devonischen Systems,' St. Petersburg, 1857.

(8) Grey-Egerton, Sir P. de M., and Miller, H.—On *Pterichthys*, contained in "Palæichthyological Notes.—No. 1," Quart. Journ. Geol. Soc. 1848, pp. 302-314.

(9) Grey-Egerton, Sir P. de M.—"On a Species of *Pterichthys* (*Pterichthys macrocephalus*, Egert.) from the Yellow Sandstone of Farlow, Co. Salop," Quart. Journ. Geol. Soc. 1862, pp. 103-106.

(9*a*) Grey-Egerton, Sir P. de M.—"Remarks on the Nomenclature of the Devonian Fishes," Quart. Journ. Geol. Soc. 1859, pp. 119-136.

(10) Beyrich.—"Ueber einen *Pterichthys* von Gerolstein," Zeitschr. deutsch. geol. Gesellsch. 1877, p. 754.

(11) Lahusen, J.—"Zur Kenntniss der Gattung *Bothriolepis*, Eichw.," Trans. Imp. Min. Soc. St. Petersburg, 1879.

(12) Trautschold, H.—"Ueber *Bothriolepis Panderi*, Lahusen," Bull. Soc. Imp. Nat. Mosc. vol. lv. pt. 2, 1880.

(13) Whiteaves, J. F.—"On a new Species of *Pterichthys* allied to *Bothriolepis ornata*, Eichw., from the Devonian Rocks of the North Side of the Baie des Chaleurs," Am. Journ. Sci. xx., August 1880.

(14) Whiteaves, J. F.—"On some remarkable Fossil Fishes from the Devonian Rocks of Scaumenac Bay, P. Q., with Descriptions of a new Genus and three new Species," Can. Nat. vol. x. no. 1, 1881.

(15) Whiteaves, J. F.—"Illustrations of the Fossil Fishes of the Devonian Rocks of Canada," Trans. Roy. Soc. Can. section iv., 1886.

(16) Zittel, K. A.—'Handbuch der Palæontologie,' i. Abtheilung, iii. Band, 1 Lieferung.

(17) Cope, E. D.—"The Position of *Pterichthys* in the System," Amer. Nat. vol. xix. 1885, pp. 289-291.

(18) Cope, E. D.—"An Interesting Connecting Genus of Chordata," Amer. Nat. vol. xx. 1886, pp. 1027-1031.

EXPLANATION OF THE PLATES.

(In all the figures the same letters refer to the same things.)

m. occ. Median occipital.
l. occ. Lateral occipital.
ag. Angular.
pt. m. Postmedian.
p. m. Premedian.
l. Lateral.
e. l. Extra-lateral.
mn. Mental plates, the "Unterkiefer" of Pander.
s. l. Semilunar.
a. m. d. Anterior median dorsal.
p. m. d. Posterior median dorsal.
a. d. l. Anterior dorso-lateral.
p. d. l. Posterior dorso-lateral.
a. v. l. Anterior ventro-lateral.
p. v. l. Posterior ventro-lateral.
m. v. Median ventral.
ar. Articular of limb.
a. Anconeal of limb.
c. Central of limb.
m. Marginal of limb.

Plate XVII.

Fig. 1. Restored outline of *Pterichthys cornutus*, Ag., seen from the dorsal surface. The thin black lines in this and figs. 2 and 3 denote the edges of the plates which are overlapped, and therefore concealed; the double dotted lines indicate the grooves occupied by the lateral canal-system.
Fig. 2. Restored outline of the same species seen from the ventral aspect.
Fig. 3. Restored outline of the same species, lateral aspect.
Fig. 4. Outline of extra-lateral plate of *Pterichthys*, natural size.

Plate XVIII.

Fig. 1. Outline of external surface of anterior median dorsal plate of *Asterolepis maximus*, Ag. sp., much reduced. The shaded area *z* is that overlapped by the front of the posterior median dorsal plate.
Fig. 2. Outline of the internal surface of the same plate; *x* and *y*, marginal areas overlapping the anterior and posterior dorso-lateral plates respectively.
Fig. 3. Outline of internal surface of anterior median dorsal plate of *Bothriolepis giganteus*, Traq.; *x*, area overlapping the anterior dorso-lateral.
Fig. 4. Restored outline of the dorsal aspect of *Bothriolepis hydrophilus*, Ag. sp., from specimens in the Edinburgh Museum. The overlapped edges of the plates are not given here, but the lateral-line grooves are shown by double dotted lines.
Fig. 5. Front of anterior ventro-lateral plates of *B. hydrophilus*; *s. l.*, the single plate representing the semilunars.
Fig. 6. Outlines of the bones of the head of *B. canadensis*, Whiteaves, from specimens in the Edinburgh Museum, except the plates filling the median opening, which are copied from Whiteaves.
Fig. 7. Anterior median dorsal plate of *Microbrachius Dickii*, Peach, sp., showing its articulation with the anterior dorso-laterals.
Fig. 8. Dorsal plates of the carapace of *Microbrachius Dickii* seen from the internal aspect; the outlines of the head and of one of the arms are likewise shown.

LXV.—*Second List of Reptiles and Batrachians from Cyprus.* By G. A. Boulenger *.

A SECOND collection of Reptiles made in Cyprus by Dr. Guillemard on behalf of Lord Lilford contains examples of the following species not previously recorded by Dr. Günther or by myself. *Clemmys caspica* is apparently recorded from Cyprus for the first time.

1. *Clemmys caspica*, var. *rivulata*, Val.
2. *Gymnodactylus Kotschyi*, Stdr.
3. *Hemidactylus turcicus*, L.
4. *Mabuia vittata*, Oliv.
5. *Ablepharus pannonicus*, Fitz.
6. *Bufo viridis*, Laur.

The collection also contains large series of *Acanthodactylus Schreiberi*, Blgr., showing the characters upon which the species was founded to be constant, and of *Ophiops Schlueteri*, Bttg. I now regard the latter form as merely a variety of *O. elegans*, Mén., the characters upon which it was based not being sufficiently constant. Having counted the scales round the middle of the body (ventrals included) and the femoral pores (on each side) in 100 specimens, I find the numbers vary as follows:—*Scales*: 1 specimen with 49, 3 with 48, 2 with 47, 10 with 46, 11 with 45, 21 with 44, 8 with 43, 16 with 42, 10 with 41, 13 with 40, 3 with 39, 2 with 38. *Pores*: twice 16, 8 times 15, 23 times 14, 79 times 13, 59 times 12, 25 times 11, 4 times 10.

The following is a complete list of the Reptiles and Batrachians hitherto found in Cyprus. Species (from Unger and Kotschy's list, published in 1865) as to the occurrence of which some doubts exist are queried. B. M. signifies that specimens from Cyprus are in the British Museum.

Chelonia.

1. *Clemmys caspica*, var. *rivulata*, Val. B. M.
? 2. *Testudo marginata*, Schœpff.

Lacertilia.

3. *Gymnodactylus Kotschyi*, Stdr. B. M.
4. *Hemidactylus turcicus*, L. B. M.

* *Cf.* Ann. & Mag. Nat. Hist. [5] vol. xx. (1887) p. 344.

?5. *Tarentola mauritanica*, L.
6. *Agama stellio*, L. B. M.
?7. *Anguis fragilis*, L.
?8. *Blanus Strauchii*, Bedr.
??9. *Lacerta vivipara*, Jacq.
?10. —— *muralis*, Laur.
11. —— *lævis*, Gray.
12. *Acanthodactylus Schreiberi*, Blgr. B. M.
13. *Ophiops elegans*, var. *Schlueteri*, Bttg. B. M.
14. *Mabuia vittata*, Oliv. B. M.
15. *Ablepharus pannonicus*, Fitz. B. M.
16. *Eumeces Schneideri*, Daud. B. M.
17. *Chalcides ocellatus*, Forsk. B. M.
??18. —— *tridactylus*, Laur.
19. *Chamæleon vulgaris*, Daud. B. M.

OPHIDIA.

20. *Typhlops vermicularis*, Merr. B. M.
21. *Ablabes modestus*, var. *quadrilineatus*, Jan.
22. *Tropidonotus natrix*, L. B. M.
?23. —— *tessellatus*, Laur.
24. *Zamenis atrovirens*, Shaw. B. M.
25. —— *Dahlii*, Sav.
26. —— *Ravergieri*, Mén. B. M.
27. *Cœlopeltis lacertina*, Wagl. B. M.
28. *Tarbophis vivax*, Fitz. B. M.
29. *Vipera euphratica*, Mart. B. M.

BATRACHIA.

30. *Rana esculenta*, var. *ridibunda*, Pall. B. M.
??31. —— *temporaria*, L.
32. *Hyla arborea*, var. *Savignyi*, Aud. B. M.
33. *Bufo viridis*, Laur. B. M.
?34. —— *vulgaris*, Laur.

LXVI.—*Descriptions of two new Indian Species of* Rana. By G. A. BOULENGER.

Rana Leithii.

Vomerine teeth in two oblique groups just behind the level of the choanæ. A free pointed papilla on the middle of the tongue. Head moderate; snout obtuse, with obtuse canthus rostralis and concave loreal region; nostril nearer the end of the snout than the eye; interorbital space a little narrower than the upper eyelid; tympanum distinct, two thirds the diameter of the eye. Fingers moderate, first not extending quite as far as second; toes two thirds webbed, the web reaching the disks of the third and fifth; tips of fingers and toes dilated into small but well-developed disks; subarticular tubercles moderate; a single small, oval, inner metatarsal tubercle; no tarsal fold. The tibio-tarsal articulation reaches halfway between the eye and the end of the snout. Skin of back with small, scattered, longitudinal warts; a strong fold from the eye to the shoulder. Brown above, with small dark spots; limbs with dark transverse bands; lower parts white, throat mottled with brown.

From snout to vent 33 millim.

Closely allied to *R. Beddomii*, Gthr., but distinguished by the shorter inner finger.

Matheran, Bombay. A single (female) specimen, presented by Dr. Leith.

Rana himalayana.

Vomerine teeth in two oblique series, forming a very open angle, on a level with the posterior border of the choanæ, which are unusually small. Head much depressed, broader than long; snout short, rounded; canthus rostralis obtuse; loreal region concave; nostril a little nearer the eye than the tip of the snout; interorbital space as broad as the upper eyelid; tympanum not or but slightly distinct, hardly one third the diameter of the eye. Fingers very long, dilated into very large disks, which measure more than half the diameter of the eye; inner finger with small distal expansion, as long as the second minus the distal disk; third finger at least as long as the distance between the end of the snout and the tympanum. Toes moderate, much depressed, webbed to the disks, which are smaller than those of the fingers; subarticular tubercles large; an oval, flat, inner metatarsal tubercle; no outer tubercle; no tarsal fold. Tibio-tarsal articulation reaching beyond the tip of the snout; tibia as long as the trunk. Skin smooth above, with small granules on the sides and temples; no lateral fold; a rather feeble supratemporal fold; belly and proximal under surface of thighs granulate. Olive or greyish above, with rather indistinct large, round, darker spots on the body and cross bands on the limbs; hinder side of thighs purplish brown; lower surfaces brownish or pale olive. Male with internal vocal sacs.

From snout to vent 80 millim.

Darjeeling; four specimens.

This species is intermediate between *R. latopalmata*, Blgr. (=*R. afghana*, Gthr.), and *R. formosa*, Gthr. It is to the latter species that I referred the first two specimens which came under my notice (Cat. Batr. Ecaud. p. 70, *R. formosa*, specs. *c–d*). With more material before me, which I owe to the kindness of Mr. W. T. Blanford, I have now no hesitation in establishing the above new species. The four closely allied forms which occur together at Darjeeling may be easily distinguished by means of the following synopsis:—

A. Third finger not longer than the distance between the nostril and the tympanum.

- *a.* First finger extending a little beyond second; tympanum about half the diameter of the eye .... *R. livida*, Blyth.
- *b.* First finger not extending quite as far as second; tympanum not half the diameter of the eye .... *R. latopalmata*, Blgr.

B. Third finger at least as long as the distance between the tip of the snout and the tympanum; first finger much shorter than second.

- *a.* Tibio-tarsal articulation reaching beyond the tip of the snout; tibia as long as the trunk *R. himalayana*, Blgr.
- *b.* Tibio-tarsal articulation reaching the tip of the snout; tibia considerably shorter than the trunk .... *R. formosa*, Gthr.

LXVII.—*Description of a new Snake from Muscat, Arabia.* By G. A. Boulenger.

In addition to specimens of *Dermochelys coriacea*, L., *Zamenis diadema*, Schleg., *Rhagerrhis producta*, Ptrs., *Hydrophis cyanocincta*, Daud., *Echis carinata*, Schn., and *Echis colorata*, Gthr., a collection recently presented to the British Museum by Surgeon-Major A. S. G. Jayakar, of Muscat, contains a new *Eryx*, which I have much pleasure in naming after its discoverer

Eryx Jayakari.

Snout much depressed, the nostril projecting and with trenchant edge; a loreal groove; nostril between three nasals, the upper of which is the largest; the rostral, the two upper nasals, and an internasal meet with their angles, the sutures forming an X; upper head-scales small, in four longitudinal series between the eyes, which are very small, turned upwards, and surrounded by a circle of nine scales; eleven upper labials, third deepest and extending to the loreal groove; two large shields between the three following labials and the loreal groove, the second of which enters the eye; fourteen lower labials. A mental groove. Scales smooth, in 39 longitudinal series. Ventrals about 180; subcaudals 20. Anal spurs well developed. Tail once and a half the length of the head, pointed, ending in a curved, claw-like, horny scute similar to the anal spurs. Greyish brown above, with whitish spots and numerous, rather irregular, dark brown cross bands; head dotted with dark brown; lower parts white.

Total length 40 centim.

A single specimen.

MISCELLANEOUS.

The Nest and Eggs of the Alligator (Alligator lucius, *Cuv.*). By Prof. Samuel F. Clarke, Williams College, Mass. U. S.

It is somewhat remarkable that so promising a field of inquiry as that of reptilian embryology should have been so generally neglected; and it is certainly remarkable that almost nothing is known of the development of the Crocodilia or Loricata, the largest and most highly organized of the reptiles. The eggs and young alligators are such common objects in the shop windows in many of the Southern States that it appeared to be a simple matter to secure the eggs at the right time and in abundance. It proved, on the contrary, to be very difficult. I was assured by various hunters in Florida that each month from January to September inclusive was the only month in which the alligators lay their eggs, and this resulted in my having to make two journeys of over 2600 miles each.

At the time of my first visit, the first week in April, no eggs had been laid, and the ovaries of adult female alligators were full of eggs of all sizes up to 26 millim. in diameter. I returned to Florida on June 4, and found that I was still somewhat early, as the nests were then being built. With the aid of five experienced hunters I at last succeeded in finding, on the 9th of June, a nest evidently just completed in which there were twenty-nine eggs. The next day, at a point 40 miles further north, a second nest was found with thirty-one eggs.

There were many nests found, old and new, but only these two contained eggs.

The nests vary much in size, the largest being about 2½ metres in diameter at the base and 80 centim. high in the central part, the whole having the shape of a rounded cone; they are located generally on a slightly elevated place, which is higher by a metre, or slightly more, than the surrounding level, and covered with a thick growth of palmettos, mangroves, magnolias, &c. These are called "hummocks" by the natives. On one side of the hummock at least, in some cases on all sides, is a pond from $\frac{1}{3}$ to 2 metres in depth, and in the bank, under the water, the female alligator digs a cave which in some cases extends 3 metres under the hummock and which is always close to her nest. The nest is made by scratching together a great pile of dead leaves and twigs and humus which forms the surface of the ground, and which is arranged with some care; the inside is made of the more finely divided, almost powdery material of the deeper layers of the top soil, while the outside even to the top is covered with twigs and leaves which are whole or but little broken, and with many of the long unbroken leaves or needles of the southern pine. The eggs are deposited about 20 centim. from the top, and in the nests found were lying on top of one another, making rows or layers with the fine humus filling all interstices. The top of the nest is always well exposed to the sun.

The eggs are white, elliptical, and vary in the shorter diameter from 39 to 45 millim.; in length they vary from 67 to 88 millim. The shell is thicker than that of a hen's egg and more brittle; the shell-membrane is also thicker than that of a hen's egg and consists of an inner and an outer layer; the fibres of both extend obliquely around the egg and those of the two layers are always at right angles to each other; the shell-membrane is most closely attached to the shell in a zone around the smaller diameter, which varies greatly in width, and wherein the membrane is less translucent than towards either end, being much more opaque white. The white of the egg has the consistency of a very thick jelly, so that it will adhere to the yelk after the shell-membrane has been removed to such a degree that the whole egg can be held on the palm of the hand and transferred from one hand to the other. The yelk is spherical, large, and of the faintest yellow or straw-colour; it is so large that it nearly touches the shell-membrane in the middle line of its opaque zone, leaving but an extremely thin layer of white between yelk and membrane, and which white adheres very closely to the membrane throughout the opaque zone; this layer of white grows thinner as incubation proceeds and a very light watery liquid increases.

After the first day it is almost impossible to get off the membrane without rupturing the thin pellicle of white; and if this be done, the embryo is carried away with the outflowing liquid and is quickly broken into innumerable pieces.

They are for these reasons the most difficult eggs that I have ever tried to work with.

Very often the opaque zone is larger at one point, and that always marks the position of the embryo; when the zone is of equal breadth throughout it is impossible to determine its exact position.

Examining an egg on the day after they were found, and finding that no change had occurred, I concluded to pack them all carefully and get back with them as quickly as possible to my laboratory, where I could have the best facilities for the difficult work in hand.

This took six days of day and night travel, owing to unfortunate conditions, and I found upon my arrival that incubation had been going on for some time, and the neural folds had nearly completed their coalescence.

While it is possible to get several chapters of value in the life-history from the material secured, it will be necessary to make another trip and a more prolonged stay next summer to get the more important early stages.

Biological Laboratory, Williams College,
July 12, 1888.

—*Zoologischer Anzeiger*, No. 290, October 8, 1888, p. 568.

On a new Cyamus *parasitic on the Cachalot.* By M. G. Pouchet.

Hitherto we have very little knowledge of the parasites of the Cachalot. The animal which grounded in 1874 near Ancona bore *Penellæ.* Bennett and Scammon speak of *lice*, but up to last year M. Lütken had been unable to procure any. The author, who accompanied Prince Albert of Monaco in the 'Hirondelle,' was enabled, by the kindness of Mr. S. W. Dabney, to examine a Cachalot while it was being cut up at Lagens (Isle of Pico). He found three kinds of parasites:—1. In the first stomach a great number of Nematoid worms mixed with the beaks and crystalline lenses of Cephalopods; 2. A Cestoid worm encysted in the fat and also very abundant; 3. On the surface of the body a new *Cyamus*, for which he proposes the name of *C. physeteris.*

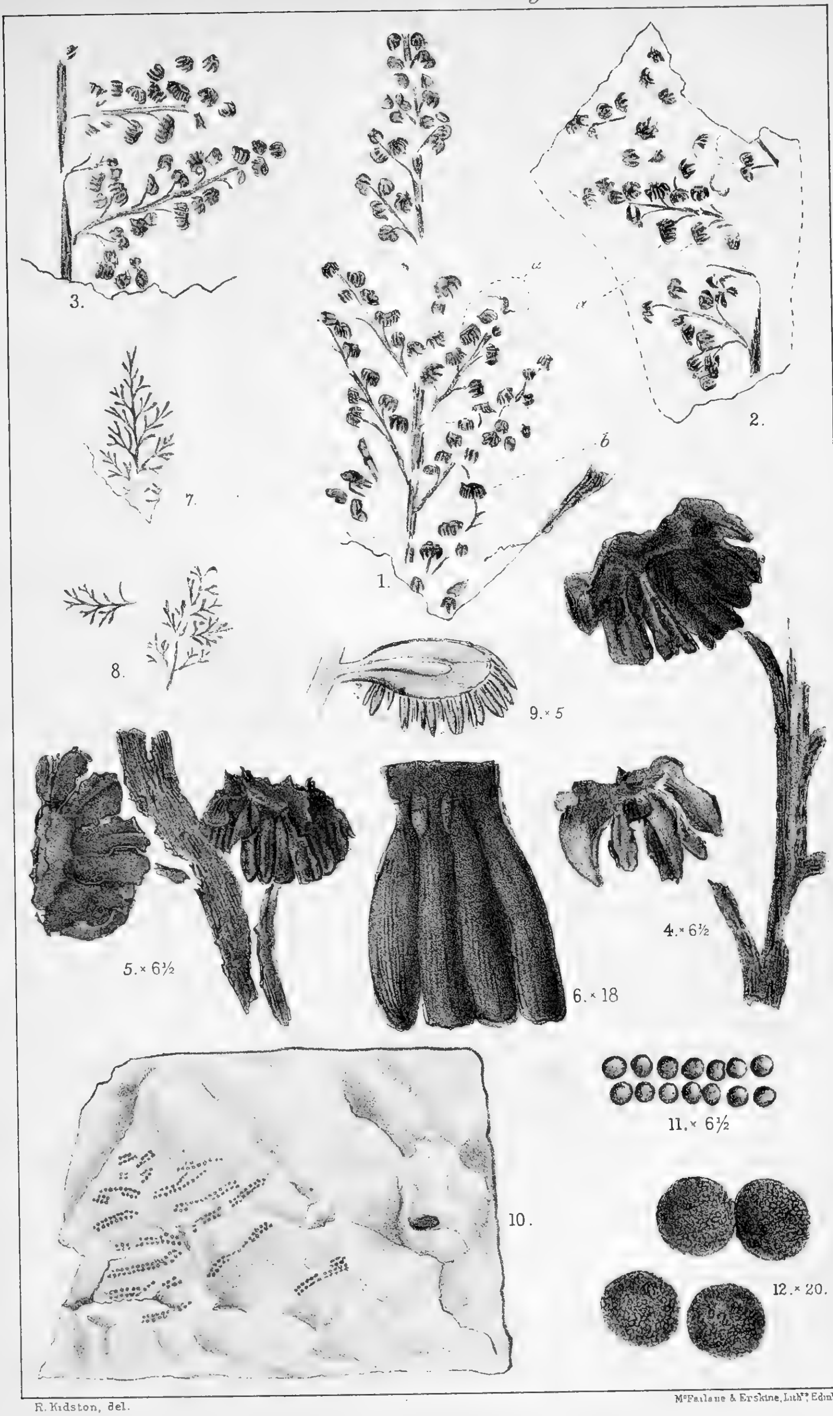
The resemblance presented by this *Cyamus* to other species of the same genus, especially that which lives on *Megaptera boops*, has no doubt led to the whalers having omitted to collect the *louse* of the Cachalot, which has thus remained undescribed. It is, however, at once distinguished by its numerous short branchiæ arranged in tufts on each side of the second and third (free) segments; their length does not exceed the antero-posterior diameter of the segments. By its head, which is intimately united with the first segment, and by its slender first pair of legs, which are turned inwards, it resembles *C. mysticeti* and *C. ovalis.* On the other hand the last joint of the large hook-shaped limbs is at first continuous with the axis of the limbs, and then curves into a complete semicircle, and it thus approaches *Platycyamus Thompsoni.*

The male and female are of the same size. In the latter the ventral laminæ appear to be caducous. As the young which they shelter are developed they separate and spread outwards, so that the body of the animal at the level of the first three (free) segments acquires the form of a spherical hood, within which the young of very different sizes are in contact with the epidermis of the host upon which they already feed.—*Comptes Rendus*, October 29, 1888, p. 698.

INDEX TO VOL. II.

END OF THE SECOND VOLUME.

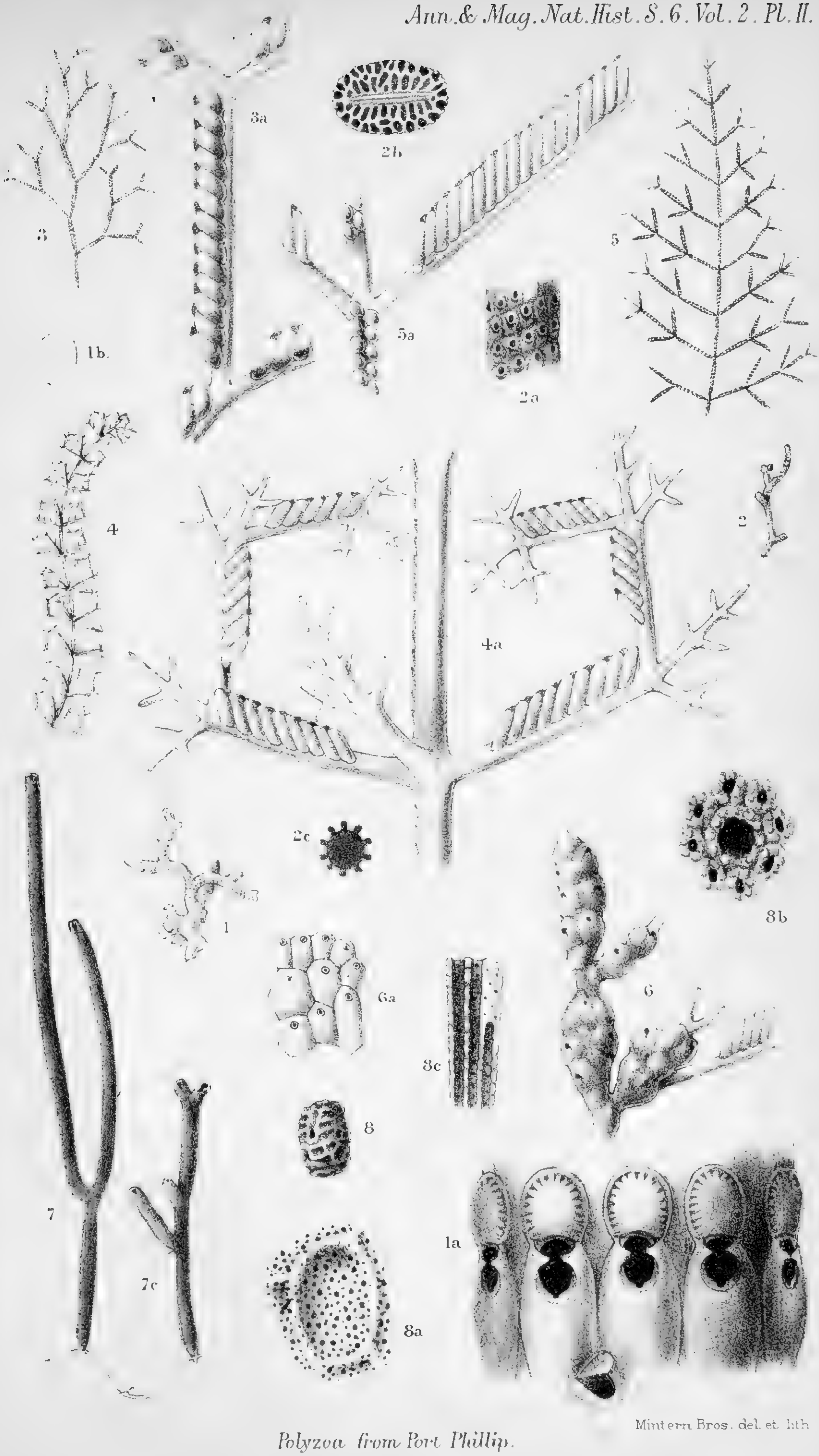
PRINTED BY TAYLOR AND FRANCIS,
RED LION COURT, FLEET STREET.



R. Kidston, del.

McFarlane & Erskine, Lithrs Edinr

Figs. 1-8, CROSSOTHECA FIMBRIATA, *Kidston, n. s.*
9, CROSSOTHECA CREPINI, *Zeiller*
10-12, CYCLOTHECA BISERIATA, *Kidston, n. s*

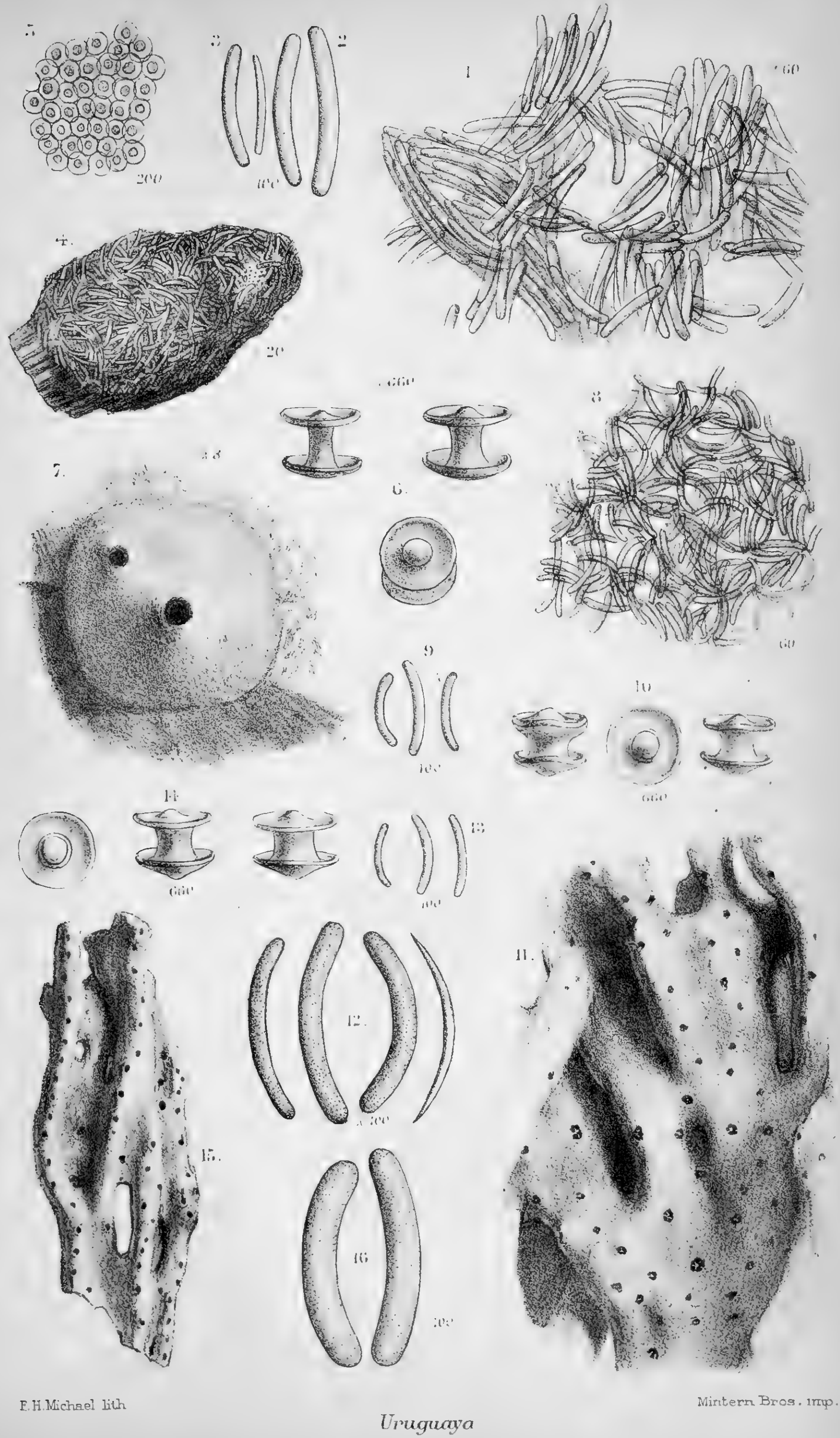


Mintern Bros. del. et. lith.

Polyzoa from Port Phillip.

Mintern Bros. del et lith.

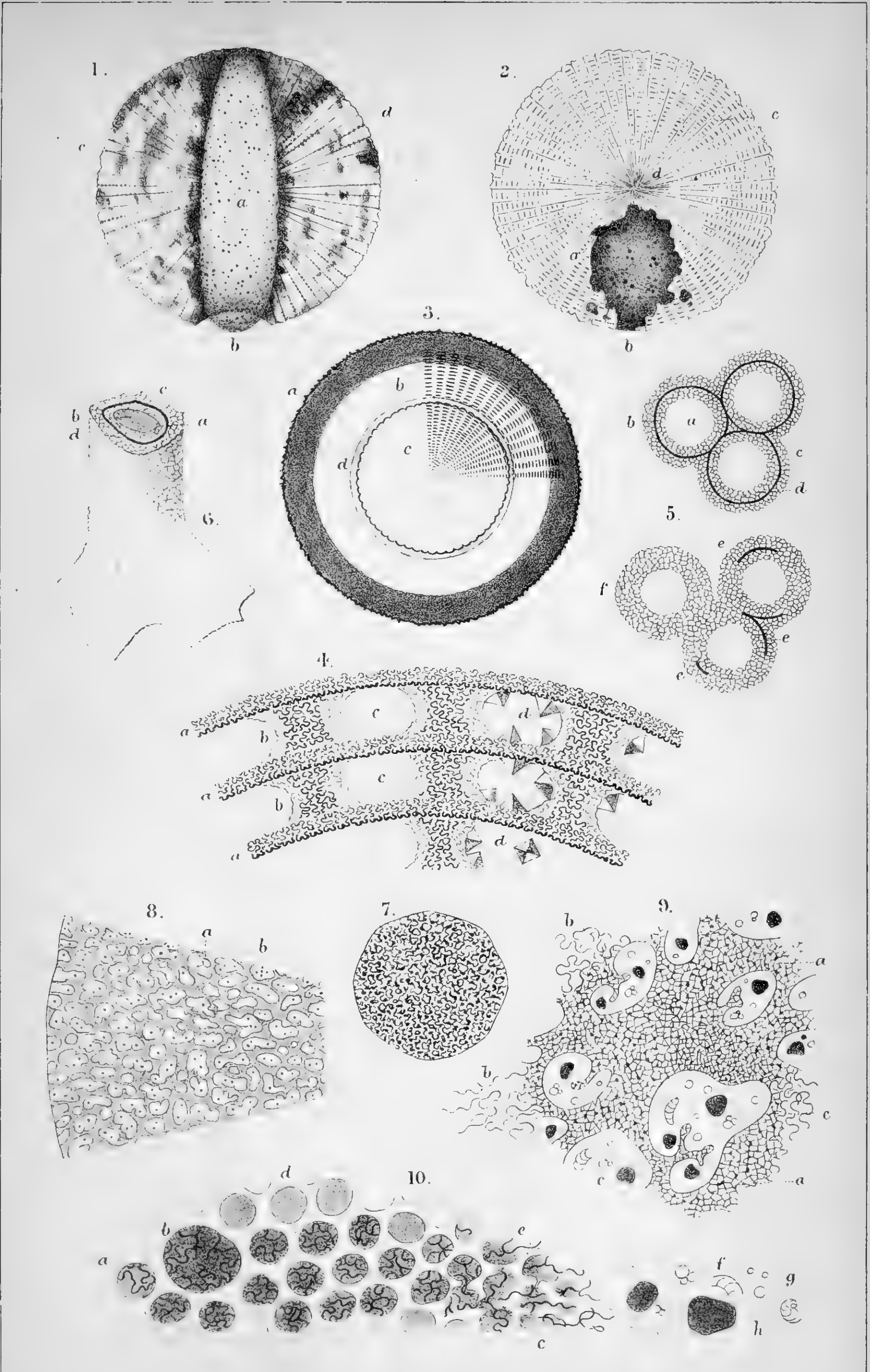
Nototrema fissipes.



F. H. Michael lith.

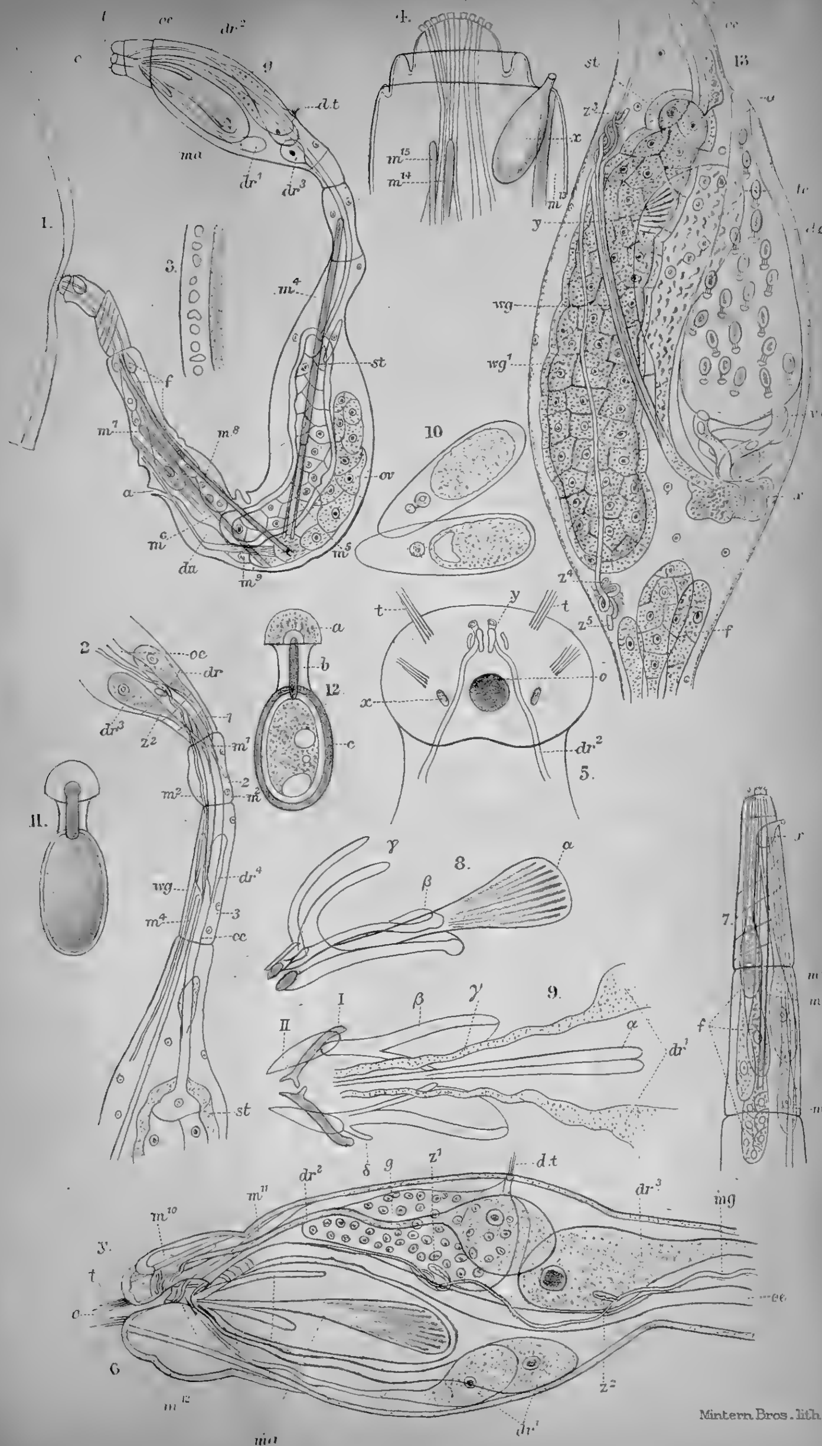
Mintern Bros. imp.

Uruguaya



H. I. C. del.

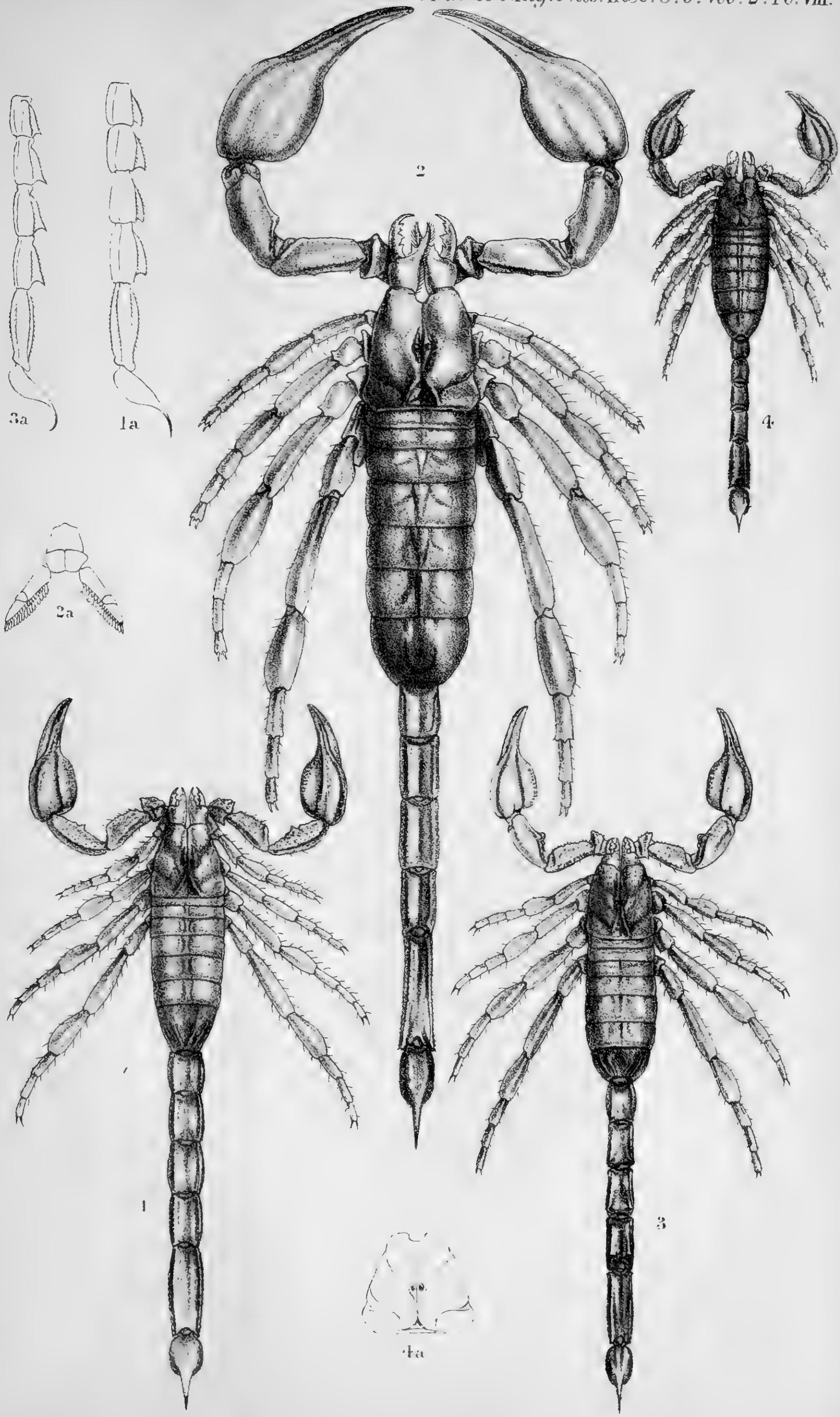
Mintern Bros. lith.



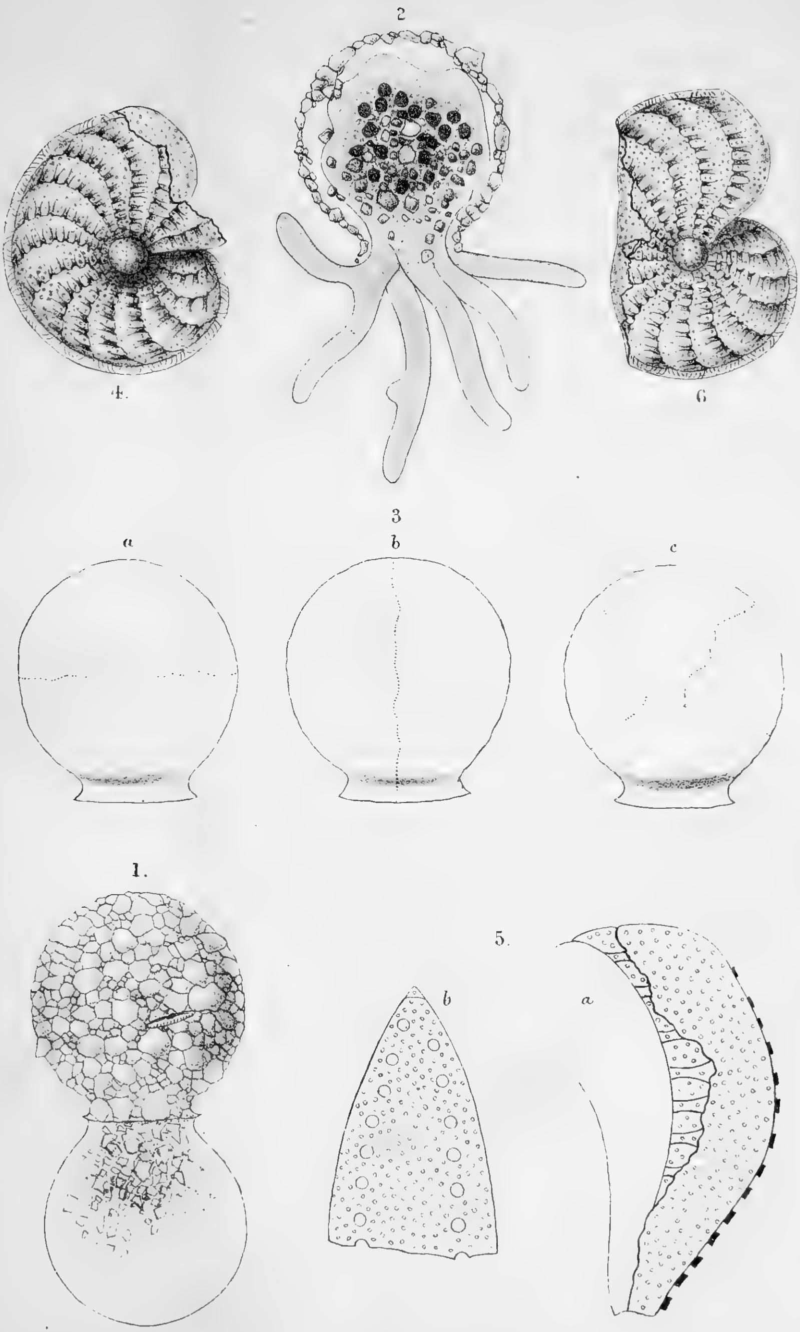
Mintern Bros. lith.

R. Kidston, del. M^c Farlane & Erskine, Lith^rs Edin^r

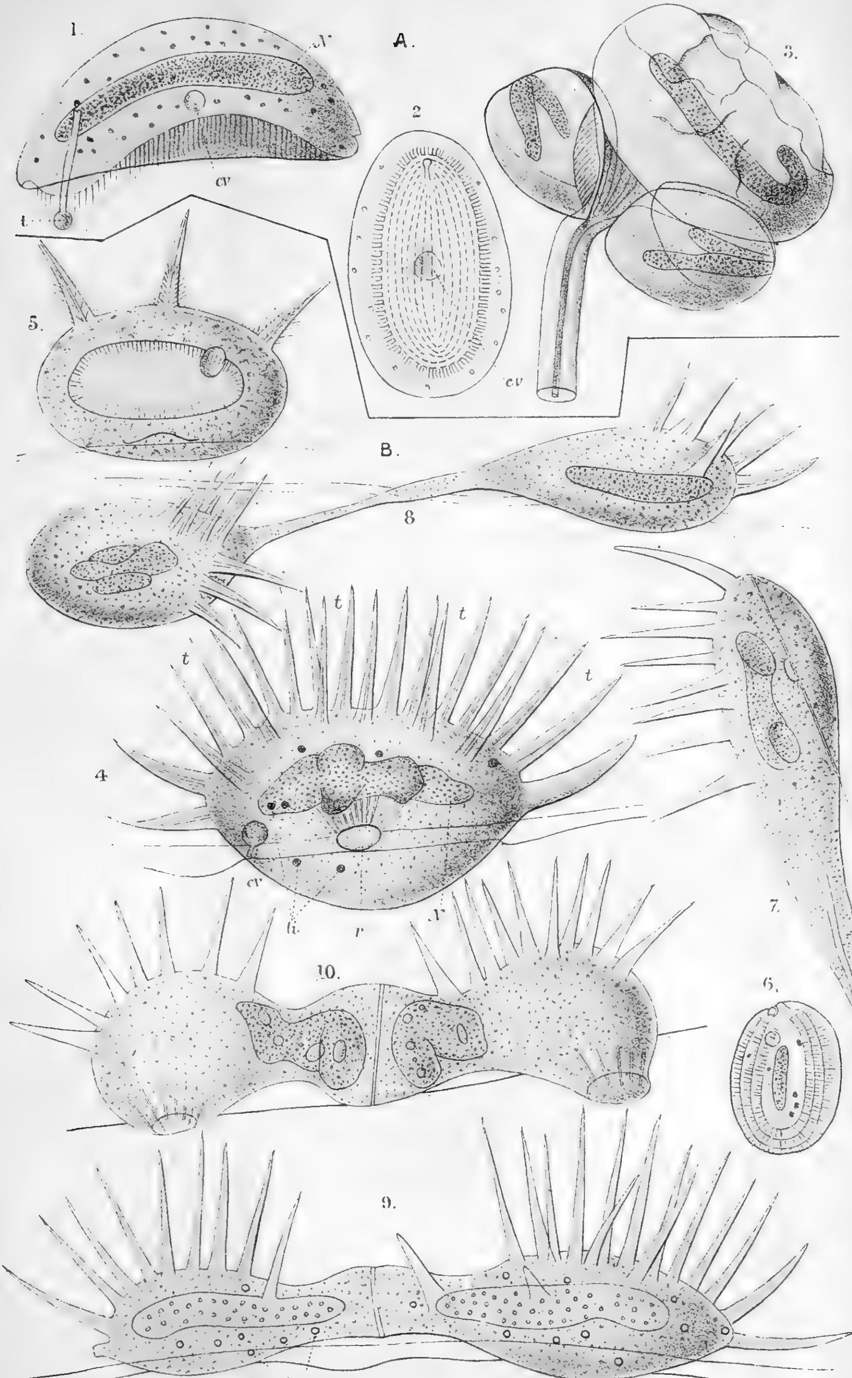
CALAMITES (EUCALAMITES) BRITANNICUS, *Weiss.*



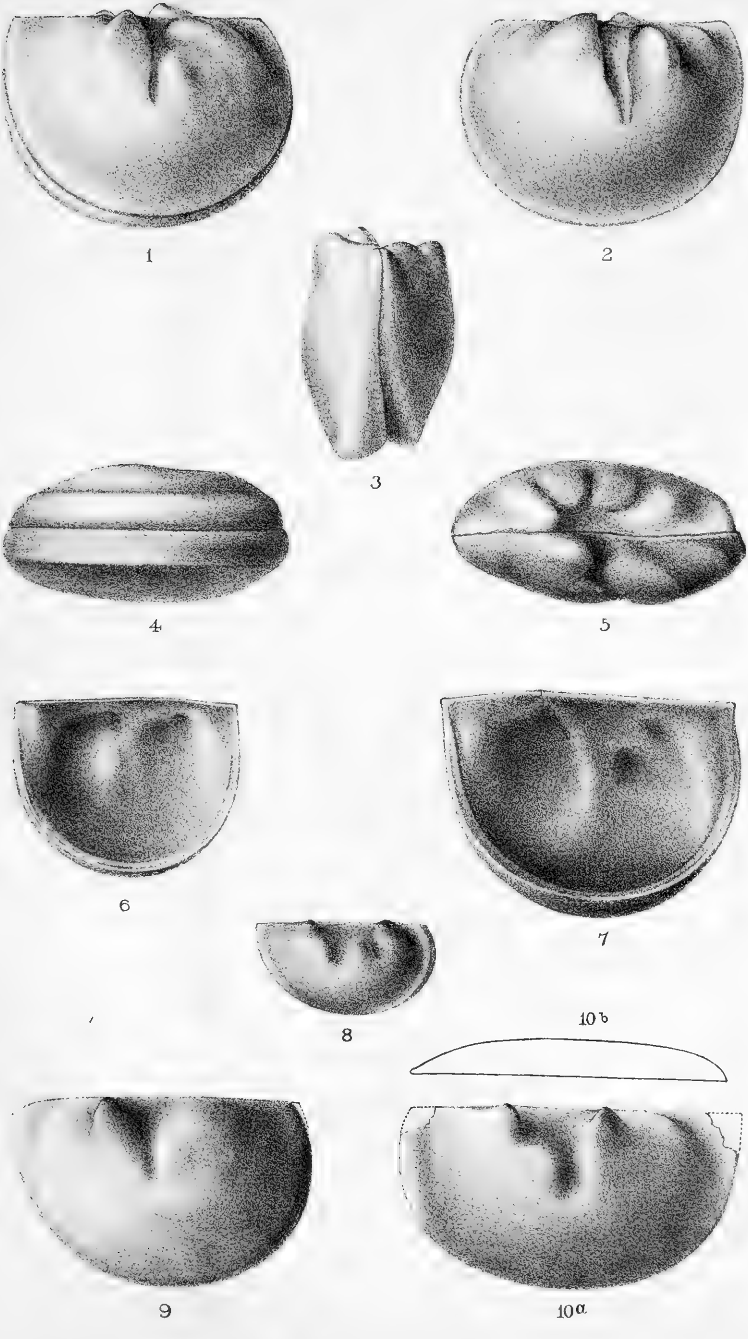
Mintern Bros. del. et lith.



Mintern Bros lith



Mintern Bros. lith.

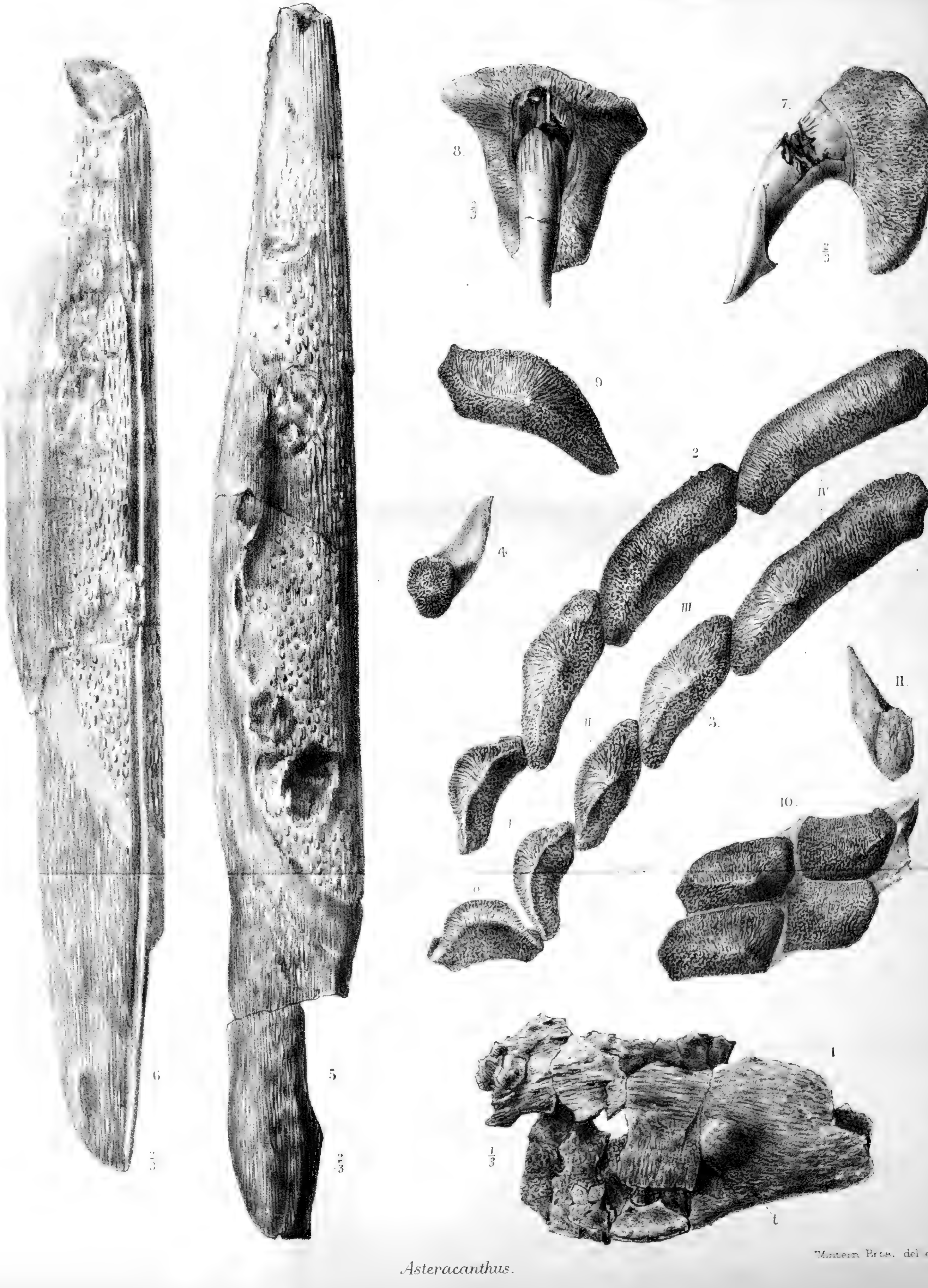


Geo. West & Sons, del. lith. et imp.

NEW DEVONIAN OSTRACODA

Mintern Bros. del. et lith.

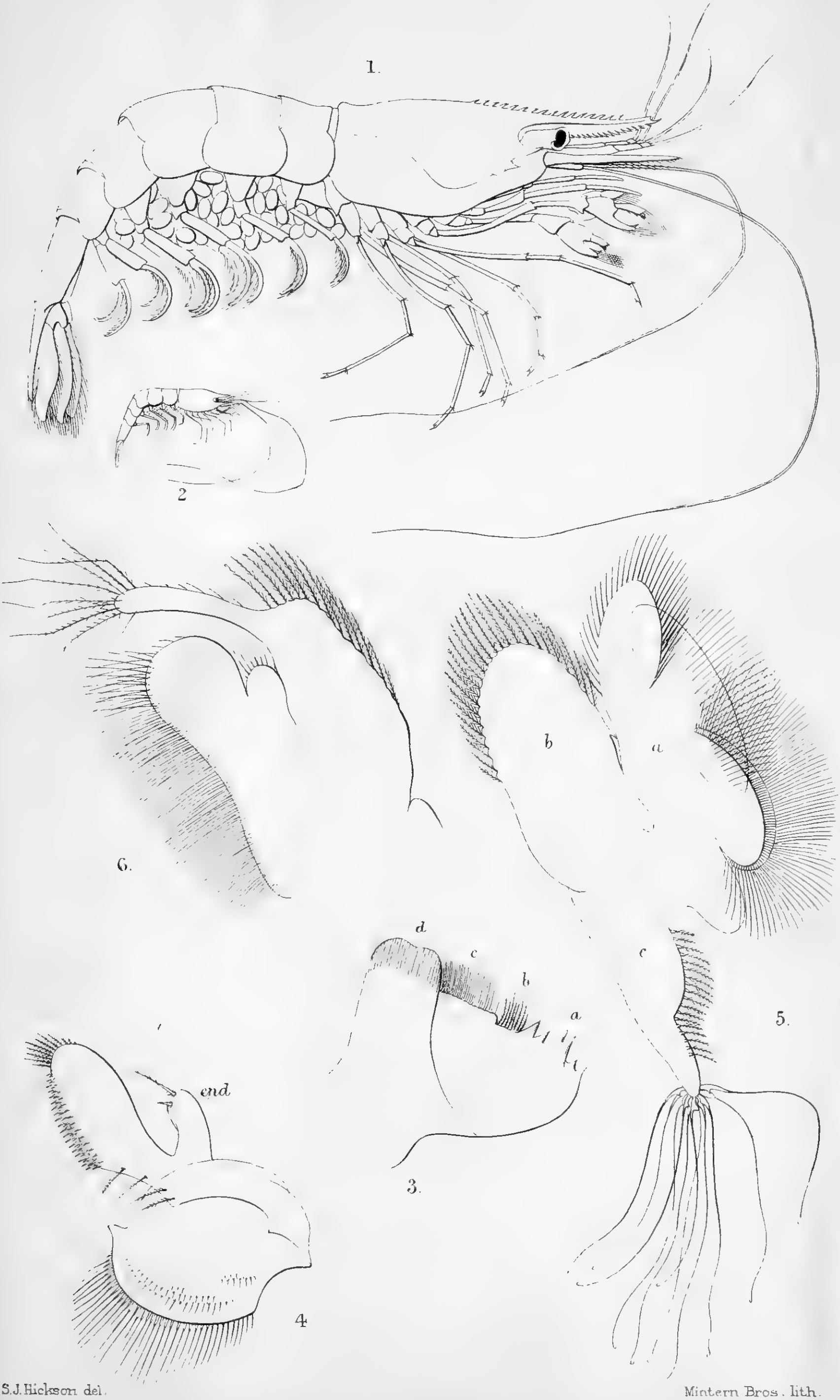
Asteracanthus.



Mintern Bros. del et lith.

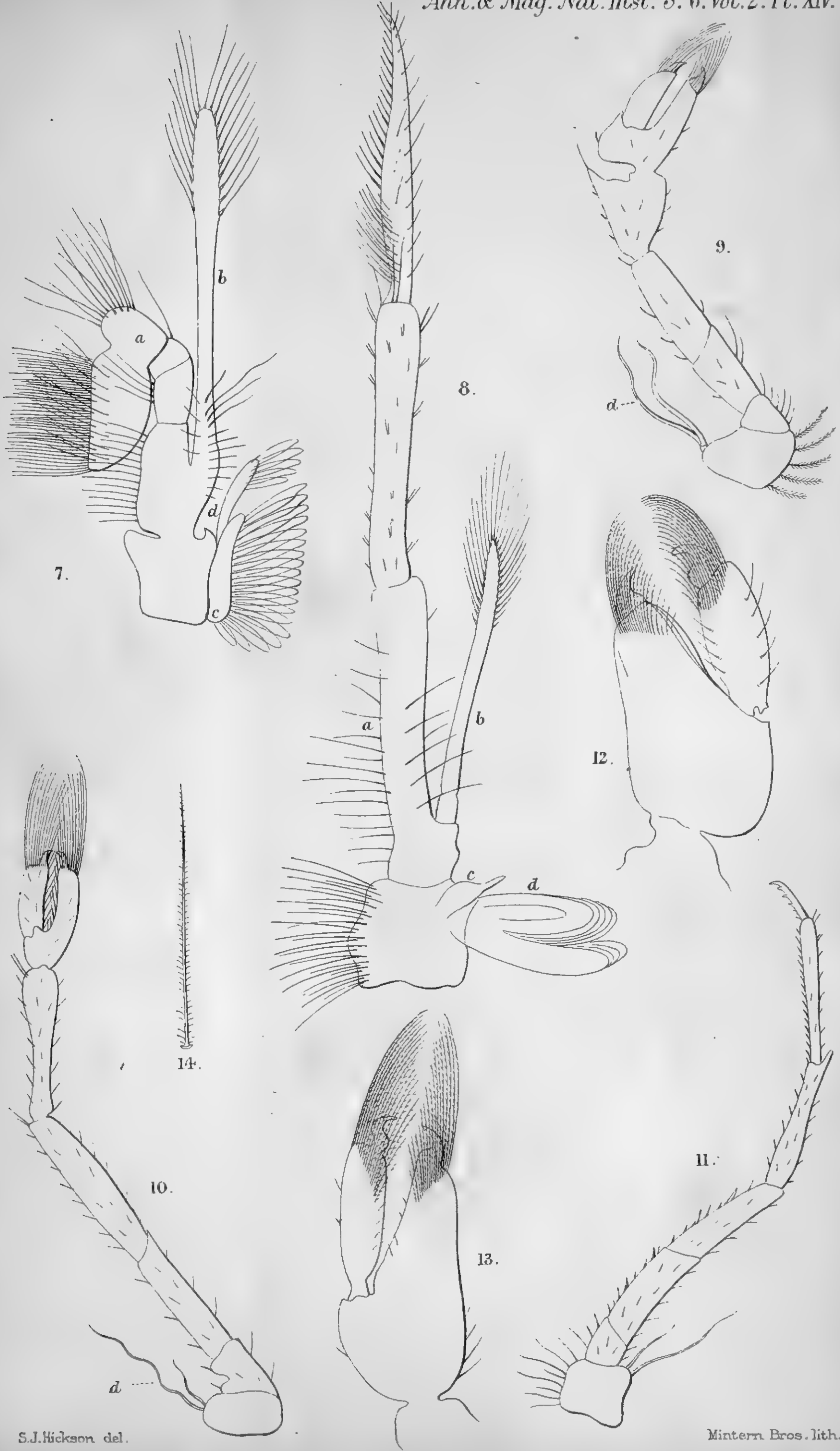
Asteracanthus.

Ann. & Mag. Nat. Hist. S. 6. Vol. 2. Pl. XIII.



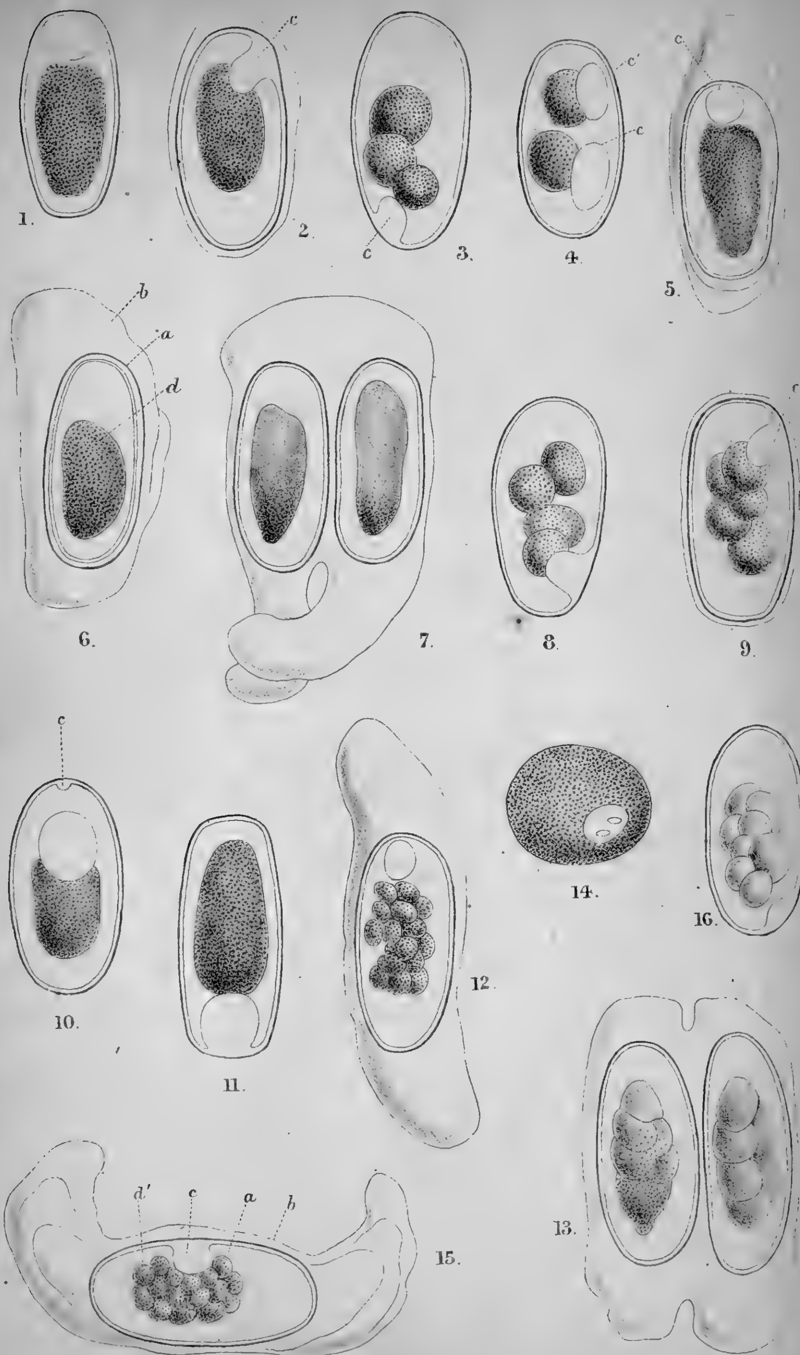
A.W & S.J. Hickson del.

Mintern Bros. lith.



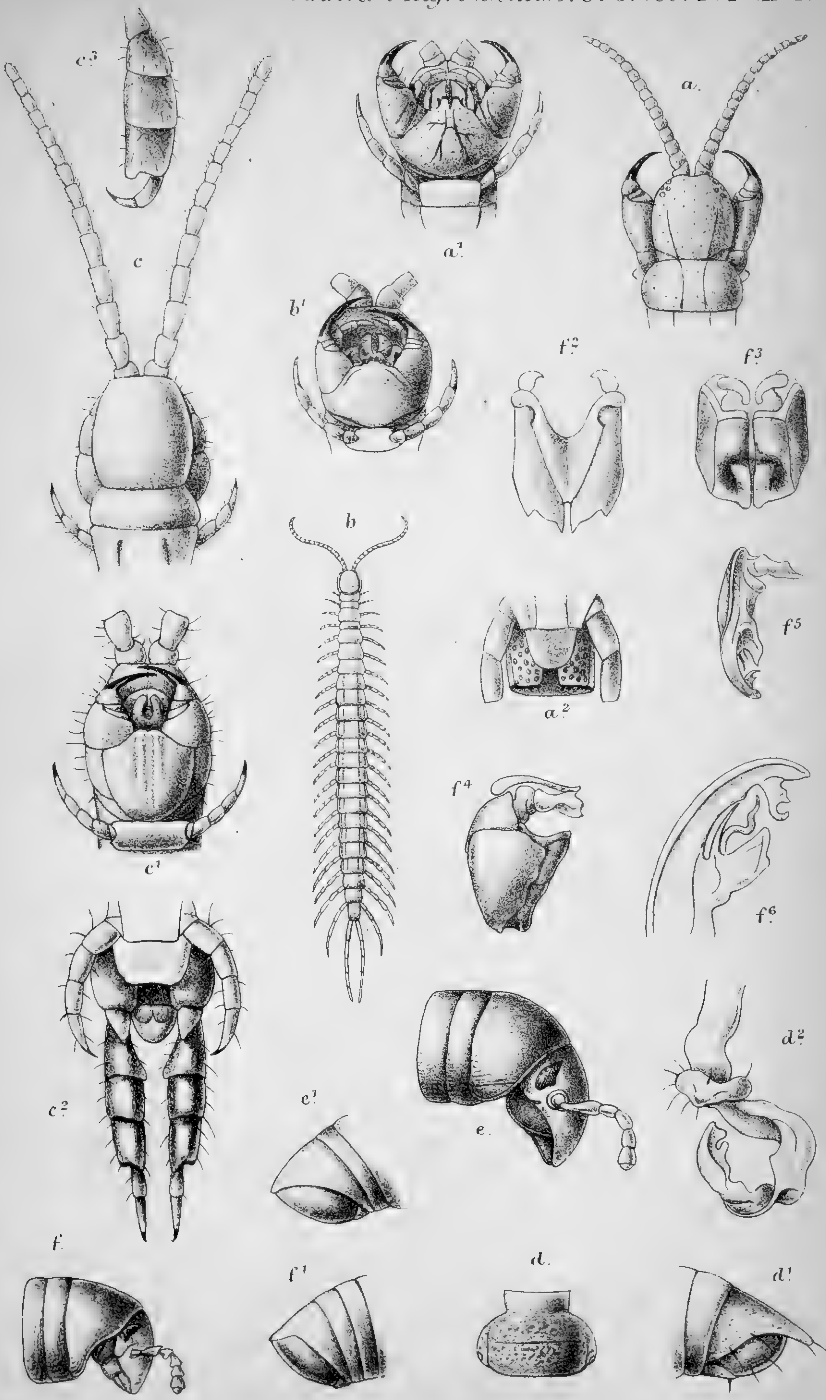
S. J. Hickson del.

Mintern Bros. lith.



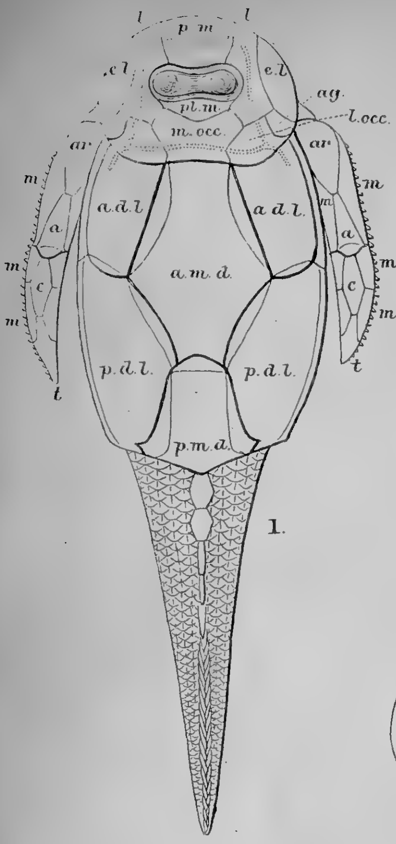
B. del.

Mintern Bros. imp.

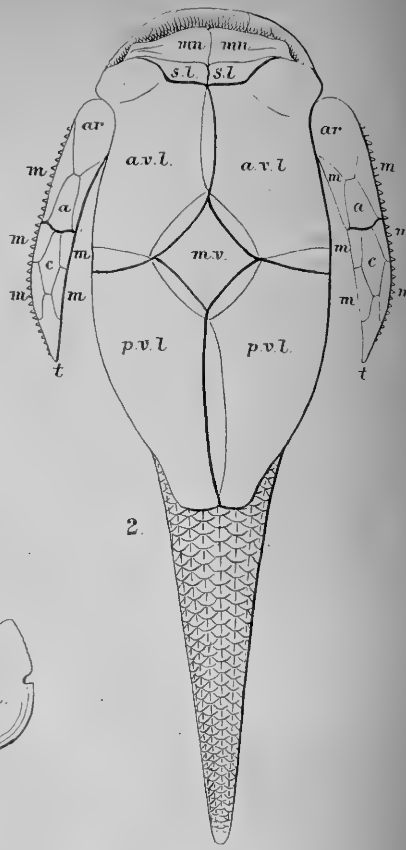


R. I. Pocock del.

Mintern Bros. lith.

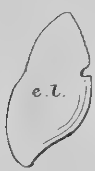


1.

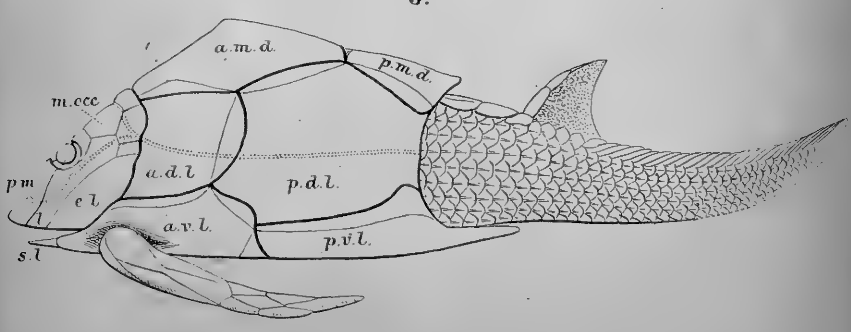


2.

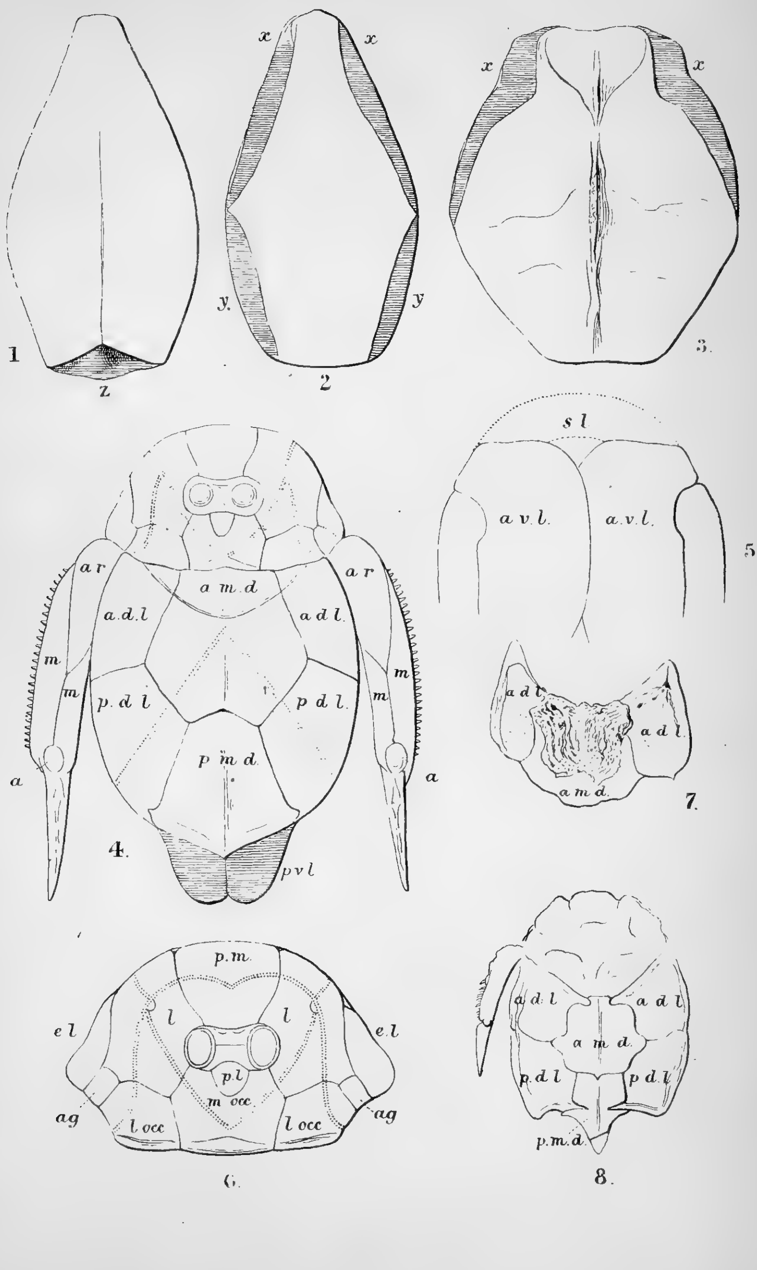
4.



3.



Mintern Bros. lith.



Mintern Bros. lith.