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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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

CONDUCTED BY

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1876.

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

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

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

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

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

No. 103. JULY 1876.

I.—*On the Affinities of the Anthozoa Tabulata.* By Dr. Gustav Lindström*.

Since Milne-Edwards and Haime first laid the foundations of their classification of the Anthozoa in their great works, a large amount of material has been amassed on various hands, and necessitates on nearer investigation a revision and, as an unavoidable attendant of the progress of science, a rearrangement of the various parts of the system. But amongst all the orders of Anthozoa none seems to stand so much in need of revision as that of the Tabulate Corals; and the purport of the present paper is to demonstrate that this order is composed of genera belonging to quite different classes of the animal kingdom, and having no zoological affinities with one another; whence it results that the order Anthozoa Tabulata must be broken up and its constituent genera distributed amongst other classes and orders previously known. Having examined almost all genera belonging to the Tabulate Corals, I cannot but concur in the opinion, which Prof. Verrill†, as far as I know,

* Published in the Proceedings of the Swedish Academy of Sciences, 1873, and translated, with amendments and additions, by the author. Communicated by Dr. H. Alleyne Nicholson.

† "On the Zoological Affinities of the Tabulate Corals," Proc. Amer. Assoc. Adv. Sci. 1867, p. 150; "Review of Corals and Polyps of W. Coast of America," Trans. Conn. Acad. vol. i. 1868–70, p. 518; "Affinities of Palæozoic Tabulate Corals with existing Species," Silliman's Journ. 1872, p. 187. See also W. S. Kent, Ann. & Mag. Nat. Hist. 1870, vi. p. 384.

was the first to express, that the order Tabulata is founded on a character too artificial to allow of its retention.

The chief distinctive feature of the Tabulate Corals is stated to be the presence of tabulæ or floors, representing what may be aptly called the horizontal element of the coral, in direct opposition to the vertical elements, viz. the wall and the septa. According to my views of the different parts of the corallum, these tabulæ are completely homologous with the dissepiments of the other corals. They consist of sclerenchyma secreted by the basal parts of the animal, within the wall and between the septa. In many Cyathophylloids it is very easy to see how the vesicular dissepiments in the centre of the visceral chamber, where the septa are absent, pass without the least interruption into larger, elongated, faintly convex, and horizontal laminæ, or even into a single lamina, which, being smooth and more or less horizontal, can in no way be distinguished from a complete tabula. In longitudinal sections of the Cyathophylloids, tabulæ are seen in one place and small vesicular dissepiments in another, at the centre of the same individual. We can thus see without any difficulty how the lateral vesicular dissepiments are changed into tabulæ. In some Cyathophylloids in which the cup is deep there seems to exist an exception, in so far that there is apparently an exterior zone of vesicular dissepiments, the laminæ composing which are directed in a slanting manner outwards and upwards, and which have no connexion with an interior zone of horizontal tabulæ. This sharp distinction is due to the circumstance that those parts of the dissepiments which are simultaneously formed do not lie in the same plane, but are elevated at the sides and deeply depressed centrally. Thus the tabulæ, lying deep down centrally, are environed laterally by older masses of dissepimental tissue; and this causes an apparently distinct line of demarcation between the central and peripheral zones (see, for example, Edw. & Haime, Pol. Foss. des Terr. Pal. pl. viii. fig. 4 *a*). In other genera, again, as *Diphyphyllum*, *Columnaria*, and *Lithostrotion*, the dissepiments are in a very high degree, as it were, pushed aside and the septa somewhat shortened; whilst in other genera, such as *Pholidophyllum* and some *Cystiphylla*, the dissepimental vesicles have quite disappeared, and the septa are reduced to a minimum, being sometimes wholly wanting, or only faintly indicated by rows of sparsely developed spines. This diminution of the septa and dissepiments is of necessity accompanied by an enlargement of the smooth central space, which is seen at the bottom of the cup to be uncovered by the septa and to be formed by the tabulæ. This surface is continned without interruption between the septa, and occupies the place of the dissepiments (as, for example, in some *Ptychophylla*), just in the same way as the dissepiments may occupy the place of the tabulæ. This identity of the tabulæ and dissepiments is perhaps in no forms so evident as in the *Cyathophylla*, in which there are frequent passages between both these sclerenchymatous secretions, whereby it is demonstrable that they are immediate continuations or transformations of one another. On the other hand, there are Heliolitidæ in which a longitudinal section shows dissepimental tissue of quite a Cystiphyllidean type partially superseding the usual regular tabulæ. A compound *Cystiphyllum* (such as *C. cylindricum*, Lonsd.), where the individual corallites are often very narrow, and are each traversed by crowded and regular horizontal dissepiments, quite resembles a "tabulate" coral in its longitudinal section, and cannot be distinguished from one so far as this particular point is concerned. The fact seems to be that some corals which, like *Syringopora* and *Columnaria*, have been placed amongst the Tabulata on account of their "floors," are rather to be regarded as Rugose corals. It is also very difficult in longitudinal sections to see any great difference between a *Michelinia* or *Emmonsia* and a *Cystiphyllum*, all alike having the visceral chamber filled up with abundant vesicular dissepiments. Besides, there are several recent corals of quite remote zoological affinities, such as *Tubipora*, which are provided with tabulæ, thus resembling *Syringophyllum* and *Syringopora*. Duncan has also shown how *Lophohelia* is provided with tabulæ (Madrepor. of the 'Porcupine' Exp. p. 323). Amongst Mesozoic genera, *Clausastræa* and *Cyathophora*, according to De Fromentel (Intr. Pol. Foss. pp. 278, 280), have tabulæ so strongly developed as to lead him to place them in the Tabulata. I am of opinion, therefore, that there is no difference of kind between dissepimental tissue and tabulæ, both belonging to the same sort of endotheca. The Rugose corals therefore, and some other forms, are just as much tabulated as the Tabulata, and the latter are just as much dissepimental as the former, there being in this respect a complete agreement between the two groups.

There are, moreover, other animals which in their hardened tissues possess tabulæ, or have the cavity formerly occupied by their body divided into compartments by transverse floors placed at tolerably regular intervals; and these have therefore been regarded as Tabulate corals, though I think there is no longer any reason for retaining them amongst the Anthozoa. This is the case with *Millepora*, and probably also with *Axopora*. In a former paper ("Anthozoa Perforata of Gotland," p. 3) I endeavoured to show that the polypary of *Millepora* has not the least relationship to that of the Heliolitidæ. In its spongiose mass there are no calicles proper, clearly circumscribed by a wall of their own; nor are there any septa. The animal is sheltered in an irregular tube of the general mass, the texture of which is such that the coral, if Anthozoan, would have to be placed amongst the Perforata. According to the observations of both L. Agassiz and Pourtalès*, the animal of *Millepora* is a true Hydrozoon; and although the latest researches of Moseley ('Nature,' vol. xiii. p. 138) seem to leave it undecided whether it is truly Hydrozoan or Anthozoan, I think it better to remove the genus from the Anthozoa—the more so as the above naturalists, who alone have described the animal in its living state, are of this opinion †. At the same time we may discard all conclusions that might be drawn as to the systematic position of the supposed relations of *Millepora*. Through the researches of Verrill ‡, it is known that the animal of *Pocillopora* in no way resembles that of *Millepora*, but that the former is a true Anthozoan, akin to the Oculinidæ and *Stylophora*.

The Silurian genus *Labechia*, E. & H., also seems to partake of Hydrozoan characters. In its earliest stages of growth this fossil consists of a very thin circular disk, with concentric lines of growth beneath, and having the superior surface studded with blunt spines, which radiate from the centre, and also coalesce and form continuous ridges. In this state it reminds one of nothing more than the sclerobasis of the Hydrozoan genus *Hydractinia*; and the only difference seems to be that *Labechia* is entirely calcareous, whilst *Hydractinia* is corneous. During the course of growth the primitive disk of *Labechia* is increased in thickness by the addition of successive thin strata, which closely conform to the subjacent fundamental crust, being elevated where the spines are situated. As these successive layers leave a small space between them, and are in themselves very thin, they give rise to a false appearance of tabulæ. Milne-Edwards considers (Hist. Nat. Cor. iii. p. 284) that the spines are projections upwards from the rim of the supposed calicular wall; but there is not the least trace of any wall circumscribing any calicle, or of any septa, and these spines are only the last ones of the uppermost stratum superimposed on

* Pourtalès, "Deep-Sea Corals," Illustr. Cat. Mus. Cambr. no. iv. p. 56.

† If, as Dr. Duncan states, in consequence of the last researches of Mr. Moseley ('Nature,' April 13th, 1876), *Millepora* is really an Anthozoan, it deviates in a high degree from other Corals, and can by no means be allied with the Heliolitidæ.

‡ "Review of Corals of W. Coast of America," Trans. Conn. Acad. vol. i. pp. 2, 523.

their predecessors, one beneath the other, like so many inverted funnels. It was recently pointed out to me by G. Eisen that there are large specimens found in Gotland combining the peculiar features of *Labechia* with those of *Cœnostroma*; so, perhaps, there may also be reason to eliminate the latter from the Anthozoa.

Next we have to consider a great variety of other fossils which are generally stated to be Tabulata, but which in reality are Bryozoa. Foremost stands the genus *Monticulipora*. If numerous specimens of the common Silurian *M. petropolitana*, Pand., be closely scrutinized, it will be seen that its semiglobose colony, so closely resembling a *Favosites* in its initial development, has an origin that could hardly be suspected. It begins, indeed, as a Bryozoon, as a *Discoporella*, as what Hall has termed *Ceramopora imbricata* (Pal. N. Y. vol. ii. p. 169, pl. 40 E. figs. 1 *a*–1 *i*). There can be no doubt that this is closely allied to the recent *Discoporella* (see Fr. Smitt, Œfvers. Vet. Akad. Förhand. 1866, p. 476, pl. xi. fig. 4). The basal surface of a *Monticulipora*, when the epitheca is very thin, clearly shows that it is in its first origin a *Ceramopora*. The smallest *Ceramoporæ* which I have hitherto seen consist of a thin circular disk with elevated edges. From the smooth centre of the superior surface four or five wedge-shaped zoœcia radiate outwards, each of a length of $\frac{1}{5}$ millim., their mouths being oblique, with the inferior lip somewhat protracted. On both sides of the mouth there is a short, pointed spine. In its interior such a zoœcium is transversely divided by some irregular tabulæ. The interstitial ribs, which are so characteristic of the Discoporellidæ, are also distinctly seen between the zoœcia of *Ceramopora*. New zoœcia are budded forth in quincunx from the corners of the old zoœcia; and in the periphery of the colony they become more crowded, having the mouth oval and erected. In the interstices is seen what might be taken to be a cœnenchyma; but this in reality is composed of nothing but smaller irregular zoœcia. When the colony has spread out laterally, there are seen at the sides of the first smooth centrum several others regularly distributed on the surface, from which zoœcia radiate, just as if the disk were composed of an aggregation of coalescent initial buds. When the colony has thus gained the expanse of an inch or more, the zoœcia grow vertically upwards; and the colony by-and-by assumes a semiglobular shape, and is converted into a *Monticulipora*. All the zoœcia are then tubular, their mouths quite circular, and armed with a pair of very short spines, their size varying in different cases. The larger zoœcia have around them either an empty space or, as above stated, a cellular tissue, resembling a cœnenchyma, and consisting of smaller circular or polygonal tubes. The walls of the zoœcia are solid, without any perforations, and interiorly quite smooth and destitute of projecting ridges or septa. The tabulæ are very irregular in the large tubes, being oblique or deeply sunk at the walls; in the narrower tubes they are dense and regular. The large zoœcia are clustered in groups at tolerably regular intervals, each group of six or eight members. In Upper-Silurian specimens they very seldom project above the surface, and do not form the strange monticules which are so common on the surface of the Russian Lower-Silurian specimens. I suppose that these clusters are continuations from the original and larger zoœcia, which were budded out round the smooth centra when the colony was in its *Ceramopora* stage. In some there is seen a sort of "reversion," the zoœcia on the surface of *Monticulipora* having again assumed the unmistakable characters of a Bryozoon, becoming oblique, and radiating as in a *Ceramopora*. Longitudinal sections, however, demonstrate that there is a direct continuation from the tubes of the *Monticulipora* into those of the *Ceramopora*, or that the former again have changed into the latter.

A more common and more protean *Monticulipora* is that which Hall described as *Trematopora ostiolata* (Pal. N. Y. vol. ii. p. 152, pl. 40. fig. 5), and which I consider to be identical with *M. papillata*, M'Coy (Edw. & Haime, Brit. Foss. Cor. p. 266, pl. 62. figs. 4, 4 *a*), with *Thecostegites hemisphæricus* (Ferd. Römer, 'Tennessee,' p. 25, pl. ii. figs. 3, 3 *a*), and with *Stictopora malmoënsis*, Kjerulf (Veiviser, p. 21, fig. 29). All these are only different stages of growth of the same species, viz. *Monticulipora ostiolata*, the fully developed form belonging to this genus. The *Discoporella* stage, the initial one, consists of a thin crust covered with small tubular zoœcia, varying in form, with oval or crescentic mouths, or having the sides faintly indented, with a short spine at each indentation. Interstitial ribs are also present. The smallest colony I have seen is 3 millims. in diameter; and, as in the *Discoporellæ* in general, the centre is smooth and concave, without zoœcia, but surrounded by cells radiating in all directions. As this primitive colony always spreads as a thin membrane over the object on which it is fixed, its shape depends on the shape of its basis; and in consequence the polyparium is discoidal, globular, or branching; rarely it is semiglobular, on its own free basis. From this *Discoporella* stage it passes into what may aptly be called the *Fistulipora* stage. The genus *Fistulipora* is, indeed, chiefly made up of Silurian and Devonian Bryozoa. The cells are now elevated, some being angular, the walls being bent inwards in 3–4 (or sometimes only 1–2) folds, which project into the interior as longitudinal ribs having the appearance of septa. It is possible that these longitudinal ribs are connected with the cleavage of the cells into two or more—a mode of increase which is shown by sections to have often occurred, though it is difficult to see why some cells should have grown to such a length without fission taking place. Good information on these points can be gathered from an elaborate paper by Rominger*, who, as early as 1866, stated his opinion that *Chætetes*, *Monticulipora*, and other related forms were referable to the Bryozoa, though he had had no opportunity of observing how they had grown out of *Discoporella* and *Ceramopora*. Each cell is now surrounded by a mass of small, vertical, circular or polygonal tubes, having the appearance of a cœnenchyma. Consequently the surface of the polyzoarium quite resembles that of *Heliolites*, next to which genus *Fistulipora* has also been ranged. At regularly distant points there are smooth patches without any cells. Such patches are in vain looked for in the true Heliolitidæ; and in these there are moreover generally twelve septa, with which the longitudinal ribs of the *Fistulipora*, variable as they are in place and number and often wanting, can in no way be considered homologous. All the cells, as well as the interstitial tubes, are traversed by tabulæ of the same incomplete type as those which characterize *Monticulipora*. Finally, there is a third stage in the growth of this Bryozoon. The interstitial cells now become covered by a thin, smooth, calcareous membrane, resembling that which forms the maculæ, leaving the larger cells (or zooecia proper) open, and giving their orifices a new shape. They become circular or oval, with a much thicker wall than before, and they project high above the surrounding smooth surface. There is now such a dissimilarity to *Fistulipora*, that only the circumstance that both the *Fistulipora* stage and the one just mentioned are seen in the same polyzoarium could convince one that they are really only different stages of growth of the same species. This third stage I have called the *Thecostegites* stage, in consequence of a certain likeness to the genus *Thecostegites*, which caused Ferd. Römer to include this Bryozoon in that genus. This phase of growth more often changes into a *Monticulipora* than does the preceding or *Fistulipora* stage. The *Monticulipora* thus produced is remarkable for its regular "monticules," arranged in quincunx, and formed at the points where seven or eight large cells are clustered, just as in *M. petropolitana*,

* "Observations on *Chætetes* and some related Genera, in regard to their Systematic Position, with an appended Description of some new Species," Proc. Acad. Nat. Sci. Philad. 1866, p. 113.

though not always formed at these points. On the contrary, the bare patches, or "maculæ" of authors (the thin, smooth, calcareous membranes which have completely covered the orifices of several cells), are also sometimes elevated so as to form "monticuli." This is the case, at least, with *M. ostiolata*, and with Russian specimens of *M. petropolitana*, where monticules formed by the large cells are almost wholly covered by a membrane, which forms a macula. Maculæ are seen only where there are monticuli, or groups of large cells. The excellent figures of some Silurian *Monticuliporæ* in the works of Milne-Edwards (see Pol. Foss. des Terr. Pal. pl. xix.) show the same feature. This, however, is not peculiar to the Palæozoic Bryozoa; since J. Haime has described Bryozoa of the genera *Heteropora* and *Neuropora*, from the Jurassic formations of England and France, as not only having "maculæ" hiding the cells beneath them but also monticuli ("mamelons") and tabulæ, just as in *Monticulipora* ("Bryozoaires Foss. de la Form. Jurass.," Mém. Soc. Géol. de France, 2e sér. t. v. part 1, p. 207). The maculæ in question may be identical with the smooth patches which are so prominent in the Cretaceous Bryozoan family Clusidæ; and it may be doubted whether this phenomenon, which was periodical and not constant, is not of the same nature as the calcareous membrane which is so often seen to close the orifices of the cells in recent Bryozoa (e. g. *Retepora intricaria*, Fr. Smitt). It occurs also in single cells of some species of *Chætetes* and *Callopora*, where it is seen in all stages, from a mere commencement round the wall of the zoœcium to its complete form. Rominger regards this covering as an operculum, which it cannot be, the formation of such a cover necessarily proceeding in a way quite opposite to what obtains in the Bryozoa just mentioned. Moreover there seems to be no instance of the genuine opercula of certain Bryozoa having ever been preserved in a fossil state, as these structures are of a corneous nature. It is remarkable that such unquestionable corals as the Favositidæ often have had their calices closed in a somewhat similar way. In these the orifices of single calices are closed by a thin, operculoid, calcareous membrane, formed, as in the Bryozoa, by successive strata, which grow concentrically from the wall towards the centre, where they are often left incomplete and not filled up. There are also species in which several adjoining calices are covered in a similar manner. In the Favositidæ these covering membranes are clearly of an epithecal nature, being a direct continuation of the epitheca, which spreads successively over the calicles, as may be seen nowhere so clearly as in the strange Devonian *Favosites turbinata*, Bill.

(Geol. Russia, i. p. 593), as well as Eichwald (Leth. Ross. i. p. 475), includes under this name the species of both *Monticulipora* and *Chætetes*. Milne-Edwards at first adopted the same course, but finally (Hist. Nat. des Cor. vol. iii. p. 270) separates the species with maculæ (=verrucæ or monticuli) under the name of *Monticulipora*, and retains *Chætetes* for the species with calicles of the same size, thereby approaching *Stenopora*.

?*Cladopora*, Hall (*loc. cit.* p. 137). Embraces species of *Favosites* and *Cœnites*, the latter being probably a Bryozoon.

?*Cœnites*, Eichw. (Zool. Spec. i. p. 179).

Constellaria, Dana (U.S. Expl. Exped. Zooph. p. 537). Possesses star-shaped monticules, and is synonymous with *Stellipora*, Hall. Rominger identifies with it *Hellipora*, Meek & Worthen (*loc. cit.* p. 118). According to D'Orbigny the genus is Bryozoan.

Cyathopora, Dale Owen (Rep. Geol. Iowa, 1844, p. 69). According to De Koninck (Anim. Foss. p. 142) this genus is identical with *Monticulipora*.

Dania, E. & H. (Comptes Rend. t. xxix. p. 261).

Dianulithes, Eichw. (Zool. Spec. i. p. 180). Typical species *D. detritus*, Eichw., = *Monticulipora Panderi*, E. & H.

Fistulipora, M'Coy (Pal. Foss. p. 11). Under this generic name have been included fossils which are partly Heliolitidæ and partly *Monticuliporæ* in what I have called the "*Fistulipora* stage" of growth. One of M'Coy's species, viz. *F. decipiens*, is a *Heliolites* in which the septa are aborted; whilst his *F. minor* seems to belong to a group of Polyzoa often described by American palæontologists, especially from the Devonian formation. It seems doubtful whether these species are really identical with *Trematopora*; and Rominger thinks *Hellipora*, Meek & Worthen, to be really a *Constellaria*.

Limaria, Steininger (Mém. Soc. Géol. de France, i. p. 339). Identical with *Cœnites*, Eichw.

Lunatipora, Winchell (Append. Rep. on Grand-Traverse Region, p. 89). Possesses a branching polyzoary, with tabulæ.

Monticulipora, D'Orb. (Prodr. de Pal. i. p. 25). In his Elém. de Paléont. ii. p. 109, D'Orbigny places this genus amongst the Bryozoa, next to *Acanthopora*, but unites with it species belonging to different genera and from different formations. Synonyms are *Nebulipora*, M'Coy, and *Rhinopora*, Hall. Some authors also consider *Dianulithes*, Eichw., a synonym of this; but the typical species (*D. detritus*) has no monticuli, sparse tabulæ, and the tubes filled up in a peculiar manner, so as to constitute a separate genus.

Myriolithes, Eichw. (Leth. Ross. i. p. 450). Comprises different forms. Referable to *Trematopora* or *Cœnites*, bu not to *Monticulipora* as stated by De Koninck (An. Foss. p. 142).

Nebulipora, M'Coy (Ann. Nat. Hist. 1850, vi. p. 283), = *Monticulipora.*

Orbipora, Eichw. (Leth. Ross. i. p. 484). Comprises discoidal *Monticuliporæ* or *Chætetes.*

Orbitulithes, Eichw. (Zool. Spec. i. p. 180). Identical with *Monticulipora.*

Phænopora, Hall (Pal. N. Y. vol. ii. p. 46).

Pustulipora, Keyserling (in Schrenk's 'Reise in der Norden Russlands,' vol. ii. p. 101). According to Eichwald (Leth. Ross. vol. i. p. 451), identical with his *Myriolithes.*

Rhinopora, Hall (Pal. N. Y. vol. ii. p. 48). Identical with *Monticulipora.*

Stellipora, Hall (Pal. N. Y. vol. i. p. 79). Identical with *Constellaria.*

Stenopora, Lonsd. (in Strzelecki, Phys. Descr. N. S. Wales, p. 262, and Geol. of Russia, vol. i. p. 631). At first called *Tubuliclidia.*

Stomatopora, Bronn (Leth. Geogn. i. p. 54). Comprises young colonies of *Syringopora*, along with the stolons of Bryozoa of various formations.

Tetradium, Dana (Zooph. p. 701). Related to *Chætetes.*

Trematopora, Hall (Pal. N. Y. vol. ii. p. 149). A branching Monticuliporoid, with characters of the "*Fistulipora* stage."

Verticillipora, M'Coy (Carb. Foss. Ireland, p. 194). A dubious *Chætetes.*

It now remains to pass under review the other genera of the old order of the Tabulata. Since the researches of Dana ('Corals and Coral Islands,' p. 76), Kent (Ann. Nat. Hist. 1870, vi. p. 384), and Verrill (Amer. Journ. Sc. & Arts, 1872, p. 187), there can no longer be any doubt that *Favosites* and the closely related *Rœmeria*, *Emmonsia*, *Striatopora*, *Koninckia*, *Pachypora*, n. gen.*, and *Nodulipora*, n. gen.†, belong

* PACHYPORA, nov. gen.

Calyces annuliformes, ad summitates ramulorum, oblique semilunati, septis sparsis, spiniformibus. Strata densissima, tenuissime lamellata calyces circumdant, unde hi in superficie spatio aliquanto inter se distantes, muri canaliculis perforati. Species unica *P. lamellicornis* n. (forsitan = *Millepora ramis vagis, punctis sparsis*, Linn., Cor. Baltica, p. 27, fig. xii.) ramos habet complanatos, quorum complures inter se coalescunt et laminas latas formant; calyces annuliformes vel oblique lunati, hi præsertim septis muniti. Tabulæ rarissimæ vel obscuræ. Occurrit ad Visby.

† NODULIPORA, nov. gen.

Polyparium turbinatum, totum e nodulis minimis contextum, ceterum to the family *Poritinæ* of the Perforate Corals. *Beaumontia*, in so far as it can be separated from *Favosites*, belongs also to this group, and not to the Monticuliporidæ. *Laceripora*, Eichw., again, is nothing more than a highly perforated *Favosites*. *Alveolites*, as represented by M.-Edwards (Hist. Nat. des Cor. vol. iii. p. 263), is an assemblage of most heterogeneous fossils, some having perforate walls, septa, and tabulæ, and others totally void of these parts, their only common character being the non-essential one of having the mouths of the tubes oblique and semilunate. This character, however, is far from being always present. Two very common Upper-Silurian species, viz. *A. Fougti*, E. & H., and *A. Labechei*, E. & H., show themselves to be genuine *Favosites*, being primitively provided with erect polygonal corallites, the tubes ultimately becoming reclined, with oblique mouths, as the corallum grows out in a lamellar form, but the perforated walls and the septa being still retained. Of the other species there are some which, as the Devonian *A. suborbicularis* and its allies, are rather referable to *Cœnites*. *A. repens* and *A. seriatoporoides* are finely branched forms, without septa and with few tabulæ, and cannot with any certainty be numbered amongst the corals as long as their initial stages are unknown. *Michelinia*, again, deviates from the Favositidæ through its more fully developed septa, its cystiphylloid dissepiments (tabulæ), and the root-like prolongations given off from the border of the corallites. The perforations in the walls are homologous with the inner openings of these rootlets, and not with the mural pores of the Perforata *. There are so many points of affinity between *Michelinia* and the *Cystiphylla*, that the genus must be included in the same family as the latter. *Chonostegites*, E. & H., resembles an eroded *Michelinia*.

We next have a clearly circumscribed family formed by some genera which are characterized by having twelve septa, all of the same size, and a peculiar cœnenchyma composed of small tabulate tubes. This family consists of *Heliolites*, *Lyellia*, *Plasmopora*, *Calapœcia*, and probably *Thecostegites*. When a longitudinal section of a *Heliolites* is compared with that

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et forma et septis *Favositarum*. Epitheca tenuis, longitudinaliter rugosa. Superficies calycigera lata, plana. Calyces inæquales, sæpe in radios crescentes, obovati, angusti vel circulares, polygonii et curvi. Muri incompleti, perforati. Noduli corpore rotundo, processibus tenuibus inter se conjuncti. Partes inferiores vel primariæ polyparii materia calcarea consolidatæ. Superficies calycigera processus radiciformes emittit. Species unica *N. acuminata* n. in Dalhem, Gotlandia, reperta.

* *Favosites maximus*, Troost, is a *Michelinia*, and is perhaps the same as the *M. convexa* of Yandell and Shumard.

of a *Halysites*, the great accordance in their intimate structure is very striking. In both there are the large-sized corallites, and between these a more or less dense cœnenchyma of narrow tabulate tubes. This structure (the "Zwischenwände" of Fischer-Benzon, in his paper "Ueber *Halysites*," p. 12) is of a very variable nature both in *Halysites* and in the Heliolitidæ. Longitudinal sections of *Plasmopora* (*Propora*) *tubulata* and *Halysites catenularius* resemble each other most; but there is also a great similarity in the initial stages of growth in both genera. In all the Heliolitidæ, as well as in *Favosites*, *Syringopora*, &c., the earliest stage of growth is that of a small, narrow, conical polypary affixed to some other fossil along its whole length. In *Favosites* and several other corals, new corallites bud out immediately from the inferior lip of the first corallite. In *Heliolites* and *Halysites*, again, there is first formed the cœnenchyma, as an excrescence of the calicular rim, all around it; and out of this cœnenchyma the new corallites are developed. The difference between the further growth in these last-mentioned genera is only that in *Heliolites* the new corallites group themselves around their parent; whilst in *Halysites* they range themselves in a line, each new one at the side of its predecessor. Both genera agree also in having, as a rule, twelve septa, which are subjeet to great variations in size in different corallites, being always of the same size in the same corallite. In some species the septa meet centrally and form a kind of columella, which is elevated and styliform in *Heliolites*—but in other forms is alone present, the septa having almost disappeared. Where the corallites are large the septa are generally small or quite deficient, as in *Heliolites megastoma* and *Halysites catenularius*. In those species, again, which have small corallites, as *Halysites escharoides* and *Heliolites inordinatus*, the septa are proportionally more developed. I, then, consider *Halysites* to be a member of the Heliolitidæ; and it is not improbable that *Thecia*, with its twelve septa and dense tubular cœnenchyma, also belongs to the same family. Amongst recent corals *Pocillopora* most closely resembles the Heliolitidæ.

The genus *Battersbyia* I have not seen; but it has been shown by Duncan (Trans. Roy. Soc. 1867, p. 648) to be one of the Astræidæ.

Columnaria (or *Favistella*, which has the priority) is one of the Cyathophyllidæ, as may be seen by its gemmation.

Fletcheria, represented only by *F. tubifera*, E. & H., seems to be a Cystiphylloid of very variable characters. In the smaller varieties the vesicular endotheca has been converted into tabulæ, and the septa have almost disappeared.

Syringopora, finally, cannot, any more than the preceding, be considered a Tabulate coral. In large specimens there is a perfect accordance with the Rugosa. "Costæ" and septa are present; and the mode of growth agrees with that of the Rugosa. The corallum, as in all other Palæozoic corals, commenees as a small, narrow, conical corallite, which is reclining and attached. From the inferior lip of the calicular orifice there shoot forth two diverging stolons; and the orifice itself simultaneously is directed upwards at right angles, and becomes circular instead of semicircular. The stolons change into new corallites, which in turn send forth stolons, generally two each, and become simultaneously cylindrical and erect tubes. A network of diverging corallites (=*Aulopora*) being thus formed, the growth of the colony is continued chiefly in a vertical direction, and the *Syringopora* proper begins to propagate itself. The ascending tubes continue to emit from their calicine margins the narrow connecting tubes, often to the number of six, which have a horizontal direction and unite adjoining corallites. Some of these, however, turn upwards, without fusion with neighbouring tubes, thus constituting new corallites, from which in turn connecting processes or new tubes are again produced. In fact, the conneeting-tubes and new corallites are morphologically nothing but the stolons, no longer creeping or attached, but suspended freely between the corallites. They have nothing in common with the mural pores of the Favositidæ, which are true lacunæ in the wall, as is characteristic of the Perforata generally. The stolons or connecting-tubes of *Syringopora* are homologous with those expansions of the calicular lip which are so common amongst so many other corals and assume such a variety of shape. Such are the radicular processes which the polype forms during its first growth round its calicle, as in *Omphyma*, where they attain a length of several inches and sustain the coral in an erect position. In those corals, again, which were primitively prostrate and attached to foreign bodies, as in *Pholidophyllum*, *Goniophyllum*, *Rhizophyllum*, and *Cystiphyllum*, the rootlets radiate only from the lip of the attached surface. In others, again, as in several *Cyathophylla*, in *Ptychophyllum*, *Acervularia*, and *Arachnophyllum*, the expansions of the lips of the calicle give rise to those large hooked processes which M.-Edwards called "crampons." In none of the genera just mentioned have I ever observed new corallites budded forth from the crampons or rootlets. This occurs, however, in *Diphyphyllum* (=*Eridophyllum*, E. & H.), in *Lithostrotion*, and in a new genus allied to these. The corallites in this last genus are cornet-shaped, attached, and strongly fluted by pseudo-costæ. As in *Syringopora*, a pair of diverging stolons shoot out from the lip of the affixed surface. These are converted into new corallites, but after attaining a certain size become detached from their parent; so that a compound colony is never produced. In *Lithostrotion*, *e. g.* in *L. irregulare* and *L. harmodites* (in which true connecting-tubes are present), similar expansions may give rise to new corallites. In some (*Lithostrotion cæspitosum*, Mart., De Koninck, An. Foss. 1872, pl. ii. fig. 2) they were very short, and are seen as knobs on the surface of the corallum. In *Diphyphyllum* the large hooked processes are most numerous, and either coalesce with other corallites, or abut on their epitheca without actual fusion. Often new corallites which grow erect, and thus enlarge the corallum, are produced out of these processes (Edw. & Haime, Pol. Foss. des Terr. Pal. pl. x. fig. 4). It is assumed by various authors that such calicular expansions are only prolongations of the epitheca, and that they are formed of this. These rootlets, however, were in many genera clearly formed only when the corallum was young; and hence they are only found round its lower extremity. In others (as *Lithostrotion*, *Diphyphyllum*, and *Syringopora*) they continued to be formed during life. By sections it can be readily shown that the rootlets are in immediate connexion with the interior calicular walls of the coral, and that they themselves are not only covered by the epitheca, but are also provided with endothecal dissepiments. In *Nodulipora acuminata* this outflow (of rootlets) takes its origin from several corallites in common, and has the form of reclined root-like processes, from which corallites are budded forth and form a new colony at the side of the former.

From what I have here stated concerning the internal structure and mode of propagation of *Syringopora*, it seems to me evident that its systematic place should be rather in the vicinity of *Lithostrotion* and *Diphyphyllum* than of the Favositidæ (as proposed by Duncan), or of *Halysites* (as placed by M.-Edwards).

As a summary of the above statements, I append a list of the genera which constitute the order of the Zoantharia Tabulata of M.-Edwards and Haime, with remarks on what I hold to be their natural place in the zoological system :—

Name of Genus.	To be removed to
Millepora.	Hydrozoa?
Heliopora.	*Alcyonaria* (Moseley)
Polytremacis.	*Alcyonaria.*
Heliolites.	*Heliolitidæ* (special family).
Fistulipora.	Some species to *Heliolites*; others to the Bryozoa.

Name of Genus.	To be removed to
Plasmopora.	*Heliolitidæ.*
Propora.	As there is no difference between them except in the size of the septa (a very variable character), this genus should probably be merged with *Plasmopora*, of which many species are known.
Lyellia.	*Heliolitidæ.* (The original specimen in the Musée du Jardin des Plantes resembles an eroded *Heliolites*).
Axopora.	Hydrozoa ?
Battersbyia.	*Astræidæ* (Duncan).
Favosites, *Emmonsia.*	Subfamily *Favositinæ*, of the *Poritinæ.*
Michelinia.	*Cystiphyllidæ.*
Alveolites.	Partly *Favositinæ*; partly Bryozoa.
Rœmeria, *Koninckia.*	*Favositinæ.*
Chætetes, *Monticulipora,* *Dania,* *Stellipora.*	Bryozoa.
Dekayia.	Bryozoa ?
Beaumontia.	*Favositinæ.*
Labechia.	Hydrozoa.
Stylophyllum.	Hydrozoa ?
Halysites.	*Heliolitidæ.*
Syringopora.	Vicinity of *Lithostrotion* and *Diphyphyllum.*
Thecostegites.	*Heliolitidæ.*
Chonostegites.	=*Michelinia.*
Fletcheria.	*Cystiphyllidæ.*
Pocillopora.	*Oculinidæ* (Verrill).
Cœnites.	Bryozoa ?
Seriatopora.	*Oculinidæ* ? (See Dana, 'Corals and Coral Islands,' 1st ed. p. 70.)
Thecia.	*Heliolitidæ* ?
Columnaria.	*Cyathophyllidæ.*

In conclusion, I may attempt a provisional arrangement of the two most important families of the old group of the Tabulata :—

I. Subfamily Favositinæ.

(Family *Poritinæ.* Order *Perforata.*)

Genus 1. *Favosites*, Lam.
2. *Favositipora*, Kent.
3. *Rœmeria*, Edw. & H.
4. *Striatopora*, Hall.

Genus 5. *Pachypora*, Lindstr.
6. *Nodulipora*, Lindstr.
7. *Koninckia*, E. & H.
8. *Beaumontia*, E. & H.

II. Family Heliolitidæ.

Genus 1. *Heliolites*, Dana.
2. *Plasmopora*, E. & H. (inclus. *Propora*).
3. *Lyellia*, E. & H.

Genus 4. *Calapœcia*, Billings.
5. *Thecostegites*, E. & H.
6. *Halysites*, Fischer.
7. *Thecia*, E. & H. (?).

should have almost preferred to use Mr. Wollaston's *Tarphiomimetes* had it not been objectionably polysyllabic.

4. *Tarphiomimetes Lawsoni*, Woll. This species may also be at present classed in the genus *Ulonotus*, though it is aberrant from the sides of the thorax being without notches.

5. *Tarphiomimus indentatus*, Woll. With this *Ectomida lacerata*, Pasc., is specifically identical, as I judge both from the descriptions and from information received from Mr. Pascoe.

6. *Bitoma insularis*, White, which is at present correctly associated with the generic name given to it by White.

I have included in the eighteen species I have described a very interesting insect allied to *Aglycyderes setifer*, West. Though *Aglycyderes* has not yet been referred to the Colydiidæ, it appears to me that this may at present be done with advantage.

Thus the number of species of Colydiidæ at present known to me from New Zealand is twenty-four. This number, though large, will undoubtedly be much increased (more than doubled I have no doubt, and highly probably even quadrupled); and it is pretty certain that, like the Atlantic islands, New Zealand will prove to be very rich in species closely allied to *Tarphius*; the genus *Syncalus*, indeed, here described, is especially close to the European and Atlantic *Tarphius*. I anticipate that some very interesting comparisons will be suggested when the New-Zealand forms of the family are better known, as I hope may soon be the case.

The Colydiidæ form one of the less specialized of the Coleopterous families. Many species appear to feed on the woody tissue of phanerogamic plants, others on dry cryptogamic products, while others, again, are found amongst much-decayed leaves and woody matter in dark woods. Other species, on the contrary, prey on the larvæ of wood-feeding Coleoptera; and these species are often slender, elongate, and subcylindric in form, to enable them to penetrate the burrows formed by their victims. It is probable that New-Zealand species will be found of all these groups.

Ulonotus Brouni, n. sp.

U. oblongus, piceus, supra variegatus, inæqualis (et in elytris tuberculatus), subtus setulis brevissimis tenuissimisque adspersus; prothorace lateribus bis indentatis; antennis, tibiis tarsisque rufoferrugineis, clava, tibiisque in medio nigrescentibus. Long. corp. 4½ m. m.

This species is very closely allied to *Tarphiomimetes viridipictus*, Woll., but is larger, and has the indentations at the sides of the thorax considerably deeper, and the setæ of the under surface much finer. The surface of the thorax and elytra is very similar in the two species (the green nodules of *T. viridipictus* being, I judge, not constant in colour); the surface of the thorax is very uneven, but still without distinct nodules; the elytra bear numerous nodules, which, however, are not very distinct, and their colour is a patchwork of sober green and grey, with a little black intermixed.

Three individuals sent from Tairua by Captain T. Broun.

Ulonotus asper, n. sp.

U. piceo-ferrugineus, marginibus dilutioribus, antennis pedibusque rufis; oblongus, subdepressus; prothoracis lateribus trilobatis, lobis duobus posterioribus angustis, et bene separatis; elytris crebre asperatis, ante apicem tuberculis nonnullis sat elevatis. Long. corp. 3¼ m. m.

Antennæ, including the club, red. Thorax transversely convex, with the surface rough, and showing some indistinct depressions; the front angles acute and prominent; at the sides in the middle is a broad and deep indentation, and in front of the hind angles there is a second rather smaller indentation; the part separating these two indentations is narrow; and the third or posterior lateral lobe is, though very prominent, very narrow. The elytra are pitchy in colour, with the base and the margins pitchy; their surface is very dull, and is densely covered with very rough granules, and a little before the apex there are three or four not very distinct tubercles on each; the lateral margin is finely and densely serrated. The legs are entirely red; and the under surface is nearly destitute of any pubescence or scales.

Tairua; a single individual sent by Captain Broun.

This species in its form resembles *Tarphiomimus indentatus*, Woll.; but it cannot be associated with that species, on account of the minute basal joints of the tarsi. It much resembles a small *Endophlœus spinosulus*; and, as in that species, the surface on its protected parts is covered with a peculiar pale exudation.

Coxelus dubius, n. sp.

C. oblongus, angustulus, parallelus, piceus, antennis pedibusque rufis, supra dense breviterque hispidulus, subvariegatus, subtus breviter griseo-setosus; tibiis extus hispidulis. Long. corp. 2⅓ m. m.

Antennæ short, red, 11-jointed, the basal joint scarcely visible from above; second a good deal larger than the following ones; third small, but distinctly longer than the following joints, the fourth to eighth being small, ninth small but transverse, tenth broad and transverse, eleventh short and not quite so broad as the tenth. Eyes bearing a few short coarse setæ. Thorax about as long as broad, nearly as broad as the elytra, only slightly narrowed behind, and the sides very little curved towards the front angles; the surface a little uneven, bearing short coarse setæ or scale-like hairs; the lateral margins densely fringed with such setæ. Elytra apparently rather coarsely and closely sculptured, but their sculpture rendered indistinct by the dense short setæ with which they are clothed; these setæ are a little variegated in colour; there are no tubercles or depressions. Head with rather long cavities beneath, directed backwards, so as to be parallel along the inner margin of the eyes; sides of the thorax near the front angles slightly depressed, so as to indicate the rudiments of cavities for the protection of the antennæ. Legs red; tibiæ armed externally with fine short setæ.

Sent both from Auckland and Tairua by Mr. Lawson and Captain Broun.

Obs. This species departs somewhat from the European *Coxelus pictus*, by the more elongate antennal cavities and by the slightly concave front part of the surface of the undersides of the thorax; but its general structure seems to be so similar to that of the European species, that I think it would be premature to characterize it at present as a distinct genus.

Coxelus similis, n. sp.

C. oblongus, angustulus, parallelus, piceus, antennis pedibusque rufis, supra dense breviterque hispidulus, vix variegatus; tibiis extus breviter pubescentibus. Long. corp. $2\frac{1}{2}$ m. m.

This species is extremely closely allied to *C. dubius*, and only differs therefrom, so far as I can see, by the following characters:—The antennæ and legs are a little stouter; and the tibiæ, instead of bearing externally coarse setæ such as are seen on the elytra, bear only a few fine hairs; the base of the thorax is less depressed, so that the outline at the junction with the elytra seems less interrupted.

Sent from Auckland by Mr. Lawson.

SYNCALUS (nov. gen. Colydiidarum).

Corpus crassum, convexum, setosum. Antennæ 11-articulatæ, clava triarticulata; retractiles. Prothorax lateribus subtus impressis. Coxæ sat distantes. Tarsi 4-articulati, articulo basali sat elongato, subtus setoso. Facies generis *Tarphii.*

I propose this generic name for two species which have extremely the appearance of *Tarphius*, but differ therefrom by the 3-jointed antennal club and the more elongate basal joint of the tarsi. I have little doubt that these insects have the habits of *Tarphius*, and will require to be sought among the dead leaves and decaying vegetable matter of the New-Zealand woods and forests. The two species before me, though they look extremely like one another at first sight, show on examination structural differences that leave me no doubt that numerous other species will be found in New Zealand. *Enarsus Bakewellii*, Pascoe, is a very interesting allied form; but its appearance indicates very different habits, its tarsi have the second and third joints much more developed, and I believe the trophi will show important differences.

Syncalus optatus, n. sp.

S. oblongo-ovalis, convexus, piceus, antennis pedibusque rufis; setis elongatis, erectis adspersus, et cum pube depressa inæqualiter vestitus; tibiis setosis. Long. corp. $4\frac{1}{2}$ m. m.

Antennæ short, red, with the basal joints pitchy; first joint elongate and exposed; third longer, but much more slender than second; fourth a good deal shorter than third, but longer than fifth; eighth small, but transverse; ninth and tenth abruptly broader; ninth not quite so broad as tenth, both of them strongly transverse; eleventh joint large, about as broad as tenth. Labrum large and exposed; last joint of maxillary palpi elongate and rather slender. Antennal cavities directed straight backwards along the inner margin of the eye. Eyes large, convex, without setæ. Head coarsely sculptured, so as to appear covered with flattened tubercles. Thorax with the sides a little rounded and narrowed towards the front; the anterior angles acute and prominent; the sides behind the middle almost straight, so that the well-marked hind angles are about rectangular; the base on each side much sinuate; its surface is covered with an exudation which conceals the irregularly distributed tubercular sculpture; and it bears some erect setæ. Elytra very convex, without tubercles, sprinkled with numerous long upright setæ, and also bearing some fine, greyish, depressed setæ, which are distributed in irregular patches; the sculpture (which apparently consists of rows of coarse punctures) is concealed by an exudation. Tibia bearing externally a row of long setæ. Tarsi with the basal joint about as long as the two following ones together; the second and third are small; the fourth is slender, and rather longer than the other three together.

A single mutilated individual sent by Mr. Lawson from Auckland.

Syncalus hystrix, n. sp.

S. breviter ovalis, convexus, piceus, antennis pedibusque rufis, setis elongatis erectis adspersus; tibiis sine setis exsertis. Long. corp. $3\frac{1}{2}$ m. m.

At first sight this insect seems to be exactly similar to *S. optatus*, except that it is much shorter in form; on examination, however, some very important differences are seen. The ninth joint of the antennæ is here scarcely more than half as broad as the tenth, the eyes are much smaller, the last joint of the maxillary palpi is broader, and the tibiæ are without erect setæ. I think, if the surface were denuded, it would be seen that the punctures on the elytra of *S. hystrix* are much coarser than in *S. optatus*; for on a denuded spot I perceive one or two very coarse punctures.

A single individual has been sent to me by Captain Broun.

EPISTROPHUS (nov. gen. Colydiidarum).

Corpus transversim convexum, rugosum, prothorace magno, basi ad elytra haud applicata. Caput in thoracem receptum. Antennæ 11-articulatæ, clava biarticulata. Prothorax lateribus subtus valde excavatis. Tarsi subtus setosi, articulo basali quam secundus longiore. Tibiæ extus dense ciliatæ, pro tarsorum receptione subimpressæ. Coxæ posteriores sat distantes. Abdomen breve.

The extraordinary little creature for which I propose this name has, so far as I know, no near described ally; but it displays in some respects an affinity with the *Tarphii*, and it should, I think, be classed in their neighbourhood. The head, by a movement of nutation, is so placed as to be protected by the front of the prosternum (as in the Histeridæ); and the antennæ are then received into the two very large, deep, and abruptly defined excavations of the thorax. The tibiæ are also a good deal modified for the protection of the tarsi; these, when turned back, are applied along the upper face of the tibiæ; and the outer and lower edge of the tibia is very densely ciliated. The excessively coarse and peculiar sculpture is much concealed by a dense exudation, which forms a covering very difficult to remove.

Epistrophus Lawsoni, n. sp.

E. niger, antennis pedibusque rufis, tuberculato-rugosus, setis breviusculis parce adspersus. Long. corp. 2 m. m.

Antennæ with the basal joint stout, and only its extremity visible from above; second joint stout and rather long, cylindric; third joint small, but more elongate than the small following joints; ninth joint small, but yet a little produced inwardly; tenth joint broad, strongly transverse; eleventh nearly as broad as tenth. Parts of the mouth small; maxillary palpi thick but very short. Eyes small, coarsely faceted. Antennal cavities not prolonged on underside of head. Thorax quite as long as broad, greatly narrowed behind, extremely convex transversely, especially in front; so sculptured as to appear covered with strongly elevated tubercles. Elytra narrowed towards the base, so that the shoulders are quite indistinct; sculptured in a similar manner to the thorax. Under surface with deep pits and depressions, the ventral sutures very deep.

A single specimen sent from Auckland by Mr. T. Lawson, in whose honour I have named this little species, one of the most interesting of those he has discovered.

Ithris gracilis, n. sp.

I. subcylindrica, angustula, rufescens, opaca; prothorace minus distincte trisulcato; elytris costatis. Long. corp. vix 3 m. m., lat. $\frac{2}{3}$ m. m.

Antennæ yellowish; first joint in large part exposed from above, second short and stout, third to eighth small, ninth and tenth forming a large broad club, ninth and tenth each strongly transverse, eleventh large. Head with the sides greatly elevated; its surface rather densely but indistinctly punctured, so as to be almost opaque. Thorax longer than broad, the sides straight and parallel, along the middle with a broad but ill-defined groove; and on each side of this central depression there is also another, but very obsolete, depression; the surface is densely and indistinctly sculptured, and is quite dull. Elytra each with three or four longitudinal costæ, and the surface between them densely sculptured, so that they are quite dull. Legs reddish yellow. Under surface dull, but only finely and indistinctly punctured, and with an extremely scanty and fine pubescence. All the pairs of coxæ are only slightly separated; the metasternum is elongate; the epipleuræ are narrow, and not accurately adjusted to the body; the tibiæ are considerably dilated at the extremity, and exhibit small but distinct spurs; the tarsi are slender, with the three basal joints rather short, and differing but little from one another in length; the first ventral segment, though not elongate, is distinctly longer than the second.

Auckland. A single individual, sent by Mr. Lawson.

Obs. This species is an undoubted member of the *Colydiini*; and as it displays pretty much the characters assigned by

Mr. Pascoe to his genus *Ithris*, I have used that word as part of its name. In many respects it approaches *Colydium elongatum* rather closely, and probably, like that species, lives in burrows in wood.

Bothrideres mœstus, n. sp.

B. niger, subopacus, antennis tarsisque rufescentibus; prothorace subquadrato, fortiter punctato; elytris apicem versus costatis. Long. corp. $4\frac{1}{4}$ m. m.

Nearly as large as *B. contractus*. Antennæ dark red; joints 3–9 small, 10 and 11 forming a broad club, the eleventh nearly as broad as the tenth. Head rather coarsely punctured. Thorax quite as long as broad, nearly straight at the sides, these not being rounded in front and only very slightly narrowed behind the middle; the surface is a little uneven, but has no distinct impression, it is rather coarsely punctured, the punctures about the middle being irregularly distributed. Elytra with the alternate interstices narrowed, and a little elevated towards the extremity, and bearing rather fine punctures. Underside rather coarsely punctured. Legs slender.

A single specimen has been sent me from Tairua by Captain Broun.

This species has the intermediate joints of the antennæ more slender and the club broader than in *B. contractus*, the legs more slender, and the thorax differently shaped.

Pycnomerus sophoræ, n. sp.

P. elongatus, parallelus, piceo-niger, subopacus; prothorace dorso impresso, impressione posterius minus distincte divisa; elytris sulcatis, sulcis punctatis, punctis distantibus. Long. corp. $3\frac{1}{4}$–$4\frac{1}{2}$ m. m.

Antennæ distinctly 11-jointed, the eleventh joint a good deal narrower than the tenth. Head very coarsely punctured, with a very deep impression on each side in front, the outer margin of which is continued backwards close to the eye as an elevated fold. Thorax about as long as broad, slightly narrowed behind, coarsely and closely punctured, with a rather large impression on the middle, the posterior part of which is indistinctly divided into two. Elytra bearing deep broad striæ or grooves, at the bottom of which are deep punctures separated from one another by a long, raised interval; the interstices between the striæ are narrow, elevated, and impunctate. Underside closely and very coarsely punctured.

Sent from Tairua by Captain Broun, and indicated as found in the wood of *Sophora tetraptera*.

tennis pedibusque rufis; prothorace inæquali, haud costato; elytris minus distincte costatis, lateribus apiceque fusco-signatis. Long. corp. $3\frac{3}{4}$ m. m.

Antennæ reddish, the ninth joint scarcely larger than the preceding one, the tenth very broad and transverse, eleventh large, nearly as broad as the tenth. Head of a brownish colour, rugose, without distinct impressions. Thorax a good deal narrower than the elytra, not quite so long as broad, nearly straight at the sides, the front angles prominent; the surface bears some irregular elevations, so that it appears to be occupied by large irregular depressions; in sculpture it is similar to the head. Elytra rather depressed, of a testaceous colour, with some ill-defined darker marks near the sides, and a larger and more distinct one just before the apex; each elytron bears three or four costæ, and between these is coarsely sculptured; but the sculpture is made indistinct by some short rigid setæ. Legs reddish; tarsi rather long and slender.

Tairua (Captain Broun).

Obs. Though this species at first sight is extremely similar to *Bitoma insularis*, White, yet it is readily distinguished therefrom by the absence of the distinct costæ of the thorax of that species.

Bitoma distans, n. sp.

B. nigro-fusca, opaca, griseo-setosa, elytris rufo-maculatis, pedibus fusco-rufis; prothorace fere æquali, haud costato, elytris duplo angustiore; his fortiter punctatis, haud costatis. Long. corp. 4 m. m.

Antennæ blackish red, with the two joints of the club black. Thorax rather longer than broad, greatly narrower than the elytra, slightly curved at the sides, the front angles acute but only slightly prominent; the surface very opaque and obsoletely sculptured, without distinct elevations or depressions, but with grey setæ arranged in an irregular manner, so as to give a good deal the appearance of depressions between them. Elytra elongate, less dull than the front parts, of a blackish colour, with numerous large but indistinct reddish marks, punctured with rows of crenate punctures, and with the alternate interstices very indistinctly elevated; the setæ rather long and distinct, though not abundant. Underside blackish, very dull. Legs infuscate red.

Also sent by Captain Broun from Tairua.

Bitoma rugosa, n. sp.

B. fusca, griseo et albido variegata, antennis pedibusque rufescentibus;

prothorace subquadrato, basin versus angustato, elytris fere duplo angustiore, inæquali; elytris rugosis. Long. corp. 2–2½ m. m.

Antennæ reddish; joints 3–9 slender, tenth abruptly larger, strongly transverse; eleventh large, quite as broad as the tenth. Head rather short, rather strongly constricted behind to form the neck, rugose. Thorax small, widest at the front angles, gradually narrowed towards the base, the front angles acute; the surface rugose, and occupied by several ill-defined large impressions. Elytra uneven, their sculpture coarse but indistinct, and their pubescence or setæ variegated, its most conspicuous parts being some small, white, slightly elevated tubercles. Legs reddish; underside nearly black.

Tairua (Captain Broun).

Obs. The facies of this little species is very different from the other species of the genus I know, owing, I think, chiefly to the form of the thorax; but the general points of structure seem to be those of the genus to which I have assigned the species. The European *Xylolœmus fasciculatus* is, I judge, according to Duval, similar in appearance to this species; and though *B. rugosa* does not possess the peculiarly slender basal antennal joints of *Xylolœmus*, yet it is probable that it may be ultimately considered to be as much allied to *Xylolœmus* as to *Bitoma crenata.*

Bitoma nana, n. sp.

B. fusco-testacea, supra testacea, elytris (præsertim in lateribus) fusco-maculatis; prothorace basin versus angustato, lateribus serratis; elytris æqualiter scabrosis. Long. corp. 1¾ m. m.

Antennæ with joints 3–9 small, tenth and eleventh large. Head short, yellowish, quite rough and dull. Thorax much narrower than the elytra, a good deal narrowed towards the base, the sides coarsely serrate, the front angles not acute; it is yellowish in colour, rough and dull, and with very indistinct large impressions. Elytra yellowish, with some indistinct dark marks on the middle, and a large one covering most of the side; their sculpture is very indefinite, but consists apparently of regular rows of coarse punctures, the interstices between which are narrow and interrupted; and they are hispid with short erect setæ. The legs are yellowish, short and stout; the femora somewhat infuscate.

A single specimen, sent from Tairua by Captain Broun.

This minute species in size and form much suggests a *Latridius.* It appears, however, to be closely allied to *B. rugosa*, but is very readily distinguished by the pale colour and the more ragged sides of the thorax.

Philothermus nitidus, n. sp.

P. piceo-castaneus, angustulus, subdepressus, nitidus, fere nudus; prothorace parcius fortiter punctato; elytris punctato-striatis, striis apicem versus obsolescentibus. Long. corp. 2 m. m.

Antennæ about as long as the thorax, yellowish; the basal joint stout, second joint rather slender, but distinctly thicker than the following ones; 3–9 similar to one another in thickness, the ninth being only slightly broader than the eighth; tenth and eleventh joints large, very distinctly separated from one another. Head small, immersed in the thorax up to the convex eyes. Thorax about as long as broad, straight at the sides, which are a little rounded at the front, the hind angles rectangular; the surface bearing rather large but sparing punctures, and with a small and indistinct impression at the base on each side. Elytra with rows of distinct punctures, which become obsolete at the extremity. Legs reddish; front tibiæ rather strongly dilated towards the extremity.

Tairua. A single individual found by Captain Broun.

Obs. This species has exactly the appearance of our European species of *Cerylon*; but the two large and very distinct apical joints of the antennæ induce me to call it a *Philothermus.*

Aglycyderes Wollastoni, n. sp.

A. corpore superne hispido, antennis pedibusque rufescentibus, subtus nigricante; antennis articulis duobus ultimis subclavatis. Long. corp. 2–3 m. m.

Antennæ reddish, short; the two basal joints stouter than the following ones, joints 3–8 small and bead-like, tenth joint subquadrate, both broader and longer than the preceding joints; eleventh joint almost oval, quite as broad and two or three times as long as the tenth. Head very variable in size, abruptly constricted at the neck, the forehead rather convex; it is of a reddish colour and rugose, but hispid, so that the sculpture is concealed. Thorax transversely quadrate, straight at the sides, a little narrower than the elytra, the surface rugose and hispid. Elytra rather elongate and parallel, similar in colour to the head and thorax; their sculpture very coarse but indistinct, and consisting of rows of coarse punctures separated by narrow interstices, hispid, being clothed with both long and short setæ. Underside pitchy black; the metasternum coarsely but sparingly punctured. Legs red, short, hispid.

Several specimens sent from Tairua by Captain Broun; one of them was sent amongst a lot of Coleoptera found on *Cyathea dealbata*, one of the tree ferns.

Obs. The structure of the antennæ, as well as their insertion, seems to justify the location of this insect in the Colydiidæ. The anterior coxæ are very small, and their cavities completely closed behind; and this is the only character, so far as I can see, which would throw any doubt on the propriety of the association mentioned. Mr. Wollaston, in calling attention to the peculiarities of this important genus, has already suggested its affinity with the Colydiidæ. The New-Zealand insect I have here described approaches the *Aglycyderes setifer* closely in appearance; but it differs in the structure of the antennæ, as well as in its remarkably widely separated anterior coxæ. The Colydiidæ as a group is one of the less specialized of the Coleopterous groups; and it is not therefore surprising that we should find some of its members exhibiting wide and puzzling affinities. I am unable to see any close relationship in *Aglycyderes* with Bruchidæ and Anthribidæ; and if the genus be not accepted as an aberrant member of the Colydiidæ, I think there is no other course but to do as Mr. Wollaston has suggested, viz. to regard it as representing a distinct family of Coleoptera.

III.—Eozoon canadense, *according to Hahn.* By J. W. Dawson, LL.D., F.R.S., F.G.S.

We may probably expect, for some time, to find enthusiastic mineralogists suggesting plausible theories to account for *Eozoon* by purely physical causes; for the doctrine of "plastic force" is not yet extinct in this particular case. Hahn's recent memoir is one of these efforts, and is certainly creditable to his ingenuity and boldness, more especially as it is quite at variance with the hypothesis advocated by Messrs. King and Rowney. It is, however, in my judgment, so improbable that, but for the sanction given to it by a translation into the 'Annals,' and for the new statements which it makes as to certain histological facts, it would scarcely merit a serious discussion. Yet it affords an opportunity to notice a number

looked by those who have studied it, have not been brought prominently forward, lest they should confuse the minds of geologists as to essential facts.

Hahn's explanation refers only to the specimens of *Eozoon* mineralized with serpentine, the only specimens which he appears to have studied. It does not apply to those mineralized with calcite, Dolomite, Loganite, or pyroxene, except in so far as the cases of these may be supposed to be covered by the assertion that structures resembling the canal-system of *Eozoon* may be seen in gneissose rocks.

As applied to the ordinary serpentinous specimens, Hahn's theory of their origin may be stated thus:—He agrees with the advocates of the organic nature of *Eozoon* in admitting that the layers of calcite are an original part of the formation. He supposes, however, that the serpentine was originally olivine, which, like serpentine, is a silicate of magnesia, but anhydrous, and differing somewhat in the proportions of its ingredients. The olivine by absorption of water became converted into serpentine, and necessarily swelled to a greater bulk than before*. This expansion caused it to force itself between the layers of limestone and to assume a laminated form. The limestone at the same time became softened and fissured; and its fissures or pores were injected with calcareous matters held in solution or suspension in the water saturating the rock. In this way the laminæ and the canal-system are to be accounted for. The "proper wall" he holds to be merely a film of needles of chrysotile or fibrous serpentine surrounding the grains and plates of that mineral. These views he supports by statements grouped under the three heads of Geological, Mineralogical, and Zoological Facts; but the two former cannot well be separated from each other, and the latter are, from his point of view, of course altogether subordinate. For the sake of clearness, I may arrange his arguments and my criticisms under the following heads.

1. *Preliminary Assumption.*—Hahn informs us that he "started from the proposition that for every part of a rock the presumption is in favour of mere rock-formation." Surely not, when a definite form visible to the naked eye is in question. In the present case it was the resemblance of the masses of *Eozoon* to the familiar *Stromatoporæ* of the Silurian which first directed attention to them. The microscopist has a right to inquire whether in such a case internal structure confirms the indication of external form, but not to proceed from the assumption of mineral origin, even when the microscope fails to reveal structure. Further, when portions only of such a specimen show organic structure, this is always held to afford evidence of organic nature, even though these portions should be small and exceptional.

2. *Geological Relations.*—As to these, Hahn seems to be in some doubt. He asks—"Are they [the serpentine nodules and layers] merely imbedded in the limestone, and therefore formed before it, or were they produced simultaneously?" and he remarks, "This question can be decided only on the spot." It

* The expansion would be about in the ratio of 4 to 3.

is possible that he may not have read the elaborate reports of Sir W. E. Logan and his assistants on the Laurentian rocks, or even the descriptions of the beds containing *Eozoon* given by Logan, Hunt, and myself. In any case, the question shows want of acquaintance with the actual facts as to the inclusion of the masses and fragments of *Eozoon* in regularly bedded limestones which contain also nodules and layers of serpentine. Had these facts been clearly before his mind, he would probably have adopted some other theory of the origin of *Eozoon*, since it seems physically impossible that regularly bedded and laminated limestones can have suffered such changes as he supposes. The bands and nodules and grains of serpentine, whether with or without the structure of *Eozoon*, present no indications of any such expansion as would have resulted from the conversion of olivine into serpentine. This one consideration might indeed close our case with reference to Hahn's hypothesis, were there not some points of interest in his further statements.

3. *Associated Minerals.*—He seems to be unaware of the elaborate series of microscopic examinations to which I subjected the limestones containing *Eozoon*, and many others more or less resembling them, before the specimens were submitted to Dr. Carpenter. These researches were made with the best instruments, with large series of specimens prepared in the best manner by Mr. Weston, of the Geological Survey, and with the experience of twenty years in observations of this kind, and were aided by the unsurpassed chemical skill of Dr. Sterry Hunt. The whole of the results have not, it is true, been published in detail. Yet he cannot have read the published descriptions of *Eozoon*, and the replies to opponents, without perceiving that large series of facts bearing on the texture and microscopical characters of the serpentine, calcite, Dolomite, Loganite, mica, pyroxene, graphite, pyrite, chondrodite, spinel, and other mineral substances associated with *Eozoon* had been accumulated and recorded. Many of these facts, indeed, seem entirely to have escaped his attention. I may instance the occurrence of crystals of mica in the specimens of *Eozoon*, this being by far the most common accidental mineral present. Perhaps he has confounded its crystals with aragonite and olivine. It is to be observed here that mica is one of the most usual minerals developed in altered fossiliferous rocks. I have observed it in connexion with *Halysites* and Crinoids in the schists of the White Mountains, and with similar fossils of Upper Silurian age in the slates of Lake Memphramagog and the New-Canaan district in Nova Scotia. A still more strange omission is that of the Dolomite which

fills large portions of the canal-system, and which in decalcified specimens shows beautifully its characteristic cleavage and lustre in the casts of the canals.

4. *The Origin of Serpentine.*—"Serpentine," he says, "is not an original, but a metamorphic rock." It may be answered that on both geological and chemical grounds Hunt, Delesse, Credner, and Gümbel arrive at a different conclusion, and that in Silurian and other rocks serpentine itself and allied silicates, like glauconite, iollyte, &c., occur as fillings of the cavities of fossils. With regard to the *Eozoon*-serpentine, however, he believes that it is a product of the alteration of olivine. He does not explicitly assert the occurrence of olivine in the Canadian serpentines, but bases his assertion on certain other specimens not Canadian, and on the appearance of fissures and colours akin to those of olivine in some parts of the Canadian specimens. In point of fact, as Dr. Hunt has shown, olivine does occur in some Canadian serpentines of Huronian or Silurian age, but not, so far as ascertained here, in those of the Laurentian system, in which the large proportion of water indicated on analysis shows that this anhydrous silicate cannot be present in any appreciable quantity. Independently of this consideration, as olivine is a mineral having a hardness of 6·5 to 7, or nearly twice that of serpentine, if present in any of the numerous specimens sliced and polished by Mr. Weston and myself, it could scarcely have escaped our observation. In these circumstances I must regard Hahn's determination from polariscope characters as quite uncertain. Besides, I am familiar with the optical characters of olivine, and know that serpentine often very closely resembles it. Further, with reference to the alleged metamorphosis of olivine into serpentine, it must be borne in mind that olivine contains more of magnesia and other bases and less of silica than serpentine, so that the mere addition of water could not suffice to effect this change. As Dr. Hunt suggests to me, the removal of a considerable part of the magnesia would be necessary; and this could scarcely have been effected except by carbon dioxide, which would have acted by preference on the surrounding limestone. Still further, as Scheerer long ago objected, in the case of the Snarum serpentine, the expansion consequent on the conversion of olivine into serpentine would have broken up all the surrounding minerals. In the case of the Canadian serpentine we have not only an absence of disturbance, but the serpentine has actually become shrunken and has had its fissures filled with chrysotile.

But the conclusive facts with reference to the ordinary aqueous origin of serpentine remain to be stated. In those

difficulty in distinguishing these from the limited, tuberculated, and Stromatoporoid chamber-casts of *Eozoon*.

6. *The Canal-system.*—I am not quite certain how Hahn regards this. To accord with his expansion theory, the canals should be mere cracks or fissures; and in one place he describes them as such, though they are in reality cylindrical in form. In another place he speaks of them as produced by the injection of a fluid containing lime in solution into a more dense fluid or semifluid substance. He objects to their being of different dimensions, though this is a necessary result of their ramifying into small branches. In regard to their composition, he seems to state that they are entirely soluble in dilute acid, and speaks of them as originating in crystals of aragonite—though the fact is that large portions of them remain intact in specimens treated with dilute acid, as he must have himself observed. He appears also to suppose that they should show a "tube or envelope"—which is not at all necessary, since, according to the organic theory of *Eozoon*, they were originally merely ramifying perforations in a calcareous skeleton. In point of fact, in the ordinary serpentinous specimens the chambers and chamberlets are in part filled with a flocculent or porous serpentine, white by reflected light and brown by transmitted light; and this fills the larger canals; but the finer branches of these canals are often filled with calcite or Dolomite. This mode of filling, which has been fully illustrated by Dr. Carpenter and myself, does not, however, at all suit the requirements of the olivine and expansion theory.

He has, however, made the observation, for which he deserves some credit, that "a canal-system does not generally extend beyond one crystalline individual." There is an element of truth in this, though it is not strictly correct. The canal-systems are in general related to definite portions or thickenings of the supplemental skeleton. These may often be called in a certain sense crystalline individuals, their cleavage-planes being uniform in direction. But otherwise it is not usual to find the canals ceasing at interruptions of the crystalline structure, except in certain easily explicable cases. It is observable, for instance, that the perfection of the structures and of the crystallization are often in inverse ratio. Thus in portions where the skeleton retains its granular character (regarded apparently by Hahn as a "fluidal structure")* the canals are

* The skeleton of *Eozoon* in its natural state seems to have been finely porous, like that of *Stromatopora*, but on a more minute scale. This gives it a granular structure, often very distinct; and in the Burgess specimens the pores seem to have been filled with Dolomite, which remains as a flocculent mass after the calcite has been removed by dilute

more perfect than where the skeleton is transparent cleavable calcite; and where the cleavage-planes become very distinct the canal-system has apparently in some places been altogether obliterated. Again, when the large trunks of the canals are filled with serpentine, and the finer branches with Dolomite or calcite, the serpentine sometimes ends abruptly, as if cut off. In those beds which contain angular fragments of *Eozoon*, the canals of course end at the limits of such fragments. Cases of these kinds account for this appearance in the instances in which it is observed. But if the canals did happen, without any such peculiar circumstances, to be limited by crystalline forms, this would only be an example of a fact familiar to every one experienced in examining fossils under the microscope. I have now before me a slice of crinoidal Trenton limestone in which the fragments of Crinoids show perfectly their cellular structure; but each fragment is inscribed in a hexagonal or rhombic crystal of transparent calcite, so that the structure may be said in every case to be limited by a crystalline individual. I have another specimen of a crinoid from the altered rocks of the White Mountains, in which each joint has the cleavage proper to a crystalline individual, and the minute structures are preserved only in small spots here and there. I have many specimens of calcified coniferous wood from the Coal Formation in which the whole substance consists of cleavable calcite crystals; and yet in some portions the structures are completely preserved, though in places they end abruptly and mysteriously at the edges or in certain parts of the length of crystalline individuals. I might cite many other illustrations; and such cases are familiar to microscopists.

As to the minute prismatic crystals of carbonate of lime sometimes seen to be imbedded in the calcite of the skeleton of *Eozoon*, and which Hahn regards as aragonite (though they are certainly sometimes seen to be traversed by cleavage-planes like those of calcite), these have no definite relation to the canals, among or beside which they lie j s as any other imbedded minerals would do. They are evidently merely portions of the calcareous matter which for some reason have crystallized differently from the rest; and possibly in some cases proximity to the canals may have been one determining cause of their formation.

7. *The tubulated Proper Wall.*—This Hahn is content to

acid. A practised eye can detect the peculiar granulation of the foraminiferal skeleton even in fragments scattered through inorganic limestone or Dolomite, and when the other structures may not be perceptible.

confound with the veins of chrysotile or fibrous serpentine which traverse the specimens, or with fringes of fibrous crystals at the margins of the grains and plates of serpentine. Yet I can testify that the difference between the cell-wall, when properly preserved, and any vein of crystalline mineral is as great as between the tubulated shell of a Brachiopod or a worm and the prismatic shell of a *Pinna* or *Inoceramus*. Further, under polarized light the chrysotile veins have a brilliancy altogether wanting in the proper wall; and I have shown that the chrysotile is of subsequent origin to the cell-wall, and forms true veins traversing all the structures of the masses of *Eozoon*, and passing through the containing rocks. I am not, however, surprised at this confusion, as I have often had occasion to observe the similarity at first sight of things so unlike as sections of crystals of mica, of veins of satin-spar, and of shells of mollusks, crustaceans, and Nummulites. But the existence of the chrysotile veins themselves or of the supposed fringes of serpentine crystals is almost as inexplicable on Hahn's theory as that of the organic cell-wall itself.

Supposed Prejudices of Zoologists.—Both at the beginning and end of his paper Hahn takes occasion to refer to the prepossessions of zoologists, and their inexperience in examining mineral substances, and even hints at their being likely to mistake the crystals in the pitchstone of Arran for organic forms. He forgets that there are now many observers familiar not only with the structures of all kinds of animal and vegetable fossils, but with mineral substances as well. In the case of the canals and tubuli of *Eozoon*, I may merely mention the several kinds of mineral or organic structures which I have found to be capable of misleading unpractised observers, and all of which have actually been compared carefully with this ancient fossil. They may be arranged under the following heads:—(1) Dendritic crystallizations, as those of oxides of iron and manganese in moss-agates and in calcite &c., of native copper and silver in calcite veinstones, and of mica in certain felspars. (2) Coralloidal and vermicular crystallizations, as those of aragonite, Dolomite, and of vermicular mica. (3) Radiating and fibrous crystallizations, as those of satin-spar, of oolitic grains and other concretions, and of tremolite in limestones, and the very similar structures which are found in the shells of *Inocerami* and other mollusks. (4) Microscopic cracks, such as occur in mineral substances which have been affected with shrinkage, which has permitted their fissures to be filled with different substances of later origin; or minute segregation-veins, such as occur in masses of heterogeneous mineral matter: these fissure-veins are often beautifully developed in serpentine. (5) Crystalline cavities, fluid-cavities, &c., in minerals, which, when carefully studied, show a definite relation to the crystallization, quite different from the canals of *Eozoon*. (6) Fibrous vegetable and animal substances, as the fibres of *Vaucheria* sometimes beautifully preserved in moss-agates, the fibrous structure of sponges and of certain zoophytes. (7) Porous shells and crusts. More especially I have found the shells of *Serpulæ*, of certain Brachiopods, of *Hyolithes*, of Trilobites, and of certain parts of crinoids to present, when injected with mineral substances, appearances very similar to that of *Eozoon* and other Foraminifera. All of these and other mineral and organic structures have actually, in the progress of the researches on *Eozoon*, been under examination; and my own collection contains slices and other preparations of them, accumulated for this special purpose. No doubt, after all this care, mistakes may be made; but I think it right to mention the precautions which have actually been taken, before launching the doctrine of Laurentian life on an incredulous world.

In conclusion, while I must regard Hahn as deserving of some blame for his want of attention to the labours of others, and for the partial and limited way in which he regards the subject, he deserves credit for the minuteness with which he has examined the particular specimens which he has studied; and I trust that when his information as to facts shall have become more complete, his theoretical views will be very much modified.

Postscript.

Since mailing the above communication, I have received the May number of the 'Annals,' containing the second Review with which its correspondents have honoured my little book 'The Dawn of Life.' This review does not, however, induce me to modify any thing I have stated above, nor does it require any detailed reply in the interest of scientific truth, since, though sufficiently rich in personal references, it contains no new facts of any importance to the discussion, and the want of fairness in its treatment of the book will be sufficiently apparent to any one who has the work to refer to. Should my book have the good fortune to go into a second edition, I shall endeavour to give the review such attention as it deserves. In the mean time I am devoting the few hours I can spare for such work to a reexamination of the Palæozoic serpentines and ophiolites of this country, with the view of illustrating the precise conditions under which corals and other familiar fossils occur in these rocks; and the facts thus obtained may perhaps furnish the best answers to what may be called the "pseudomorphic" objections to *Eozoon*.

It may, however, be useful to notice the few points raised in the "Supplementary Note," as these refer to my recent paper in the Journal of the Geological Society. (1) In this, as well as at page 368, your correspondents appear to object to the canals filled with Dolomite as exceptional, though it is not easy to understand the meaning of the statement by which they endeavour to reconcile this Dolomite-filling with their theory of the formation of the canal-system by the "erosion or decretion of portions of serpentine." I may explain that this kind of filling is not at all rare in the specimens from Petite Nation. I have now in my cabinet at least thirty preparations of this kind, decalcified to show the canals, besides others as slices, and many which I have prepared but have not preserved. Of course I could not figure more than a few; but I did not intend to convey the impression that this appearance is very rare at the locality in question. (2) They absurdly, perhaps in jest, claim me as a disciple of their theory of pseudomorphism, because I have described a specimen, the only one I have yet met with, in which the skeleton is in part "replaced" with serpentine; but such replacement is of course no more pseudomorphism than that which occurs when corals, shells, or wood are replaced with quartz or pyrite. (3) As to the "chevron arrangement," I think I have stated clearly enough that this is not in accordance with my observation; and I cited Mr. Weston as one who has prepared and examined more specimens than any other person. Both of us have the impression that the tubuli of the cell-wall are somewhat uniform in length, and the cell-wall itself parallel-sided, except where affected by flexures and microscopic faults. But on this subject your correspondents may, I have no doubt, obtain Mr. Weston's direct testimony, if they desire it. It is no doubt true that decalcified specimens of the cell-wall often have a ragged and imperfect appearance; but this is due to the great difficulty of preserving such delicate fibres intact; and this is a sufficient reason for my preference of very thin slices as the best means of exhibiting this structure. I may add that I think no one who has seen under polarized light such specimens as those figured in plate viii. figs. 1 to 3 of 'The Dawn of Life,' or plate x. fig. 3 of my paper in the Journal of the Geological Society, could for a moment doubt the fundamental difference of the proper wall and chrysotile veins.

May 27, 1876. J. W. D.

IV.—*Descriptions of two new Species of* Ophiocoma. By Edgar A. Smith, F.Z.S., Senior Assistant in the Zoological Department, British Museum.

These two interesting forms of Ophiuridæ were collected by Mr. George Gulliver at the island of Rodriguez, together with *Ophiocoma erinaceus*, Müller and Troschel, and *Ophiomastix venosa*, Peters.

Ophiocoma variegata, n. sp.

Disk circular, finely granulated above and beneath; oral shields rather longer than broad, faintly octangular, sides rectilinear; adoral shields narrow, extending along the lateral margins of the oral shields; mouth-papillæ three on each side of each oral angle, the outermost being the largest and squarish; and above the teeth at the apex of the angle is an irregular cluster of about twelve smaller papillæ; teeth four, strong, with curved ends. Arms about four times as long as the diameter of the disk, rather stout; upper plates transversely narrowly oval, with the outer margin faintly angulated in the middle, about twice as broad as long; lower plates squarish, the aboral angles rounded, the side margins excavated; arm-spines four, subequal, the uppermost a trifle the shortest and stout, and the lowest but one a little the longest, about as long as the width of the dorsal arm-plates (the tenth); ambulacral scales two in number to the extremity of the arms, short and compressed.

Colour (of specimen in alcohol):—disk above and beneath uniformly purplish brown; upper arm-plates dirty brown, at intervals varied with three or four contiguous pale ones, which are marked with the dark outline of a subquadrate figure, particularly observable towards the ends of the arms; lower arm-plates pale, blotched, particularly towards the extremity of the rays, with dirty brown; arm-spines of a uniform tint, but paler than the upper arm-plates; oral shields pale, mottled with dirty brown.

Diameter of disk 28 millims., length of arm 105, diameter of widest dorsal arm-plates 4.

The nearest ally of this species is *O. scolopendrina*, Lamarck, which differs from it in coloration, the form of the arm-shield, oral shields, and the brachial spines. The dark outline which encloses a somewhat quadrate light-coloured space, on the pale superior arm-plates, is very characteristic, as also is the dirty-brownish mottling on the oral shields and lower arm-plates.

Ophiocoma brevispinosa, n. sp.

Disk subcircular, flat above, minutely granulated above and below; oral shields heart-shaped, broader than long; adorals small, crescentiform, bordering the sides of the orals; mouth-papillæ three or four on each side of an oral angle, and a group of about twelve at the apex; teeth four, the two intermediate ones larger than the two exterior. Arms a little more than three times as long as the diameter of the disk; upper plates transversely oval, about twice as broad as long; lower plates (twelfth from the base) a trifle longer than broad; aboral margin arched and a little pointed in the middle, lateral edges rather deeply excavated; oral margins a little convergingly sloping and interrupted by the outer margin of the previous plate; tentacle-scales two, short and compressed: brachial spines short, four (sometimes five on a few plates just beyond the contour of the disk), the two upper ones shorter than the others, broad and flattened; the two inferior ones (of which the second or upper one is a trifle the larger) are slightly conical, and not so long as the width of the broadest dorsal arm-plates.

Colour (of specimen in alcohol):—disk dirty white, mottled irregularly with green above and beneath; arms of the same colour as the disk, with a narrow green line, more or less distinct, down the centre; lower plates, ambulacral scales (and two lower series of spines for the most part) uniformly dirty white, and the two upper series of spines with one or two greenish rings and dots; oral shields spotted with green.

Diameter of disk 17 millims., length of arm about 54.

V.—*The Mammals of Turkestan.* By Dr. N. Severtzoff.

[The results of Dr. Severtzoff's investigations into the vertebrate fauna of Turkestan appeared in 1873 (Proceedings of the Moscow Society of Naturalists, vol. viii. p. 2); but having been written in Russian, they have remained practically unknown to most western zoologists. Mr. H. E. Dresser has recently published an abstract of the ornithological portion, with critical notes and additional information communicated by the author, who visited England last summer ('Ibis,' 1875, pp. 96, 236, &c., 1876, pp. 77 &c.). In the following pages I have translated Dr. Severtzoff's observations on the Mammals, and have added the substance of a few MS. notes of the author from Mr. Dresser's copy of the work. I have to acknowledge

4. *Vesperugo akokomuli*, Temm., var. *almatensis*, Sev.

Is common in the north-eastern portion of Turkestan, viz. about the Semiretchje, the upper part of Narin, Aksay, Copal, and Vernoe. As to its vertical range, it is found at about the same altitude as the foregoing species.

A male specimen, obtained at Vernoe in May 1865, somewhat resembles *V. abramus*, Temm., in the shortness of its muzzle; but the colour, the form of the ears, and all other characters are like those of *V. akokomuli*. The ears are very wide at the base; the belly towards the tail is white, forming a semilunar white patch. It mostly inhabits the houses.

Very remarkable is the distribution of this Japanese form; but the circumstance of the characters of two Japan species being found in one specimen from Vernoe shows that the original race from which the two Japanese forms have their origin is a Central-Asian species.

5. *Plecotus auritus*, var. *brevimanus*.

Found only in the north-eastern portion of Turkestan, and very rare. It has been obtained at an altitude of from 4000 to 8000 feet.

The only specimen obtained by me I met with at the Djanbulak, on the southern side of the Kuraminsk mountain-chain, between Tashkent and Hodgent. It was at first taken by me for a new species, *P. leucophæus*; but this specimen quite agrees with the description of *P. brevimanus*, and, like it, differs from the real *P. auritus* in the shorter ears and lighter colour—characters which, according to Blasius, are not constant. The true *P. auritus* has been found in Turkestan about Vernoe, at a height of about 6000 feet; the real *P. brevimanus* only in Sicily; and specimens intermediate between the two in Sicily and Italy. But still, on these short diagnoses, I do not venture to say for certain that my *P. leucophæus* is identical with *brevimanus* without having a sufficient number of specimens for comparison; but its geographical relationship to the Turkestan *P. auritus* is the same as that of the European *P. brevimanus* to the European *P. auritus*; only no intermediate specimens have yet been met with.

6. *Plecotus leucophæus*, n. sp.

Has been found in the north-western portion of Turkestan, as stated above.

7. *Rhinolophus euryale?*

Is distributed over the whole western half of Turkestan, where it remains all the year round, at an altitude of from 1000 to 4000 feet—that is, on the grassy plains and steppes.

8. *Sorex pulchellus.*

Has been found about the Syr-Darja, in the north-western portion of Turkestan, where it is very rare, and appears to inhabit localities not more than 1000 feet above the level of the sea.

9. *Sorex leucodon.*

This shrew, as well as the foregoing speeies, inhabits the north-western portion of Turkestan, viz. the Syr-Darja, Aris, Callesse, and the neighbourhood of the Aral Sea. It may be seen in the hills all the year round up to an elevation of 4000 feet.

10. *Erinaceus auritus.*

Is common throughout Turkestan, its vertical range being limited to about 4000 feet above the sea.

11. *Ursus leuconyx*, n. sp. (*U. isabellinus?*, Horsfield).

The Himalayan pale-coloured yellowish-brown bear (*U. isabellinus*) described by Mr. Horsfield is known to me from Middendorff's account (Sibirische Reise, iii. pp. 51, 53), who takes it for a light southern variety of *U. arctos*. I cannot state with certainty whether his Himalayan bear is identical with the Thian-Shan specimens procured by me, which are also light-coloured; but the colour of the latter is rather variable, and is certainly not constantly isabelline. Consequently I have established my species on an important and constant character, the white colour of the claws. In structure it resembles *U. arctos*, especially in the skull, in the convex forehead, and the width of the jaws; the head just before the eyes suddenly narrows, and the muzzle is extremely slender compared with the massiveness and width of the temporal region. The snout is shorter than in the other species; but taking into consideration Middendorff's statement about the great variation of the proportions of the skull of *U. arctos*, we cannot fix the cranial characters of *U. leuconyx*, of which I obtained only two complete specimens. The eyes, like those of our bear, are small; the ears are rather larger, of about the same size as the muffle of the animal.

The most striking difference is in the claws, which are white, whilst those of *U. arctos* are black. The claws of the front feet of *U. leuconyx* are long and very little bent, whilst those of *U. arctos* form almost half a circle. The claws of the hind feet of *U. leuconyx* are only half as long as the front claws, and also very little bent. Its fur is wavy, and much longer than that of *U. arctos*, but not so thick; the hair is 3 to 4 inches long, especially in winter at a great altitude. The general colour is reddish brown, the hairs having yellow tips; but the legs are pure reddish brown. The coloration varies. On the high plains about the Upper Narin the fur at the root is tolerably light, and the terminal half of the hairs is whitish, so that the animal often appears dirty white with light brown legs. In the forests about Vernoe, at a height of about 3000 to 6000 feet, three fourths of the hair is reddish brown, the ends yellowish, and the general colour is reddish brown, shaded with yellow. In Karatau the bear lives at low altitudes of 2000 to 3000 feet, in small woods which afford very little shade; and in this warm climate its colour is very pale, not whitish, but yellowish, and the ends of the hair are hardly lighter than the roots. The young have a white collar like *U. arctos*.

The habits are different. About Vernoe, from the time when the Cossacks commenced to keep bees, the bear very intelligently empties the beehives. In the western spurs of the Thian-Shan mountains, and in the fertile country about Chirchick, it principally feeds on fruits, such as apples, grapes, walnuts, &c.; and, finally, at the Narin it preys principally on the marmots, and for that purpose ascends to the high table-lauds considerably above the limit of the forests. I met with it in such localities during the month of October, even at an altitude of 11000 feet, when the marmots are in their winter sleep and do not come out of their holes. Then the bear digs them out, and kills in their colonies more than he is able to eat. Those he cannot eat at the time he buries again, after having first bitten through their nape. Such marmots my huntsmen found buried and quite fresh at a place where they afterwards killed a bear. This was a full-grown female 4 feet $5\frac{1}{2}$ inches long, height at the shoulders 2 feet 7 lines, consequently much smaller than *U. arctos*, but proportionally higher on the legs.

The real habitat of these light-coloured bears is in the thickets, at a height of from 8000 to 10500 feet, and in the fir-forests up to 9500 feet, whence they make their hunting-trips to the high steppes.

12. *Meles taxus.*

Is a common resident throughout Turkestan, except in the highest mountains. I have never found it beyond an elevation of from 7000 to 8000 feet.

13. *Fœtorius putorius*, var. *Eversmanni.*

Is common throughout Turkestan, with the exception of the south-western district, where it does not occur at all. It hardly ever goes beyond 3000 to 4000 feet in the hills, keeping more to the lower localities.

14. *Fœtorius alpinus.*

I met with it about the Upper Narin, at an elevation of about 9000 feet.

15. *Fœtorius ermineus.*

Is a common resident, and is found throughout Turkestan; I have not observed it, however, in the south-western portion. It occurs at high altitudes, even at the summits of some of the highest mountain-chains.

16. *Fœtorius gale.*

Inhabits the Karatau and Thian-Shan mountains and the neighbourhood of the Syr-Darja.

17. *Mustela foina.*

Is a resident throughout Turkestan, and inhabits the hills at a height of from 4000 to 8000 feet above the sea all the year round, but in winter some individuals descend even lower.

18. *Mustela intermedia*, n. sp.

Inhabits the eastern portion of Turkestan, viz. the basin of the rivers Chu, Tallas, Narin, &c. It does not ascend high in the mountains, only up to about 9000 feet, and has never been seen by me below 4000 feet above the sea. It probably occurs also in the north-western part of Turkestan, which, however, I cannot state with certainty. (See below.)

19. *Mustela martes.*

Is found exactly in the same localities as the foregoing species, except the south-eastern parts of Turkestan, where its occurrence is rather doubtful.

Mustela intermedia, M. foina, M. martes.

In the great quantities of pelts of martens, obtained by the Kirgies in the Thian-Shan and sold at the Turkestan fairs, are found those of both *M. martes* and *M. foina*, with their characteristic light-coloured mark on the throat like an inverted V. This mark is quite regular and of a *reddish yellow* colour in *M. martes*, and does not reach quite to the fore legs; in *M. foina* the similarly shaped but more irregular spot, of a *white* colour, reaches quite to the fore legs. On the great majority of the skins for sale these characters are plainly marked.

On the other hand, there are very many specimens which present intermediate characters—sometimes as regards shape, sometimes in interruption of the branches or in the colour of the spot on the throat, which even on the most yellow-throated specimens is lighter than on the European race of *M. martes*. Between these light-reddish-yellow and pure white-coloured throat-spots, the Turkestan specimens present the most complete series of intermediate degrees. I at the same time noticed that the rarest of all is the pure white-throated race, as also the very dark yellow colour; but usually they have light-yellow or yellowish white throats, the shape of which inclines more towards *M. foina* than *M. martes*, particularly in skins sold at the western fairs about Tashkent and Chimkent.

The general colour of these two species in Europe is different. *M. martes* is of a dark reddish brown, and the under-fur is light brown; while *M. foina* is blackish brown, and the under-fur is greyish white, so that the whole coloration is greyer. In Turkestan there is no such difference in the colour; the under-fur is always light ash-colour: the long hair is sometimes blacker and sometimes more reddish brown; but both colours occur with either light or dark-coloured throat-spots; and their difference might originate from the fading of long-kept skins.

Therefore *M. martes* and *M. foina* in the Thian-Shan mountains are much less distinct than in Europe. As to proportions, I only can state that in the Turkestan species the tail is almost twice as long as the hind legs, just as it is in the two European species. But these intermediate specimens I have called in my catalogue *M. intermedia*; and another specimen was shown to me by a Tartar, who spoke Russian, under the name of the "Cashgar sable." Two of these animals, in summer and winter dress, obtained by me later on, certainly come nearer to the sable in the quality of the fur and the short tail. Its long hairs are much finer and closer-set than those of the Turkestan or European specimens, and in winter the hairs are longer. Their colour is bright brownish black; the under-fur is hardly to be seen, being nearly altogether covered by the long hair, and is light grey with smoke-coloured ends, a little darker than in the other two species of marten. The spot on the throat is variable: usually it consists of several pale yellow or yellowish white spots placed in the form of a triangle, of which one angle points towards the mouth; these spots often reach to the fore legs. Sometimes there are even two lines formed by spots, which are even more irregular than in *M. foina*, in which the *M. intermedia* approaches the sable. The tail is longer by about one fourth than the stretched hind legs, and is a little shorter than one half of the whole body, the neck and head included—for instance, 18 inches from the tip of the nose to the root of the tail, 6 inches from the root of the tail to the claws of the hind legs, 8 inches length of the tail. If the marten is 18 inches long, the tail measures 10 inches; in a sable of the same size the tail measures only 6 inches.

In summer *M. intermedia* has the long hair of a blackish brown colour, a little shorter and duller than in winter; the under-fur is shorter and coarser, and of a darker brownish grey colour.

The price of marten-skins in Tashkent ranges from 3 to 5 roubles, according to their quality aud the number of skins brought for sale by the Kirgies. Those of *M. intermedia*, or "Cashgar sable," fetch twice as much, say up to 10 roubles. The Kirgies sell them wholesale at a uniform price; but they are sorted afterwards before resale by the Tashkent dealers. The trapping is carried on during the autumn and winter.

The martens which approach to *M. martes* live in the fir-woods of the Semiretchje and Saeleysky Alatan and about Issik-kul; those which resemble *M. foina* inhabit all the Thian-Shan mountains (at Merke they descend in winter into the steppes and plains in pursuit of mice and birds); and, finally, *M. intermedia* inhabits the fir-woods at extremely high elevations, as well as the bilberry-bushes, and even beyond the limit of the tree-growth. Altogether *M. intermedia* keeps in the central and highest parts of the Thian-Shan mountain-chains, at both sides of the Narin river.

All this information was given to me by the Kirgies, to whom I showed the different marten-skins, asking them where they had met with them. Some of the Kirgies consider them to be one species, but always distinguish them by the localities they inhabit.

For the definite determination of the Turkestan martens skeletons are wanted; for *M. martes* and *M. foina* differ in their dentition and palatal ridges, and *M. zibellina* differs from both by the number of the caudal vertebræ. Judging only from the skins, it appears probable to me that *M. foina*, *M. martes*, and *M. zibellina* have one origin, and that the Thian-Shan is the native place of all the three, where, up to the present, as it appears, they have not fully differentiated and obtained specific independence. This may be caused by the want of large woods on the mountains, where even the fir and birch trees grow only in small groves or even singly.

20. *Lutra vulgaris.*

Is to be met with all the year round in Turkestan, except the Zarevshan steppes and mountains and the vicinity of the river Syr-Darja. It does not go up in the mountains very high, never having been met with by me above the cultivated district of about 4000 feet altitude.

21. *Canis lupus.*

Inhabits all Turkestan, and is met with at almost every altitude in the mountains, except in winter, when they leave the summits of the highest mountains.

22. *Canis alpinus.*

I have met with this species in the vicinity of Kopal and Vernoe, but not lower than 5000 feet altitude.

23. *Canis familiaris.*

Extremely common throughout Turkestan in summer; but in winter they leave the highest parts of the mountains.

24. *Canis vulpes.*

If any thing, it is even commoner than the preceding species, as even in winter it was met with in the highest-situated localities.

25. *Canis melanotis.*

Is found all over Turkestan, except the south-western districts comprising the Hodgent valley, the entire Zarevshan valley, and the Syr-Darja steppes. It is not found higher than about 7000 feet above the sea.

33. *Felis catus domestica.*

Throughout Turkestan; but does not occur above the apple and ash-grove district.

34. *Arctomys baibacinus.*

I found this species in the highest mountains of the east; below 4000 feet altitude they did not come under my observation *.

35. *Arctomys caudatus.*

Up to the present time I have found this species only in one locality, viz. in the Carahurinsk rocks, south of the Aulje-ata, in the mountain-chains between Tallas and Chirchik. The only specimen preserved has been lost; but I remember that it was yellow, with fine black longer hair, the head was darker and blackish; the colour and shape (except the tail) were generally like those of *A. baïbak*. In my notes, however, I have the measurements of a young specimen obtained by me: its length from the tip of the nose to the root of the tail was 14 inches 2 lines, tail 8 inches 5 lines. This long tail affords a good specific character for *A. caudatus*.

At the place where this specimen was killed there were about twenty holes in the ground, proving that this species, like the other marmots, lives gregariously.

Jacquemont, who discovered this species, also found it only in one high-situated plain of the Himalayas, a little east of Cashmir, on the road to Ladak.

These two localities show that *A. caudatus* inhabits the south-western Thian-Shan and the north-western Himalayas, and probably also all the space between the two mountain-chains where they are interrupted; but the occurrence in the above two localities might also be sporadic, being the two outer limits, and the space between them unknown.

Darja (not Dyanau), a branch of the lower Syr, now dry, but at that time flowing. All my specimens I gave to the Academy of Sciences in St. Petersburg, and this also. I do not know how it came into the British Museum.

[The true *F. servalina* is a West-African species. *Cf.* Sclater, Proc. Zool. Soc. 1874, p. 495, pl. lxiii.—E. R. A.]

* [Dr. Severtzoff subsequently suggested that these specimens might belong rather to Milne-Edwards's *A. robustus*, which Mr. Blanford identifies with *A. himalayanus* of Hodgson. *Cf.* Journ. Asiat. Soc. Beng. xliv. p. 126.—E. R. A.]

36. *Spermophilus fulvens.*

Has been met with by me in the low plains of western Thian-Shan and Karatau, not above 4000 feet altitude.

37. *Spermophilus leptodactylus.*

Is a resident in the low-situated localities of Western Turkestan.

38. *Spermophilus brevicauda*, Brandt (*mugosaricus*?, Licht.).

Inhabits all the low-lying parts of Turkestan, except the south-western district, comprising the whole Zarevshan valley and Hodgent district, where I have not met with it.

39. *Spermophilus* sp.? (*brevicauda*?).

The note of interrogation is placed here on account of my having lost the specimens obtained at Karabur, and not being able to compare them with typical *S. brevicauda*; but the latter I know well from specimens of my own collecting in the Kirgies steppes of the lower Ural, and from the careful examination of one hundred and fifty specimens obtained by Carelin in the latter locality. At first sight I referred the Karabur specimens to *S. brevicauda*, on account of the small size (7–8 inches exclusive of the tail), the short tail, and the grey colour, with indistinct, almost insignificant pied markings, caused by the blackish and pale yellow rings round each hair. I was rendered doubtful of the correctness of this determination only by the fact that *S. brevicauda* is an inhabitant of low plains, and no specimens of this genus have been found in the cultivated altitude of the Karabur; but these steppes are not well known yet. But then there is the analogical fact that *S. musicus* has been found high up in the Caucasus and in the New-Russian steppes.

I may mention here that I did not find any great difference between *S. musicus* and *S. brevicauda*. The former is described as quite grey, and the latter as greyish pied, with each hair of two colours, and a yellow belly; but the roots of the belly-hair of *S. brevicauda* are yellow, their ends are sometimes yellowish brown and sometimes whitish. The pied appearance of the back is sometimes very plain and sometimes quite insignificant; and the shades of these characters on Ural specimens are innumerable; no two are alike. On the other hand, *S. musicus* is unicolorous only in comparison with *S. guttatus*, which inhabits just the same New-Russian steppes, the hair of the former being closely marked with rings; the mottled appearance is not so easily noticed; but the width and number of these rings on the hair of *S. brevicauda* is also variable.

Therefore it would be useful to make more exact comparisons between *S. mugosaricus*, *S. brevicauda*, and *S. musicus*, the ranges of which meet on the Lower Volga and Don; and *perhaps* they may prove to form only one species. Here it also must be stated that the first description of *S. mugosaricus* was taken by Lichtenstein from a specimen from the Kirgies *steppes*; whilst the first description of *S. musicus* was made by Ménétriés from a *mountain* specimen from the Caucasus. The Karabur specimens were obtained at an altitude of from 7000 to 9500 feet, on the grass-covered plains of the summits of the Karabur Mountains.

40. *Arvicola arvalis.*

Inhabits the north-eastern portion of Turkestan, and does not appear to go beyond an altitude of about 6000 feet.

41. *Arvicola leucura*, sp. n.*

Is found in the north-western parts of Turkestan. It goes exactly as high as the preceding species, but has not been observed below 1000 feet altitude.

The fur is soft like that of *Cricetus*, light brownish grey, on the belly white; the base of the hair on the whole body is plumbeous. The ears project beyond the fur. The tail is one fourth as long as the body, and is snowy white, with a black tip of rather longer hair. The first lower molar tooth has nine prisms, like that of *Arvicola*.

The most striking specific characters are in the white tail and soft hair; and the species may thus be diagnosed:—

Arvicola cauda nivea subpenicillata, apice obscuriore, vellere molli cinerascente, infra albo, auriculis e vellere prominentis.

I obtained only one specimen, on the Upper Massat in the lower mountains of the Thian, between Aulje-ata and Chimkent, in December 1866.

42. *Arvicola gregalis.*

Has been observed in the same localities as the preceding species. I myself met with it in the Karatau at the upper

* [Should this prove to be a good species it will require a new name, *A. leucurus* having been used by Gerbe (Rev. Zool. 1852, p. 260) for a European vole which Blasius and Fatio consider to be identical with *A. nivalis* of Martius.—E. R. A.]

Bugun, where it is abundant. My specimens, four in number, differ from Siberian examples in the darker and more yellowish colour (*supra cano-fulvescens pilis permultis nigris obumbrata*); but the first molar tooth consists of only eight prisms, which is a good character of *A. gregalis*, as all the other *Arvicolæ* have nine. The size, length of tail, ears, and all other characters are similar to those of the Siberian specimens.

43. *Mus Wagneri.*

Is an extremely common resident throughout Turkestan, and is to be found in the hills up to 4000 feet high (*i. e.* in the cultivated districts and on the grassy steppes).

44. *Mus Wagneri*, var. *major* (*M. tokmak*?, n. sp.?).*

From the typical form this race differs only in its larger size, in which it approaches *M. sylvaticus*, which has also some resemblance to the small *M. Wagneri*. I am sorry to say, however, that the large as well as the small specimens which I preserved in spirits were left at Tashkent.

I will mention here that this mouse is a steppe-inhabitant in the Ural, as well as on the Kirgies steppes; but in Turkestan, where *M. musculus* is absent, *M. Wagneri* is the house-mouse. It is numerous in the Chimkent and Tashkent houses, where it does not differ at all from the Kirgies-steppe specimens. The large variety I have obtained in a house in a village built in 1864.

This domestic breed of *M. Wagneri* get soon used to men if they are not disturbed; they are easily startled, but not shy or wild, and extremely inquisitive. In my room in Tashkent one of these mice lived, which used to creep up on my table when I was writing. It fed in my presence on the remains of my dinner or supper; often sat even on my books, watching my hand when writing. It would even eat from my hands; but as soon as I moved it tried to hide itself between the books on the table, and after a very short time appeared again at the old place. It appeared to be quite tame; so that once I caught it with my hands in order to feed it; it got, however, frightened, and never appeared again, notwithstanding my leaving out food for it; it had evidently lost its confidence in me.

* [Mr. Blanford has since described "the common house-mouse of Eastern Turkestan" as a new species, under the name of *M. pachycercus*; he regards it as most nearly allied to *M. bachtrianus*: Journ. Asiat. Soc. Beng. xliv. p. 108.—E. R. A.]

45. *Cricetus songarus.*

Has been observed almost all over Turkestan, except in the Zarevshan districts and the neighbourhood of Hodgent; it is more an inhabitant of the lower altitudes, to which it appears to keep the whole year round.

46. *Cricetus Eversmanni.*

Has been obtained about Issik-kul in the larch-wood and apple-tree district.

47. *Cricetus accedula* (sec. Eversm., e coll. Karel.).

Occurred at the same place as the preceding species, but on a lower-situated plain.

I do not describe here the well-known *Criceti* of Turkestan (*C. songarus, C. Eversmanni, C. accedula*)*, but will mention a new species discovered, although it does not belong to Turkestan.

[*Cricetus murinus*, sp. n.

Belongs to the genus *Cricetus*, as proved by its cheek-pouches (*sacci buccales*), but does not at all resemble the hamster in outward appearance. The form resembles that of the mice; the body is tolerably slender; the tail measures half of the length of the body, the head included; the colour and size are like those of *Arvicola arvalis*, viz.:—length from the tip of the nose to the root of the tail about $3\frac{1}{2}$ inches; tail $1\frac{1}{2}$ inch, or a little longer; the colour above is greyish dark brown, below ash-colour. Only two specimens are known to me:—the one which I caught in August 1857 on the steppe grass of the summit of Ori, and presented to the Museum of the Academy of Moscow; and the second is in M. Gluch's collection at Sarepta, near which place it was obtained: both specimens are preserved in spirits. The latter was marked *Arvicola arvalis*; and I had my attention drawn to it by the long ears, which are half as long as the head, whilst the ears of the true *Arvicola arvalis* are much shorter and almost hidden by the fur. Then I looked for the cheek-pouches, which I found.

On account of its resemblance to *Arvicola arvalis*, this little beast is easily overlooked. The collector ought to look out for the combination of murine ears with the form and colour of *A. arvalis*; and in such specimens the cheek-pouches

* [*C. fulvus*, a new species allied to *C. phæus*, is described by Mr. Blanford from Eastern Turkestan, Journ. Asiat. Soc. Beng. xliv. p. 108. —E. R. A.]

must be sought for. I will also add that *C. murinus* is somewhat darker than *A. arvalis*. As regards the geographical distribution of this hamster, only the two above-mentioned localities are known, as I have not since then met with any others.

In the spring of 1864 I met with many *A. arvalis* on the Irtish and Ishim. I examined them in search of cheek-pouches; but there were no *C. murinus* among them.]

48. *Meriones tamaricinus.*

Has been met with by me about the Lower Syr-Darja and Lake Aral in the low plains, where it is a resident.

49. *Meriones meridianus.*

Range similar to that of the preceding species.

50. *Meriones opimus.*

A very common resident throughout Turkestan, except the south-western parts. It keeps, however, always at low elevations.

51. *Meriones (Rhombomys) collium*, n. sp.

Is an intermediate form between *M. opimus* and *M. tamaricinus*, having the size and coloration of the latter and the tail-tuft of the former; but it is differently coloured from either, and somewhat smaller. Here I give the comparative diagnoses:—

M. collium. Supra rufescens, nigro irroratus, apicibus pilium nigris, subtus albus; cauda corpori concolor, floccosa, bicolor, pilis rufescentibus et nigris intermixtis; fiocco etiam bicolori, fuliginoso et canescente; dentes incisores supra unisulcati.

M. opimus. Supra pallide et sordide fulvescens, fuliginoso irroratus; cauda præter floccum nigrum unicolor, intensius fulva; dentes incisores bisulcati.

(*M. lybicus*). Ut *M. opimus*, sed incisoribus unisulcatis.

M. tamaricinus. Ut *M. collium*, sed flocco caudæ perparvo, pæne distincto, cauda unicolori fuliginosa.

M. collium has the black tail-tuft surrounded by a pale grey margin; the hair of the latter is just as long as the black-tuft hair. Length about 7–8 inches, tail 6½–7 inches. Obtained on the lower spurs of the Semirechinsk-Alatan, between Koksa and Iley, and also on the Karatau Mountains. In the latter locality I obtained in June 1867 a young specimen, which differs from the adult only by its smaller size and the proportionally smaller tail-tuft.

M. opimus, which has been collected in great numbers on the Iley, near Hodgent, and lower down at the Syr-Darja, has sometimes a sharply marked black line running from the tail-tuft along the upperside of the tail almost to its root; this line, however, is very variable in its length.

According to the characters and distribution it appears to me that *M. collium* is the general origin of the steppe gerbilles (*M. tamaricinus* and *M. opimus*), which inhabit the bottom of what, geologically speaking, was at no distant period a lake; as well as of *M. lybicus*, which, in its dentition, comes closer to *M. collium* than is *M. opimus*, and perhaps has been driven out by the latter to the south-west.

But up to the present time the limits of the ranges of *M. opimus* and *M. lybicus* are unknown; they probably meet in the deserts of Persia or Syria *.

52. *Dipus jaculus.*

Has been found by me almost all over Turkestan, being not rare in the eastern parts and very common in the north-western districts, where it appears to be a resident at an altitude of from 1000 to 4000 feet above the sea, *i. e.* in the cultivated districts.

53. *Dipus acontion.*

54. *Dipus sagitta*, var. *telum.*

55. *Dipus lagopus.*

56. *Dipus platyurus.*

These four species have been observed in the low plains at the mouth of the Syr-Darja, at the sources of the Aris, and about Lake Aral as residents.

57. *Ellobius talpinus*, var. *rufescens.*

Has been met with by me throughout the east and north of

* [In his list Dr. Severtzoff originally named this species *Meriones montanus*; but having discovered that this name was preoccupied by Sir Andrew Smith for a South-African species, he renamed it (at p. 83) *Meriones collium*.—F. C. C.]

[Mr. Blanford describes an interesting new species from Eastern Turkestan, which he names *Gerbillus cryptorhinus*, from the remarkable semicircular flap which covers the nostrils (Journ. Asiat. Soc. Beng. xliv. p. 108).—E. R. A.]

and deeper punctures by which they are divided. The squamosity is chiefly confined to the sides, is of a yellowish or whitish colour, and is apparently very liable to fall off. It is found under bark on the Ngalho tree (*Myoporum lætum*).

Lagrioda Brounii.

L. anguste oblonga, pallide fulvescens, elytris aliquando plus minusve infuscatis, sparse griseo-pubescens, supra sat dense punctata; antennarum articulis tribus ultimis crassioribus; prothorace antice paulo rotundato, postice angustiore; elytris oblongo-ovatis, humeris rotundatis; abdomine infra nigrescente. Long. $2\frac{1}{2}$ lin.

Hab. Tairua.

I see nothing to differentiate generically this interesting species from the Chilian *Lagrioda* (Fairm. et Germ., Ann. Soc. Ent. de Fr. 1863, p. 234). It is very like *L. obscurella*, which is probably only a variety of *L. rufula*, and is found on a *Mesembryanthemum*. Capt. Broun took five specimens of the present species under logs on the sea-beach at Tairua.

THELYPHASSA.

Oculi integri. *Palpi* maxillares in mare elongati, articulo ultimo apice profunde emarginato; in fœmina breviores, articulo ultimo securiformi. *Tibiæ* omnes bicalcaratæ. Cætera ut in *Xanthochroa.*

Xanthochroa is principally a European genus, from which the present differs structurally only in the above characters. The male has the same deeply incised terminal abdominal segment; but there is no trace of it in the female. The elytra do not cover the extremity of the abdomen, even in the male. The peculiarly shaped maxillary palpi have just the same semicircular notch that is found in *Selenopalpus.* The species is remarkable for the delicacy of its texture. It was found under logs thrown up on the beach just above high-water mark. Capt. Broun says it makes great use of its palpi, as well as of its antennæ, in confinement. Of the two pairs which that gentleman has kindly sent me, the females are the largest, but with somewhat shorter antennæ than the males.

Thelyphassa diaphana.

T. oblonga, subparallela, depressa, flavo-albescens; oculis nigris; supra capite prothoraceque subtiliter punctatis; antennis dimidio corporis longioribus; scutello parvo; elytris subtilissime punctatis et pubescentibus, singulis lineis tribus pallidioribus notatis, pedibus gracilibus, pallidis. Long. 6–7 lin.

Hab. Tairua.

Trachyphlœus porculus.

T. obovatus, niger, squamis albidis depressis dense vestitus, setulisque tenuibus erectis seriatim adspersus; rostro crasso, scrobibus cavernosis, ad oculos haud extensis; antennis ferrugineis, clava infuscata; prothorace versus apicem haud constricto; elytris breviusculis, substriatis; tibiis anticis bicalcaratis. Long. $1\frac{1}{4}$ lin.

Hab. Otago.

Allied to our *T. squamulatus*, from which its cavernous scrobes and slender setulæ will at once distinguish it.

Brexius ascitus.

B. angustus, vix depressus, piceo-brunneus, squamis obscure griseis tectus; rostro supra lineis quinque elevatis distinctis, quarum intermedia majore, instructo; antennis ferrugineis, clava pubescente; prothorace longitudine latitudini æquali, in medio nonnihil carinato; scutello parvo; elytris striatis, leviter punctatis, interstitiis convexis, quinto versus apicem tuberculato-elevato; tibiis anticis intus denticulatis. Long. $2\frac{3}{4}$ lin.

Hab. Waikato.

A much narrower form than the Victorian *B. murinus*, to which it is the most nearly allied.

Phrynixus astutus.

P. ovatus, fuscus, supra squamositate dilutiore vestitus; rostro tenuiore, basi ante oculos tuberculo instructo; prothorace longiore quam latiore, dorso tuberculato; elytris breviusculis, utrinque rotundatis, supra tuberculatis, angulis anticis minus productis; tarsis minus elongatis. Long. $1\frac{3}{4}$ lin.

Hab. Tairua.

This species differs from *P. terreus* (*antè*, vol. xvi. p. 221), *inter alia*, in the tubercle on the rostrum, the narrower and longer prothorax, the shorter and rounded elytra, &c. There are only very shallow impressions on the elytra indicating any punctuation.

EMPÆOTES.

Inophlœo proximus, sed scrobibus ad oculos profunde impressis. *Rostrum* robustum. *Antennæ* graciles. *Prothorax* basi truncatus; lobis ocularibus obsoletis.

In *Inophlœus* the scrobes are well marked only at the point where the antennæ are inserted, rapidly disappearing behind. In this genus the scrobe, curved at first, runs to the middle and front of the eye; the scape, however, extends to the hind margin of the eye, so that the scrobe can only receive a portion of it.

Empæotes crispatus.

E. fuscus, griseo-squamosus; rostro supra in medio carinato; funiculo elongato, articulis sensim brevioribus, clava oblongo-ovata; prothorace rugoso-granulato, in medio profunde sulcato; scutello transverso; elytris subcordatis, modice convexis, postice sat abrupte declivibus, substriato-punctatis, interstitiis tertio quintoque paulo elevatis, illo postice calloso-cristato, apicibus divaricatis; pedibus squamosis. Long. $4\frac{1}{2}$ lin.

Hab. Tairua.

Differs in breadth, probably according to the sex. Capt. Broun remarks that it has a pinkish tint when alive.

Empæotes censorius.

E. fuscus, griseo-squamosus; rostro supra fortiter bisulcato; antennis ferrugineis; funiculo articulis duobus basalibus longitudine æqualibus; prothorace fortiter granulato, in medio excavato; scutello apice rotundato; elytris subovatis, supra valde inæqualibus, postice sexcallosis, abrupte declivibus, striato-punctatis, interstitiis tertio quintoque elevatis; pedibus squamosis. Long. 4 lin.

Hab. Otago.

When deprived of the scales, the elytra are seen to be divided into irregular areas by short ridges rising between the rows of punctures.

Aldonus celator.

A. angustior, subparallelus, fusco-piceus, squamis griseis dispersis; rostro tenuato, prothorace manifeste breviore, antennis apicem versus insertis; funiculo articulis duobus basalibus longitudine fere æqualibus; prothorace apice angusto, utrinque antice rotundato, pone medium parallelo, crebre punctato; scutello parvo; elytris prothorace vix latioribus, indeterminate striato-punctatis, granulis nitidis squamis intermixtis, pone medium fascia indistincta notatis. Long. 4 lin.

Hab. Tairua.

A much narrower insect than *A. hylobioides*, covered, especially on the legs, with long, erect, spatulate scales, not setiform as in that species. *Aldonus* is closely allied to *Strongylopterus*, and, like *Psepholax*, the pectoral canal terminates behind the anterior coxæ, and is not bounded by the mesosternum.

Oreda brevis.

O. breviter subcylindrica, fusca griseo-varia; rostro brevi crasso; antennis crassiusculis; funiculo articulis duobus basalibus fere æqualibus, quinque sequentibus valde transversis; clava oblongo-ovata; prothorace lato, apice angusto, basi bisinuato; scutello parvo; elytris prothorace vix latioribus, striato-punctatis, interstitiis late planatis, squamulis erectis albidis adspersis; femoribus infra subdentatis; tibiis unco valido armatis, intermediis basi extus angulatis. Long. 2½ lin.

Hab. Tairua.

This is a very much smaller and shorter insect than *O. notata*, Wh., and is remarkable for its short thick rostrum like *Psepholax*.

HYPOTAGEA.

Rostrum cylindricum, arcuatum; *scrobes* præmedianæ, rectæ. *Antennæ* longiusculæ; *funiculus* 7-articulatus; *clava* distincta. *Oculi* rotundati, grosse granulati. *Prothorax* basi subsinuatus, lobis ocularibus nullis. *Scutellum* parvum. *Elytra* obovata, pygidium tegentia. *Femora* clavata, antica mutica, cætera dente parvo instructa. *Unguiculi* appendiculati. *Abdomen* segmentis tribus intermediis subæqualibus.

Allied to *Anthonomus*; but the mutic anterior femora forbids its being referred to that genus. The species is a somewhat glossy reddish ferruginous insect, with scattered whitish hair-like scales.

Hypotagea rubida.

H. subcylindrica, rufo-ferruginea, subnitida; rostro prothorace multo longiore, rugoso-punctato; prothorace subtransverso, sat crebre punctato; elytris prothorace paulo latioribus, fortiter striato-punctatis, interstitiis convexis; tibiis anticis leviter crenatis, intermediis intus bisinuatis. Long. 1½ lin.

Hab. Otago.

Eugnomus elegans.

E. niger, parce setulosus; rostro versus apicem gradatim latiore; antennis nigris, scapo ferrugineo, clava elongata; oculis prominulis, supra contiguis; prothorace vix transverso, postice utrinque rotundato, crebre punctulato; scutello rotundato; elytris basi prothorace multo latioribus, leviter striatis, interstitiis planatis, squamis minutis vestitis, vitta lata azurea, postice nivea et gradatim attenuata, a scutello fere ad apicem, ornatis; corpore infra dense albo-squamoso, macula ochracea antica utrinque notato. Long. 1¾ lin.

Hab. Tairua.

This and the following species agree pretty well with *Eugnomus*, Schönh., no member of which has, I believe, hitherto been described. There is a common variety of this species in which the blue stripe disappears, leaving only a short white line on the third interstice near the apex.

Eugnomus picipennis.

E. subniger, nitidus, elytris, tibiis tarsisque piceis; rostro apicem versus multo crassiore, leviter punctato; scapo testaceo, funiculo articulo secundo quam primo paulo breviore; clava ampla, elliptica; oculis haud approximatis; prothorace longitudine latitudini æquali, crebre punctato, utrinque albo-pubescente; scutello triangulari; elytris paulo elevatis, postice manifeste declivibus, substriatim punctatis, interstitiis latis, secundo, tertio quartoque posticis gibbosis, humeris prominulis; corpore infra nitide nigro, parce squamoso. Long. 2 lin.

Hab. Tairua.

Eugnomus fervidus.

E. pube silaceo-rufa sat dense tectus, lateribus infra scutelloque sulphureis; capite inter oculos excavato; rostro minus tenuato, pubescente; antennis testaceis; funiculo, ut in præcedentibus, articulo primo ampliato; prothorace parvulo, subtiliter confertim punctato; scutello conspicuo; elytris striato-punctatis, punctis approximatis, interstitiis leviter convexis; pedibus minus pubescentibus. Long. $1\frac{3}{4}$ lin.

Hab. Tairua.

Sibinia tychioides.

S. anguste elliptica, fusca, subdepressa, squamulis angustis declinatis cinereo-albidis vestita; rostro versus apicem attenuato, arcuato, apice fulvo; antennis fulvis, apice nigro excepto; prothorace latitudine longitudini æquali; scutello inconspicuo; elytris basi prothorace paulo latioribus, fortiter striatis, interstitiis solis plerumque squamulosis; pedibus fulvis; femoribus dentatis, tibiis breviusculis. Long. $1\frac{2}{3}$ lin.

Hab. Tairua.

Like *Tychius Schneideri*, but, in consequence of its more or less exposed pygidium, I refer it to *Sibinia*.

Psepholax simplex (Sharp *in litt.*).

P. breviter subcylindricus, brunneus, squamis flavescentibus vestitus; rostro brevi lato, in medio et inter oculos lineis duabus brevibus impresso; antennis subferrugineis, scapo brevi, funiculo articulis quinque ultimis valde transversis; clava ampla, pubescente; prothorace transverso, postice sensim latiore, basi bisinuato, in medio carinato; elytris striato-punctatis, interstitiis late planatis, apice rotundatis; tibiis sat elongatis, intermediis extus in medio dente tenuato armatis. Long. 2 lin.

Hab. Tairua.

This very distinct species has much the habit and coloration of our *Hylesinus fraxini* (a Scolytid), but is considerably larger.

Acalles intutus.

A. ovatus, fuscus, griseo-squamosus, squamulis erectis adspersus; rostro breviusculo, modice crasso; antennis subferrugineis, funiculi articulo primo quam secundus paulo longiore; clava breviter ovata; prothorace subtransverso, antice constricto, postice rotundato; elytris breviter ovatis, basi prothoracis paulo latioribus, striato-punctatis, punctis linearibus, interstitiis secundo quartoque leviter elevatis et postice paulo callosis; pedibus squamis erectis numerosis vestitis. Long. $1\frac{2}{3}$–2 lin.

Hab. Tairua.

There is a very small but distinct scutellum in this species, which should perhaps exclude it from *Acalles.* It is about the size and shape of *A. roboris.*

Acalles erroneus.

A. obovatus, fuscus, squamis griseis fuscisque variegatus, aliis erectis adspersus; rostro breviusculo; prothorace subtransverso, apice bicristato, supra in medio tuberculis duabus magnis instructo; elytris pone medium latioribus, versus apicem gradatim angustioribus, supra elevatis, striato-punctatis, interstitio secundo in medio fortiter bicristato; pedibus variegatis, squamis erectis vestitis. Long. $1\frac{1}{2}$ lin.

Hab. Tairua.

Size and shape of *A. misellus*; the elytra furnished on each side with two strongly marked crests crowned with erect scales.

Acalles hystriculus.

A. subovatus, ferrugineus, squamis griseis fuscisque variegatus, aliis elongatis erectis numerosis adspersus; rostro modice elongato, dimidio basali squamis albidis in seriebus quatuor dispositis instructo; antennis pallidis, articulo primo funiculi quam secundo manifeste longiore; clava elliptica; prothorace vix longiore quam latiore, utrinque rotundato, antice paulo constricto; elytris obovatis, in medio utrinque rotundatis, apicem versus gradatim angustioribus, striato-punctatis; pedibus squamis erectis vestitis. Long. $1\frac{1}{4}$ lin.

Hab. Tairua.

Most of my specimens have a black sutural mark, which behind the middle is joined to a transverse one; the latter has a p posterior border; a p curved line also occurs on each sidealat the base, and is fealdy prolonged to the prothorax. The scales on *Acalles* and many other (perhaps most) genera of Cryptorhynchinæ are of two kinds—one pressed close to the derm, the other kind more or less elongate, club-shaped, or like a hair or bristle, and standing off from the derm. The latter are often denominated "setulæ."

Tychanus.

Acalli vicinum, sed prothorace basi bisinuato, et scutello manifesto. *Rostrum* tenuatum. *Antennæ* in medio rostri insertæ. *Elytra* callosa, prothorace basi haud latiora. *Femora* infra dentata.

It would, perhaps, be difficult to define *Acalles* very strictly, the species showing so many structural modifications; but it is quite certain that such a character as the prothorax presents in the present genus may be advantageously used in facilitating the systematic location of the numerous species, mostly small and dull-coloured, which centre round *Tragopus*, from which *Acalles* itself is but little removed.

Tychanus gibbus.

T. breviusculus, fuscus, sat dense griseo-sqamosus; rostro modice arcuato, prothorace vix breviore; funiculo articulis duobus basalibus elongatis; prothorace utrinque pone apicem fortiter calloso, apice ipso constricto, et supra bifasciculato; elytris apicem versus gradatim latioribus, fere a medio declivibus, dorso elevato, bicristato, lateribus fortiter carinatis, sulcato-punctatis, punctis paucis ampliatis, parte declivi dilutiore; femoribus infra dente parvulo instructis. Long. 4 lin.

Hab. Tairua.

The elytra in this species, as well as in the two following, are a little produced at the apex; and this being rounded gives, in conjunction with the abruptly terminating sides, a trilobed character to their posterior portion.

Tychanus ferrugatus.

T. perbrevis, fuscus, griseo ferrugineoque squamosus; rostro gracili, haud arcuato, prothorace breviore; funiculo articulis duobus basalibus haud elongatis; prothorace valde transverso, pone apicem elevato, apice ipso valde constricto; elytris subparallelis, modice convexis, rugosis, postice declivibus, apicibus utrinque callosis; femoribus infra dente determinato armatis. Long. $3\frac{1}{4}$ lin.

Hab. Tairua.

This and the preceding are very short thick-set species, the former, *inter alia*, readily distinguished by its very convex elytra. It is very likely that both have the transverse ridge, formed by the sudden constriction of the anterior portion of the prothorax, tufted as in the following species, but not very marked in *T. gibbus*; probably a good deal depends on age.

Crisius.

Rostrum modice elongatum, arcuatum; *scrobes* præmedianæ, rectæ. *Antennæ* tenues, funiculo articulo secundo elongato. *Prothorax* conicus, apice productus. *Elytra* subcordata, basi quam prothorace multo latiora. *Femora* clavata, infra dentata; *tibiæ* rectæ, posticæ extus arcuatæ; *tarsi* articulo penultimo late bilobo. *Rima* pectoralis ad coxas intermedias postice extensa.

This is obviously an *Acalles*-form; but the elytra greatly exceeding the prothorax in breadth, and other characters, will not allow it to be referred to any known genus.

Crisius binotatus.

C. fuscus, squamis obscure griseis vestitus; rostro prothorace longiore, versus apicem sensim latiore; antennis ferrugineis; funiculo articulo secundo quam primo duplo longiore, sequentibus sensim brevioribus; clava ampla, distincta, pubescente; prothorace apice bi- in medio quadrituberculato, basi nigro-binotato; scutello parvo; elytris convexis, sparse fasciculato-tuberculatis, substriato-punctatis, apice rotundatis, basi utrinque juxta scutellum macula atra notatis; pedibus squamosis. Long. 3 lin.

Hab. Tairua.

Pactola demissa.

P. anguste ovata, fusca vel silacea, griseo-squamosa; rostro lato; antennis tenuatis; prothorace quadrato, supra haud tuberculato; elytris basi quam prothorace fere duplo latioribus, haud tuberculatis, striato-punctatis, pone medium fascia fusca notatis; femoribus posticis minus clavatis, et nigro-annulatis. Long. $1\frac{1}{4}$ lin.

Hab. Tairua.

Much narrower than *P. variabilis*, and apparently an extreme form of the genus.

Xylotoles Traversii.

X. anguste ellipticus, nigro-viridis, nitidus, antennis pedibusque ferrugineis, subtiliter pubescens; prothorace lævigato, subtilissime sparse punctato; scutello transverso, sat dense ochraceo-piloso; elytris basi prothoracis vix latioribus, subcarinatis, dimidio basali solo parce impresso-punctatis, apicibus rotundatis; antennis subannulatis. Long. $3\frac{1}{2}$ lin.

Hab. Chatham Islands.

This species lies between *X. costatus* and *X. nudus* in its characters; the elytra carinated as in the former, but in a much slighter degree, and narrower as in the latter. It was found, with many other interesting species, in the Chatham Islands by H. H. Travers, Esq.

Stenellipsis pumila.

S. subparallela, ferruginea, tenuiter pubescens ; capite nigro, fronte planata ; tuberibus antenniferis brevissimis ; antennis corpore longioribus, articulis tertio quartoque elongatis, æqualibus ; prothorace transverso, utrinque valde tumido, subtiliter punctato ; elytris parallelis, irregulariter punctatis, linea nigra obscura arcuata a basi usque ad marginem exteriorem postice terminata, notatis ; femoribus valde clavatis ; tarsis articulo penultimo anguste bilobo. Long. $1\frac{1}{4}$ lin.

Hab. Waikato.

This is very different from any of the species described by Mr. H. Bates ; it may be regarded as an aberrant form.

VII.—*Note on a second Species of* Spirobranchus (*C. & V.*). By Dr. ALBERT GÜNTHER, F.R.S.

MR. HERBERT TREVELYAN has sent to the British Museum two fishes from King-Williamstown, British Caffraria, which are evidently identical with *Sandelia Bainsii* of Castelnau ('Mém. sur les Poissons de l'Afrique austr.' p. 36) from the Kowie river, near Grahamstown. The genus *Sandelia* differs in nothing from *Spirobranchus* ; but the species is evidently well distinguished by the following constant characters from *Sp. capensis* :—

Spirobranchus Bainsii.

D. $\frac{16}{10}$. A. $\frac{8}{8}$. L. lat. 34. L. transv. 7/14.

The maxillary extends nearly to below the middle of the eye. The scales on the back and lower part of the side are remarkably smaller than those on the middle of the side. Scales on the cheek in six or seven rather irregular series. An oblique blackish band crosses the cheek from the eye to the angle of the præoperculum. Operculum with a black spot behind on a membrane between two fascicles of spines.

Length of the larger example 7 inches.

VIII.—*Contributions to the Study of the chief Generic Types of the Palæozoic Corals.* By JAMES THOMSON, F.G.S., and H. ALLEYNE NICHOLSON, M.D., D.Sc., F.R.S.E., Professor of Natural History in the University of St. Andrews.

[Continued from vol. xvii. p. 462.]

[Plates I.–III.]

Genus RHODOPHYLLUM, Thomson.

Rhodophyllum, Thomson, Geol. Mag. dec. 2, vol. i. p. 557, pl. xx.

Gen. char. Corallum simple, cono-cylindrical, usually tall and more or less curved. Epitheca thin, complete, with well-marked annulations of growth. Calice circular, shallow, its edges more or less everted, exhibiting in the centre of its floor a dome-shaped or rounded boss, which is but slightly raised above the inner margins of the primary septa. The surface of the boss is marked by a number of spirally twisted ridges, which proceed from its margins to its summit, where there is no distinct median crest or keel. Septa well developed, of two orders, the primary never extending further inwards than the outer margin of the central boss, and the secondary septa being considerably shorter and sometimes hardly recognizable. Internal structure triareal. Central area ("interlamellar space") formed by the intersection of a series of remote and irregular, twisted, vertical lamellæ with a series of irregular and vesicular tabulæ. As seen in transverse sections, the intersection of these two series of plates gives rise to a number of lines which, though irregular, are in the main folded in a spiral or contorted manner round an imaginary centre. The central area is not partially or wholly divided into two parts by any predominant lamella; nor are the vertical lamellæ regularly arranged in a radiating manner from the circumference of the central area towards its centre. The intermediate area ("interlocular area") is composed of nearly horizontal loosely anastomosing tabulæ; and the inner lamellar ends of the primary septa extend into it. The outer area ("interseptal area") is occupied by the septa, which in this portion of the corallum are delicate and flexuous, and are united together by very numerous, close-set, anastomosing dissepiments. There is thus produced an exterior zone of dense vesicular tissue, the vesicles of which are arranged in oblique rows directed upwards and outwards. Longitudinal sections show that the central area is intersected by several discontinuous, and often wavy columellarian lines; and cross sections exhibit a well-marked septal fossula.

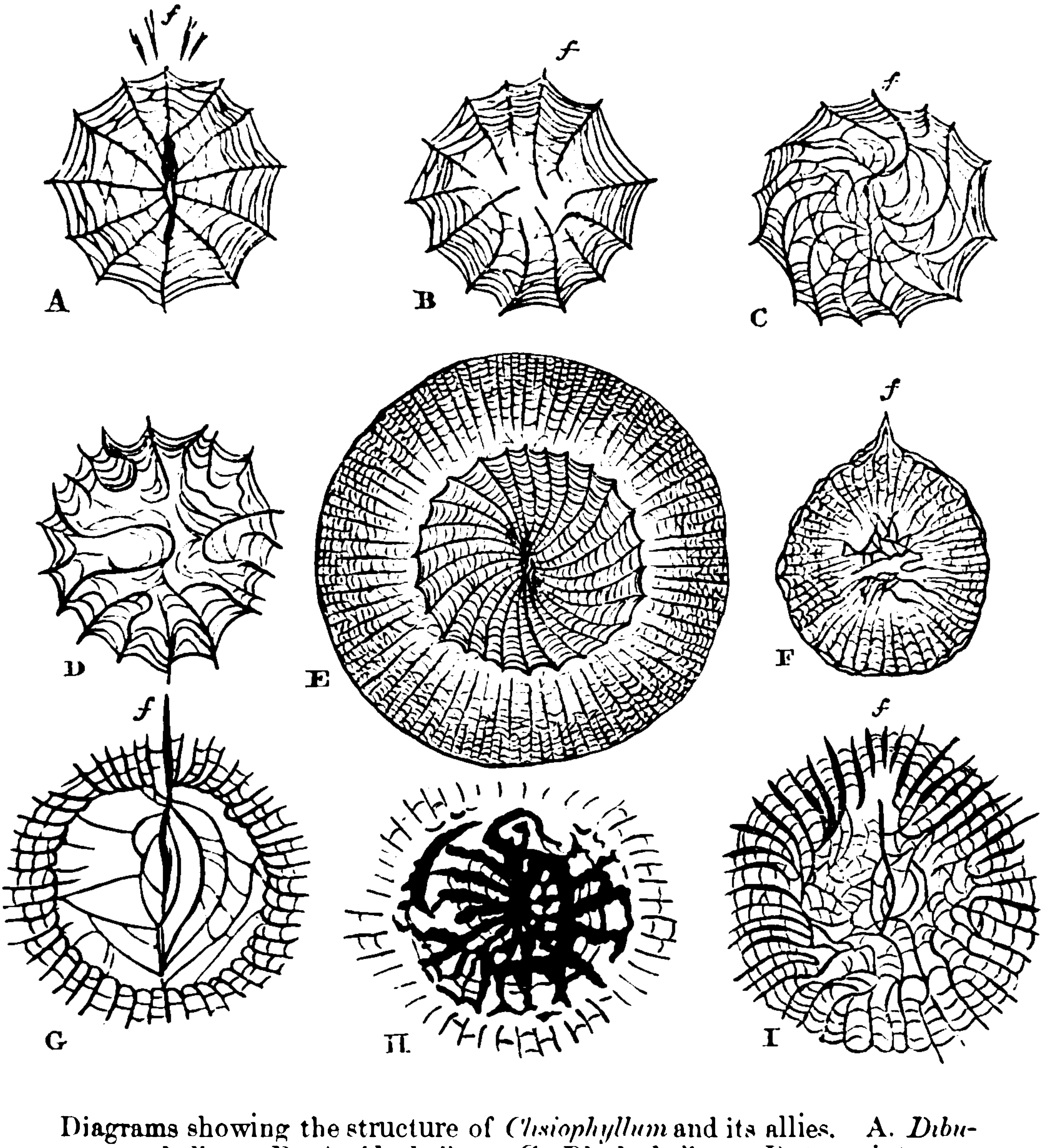
The genus *Rhodophyllum* agrees with the genera *Clisiophyllum*, *Dibunophyllum*, and *Aspidophyllum* in the following characters:—(1) There is a large central area, the free end of which projects above the floor of the calice as a central eminence or boss (Pl. I. fig. 4). This central area is formed, on the one hand, by vertical lamellæ, the free ends of which appear as so many ridges on the surface of the boss, and, on the other hand, by a series of closely approximated tabulæ, the cut edges of which appear in cross sections as so many concentric lines. The cut edges of the vertical lamellæ appear in cross sections as so many lines directed in general from the margins of the central area towards its centre. (2) A narrow but well-marked intermediate area (Pl. I. fig. 3 A) exists, which is constituted principally by a series of horizontal anastomosing tabulæ, and into which the inner extremities of the primary septa are prolonged. (3) There exists a more or less extensively developed exterior zone (Pl. I. fig. 3 A), which is formed by the intersection of the septa with a series of very numerous and closely arranged dissepiments. As seen in longitudinal sections, this area presents itself as a zone of dense vesicular tissue, formed by minute lenticular cells, the convexities of which look upwards, and which are arranged in oblique rows directed upwards and outwards. (4) The primary septa (Pl. I. figs. 1–3) appear as strong and thick lamellæ in the intermediate area of the corallum, where they are united by a few remote dissepiments; but they never extend into the central area, with the vertical lamellæ of which they are not connected in any way, save here and there by the intervention of delicate twisted plates. In the exterior zone the septa are very much more delicate, they become more or less flexuous, and they can only be traced with difficulty through the dense vesicular tissue formed by the dissepiments.

It is in the structure of the central area of the corallum that *Rhodophyllum* exhibits its distinctive peculiarities; and these, in our opinion, are sufficient to separate the genus from *Clisiophyllum* and from its immediate congeners. These peculiarities are as follows:—(1) The calicine boss is rounded, not conical, and of no great height, and exhibits no median crest, partial or complete; its surface is marked with spirally twisted ridges, which ascend from its margins to its summit. (2) As seen in longitudinal sections (Pl. I. fig. 3 A, Pl. II. figs. 1 A & 3), the tabulæ are found to be intersected by more or fewer broken and discontinuous vertical columellarian lines. Though in the main elevated towards the middle line, the tabulæ intercepted between any successive pair of these columellarian lines are more or less concave, and have their concavities directed upwards. (3) As exhibited in transverse sections, the central area does not display the complete mesial partition of *Dibunophyllum*, or the partial one of *Aspidophyllum*;

nor does it show a regular series of lines representing the cut edges of the vertical lamellæ, and radiating from the circumference to the centre, such as is present in both of the above genera and also in *Clisiophyllum*. On the contrary, we find in *Rhodophyllum* (Pl. I. figs. 1–3) a series of lines, of a wavy and irregular character, but upon the whole twisted in a convolute or contortive manner round an imaginary centre. These spirally twisted lines are formed partly by the cut edges of the vertical lamellæ of the central area, and partly by the cut edges of the tabulæ of the same region. In fact, the vertical lamellæ of the central area may be regarded as being comparatively rudimentary, as compared with their development in *Clisiophyllum*, *Dibunophyllum*, and *Aspidophyllum*.

The four groups which we have now considered under the names *Clisiophyllum*, *Dibunophyllum*, *Aspidophyllum*, and *Rhodophyllum* form four natural assemblages which are most intimately related in the fundamental plan of their organization. Though their morphological type is substantially the same, and though transitional and intermediate forms are not wanting, each of these groups is nevertheless distinguished from the others by special structural peculiarities, of such constancy and of such importance that they may be best indicated by special titles. To this conclusion we have been led after a careful examination and comparison of several hundreds of cut and polished specimens, and of thin sections prepared for the microscope. That the course which we have been led to adopt may not recommend itself to others is quite possible. We are most willing to admit that it must remain in the meanwhile a matter of opinion whether such differences as we have endeavoured to indicate as existing amongst the Clisiophylloid corals are of *generic* or *subgeneric* value, or even whether each type might not rather be considered as constituting a single, extremely variable *species*. This point can only be decided by the opinion of each individual observer; and its decision will inevitably depend more or less upon the views which each individual may hold as to what ought to be understood by the terms "genera," "subgenera," and "species." With regard to the actual *existence* of the different groups which we have described, we can confidently appeal to the facts of nature: whether our interpretation of these facts be correct or not is a matter of comparatively small moment.

As the series of related and inosculating groups, of which *Clisiophyllum* is the central form, is one of great complexity, and presenting unusual difficulties in its study, we introduce here diagrams by which the leading differences of these groups may be readily apprehended (see p. 71). In all these forms (save the aberrant genus *Carcinophyllum*) the structure of the external and intermediate areas of the corallum is essentially and fundamentally identical. They differ, however, in the structure of the great mass of endothecal tissue which occupies the centre of the visceral chamber; and these differences are shown in the annexed sketches, where the structure of the central area of these forms is represented.



Diagrams showing the structure of *Clisiophyllum* and its allies. A. *Dibunophyllum*; B, *Aspidophyllum*; C, *Rhodophyllum*; D, type intermediate between *Aspidophyllum* and *Rhodophyllum*; E, *Clisiophyllum*; F, *Cyclophyllum*; G, transition-form between *Koninckophyllum* and the typical Clisiophylloids; H, *Carcinophyllum* (gen. nov.); I, transition-form, near G. Fig. E represents a cross section of *Clisiophyllum coniseptum*, Keys., of the natural size, in which the external and intermediate areas are introduced as well as the central. Figs. A, B, C, D, and F are enlarged, and represent only the central area of the corallum; to complete these figures, an external and intermediate zone must be added, as in fig. E. Figs. G, H, and I are likewise enlarged, and represent the central area of the corallum, along with the inner ends of the septa. The letter *f* indicates the position of the fossula.

The genus *Rhodophyllum*, so far as our present knowledge goes, is exclusively confined to the Carboniferous period, and it has not hitherto been recognized out of Scotland. Though very readily recognized in typical examples, it is, as before said, united with its immediate allies by transitional forms. The best-marked of these intermediate groups is to be found between typical examples of *Rhodophyllum* on the one hand, and *Aspidophyllum* on the other hand. The figures in Plate III. represent longitudinal and transverse sections of this intermediate and transitional type. In this group the vertical lamellæ of the central area do not exhibit that contortive arrangement which is so characteristic of *Rhodophyllum*, but they are generally seen in transverse sections (diagr. D) as irregular, more or less wavy lines, often uniting with one another in a series of undulating curves, the convexities of which are directed centrally. There is no single predominant vertical lamella, such as exists in *Aspidophyllum*; but the cut edges of the tabulæ are seen in transverse sections to have much the same arrangement as in the latter genus, being strongly curved, and having their convexities directed inwards. In longitudinal sections (Pl. III. figs. 1 & 5 A), the central area is seen to be occupied with anastomosing and closely vesicular tabulæ, intersected by several irregular and discontinuous vertical lines, representing the cut edges of the vertical lamellæ.

EXPLANATION OF THE PLATES.

[Unless otherwise stated, all the figures are of the natural size. In these three plates we have tried the experiment of printing the figures in white upon a black ground. It may be questioned, however, if the results are quite so satisfactory as in the ordinary method of printing in black on a white ground.]

PLATE I.

Fig. 1. *Rhodophyllum Slimonianum*, Thomson, transverse section. Lower Carboniferous, Brockley, near Lesmahagow.

Fig. 2. *Rhodophyllum Phillipsianum*, Thomson, transverse section. Lower Carboniferous, Trearne, near Beith, Ayrshire.

Fig. 3. *Rhodophyllum Craigianum*, Thomson, transverse section; 3 A, longitudinal section of the same. Lower Carboniferous, Trearne, near Beith, Ayrshire.

Fig. 4. *Rhodophyllum simplex*, Thomson, interior of an imperfect calice, showing the form of the central boss; 4 A, transverse section of the same. Lower Carboniferous, Brockley, near Lesmahagow.

PLATE II.

Fig. 1. *Rhodophyllum Phillipsianum*, Thomson, transverse section; 1 A, longitudinal section of the same. Lower Carboniferous, Langside, near Beith, Ayrshire.

stomial and metastomial cavities are placed in communication; 2. The ganglionic masses of the nervous system are formed *above* the lateral organs, between them and the cephalic masses. Soon the whole, formed by the union of the cephalic masses, the nervous system, and the lateral organs, becomes fashioned into a coherent mass, which is the *head* of the adult. Here the head corresponds exactly to the prostomium, and the body to the metastomium; the œsophagus, therefore, is situated entirely outside the head.

In the Enopla the ganglionic masses, instead of being formed *above* the lateral organs, are formed *below* them, between the latter and the muscular laminæ of the body-wall. Combined with the lateral organs and the œsophagus they constitute a new septum, which continues to keep the two cavities distinct. Subsequently the whole of these different parts (cephalic masses, nervous ganglia, lateral organs) are condensed, as in the Anopla, into a coherent mass, which represents the *head*. Here the head includes, besides the prostomium, a part of the metastomium, with the portion of the œsophagus that is contained in the latter.

The conformity just indicated in the results of the first embryonic processes, and the constant presence of a common stage, demonstrate the general unity of the plan of development. It remains to see whether there exists a gradual passage between the different *modes of production* of that stage.

Let us take for example two embryogenies belonging to the two fundamental types of development, namely *Lineus communis* and *Amphiporus lactiflorens*.

The chief phenomena of the embryogeny of *Amphiporus* are:—1, the accumulation of deutoplasmic elements at the inner part of the segmentation-spheres, arranged radiately, and the formation of an inner nucleus of deutoplasma, which represents the middle lamella; 2, the invagination at one point of the superficial layer (*gastrula*); the invaginated cellular mass (*endoderm*) penetrates into the interior and coalesces with the nucleus of deutoplasm; we then obtain a stage formed of a superficial layer and of an interior mass; the superficial layer is the exoderm, and the interior mass represents the union of the middle and inferior lamellæ. The interior mass then undergoes a direct differentiation into musculature (which rapidly acquires its characteristic arrangement) and endodermic fatty elements (which collect in the metastomial cavity). The essential fact of the development is reduced, indeed, to the formation of the musculature by the simple *differentiation of a continuous lamella.*

Lineus communis presents generally in its embryogeny an identical course; only the musculature is formed by the *coalescence of three primitively distinct pairs of rudiments.* As regards the two primitive lamellæ there is complete concordance in both cases; the only difference, therefore, in the two most dissimilar types consists in the mode of formation of the mesoderm, the subsequent evolution of this lamella being the same on both sides. From this we may conclude that there exists a perfect continuity between the different modes of production of the common stage.

To each of these two principal modes is to be referred the development of larval forms. Here, in fact, we find an application of the principle lately affirmed again with so much authority by M. Milne-Edwards, that *the larva is only an embryo with independent existence.* The development of the *Pilidium* and of the larva of Desor shows us that the *Pilidium* is only the free representative of one of the stages existing in our first embryonic type (the *Gastrula*-stage at the moment of the origin of the four invaginations of Müller), whilst the larva of Desor is the representative of one of the stages of the second type (embryo composed of an interior mass [middle lamella, endoderm] and of a superficial layer [exoderm]). The *Pilidium* and the larva of Desor consequently cease to be enigmatic forms, opposed by the complexity of their structure to the simplicity of organization of the group; they enter with perfect right, and in the most natural manner, into the normal cycle.

The complete parallelism between the different modes of development at the same time teaches us to see in the fall of the superficial membranes in the *Pilidium* and the types which belong to it nothing more than a mere anomaly due to the exaggerated development of the exoderm. The return to the normal condition which must follow the formation of the internal organs necessarily produces an inverse phenomenon; and it is to this inverse phenomenon that we must ascribe the cases of breaking-down (*Balanoglossus*) or destruction of the skin (*Nemertes*).

These different points show that in the organization of the Nemertians there is an essential feature *around which all the embryological phenomena group themselves—the division into cephalic musculature and musculature of the body.* This fact has its analogues in the Turbellaria (*Stenostomum*, *Leucops*); it is in complete opposition to the origin of the musculature in the Annelida. Embryogeny, therefore, contrary to what has hitherto been supposed from the complexity of the larval forms, leads to an approximation to the lower Vermes and the Turbellaria, rather than to the higher Vermes and the Annelida. —*Comptes Rendus*, April 10, 1876, p. 859.

Supposed Laurentian Fossil.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—In the May issue of the 'Annals' appeared a letter from Mr. James Thomson and myself, in which we announced the discovery in the Laurentian Rocks of Harris of what we believed to be unequivocal organic remains. This opinion was based partly upon the remarkable characters exhibited by microscopic sections, and partly upon the too confident belief that the specimens were essentially calcareous in their composition. This latter belief not only formed one of the chief elements on which our conclusion was founded, but strongly weighed with Dr. Carpenter in his indorsement of our original views ('Nature,' May 4th). I wish, however, now to be allowed to state frankly that our opinion as to the calcareous nature of the specimens has not been borne out by chemical analysis. Upon investigation the specimens proved to be composed of alternating layers of felspar and silica—to be, in fact, a species of "graphic granite," as has been proved by an exhaustive examination conducted by Dr. Carpenter ('Nature,' May 25th), in the results of which I entirely acquiesce. Whether the peculiar arrangement of the minerals which constitute these specimens can be assigned wholly to the operation of inorganic causes or not, is a question which does not in the meanwhile admit of solution.

I remain, Gentlemen,

Yours faithfully,

Penrith, May 30, 1876. H. ALLEYNE NICHOLSON.

Description of a new Rodent from Central Asia.
By JAMES WOOD-MASON, Esq.

Nesokia Scullyi.

Fur fine and silky, above pale fawn-coloured, paling on the sides, below, on the insides of the limbs, on the throat, lips, and cheeks whitish, the hairs of the back being very dark slaty tipped with very pale fawn, and those of the underparts much paler slaty tipped with whitish. Face brownish grey. On the back, especially on the sacral region, some hairs longer, but hardly coarser, than the rest represent the coarse, flattened, spindle-shaped, grooved, and projecting bristle-like ones observed in *Spalacomys* (=*Nesokia*) *indicus* and some other species; these hairs have a dark brown or blackish ring intervening between the slaty basal and the pale fawn apical portion. One or two of the vibrissæ reach the bases of the ears; two or three of them are black to the tips, most of them are tipped with white; a fringe of short, stiff, silvery ones on the upper lips. Ears short, scarcely projecting beyond the fur, all but naked, being sparsely clothed with an inconspicuous lanugo. Hands and feet flesh-coloured, with a scanty covering of short hairs. Tail without a single hair, shorter than the body, obscurely scaled, the scales arranged, as usual, in rings.

The Turki name for the animal is "Mughi."

	millim.
Length from tip of the snout to base of the tail	168
Length of tail	132
,, ears (at back)	12
Breadth of ears (convex curvature)	11
Length of hand to tip of middle finger	23
,, foot to tip of middle toe	43
,, skull wi'h incisors	48
Interzygomatic breadth (at posterior root of zygoma)....	28

The first two of the above measurements were taken by Dr. Scully on the dead body of the animal, and have been converted by me from English inches into millimetres.

Hab. A single male specimen was captured on June 11, 1875, at Sanju, in Kashgharia, by Dr. J. Scully, the author of a valuable contribution to our knowledge of the avifauna of Central Asia, and has since been presented by him to the Indian Museum.

This species is at once distinguished from *Nesokia Huttoni* and *Spalacomys* (=*Nesokia*) *indicus* of Peters* (which latter will in all probability turn out to be identical with one of the insufficiently described species of the genus) by the quality of the fur, by the totally naked condition and proportional length of the tail, by the greater length of the hands and feet, and by the greater size and breadth of the skull, mandible, and teeth.

P.S. In *Nesokia Huttoni* the incisors are much broader and thicker in males than in females.—*Proceedings of the Asiatic Society of Bengal*, April 1876.

Mr. Hermann von Jhering on the Use of the Term "Homogeny."

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—Mr. Hermann von Jhering, of Gottingen, has recently published, in the 'Jahrbucher' of the German Malacozoological Society, an "Attempt to establish a Natural Classification of the Mollusca." The author has given much attention to the naked-eye anatomy of Mollusca, very little to their ontogeny, and has recently, in other journals ('Jenaische Zeitschrift' and 'Zeitschr. f. wiss. Zool.'), in the most incomprehensible manner, misrepresented both the history and the facts of recent embryological researches (my own in particular) relative to these animals. Though Mr. Jhering is totally disqualified for treating the question of the molluscan pedigree from the point of view of ontogeny, and therefore wisely assigns a supreme importance to the comparative anatomy of adult forms, yet his 'Versuch' possesses considerable interest, and has the great merit of breaking with the old traditions as to classification.

Much as there is which is novel, as well as much which is the common property of all modern zoologists, in Mr. Jhering's paper, the reader is not always clearly informed as to which statements in it are new and which are taken from other writers. Mr. Jhering has taken from me the division of Homology into the two very distinct phenomena of Homogeny and Homoplasy, which division I proposed in this Journal in the year 1870 ("On the Use of the term Homology in Modern Zoology"). Mr. Jhering says:—"Ich möchte fur diese Homologie den Unternamen der Homogenie vorschlagen." He also gives the adjectival form "homogenetic." Mr. Jhering not only does not indicate distinctly that he has taken this word and the arguments which recommend its use from me, but he has the assurance to propose it as a brand-new idea of his own. The complemental term "Homoplasy" is not appropriated by Mr. Jhering.

I am, Gentlemen,
Faithfully yours,
E. Ray Lankester.

* "Ueber einige merkwürdige Nagethiere des Königl. Zoologischen Museums," Abhandl. der Königl. Akad. der Wissensch. Berlin, 1860, p. 139 *et seqq*

On the Animal of Millepora alcicornis.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,—In the communication on the animal of *Millepora*, which appeared in the 'Annals' of May last, I omitted to mention that the tubular structure, of which a woodcut was given after a drawing by Major-General Nelson, is the organic substance which remains after decalcification. It is the tubular membrane which lines the system of cavities.

It appears also that it should have been more expressly stated that the particular tubular appearance, due to the remains of old corallites whose tabulæ had disappeared, is deeply seated and more or less radial.

Yours truly,

June 7, 1876. P. MARTIN DUNCAN.

Deep-Sea Researches.

To the Editors of The Annals and Magazine of Natural History.

GENTLEMEN,—I shall esteem it a favour if you will kindly accord space in 'The Annals' for the following small, but, I hope, not altogether unimportant, contribution to the *History* of Deep-Sea Research. The object in view is to prove (as stated by Sir Roderick Murchison) that I had not only in 1860 "extended the limits of animal life in the ocean to a depth of $1\frac{1}{2}$ mile, and worked out accurate data as to the varied conditions of the sea-bottom at different depths," but had also, so long ago as 1863, laid before the Council of the Royal Geographical Society a scheme for a systematic survey of the sea and sea-bed, which embodied all the most important propositions contained in the Report drawn up by Dr. Carpenter and his coadjutors for the information of the Council of the Royal Society in 1869, and by the Royal Society submitted for adoption to Government*.

In order not to trespass too far on your space, and at the same time place my statements beyond question, I annex:—first, an extract from Sir Roderick Murchison's Anniversary Address delivered at the Royal Geographical Society, May 1, 1863; and secondly, a copy of the "Scheme" referred to in his Address.

These documents will speak for themselves. I would only add that the Council of the Geographical Society did me the honour to adopt my proposals, and at once caused them to be printed—the diplomatic crisis then imminent between this country and the United States having alone stood in the way of Sir Roderick's application to the Admiralty being acceded to.

I remain, Gentlemen,

Your much obliged servant,

Herne Bay, June 15, 1876. G. C. WALLICH, M.D.

* See Proc. Roy. Soc. vol. xviii. no. 121, dated November 18, 1869, pp. 398 and 402.

"*North-Atlantic Sea-Bed.*—In contributing to our better acquaintance with the natural history of the sea, as ascertained during the voyage of H.M.S. 'Bulldog,' under the command of Sir Leopold McClintock, Dr. Wallich* produced, by soundings at great depths, excellent materials to enable men of science to appreciate more correctly than before the feasibility of laying down a submarine telegraph between Ireland and North America. Extending the bathymetrical limits of animal life in the ocean to the great depth of 7500 feet, or 1½ mile, beneath its surface, and working out accurate data as to the varied condition of the sea-bottom at different depths, he was well qualified to propose to our Council a scheme for such a systematic survey of the sea and sea-bed between Ireland and Newfoundland as might lead to the laying on a sound basis a submarine telegraphic cable between the two countries.

"Attributing the fears and doubts as to a successful issue of the schemes put forth chiefly to the inadequate methods hitherto employed in examining the sea-bed by the rapid transit of our surveying-ships, and by soundings taken on one line only at great distances apart, Dr. Wallich proposed that a much closer search should be made before telegraphic cables were lowered into unknown depths, and laid across submarine hills, gorges, and valleys, the irregularity of whose forms, as existing between the points hitherto sounded, might prove to be enormous. He argued that a full and proper submarine search was as essential a preliminary to a rational scheme of laying down a telegraphic cable, as a survey of the outlines of land was requisite for the engineer before he could accurately define the best and safest line to be followed by a railroad.

"Being of opinion that such an effort was well worthy of their encouragement, the Council of our Society supported the project of Dr. Wallich, not only in the belief that its execution must throw much light on this interesting branch of physical geography, but would also develop various phenomena of great interest in natural history, geology, meteorology, and physics. On my own part, being very desirous of seeing so noble an exercise of the searching powers of this great maritime nation set on foot under the management of so energetic a naturalist as Dr. Wallich, I earnestly recommended its adoption to the First Lord of the Admiralty. But, as the project matured, it speedily appeared that Dr. Wallich required two steamers for the effectual survey in question, which demand was considered to be too heavy at a moment when few vessels could be spared from our naval reserves; and hence the consideration of the subject has, for the present, been dropped. I hope, however, that in more quiet times a complete submarine survey of the Atlantic will be carried out, by the joint operations of nations on *both* sides of that ocean; and when that day arrives, I trust that the project of Dr. Wallich, with all his ingenious appli-

* "See Dr. Wallich's work, published with the sanction of the Lords of the Admiralty, entitled 'The North-Atlantic Sea-bed.' London, 1862. Van Voorst."

ances, will obtain the countenance of the public, just as in an earlier stage it has met with the approbation of the Council of the Royal Geographical Society"*.

"*Outline of a Scheme for a Systematic Survey of the Sea and Sea-bed between Ireland and Newfoundland, with a view to the establishment of Telegraphic Communication between the two Countries.* By G. C. Wallich, M.D.

"Although fully sensible that it forms no part of the province of the Royal Geographical Society to discuss the commercial or social questions involved in the establishment of telegraphic communication between distant regions of the globe, I believe myself warranted in assuming that the Society has already evinced its readiness to promote, by every means in its power, those scientific inquiries which bear more or less directly on physical geography, and on the due prosecution of which the successful accomplishment of every great submarine telegraphic enterprise must principally depend.

"It is under this impression that I venture to submit to the President and Council a scheme for a systematic survey of a portion of the ocean, devised in the present instance with reference to a particular line, but which may be made equally applicable to the survey of any oceanic area.

"It is obviously needless for me to remind the Council of the fitful and fruitless efforts that have been made from time to time during the past two or three years to raise funds for the renewal of the original Mid-Atlantic Telegraph line; and it is also unnecessary for me to dwell on the inestimable benefits both of a commercial and social nature likely to accrue to Great Britain and America when the two countries shall be 'en rapport,' since every succeeding day only tends to bring them more vividly before the public. I allude to such matters solely with a view to show that, notwithstanding an almost universal recognition of these benefits, some deep-rooted doubt prevents both the Government and the public from lending that pecuniary encouragement to the undertaking without which it is impracticable to carry it into execution.

"This doubt, I would submit, is in a great measure attributable to the conviction that the methods of surveying the sea-bed, heretofore practised, are wholly inadequate to the requirements of the case; in other words, that the mere transit of a surveying-ship across a predetermined arc of the ocean, the investigation of the depths at intervals also predetermined, or, at all events, determined with no reference to the information evolved *en route*; and, lastly, the deceptive results sometimes incidental to the hitherto employed mode of exploring the general character of the sea-bottom; do not yield either the amount or the kind of knowledge which is essential

* Anniversary Address delivered by Sir Roderick Murchison at the Royal Geographical Society, May 25, 1863. (Proc. Roy. Geograph. Soc. vol. vii. no. 4, pp. 166, 167.)

"5. Observations on the Saline, Mineral, and Organic Constituents of the water from the surface downwards.

"6. Observations, when practicable, on the Penetration of Light, and on the effects of immersion at great depths of the various substances employed as Coatings for Telegraphic Cables.

"7. Natural History generally.

"8. And, lastly, Meteorological Observations, when bearing on any of the above conditions.

"With reference to the first of these heads (namely, soundings for depth, &c.) I may state that it ought to be regarded as an object of primary importance to *probe** the deposits of the sea-bed in every instance in which circumstances engender a suspicion that they are merely superficial films resting upon otherwise uncovered rocky or stony surfaces. That such surfaces occur in some portions of the ocean I think there is no just ground to doubt; and where they occur I would suggest that an endeavour should be made to avoid them by searching out a détour, if discoverable within certain limits; or, if unavoidable owing to their great extent, that measures should be devised for the strengthening or support of that portion of the telegraphic cable which traverses them.

"I would observe that, hitherto, the bringing-up in the sounding-machine of a few grains, or even the fraction of a grain, of soft deposit, has been accepted as evidence that the bottom is composed of soft material, and not of rock, as it may unquestionably be notwithstanding.

"The observations under the second head (namely, the nature of the deposits) demand no comment beyond allusion to their direct bearing, when taken in conjunction with the ascertained depths, on the formation of sedimentary or concretionary strata, and the evidences of their alternate upheaval and subsidence.

"Those under the third head require a word or two of explanation.

"Although the temperature of the ocean, from the surface downwards, has been most ably elucidated by the late Sir James Ross in the southern hemisphere, it has not, so far as I am aware, been ascertained with equal exactitude to the north of the Equator; nor has the law which regulates the equalization of that temperature along the same parallels of latitude at a certain depth below the surface been clearly established. Accordingly, every additional observation and fact which throws light on the mutual operation of terrestrial heat and surface-radiation on the waters of the ocean must prove of value in a scientific point of view, and must exercise a direct influence on the permanent safety of a submerged cable. But, irrespectively of the general law regulating the temperature of the ocean, it is by no means improbable that deep-seated tracts of water exist, along which the temperature may be materially influenced by submarine action. Although no direct data have heretofore been elicited which would lead to the suspicion that any portion of the route likely to be passed over between Ireland and

* An instrument for effecting this purpose (together with my other instruments) was exhibited by me at the meeting of the Geographical Society, January 12, 1863.

Newfoundland is subject to volcanic action, it would surely be well to satisfy ourselves of the true state of the case by direct experiment; and to adopt means for the protection of a cable against evil consequences, should proof of volcanic action, either of this or any more active kind, unfortunately manifest itself.

"The determination of temperature at regular intervals from the surface to extreme depths would also enable us to ascertain, with somewhat greater accuracy than heretofore, the vertical limits of the Gulf-stream and great tidal wave; and the point at which the waters of the ocean are influenced by the deep reflux from the Polar towards the Equatorial regions *.

"The observations comprised under the fourth head (namely, density and pressure) would of course only be carried on occasionally and under circumstances calculated to yield the most trustworthy results. The same remark applies to the observations noted under the four remaining heads †.

"Lastly, I would suggest, in the event of the survey being carried

* In Dr. Carpenter's Preliminary Report (Proc. Roy. Soc. Dec. 1868, p. 186), and Prof. Wyville Thomson's 'Depths of the Sea,' pp. 35, 302, 303), very prominent allusion is made to my having, in my North-Atlantic Sea-bed, adopted Sir John Herschel's and Sir James Ross's doctrine of a permanent temperature of 39° in the water at great depths in the ocean. In both instances the allusion is couched in terms which certainly convey the impression that Drs. Carpenter and Thomson had not just as unhesitatingly adopted the fallacy themselves. It is a remarkable circumstance, too, that in the chapter in 'The Depths of the Sea' specially devoted to "*Deep-sea Temperatures*" (where, if anywhere, the opinion of the authors prior to 1868 on so important a point ought to have been explicitly stated), the only approach to such an opinion is that which immediately succeeds a lengthy extract from my work, described by Prof. Thomson as "an excellent résumé of this fallacy given by Dr. Wallich." "There can be no doubt" (Prof. Thomson says) "that this view, which of *late* (?) years has received almost universal acceptance, is entirely erroneous" (*op. cit.* p. 304). The fact is that Prof. Thomson had *so* unhesitatingly adopted the fallac that, in 'The Annals' for Aug. 1869 (p. 122), he said—"Though I had often wondered what could be the cause, I believed in this permanent temperature of the sea thoroughly, and *had even suggested the particular course* [for the cruise of the 'Lightning'], *because it nearly coincided with the isotherm of* 40° *F.*!" It is right that this should be clearly understood, since *my* sole aim in dwelling forcibly on a uniformly low temperature above the sea-bed, and over the greater pertien of the deep-sea area, was to show that to its influence would be mainly attributable the general uniformity in the distribution of animal life, which has already been found to prevail over that vast area. But it was obviously immaterial to my argument whether the temperature was permanent at 39° F., or ranged from 39° to 30°, or even lower (see 'The Nerth-Atlantic Sea-bed,' pp. 104, 105). The temperature observations taken on board the 'Bulldog' (with which I had nothing whatever to do) were unavoidably meagre and imperfect, every consideration having necessarily given place to the primary one of sounding, for depth, along a given telegraph route. It was indeed deep-sea research conducted under difficulties.

† In 1868, in Prof. Wyville Thomson's 'Depths of the Sea' (p. 52), this passage occurs:—"One or two other questions of the highest scientific interest are to be solved by our proposed investigations. 1st. The effect of pressure upon animal life, *upon which there is great misappre-*

into execution, and time and the primary objects permitting, that a rapid diversion from the proposed longitudinal track should be allowed on the return voyage, with a view to ascertain definitely whether soundings (in the ordinary nautical sense of the term) are to be met with in the region *about* north latitude 57°, and west longitude 30°, where, as I have endeavoured to show (in my work on the North-Atlantic Sea-bed, recently published), shoal water probably exists. I need hardly state that the discovery of soundings yielding from one to two hundred fathoms in such a locality, would be of the greatest value as affording a fresh point of departure for vessels unable, from obstacles of weather, to determine their precise whereabouts. It would also exert a deep significance in connexion with the great areas of subsidence in the North Atlantic, and the distribution of the marine and terrestrial fauna of Northern Europe and the North-American continent.

"I forbear to specify the number of observations of all kinds that might with advantage be made during the proposed voyage; being convinced that this must in a great measure depend on the information elicited *en route*, and that the rate at which the survey progresses should be regulated only by the amount and kind of knowledge obtained at every step. It may, however, be regarded as essential that not less than 300 soundings should be taken, at intervals, having due regard to depths already ascertained; and that in order to provide against unforeseen delays and contingencies, at least six months should be allowed for the completion of the enterprise.

"In submitting my project to the President and Council of the Royal Geographical Society, I am solicitous of directing attention to the results likely to accrue in the several branches of science which relate essentially to the Physical Geography, Geology, and Natural History of the Sea; and on these grounds I cherish the hope that they will exert their influence in recommending Government to grant a ship for the purpose of carrying out this survey at as early a date in the approaching season as may be deemed expedient.

"It rests with those who are competent to form an opinion on the subject to determine whether or not my proposals deserve serious consideration, and also whether I am personally qualified to undertake the various researches indicated. Should I be recommended for the duty for which I have endeavoured to fit myself, I can only say my best efforts shall be put in force to do that duty well."

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hension. . . . . 2nd. The effect of the great diminution of the stimulus of light. From the condition of the Cave Fauna, this latter agent probably affects only the development of colour and of the organs of sight."

The first question, as to pressure, had already been fully solved in my "Notes," published in 1860, p. 25, and my 'North-Atlantic Sea-bed,' published in 1862, pp. 105 to 113. To that explanation nothing material has been since added, although both Dr. Carpenter and Dr. Thomson have most freely used the same arguments and illustrations. The proposal made in the text was to ascertain the pressure at any required depth, by an instrument I designed with this object, in order to compare the results with the theoretical estimate. The action of light had in like manner been discussed in my work (*cit. sup.*, pp. 129 to 133)—the condition of the Cave Fauna, the effect on colour, and on the organs of sight being each investigated in detail.

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IX.—*Notes on the Palæozoic Corals of the State of Ohio.*

By H. Alleyne Nicholson, M.D., D.Sc., F.L.S., Professor of Natural History in the University of St. Andrews.

[Plate V.]

In the spring of the year 1874 I was asked by Professor Newberry, the accomplished head of the Geological Survey of Ohio, to undertake the description of the Corals which had been obtained by the officers of the Survey within the limits of the State. At this time I was on the point of leaving America for England; a large part of my private library was already packed up; and the only public library to which I could refer was very imperfectly supplied with works dealing with the Palæozoic corals. I had, further, neither the time nor the means for making the necessary microscopic sections of the specimens submitted to me. Under these circumstances, it was inevitable that errors would be committed to some extent. Since my return to England, my collections remained for long packed up; and I had no opportunity of revising the proofs, or of rectifying these errors, before the second volume of the 'Palæontology of Ohio' went to press. I have, however, during the last winter unpacked my collections of American corals, and have sliced a large number of them for microscopic examination. I wish, therefore, now to correct such mistakes as were made in my original Report, and to add certain details which were there omitted. On the present occasion I shall confine my remarks to certain of the species of *Chætetes*, *Constellaria*, and *Streptelasma*.

Chætetes rhombicus, Nicholson, Geological Survey of Ohio, Palæontology, vol. ii. p. 201, pl. 21. figs. 12, 12 *a*.

Microscopic sections of this beautiful species prove its distinctness from all other previously described members of the group in the most conclusive manner. In cross sections (Pl. V. fig. 1) the central portion of the corallum is seen to be occupied by the transversely divided ascending corallites of this region. Each tube is rhomboidal or diamond-shaped; and the corallites are arranged, with geometrical regularity, in a double series of decussating gently curved diagonals. The tubes are filled with transparent calcite; and each has its rhomboidal area very distinctly and regularly divided into four equal triangles by a cruciform divisional line. These divisional lines in the interior of the tubes are perfectly regular in their arrangement, and are quite uniform in their direction in each specimen (Pl. V. fig. 1 *a*); they therefore give rise to a second, fainter, double series of diagonal lines, which intersect the more strongly marked series of diagonals formed by the walls of the tubes themselves. Similar, but less conspicuous and less regular, divisional lines are visible in the calcite which fills the tubes of the corallites in many species of *Chætetes* and in *Constellaria*; but I have been unable to satisfy myself as to the true cause of this phenomenon. In longitudinal sections (Pl. V. fig. 1 *b*) the corallites are seen to be nearly vertical in the central portion of the ramose corallum, and to curve outwards at a considerable angle as they approach the surface. It is owing to this arrangement of the tubes that the central portion of a cross section (Pl. V. fig. 1) shows the corallites divided transversely, at right angles to their direction, whilst the marginal portion of a cross section shows the tubes cut obliquely but in the main longitudinally. In the central and vertical portion of their course the corallites are destitute of tabulæ; but these structures are well developed in the outer (more nearly horizontal) portion of the tubes. The corallites increase somewhat in diameter in approaching the surface; and interstitial tubuli are wholly wanting.

The increase of the corallum is clearly shown by longitudinal sections to take place by fission of the old corallites, and not by gemmation. The species must therefore be placed in the genus *Chætetes*, and not in *Monticulipora* as ordinarily understood. In fact, so far as my present investigations have gone, all the species ordinarily referred to *Monticulipora* can be shown, by properly prepared sections, to increase by fission of the old tubes; and they must therefore be placed in *Chætetes*, unless some distinction other than the mode of growth can be shown to separate these two groups.

Chætetes sigillarioides, Nicholson, *op. cit.* p. 203, pl. 22. figs. 9, 9 *a.*

I have at present only examined longitudinal sections of this species, which, however, are highly characteristic. In the central portion of the corallum (Pl. V. fig. 2), the corallites are nearly vertical, with slightly flexuous walls, and wholly destitute of tabulæ. As they ascend from the centre towards the surface the corallites become curved outwards, and a few remote tabulæ become developed in them, though these structures are always scanty and may be entirely absent. Between the proper corallites, in the outer portion of their course, are developed minute interstitial tubuli, which are furnished with close-set and regular tabulæ. The plate which I have described as filling up so many of the calices in this form, and which may probably be regarded as a species of operculum, is not visible in sections.

Chætetes nodulosus, Nicholson, *op. cit.* p. 200, pl. 21. figs. 10, 10 *a.*

The longitudinal sections of this species (Pl. V. fig. 3) agree with those of the preceding species in many points. The corallites, however, in the ascending portion of their course are furnished with remote but regular tabulæ throughout, as they are near the surface also; the interstitial tubuli which are present, though closely tabulate as in *C. sigillarioides*, are much less regular and frequent than in the latter species; and the outline of the surface is broken by projecting "monticules." The external characters of these two species are still more decisively different.

Chætetes rugosus, Edwards & Haime.

Chætetes rugosus, Nich. *op. cit.* p. 193, pl. 21. fig. 2.

Longitudinal sections of this species, as of the preceding, show that the corallites in the central portion of the corallum are nearly vertical, and that they gradually curve outwards in approaching the surface (Pl. V. fig. 4). Some of the corallites are of considerable size, and appear to be free from tabulæ; others, rather smaller as a rule, are provided with regular transverse tabulæ; and, lastly, there are a number of minute interstitial tubuli, in which the tabulæ are very numerous and closely set.

Chætetes ramosus, Edwards & Haime.

Chætetes Dalei, Nich. *op. cit.* p. 192, pl. 21. figs. 1, 1 *a*.

The form which I described as *C. Dalei*, E. & H., seems to be really the *C. ramosus* of these authors. Its internal structure, as shown by sections, is quite identical with that of *C. rugosus*, E. & H.; and it would seem to be probable that these two forms are no more than strongly marked varieties of a single species, whilst the true *C. Dalei*, E. & H., may be nothing more than a smooth variety of the same form.

Chætetes petropolitanus, Pander.

Chætetes petropolitanus, Nich. *op. cit.* p. 204, pl. 21. figs. 14, 14 *a*.

I have made sections of a considerable number of examples of this variable form from the Trenton Limestone of Canada, the Cincinnati Group of Ohio, and the Lower Silurian rocks of Sweden; but I have not as yet had the opportunity of examining Russian specimens. So far as I have seen, the internal structure of this species is very constant and characteristic, however widely different specimens may differ in external aspect and mode of growth. In longitudinal sections (Pl. V. fig. 6) the tubes are seen to differ considerably in size, and they may be considered as belonging to three groups. The largest tubes exhibit a peculiar phenomenon, which occurs in some other species of *Chætetes* as well. Each tube, namely, is divided down its centre into two compartments by an irregular, flexuous, and delicate vertical septum. On the one side of this septum the tabulæ are usually curved, with their convexities directed outwards, and are tolerably numerous, and often more or less oblique; whilst on the other side the tabulæ are more remote, and are directed at right angles across the corallites. The tubes of the second group are smaller than the preceding, and are furnished with regular transverse tabulæ. Lastly, there is a group of small tubuli, irregularly interspersed at short intervals amongst the larger tubes, in which the tabulæ are very numerous and very closely set. In transverse sections (Pl. V. fig. 6 *a*) the corallites are seen to be more or less polygonal in outline, usually hexagonal or pentagonal, with very thin walls. No interstitial tubuli are to be observed, though these would doubtless be visible in a section cut tangential to and near the external surface.

Chætetes discoideus, James.

Chætetes discoideus, Nich. *op. cit.* p. 206, pl. 21. figs. 15–15 *c*.

This species forms thin, flattened, concavo-convex disks,

sections of the branches (Pl. V. fig. 5), the corallites are vertical, diverging slightly outwards towards their summits, and then turning abruptly, and nearly at right angles, to reach the surface. In the vertical portion of their course the corallites have thin undulating walls, and are destitute of tabulæ. In the outer horizontal portion of their course the corallites have thicker walls, are provided with delicate remote tabulæ, and are interspersed with smaller tubes furnished with numerous close-set tabulæ. The increase of the tubes is by fission. Though more closely allied in its general features to *C. tumidus*, Phill., than to any other species of the genus, *C. Jamesi* is shown by microscopic sections to be perfectly distinct. The former species is distinguished by the fact that the corallites do not turn at right angles to gain the surface, but curve gradually outwards, by the presence of remote tabulæ in the central corallites and the almost total absence of tabulæ in the corallites in the external portion of their course, and, lastly, by the fact that the numerous interstitial tubuli do not seem to be provided with tabulæ.

Chætetes gracilis, James.

Chætetes gracilis, Nich. *op. cit.* p. 198, pl. 21. figs. 8, 8 *b*.

The internal structure of this species is likewise very distinct and characteristic. In long sections (Pl. V. fig. 13) the tubes in the central portion of the branches are seen to be nearly vertical, slightly undulating, with thin walls, and crossed here and there by an occasional tabula. As they approach the surface the corallites bend gently outwards, becoming much more strongly undulated, with thickened walls, and increasing in number rapidly by fission. In the outer portion of their course the larger corallites are furnished with a few remote tabulæ, whilst the smaller corallites have a considerable number of these structures. In tangential sections, taken close to the surface, the corallites are seen to be oval or rounded, with extremely thick walls, and having a number of very minute, circular, interstitial tubuli interspersed amongst them. This form is at once distinguished from *Chætetes* (*Monticulipora*) *Fletcheri*, E. & H., amongst other characters, by the thick-walled strongly undulated corallites.

Chætetes Fletcheri, Edwards & Haime.

Chætetes Fletcheri, Nich. *op. cit.* p. 197, pl. 21. figs. 7, 7 *a*.

Though very like *C. gracilis*, James, in external characters and general appearance, *C. Fletcheri* is distinguished from that species, in long sections, by the wide straight corallites, which are furnished with regular remote tabulæ, and which have small, more closely tabulate tubuli occasionally intercalated amongst them. In cross sections (Pl. V. fig. 14) the corallites are seen cut longitudinally around the margin and transversely divided in the centre, where they are polygonal and thin-walled.

Chætetes tuberculatus, Edwards & Haime.

Chætetes corticans, Nich. *op. cit.* p. 210, pl. 22. figs. 6, 6 *a*.

There can be no doubt that the form to which I gave the name of *C. corticans* is really identical with the *C. tuberculatus* of Edwards and Haime. I have not yet had the opportunity of making sections of this species, and am therefore unable to give any details as to its internal structure.

Chætetes clathratulus, James.

Chætetes clathratulus, Nich. *op. cit.* p. 209, pl. 22. figs. 2, 2 *b*.

It seems not unlikely that this is really the *Chætetes* (*Ptilodictya*) *pavonia* of D'Orbigny; but the published figures of the latter species do not allow of a satisfactory determination of this point. Be this as it may, the internal structure of *C. clathratulus* is highly characteristic and peculiar. In tangential sections taken parallel with the surface (Pl. V. fig. 9), the corallites are seen in the form of oval tubes, arranged in two series of regularly decussating diagonals, each tube being directed with its long axis oblique to the row to which it belongs. The walls of the corallites are very thick, and no interstitial tubuli are present. Each corallite seems to be primitively more or less hexagonal or diamond-shaped; and the oval section of the interior of the tube is clearly due to a secondary thickening of the walls. In long section (Pl. V. fig. 9 *a*) the corallum is seen to consist of two strata of corallites directed outwards in opposite directions from a delicate, flexuous, median lamina, with which their walls are sometimes connected by thin plates. Sometimes (as in the figure) a second stratum of short corallites may be superimposed upon one of the original layers. The walls of the corallites are very thick; and tabulæ appear to be wholly absent. This latter feature leaves it still doubtful if this singular form can really be referred to *Chætetes*.

Chætetes frondosus, D'Orbigny.

Chætetes frondosus?, Nich. *op. cit.* p. 208, pl. 22. figs. 1, 1 *b*.

I am still in doubt whether my specimens are really referable to *C. frondosus*, D'Orbigny, or whether two superficially similar forms have not been included under this name. Sections of my specimens taken parallel with the surface (Pl. V. fig. 11) show very striking features. The majority of the corallites are oval or rounded, and have very thick walls. In the spaces between the ordinary corallites are placed smaller oval or rhomboidal tubes, of the same character as the preceding; and, lastly, there is a great number of very minute, circular, interstitial tubuli, the walls of which are so dense as to look black in sections. These smallest tubuli are irregularly scattered amongst the larger ones, and very often are so placed as to project into the cavity of one of the large corallites. In long sections (Pl. V. fig. 9 *a*), the corallum is seen to consist of two strata of corallites, which are directed outwards at right angles and in opposite directions from a thin undulating median lamina, with which they are connected by delicate curved tabulæ. Three kinds of corallites are present, as in *C. petropolitanus*. In one kind, the largest of all, the interior of the tube is divided into two halves by a delicate wavy vertical septum; in one half of the tube the tabulæ are more or less curved, and in the other half they are generally straight and less numerous. In another kind, rather smaller than the preceding, the tubes are simply crossed by straight, comparatively remote tabulæ. Lastly, there are numerous minute tubuli, in which the tabulæ are very closely set.

Constellaria antheloidea, Hall.

Constellaria antheloidea, Nich. *op. cit.* p. 214.

In its internal structure this genus very closely approaches *Chætetes* (*Monticulipora*); and it is doubtful if the marked external peculiarities which it presents are sufficient to justify generic distinction. Vertical sections, taken through the centre (Pl. V. fig. 10 *a*), show that the corallites are nearly vertical in the middle of the corallum, and are divided by regular but very remote tabulæ. In approaching the surface the corallites bend outwards, and divide by fission into a number of more slender tubes, which are generally traversed by very numerous and close-set tabulæ. In cross sections (Pl. V. fig. 10) the corallites are seen on the circumference of the section to be cut longitudinally, as they bend outwards, and they are here finely tabulate, whilst a few of the larger tubes appear to be destitute of tabulæ. In the centre of the section the corallites are divided transversely, and they are here thin-walled and polygonal. The calcite filling the tubes is divided

Streptelasma corniculum, Hall.

Streptelasma corniculum, Nich. *op. cit.* p. 218.

Having now made carefully prepared thin sections of typical examples of this the type species of the genus *Streptelasma*, I am enabled to give the characters of the genus in greater detail, and to correct one or two errors in my former description. The corallum is free, simple, and turbinate, with a thick wall and a well-developed epitheca. The septa (Pl. V. fig. 15) are well developed, of two kinds. The majority of the primary septa fall short of the centre of the visceral chamber; but a certain number are continued inwards, in the form of irregular, tortuous, vertical plates, which often unite with one another, and give rise to a sort of subvesicular axis, which forms a low prominence in the bottom of the calice. Cross sections also show a well-marked septal fossula, including two or three short septa. The secondary septa are short, and alternate regularly with the longer ones. Dissepiments are not absent (as erroneously believed), but are developed to a small extent in a zone between the inner ends of the secondary septa and the central space, into which most of the primary septa do not enter. Some specimens exhibit hardly any dissepiments; others have a considerable number. In long sections (Pl. V. fig. 15 *a*) the visceral chamber is seen to be traversed by well developed tabulæ, which are convex upwards, are elevated centrally, and are somewhat, but loosely, vesicular towards the margin. In sections taken accurately across the centre, there are seen in the median line of the corallum a few vertical, sometimes more or less bent or twisted lamellæ. These are the edges of the tortuous central plates formed by the inward prolongation to the centre of a few of the primary septa. In the transverse section of *S. corniculum*, Hall, which I have here figured, there are fifty-seven primary septa and an equal number of secondary septa, and three of the primary septa are shorter than the others and stand in the septal fossula.

The genus *Streptelasma*, as founded upon the type species *S. corniculum*, can be certainly asserted to be a Rugose coral, and to be nearly allied to *Zaphrentis*. It differs from *Zaphrentis* in the smaller development of the tabulæ, in the fact that the fossula is not formed by the coalescence of a certain number of the septa, and in the prolongation to the centre of some of the primary septa as so many twisted plates.

EXPLANATION OF PLATE V.

[All the figures of this plate, except figs. 15 and 15 *a*, are highly magnified; but they are not uniformly enlarged; and, for the sake of clearness, they are rendered very slightly diagrammatic, though at the same time they are faithful representations of the objects drawn.]

Fig. 1. Portion of a cross section of *Chætetes rhombicus*, Nich., showing part of the outer margin and part of the central area; 1 *a*, a few cells from the central portion of the same, still more highly magnified, showing the peculiar divisional lines in the calcite filling the tubes; 1 *b*, long section of part of a branch of the same.

Fig. 2. Longitudinal section of part of a branch of *Chætetes sigillarioides*, Nich., showing the minutely tabulate interstitial tubuli.

Fig. 3. Longitudinal section of part of a branch of *Chætetes nodulosus*, Nich.

Fig. 4. Longitudinal section of part of a branch of *Chætetes rugosus*, Edw. & Haime.

Fig. 5. Longitudinal section of part of a branch of *Chætetes Jamesi*, Nich.

Fig. 6. Vertical section of part of a small example of *Chætetes petropolitanus*, Pander; 6 *a*, portion of a horizontal section of the same specimen.

Fig. 7. Part of a horizontal section of *Chætetes discoideus*, James, close to the centre of the corallum; 7 *a*, portion of a vertical section of the same.

Fig. 8. Part of a horizontal section of *Chætetes Newberryi*, Nich.; 8 *a*, part of a vertical section of the same.

Fig. 9. Part of a horizontal section of *Chætetes clathratulus*, James; 9 *a*, part of a vertical section of the same. On one side a second layer of short corallites is seen to be superimposed on the two original layers forming the corallum.

Fig. 10. Part of a transverse section of *Constellaria antheloidea*, Hall, showing a portion of the margin and a portion of the central region; 10 *a*, part of a vertical section of another example of the same.

Fig. 11. Part of a horizontal section of *Chætetes frondosus*, D'Orb. (?); though essentially parallel to the surface, the section has divided the corallites in a slightly oblique manner; 11 *a*, part of a vertical section of another example of the same.

Fig. 12. Part of a horizontal section of a branch of *Dekayia attrita*, Nich., taken from the central region of the branch, and showing the surface-columns cut across transversely; 12 *a*, part of a vertical section of another example of the same, showing the longitudinally divided columns as thickenings of the walls of the corallites.

Fig. 13. Portion of a vertical section of a branch of *Chætetes gracilis*, James.

Fig. 14. Portion of a transverse section of a branch of *Chætetes Fletcheri*, Edw. & Haime, showing part of the margin and part of the central area.

Figs. 15 & 15 *a*. Transverse and vertical sections of *Streptelasma corniculum*, Hall.

(All the specimens figured are from the Cincinnati Group of Ohio, with the exception of the specimens of *C. petropolitanus* figured in 6 and 6 *a*, which are from the Trenton Limestone of Canada.)

X.—*Notes on Carboniferous Lamellibranchiata.* By R. Etheridge, Jun., F.G.S.

[Plate IV.]

Class LAMELLIBRANCHIATA.

Genus Aviculopecten, M'Coy, 1851

(Ann. & Mag. Nat. Hist. vii. p. 171).

Aviculopecten subconoideus, sp. nov. Pl. IV. figs. 1 & 2.

Sp. char. Ovato-orbicular, inæquivalve. Anterior side rounded; posterior side slightly produced. Left valve the more convex of the two, with the beak larger, more inflated and more abruptly separated from the ears by a slope on each side. Anterior ear of the right valve almost triangular, defined from the body of the shell by a deep notch, with several radiating ridges, crossed by strong scale-like striæ; anterior ear of the left valve larger than the preceding, and not so deeply defined, ornamented by many radiating ridges crossed by striæ parallel to its margin. Posterior ears pointed, falcate, marked with radiating ridges crossed by striæ parallel to the margins; the radiating ridges of the left posterior ear perhaps stronger and more numerous than those of the right. Hinge-line long. Cartilage-area (in casts) well defined, and large for the size of the shell. Body of the shell ornamented with radiating ribs, larger and smaller alternately in the left valve; broader, flatter, and more nearly equal in the right valve.

Obs. The slightly extended posterior side, convexity of the left valve, and separation of the body of the shell from the ears by a slope intimately connect this species with *A. conoideus*, M'Coy*. But in this species the ears are said to be "large, equal, slightly pointed . . . and without radiating striæ;" the right valve is not specially mentioned; and the radiating striæ of the shell are "equal." In a later description, Prof. M'Coy only refers to the posterior ear†. The ornamented condition of the ears and the varying nature of the ribs, however, tend to separate the two species. The larger ribs of the left valve of *A. subconoideus* are sharper in the umbonal region, and become gradually broader and flatter towards the ventral margin, but in no case so broad or flat as those of the right valve. The intermediate smaller

* Synopsis Carb. Foss. Ireland, 1844, p. 91, t. 17. f. 2.
† Brit. Pal. Foss. p. 485.

appear referable to *A. cœlatus.* Amongst the twenty specimens before me, there are perceptible, although slight, variations in the general form of the shell, number and strength of the radiating costæ, and relative development of the concentric and regularly frilled imbrications. When full-grown the shell must have attained a considerable size, and, with an increase in age, appears to have become longer than high, with a corresponding widening of the interspaces between the radiating costæ and frilled imbrications. In all, the anterior ear of the right valve is elongate and well divided from the body of the shell, although the radiating ridges on it are not constant in number; whilst on the pointed posterior ears of some the frilled imbrications of other parts of the shell become flattened or depressed and not so broken up. In all the right valves the radiating costæ are less sharp, and the concentric imbrications much flatter and less frill-like than in the left valve, giving to the valve a somewhat reticulate appearance. The majority of our specimens, so far as I can ascertain, exhibit from fifty to fifty-five radiating ribs or costæ. The prismatic shell-structure is often visible in a fine state of preservation. The shells I have here referred with doubt to *A. cœlatus* differ slightly from Prof. M'Coy's description of the latter, and at the same time they exhibit characters not shown in the figure of that species. Unfortunately Prof. M'Coy's specimen appears to have been defective in the anterior ears; so that we labour under some difficulty in referring specimens to this species, and a certain amount of latitude must be allowed. With the view of comparing our specimens with examples of *P.? fimbriatus*, Phill., Prof. T. M'K. Hughes was kind enough at my request to forward me specimens from the Cambridge collection, which appear to be those used by Prof. M'Coy for his emended description of Phillips's species. The ornamentation, as described by the former, consists of somewhat indistinct obtuse ridges, crossed at intervals by flattened or depressed concentric imbricating growth-lamellæ, with still finer lines between them, almost assuming the character of striæ. These, with the short obtuse posterior ears and square left anterior ear, extending as far as the edge of the shell, will at once serve as characters whereby *A. cœlatus* and the present shells on the one hand, and *P.? fimbriatus* on the other, may be distinguished from one another.

A similar style of ornamentation of the left valve to that described above in the shells which I have referred to *A. cœlatus* is met with in *A. subfimbriatus*, D'Arch. and De Vern.*

* Murchison's Geol. Russia, vol. ii. Paléontologie, p. 327, t. 21. f. 5.

Loc. and Horizon. Charleston, Fife, in Encrinital shale; Teasses Quarry, Lundin, Fife, in shale: both collected by Mr. R. Gibbs. Galabraes and Petershill Quarries, near Bathgate, Linlithgowshire, in shale below the Bathgate limestone; Currielee Quarry No. 2, on the Tyne Water, Edinburghshire, in impure limestone, 20 to 30 feet above the No. 2 limestone of the Midlothian series; Hope Quarry, near Pathhead, Haddingtonshire, in impure limestone; Lower Carboniferous Limestone group: all collected by Mr. J. Bennie, &c. (collection of the Geol. Survey of Scotland).

*G*enus EDMONDIA, De Koninck, 1844

(Descr. Anim. Foss. Terr. Carb. Belg. p. 66).

Edmondia unioniformis, Phillips. Pl. IV. fig. 3.

Isocardia, Phil. Geol. Yorksh. 1836, ii. p. 209, t. 5. f. 18.
Edmondia, De Kon. Descr. Anim. Foss. Terr. Carb. Belg. p. 67, t. 1. f. 4; Morris, Cat. Brit. Foss. 1843, p. 88 (without description); Tennant, Strat. List Brit. Foss. 1847, p. 99 (without description); Bronn, Index Pal. Nomen. 1848, p. 452 (without description); Keyserling & De Vern. Murchison's Geol. Russia, ii. p. 299, t. 19. f. 18; D'Orb. Prod. de Pal. 1849, i. p. 133 (without description); Brown, Foss. Conch. 1849, p. 198, t. 81. f. 15; Morris, Cat. Brit. Foss. 1854, 2nd edit. p. 202 (without description); M'Coy, Brit. Pal. Foss. p. 503; Eichwald, Lethæa Rossica, 1860, i. p. 1034; Salter, Mem. Geol. Surv. Iron Ores of Gt. Brit. 1861, pt. 3, t. 1. f. 29; Huxley & Etheridge, Cat. Foss. Mus. Pract. Geol. 1865, pp. 111 & 117 (without description); Armstrong & Young, Cat. Carb. Foss. W. Scotland, Trans. Geol. Soc. Glasgow, iii. Supp. p. 51 (without description).

Sp. char. The very full and comprehensive description given by Prof. M'Coy renders it unnecessary to redescribe this shell. The specimen figured appears to be a somewhat more elongate variety of this species than the generality of specimens met with. It is from the "Encrinite-bed," cement-stone group of the Lower Carboniferous rocks at St. Andrews, cabinet of Dr. Traquair.

Obs. I wish more particularly to note the extensive range of *E. unioniformis*, both geologically and geographically. From the Lower Carboniferous or Calciferous Sandstone beds of Cove Harbour, Cockburnspath, Haddingtonshire, it has been recorded by the late Mr. Salter*; it occurs here, accompanied by other marine shells, in an impure limestone above the coal-beds and sandstones of that locality. We next have the present example from the Encrinite-bed at St. Andrews, of the Fifeshire Lower Carboniferous series, not far from the

* Mem. Geol. Surv. 33, Scotland, 1866, p. 73.

former horizon. Passing to the true Carboniferous Limestone, *E. unioniformis* is met with in England at Bolland (Phillips), Lowick (M'Coy), in Scotland at numerous localities, in Belgium at Visé (De Koninck), in Russia at Kasatschy-datschy &c. (De Verneuil and Eichwald). Proceeding still upwards, Mr. Salter figured a specimen from the collection of Dr. G. P. Bevan, obtained in the "Rosser-vein" ironstones, between the Farewell Rock and millstone-grit, of Glan Rhymney, South Wales, at the base of the Coal-measures*.

Genus LEDA, Schumacher.

Leda Traquairii, sp. nov. Pl. IV. fig. 4.

Sp. char. Shell clavate, ventricose, short, and arcuated; anterior end large, rounded; posterior end short, attenuated, and obtusely pointed; ventral margin arcuated, passing rapidly up to the attenuated posterior end; umbones anterior more than central; hinge-area probably wide, and bounded by obtusely rounded umbonal ridges, passing to the posterior end, where they become lost; lunule——? hinge-teeth——? ornamented with regular, equal, flattened, concentric, rib-like striæ, uniting on the obtusely rounded posterior end in small bundles to form broader and coarser fluctuations.

Obs. The distinguishing characters of *L. Traquairii* are its extremely short, clavate, and ventricose form, rapidly arcuated base, and short attenuated end. These points, with its strongly curved umbonal ridges and broad and flat concentric striæ, serve to distinguish the species from *L. attenuata*, Flem. The general proportions of the two shells also vary considerably. *L. Traquairii* appears to be intermediate between the latter and *Leda* (*Nucula*) *claviformis*, Sow.† (non Phil.), from which it may be distinguished by not possessing a truncated posterior end. The posterior end is very short, as in Sowerby's species, but is clearly rounded and not truncated. *L. claviformis*, Sow., to which the new species is closely allied in its clavate and ventricose form, is said by Prof. Morris‡ and Capt. T. Brown§ to be a Lias form. Sowerby says, "in rounded masses of grey limestone in the alluvial deposits so common in many parts of Norfolk and Suffolk." Were it not for the definite statement of these authors, I should feel much inclined to regard *N. claviformis*, Sow., as a carboniferous shell. In his 'Car-

* Mem. Geol. Surv. Iron Ores of Gt. Britain, pt. 3, p. 221.
† Min. Conch. v. p. 119, t. 476. f. 2.
‡ Cat. Brit. Foss. 1st ed. p. 94.
§ Foss. Conch. 1849, p. 185.

portion of the ventral margin straighter, and the anal angle sharper than in Prof. M'Coy's figure; it is also a smaller shell. Notwithstanding these slight discrepancies, Mr. Sharman, of the Museum of Practical Geology, to whom the shell was submitted, agrees with me in believing this to be a variety of *L. fragilis*. As in the redefined diagnosis of *Leptodomus*, the present shell did not, I think, gape anteriorly and posteriorly, and there is no sulcus in the posterior slope, neither does the dorsal margin appear to be inflected or bear an upward curvature.

Loc. and Horizon. Obtained by Mr. A. Patton from the Calderwood Cement-stone (? Lingula Limestone of Carluke), at the Kirktonholm Cement Works, East Kilbride, Lanarkshire; Lower Carboniferous Limestone group.

Leptodomus? clavatus, sp. nov.? Pl. IV. figs. 9 & 10.

Sp. char. Clavate, arcuated, very inæquilateral, and gibbous in the umbonal region. Anterior side short, convex, its margin rounded; posterior side much more compressed, transversely elongated, somewhat recurved, and truncated obliquely, with an obtusely rounded ridge from the umbones to the posterior ventral angle; posterior slope a little concave (?), and divided by a sulcus or groove from behind the beaks backwards to the posterior margin. Umbones large, prominent; beaks terminal (?). Surface ornamented with wrinkles parallel to the margins. Internal characters —— ? Shell thin.

Obs. The smaller of the two figures (fig. 10) is a small example of a shell which occurs in some abundance at two localities in this neighbourhood, but, as a rule, in a crushed and mutilated condition. I believe it to be distinct from *Leptodomus costellatus*, M'Coy*; and the profusion with which it occurs, especially at one of the two localities, necessitates a name being given to it. From the species just mentioned it differs in its more transversely elongated form, absence of any sinus in the ventral margin near the anterior end, more sharply defined posterior ventral angle, and less height of the posterior end. Fig. 9 I believe to be the same shell, but from another locality. In some specimens the posterior end is almost square, in others the obliquity is considerable; this may arise, perhaps, in some degree from pressure. Crushed specimens at first sight bear some resemblance to *Lutraria elongata*, M'Coy†.

Loc. and Horizon. Shale above the Craigleith sandstone,

* Brit. Pal. Foss. p. 508, t. 3 F. f. 5.
† Syn. Carb. Foss. Ireland, 1844, p. 52, t. 8. f. 3.

Craigleith Quarry, near Edinburgh, Cement-stone group, of the Lower Carboniferous series; the individuals much crushed, and usually more or less pyritized. Shale containing marine fossils (*Orthoceras*, *Discina*, *Bellerophon*, &c.), Water of Leith, at Woodhall, near Juniper Green, about five miles west of Edinburgh; also in the Cement-stone group (fig. 10). Collection of the Geol. Survey, Scotland; collected by Mr. J. Bennie. Brown sandstone of Knockhill Quarry, Strathkinness, St. Andrews, Cement-stone group; cabinet of Dr. Traquair (fig. 9).

Genus Myalina, De Koninck, 1844

(Doser. Anim. Foss. Terr. Carb. Belgique, p. 125).

Myalina? trigonalis, sp. nov. Pl. IV. fig. 8.

Sp. char. Transversely trigonal, diagonally gibbous; anterior side short and rounded; posterior side obtusely rounded ventrally, flat, wing-like, and slightly falcate dorsally. Ventral margin convex; byssal sinus slight. Hinge-line as long as the shell, thickened; beaks convex, anterior, but not terminal. Shell ornamented with regular, broad, obtusely rounded or almost flat concentric plaits or wrinkles, which become finer and closer on the anterior side, and apparently quite flat on the posterior wing.

Obs. I have not been able to ascertain the internal hinge-characters of this shell, and am in doubt whether it should be referred to *Avicula*, *Pterinea*, or *Myalina*. Its reference to the latter, however, is borne out by the somewhat thickened hinge-margin, which is apparent in two specimens. On the other hand, the anterior end is not obsolete in *M.? trigonalis*, as it should be according to Prof. M'Coy's redefinition of the genus. The chief characters of the species are the almost triangular outline, position of the beaks, at less than a third from the anterior end, and the flat, regular, concentric plaits.

With such forms as *Myalina Verneuilii*, M'Coy*, and *M. crassa*, Flem.†, a comparison is unnecessary. From *M. Foynesiana*, Baily‡, it may be distinguished by the more produced posterior wing and less obliquely truncated posterior end, &c. Although resembling some of the Pteronites in form, the radiating ribs or striæ, usually found in species of that genus, are here totally wanting. *M. trigonalis* appears to be a very close ally of *Pterinea? informis*, M'Coy§, but has not the very

* *Avicula*, Syn. Carb. Foss. 1844, p. 85, t. 13. f. 19.

† Etheridge, Ann. & Mag. Nat. Hist. 1875, xv. p. 427.

‡ Mem. Geol. Survey Ireland, Expl. 142, 1860, p. 13, f. 4.

§ *Avicula*, Syn. Carb. Foss. p. 83, t. 13. f. 21. *Pterinea?*, Brit. Pal. Foss. p. 479.

large, tumid, and prominent beaks of that species; the concentric wrinkles or plaits are numerous, and not merely reduced to three in number as in Prof. M'Coy's species.

Loc. and Horizon. Cockburnspath, near St. Abbs Head, Berwickshire, in a fine brown sandstone of the Lower Carboniferous or Calciferous Sandstone series. Collected by and in the cabinet of Dr. Traquair. Mr. Salter obtained a *Myalina*, "species obscure," in the bottom beds of the Cockburnspath section, and an *Avicula* or *Gervillia* in thin sandy layers, with *Cyclopteris*, of the Cockburnspath coal-beds*.

Genus Nucula, Lamarck.

Nucula Youngi, sp. nov. Pl. IV. figs. 11–13.

Sp. char. Transversely elongated, inæquilateral, and compressed; anterior side short, much smaller than the posterior, bluntly attenuated; posterior side elongated, inclined to become square, but with the margin uniformly rounded; umbones anterior, approximate, compressed; dorsal margin erect, no hinge-area; hinge-teeth —— ? ventral margin rounded, arching rapidly upwards in the antero-ventral portion; there appears to be a small lunule; surface regularly and concentrically striated with sharp, prominent striæ.

Obs. A small and elegant shell, resembling *Nucula brevirostris*, Phill.†, but having a much straighter dorsal margin anteriorly, and a less constricted anterior end. *N. Youngi* appears to be intermediate between this species and *Nucula accipiens*, Sow.‡ After searching through all the descriptions of Palæozoic *Nuculæ* at my command, I have failed to find any which would embrace this form. I name the species after Mr. J. Young, of the Hunterian Museum, Glasgow.

Loc. and Horizon. Orchard Quarry, about three miles south of Glasgow, from shale above the Orchard Limestone, Upper Carboniferous Limestone group. Collected by Mr. James Bennie, to whom I am indebted for the specimen.

I am much indebted to Mr. Walter Keeping for some notes on *P.? fimbriatus*, Phill., to Dr. Traquair and Mr. A. Patton for the loan of the specimens mentioned as in their collections, and to Mr. B. N. Peach for again undertaking the drawing of the fossils.

* Mem. Geol. Survey Scotland, No. 33, E. Lothian, pp. 72,

† Geol. York. 1836, ii. p. 210, t. 5. f. 11 *a*.

‡ Trans. Geol. Soc. 2nd ser. v. t. 39, f. 40.

Xylodes (g. n.) albovarius.
Cis insularis.
—— sexcarinatus.
Cistela brunnea.
Balanodes (g. n.) tomentosus.
Caranistes annulipes.
Cratopus inornatus.
—— virescens.
—— magnificus.
Pentarthrum Rodriguezi.
Macrotoma simplex.
Cryptonychus limbatus.

GEODEPHAGA.

Carabidæ.

Chlænius olivaceus, sp. n.

C. capite thoraceque obscure viridi-æneis; capite obsolete subtiliter punctulato; thorace sat crebre fortiter punctato; elytris obscure olivaceis, striatis, interstitiis sat crebre distincte punctatis; antennis articulis tribus basalibus pedibusque flavo-ferrugineis, tarsis obscurioribus. ♂. Long. $5\frac{1}{4}$ lin., lat. 2 lin.

Somewhat resembles *C. nigricornis*, Fab., in form; but the thorax is relatively a little narrower, the sides are a little more rounded, the posterior angles more rounded; the elytra are slightly more attenuated posteriorly. The antennæ are blackish, with the first three joints reddish yellow. The head is sculptured as in *C. nigricornis*, but rather more distinctly, the punctures are more distinct towards the eyes and on the neck. The thorax is one fourth broader than long, gently convex, strongly punctured but not very thickly; the punctures, however, are closer near the suture and towards the hinder margin; there is a single well-defined fovea near the posterior margin, slightly nearer to the side than to the sutural line. Scutellum impunctate. Elytra somewhat broader than the thorax, less parallel at the sides, and more narrowed towards the apex than in *C. nigricornis*; the pubescence is rather less close, the striæ are well marked (rather more so than in *C. nigricornis*), the interstices are thickly and distinctly punctured, but the punctures are not crowded. The underside is black, shining; a few strong punctures are scattered over the prosternum and the metasternum. The legs are reddish yellow; the apices of the tibiæ and the tarsi are pitchy.

Var. Elytra with a reddish-yellow spot near the apex on the third to sixth interstices. ♀.

HYDRADEPHAGA.

Dytiscidæ.

Colymbetes (*Rantus*) *socialis*, sp. n.

C. elongato-ovalis, supra obscure flavicans, infra niger; capite postice nigro, vertice transversim flavo notato; thorace disco guttis parvis duabus approximatis piceis notato; elytris obscurioribus (flavo limbatis); prosterno pallido. Long $4\frac{1}{2}$ lin., lat. $2\frac{3}{8}$ lin.

Elongate oval, shining. Head yellow, with an oblique spot on each side on the forehead, and the neck black, the black portions uniting at the eyes. Thorax yellow, with the middle of the anterior and posterior margins and two approximate discoidal spots pitchy; very shining, with a line of punctures along the front margin; there is also a line of obscure punctures along the sides and extending a short distance along the posterior margin; the extreme lateral margins are distinctly incrassate. Scutellum pitchy. Elytra shining, with the sutural line and the sides yellowish, the rest closely spotted with small brownish markings as in *C. notatus*, F.; each elytron with three rows of rather large punctures, each row containing about eight or ten punctures. Underside very shining, black, except the prosternum, which is yellow, and the margins of the abdominal segments, which are obscurely pitchy. Legs pitchy yellow; intermediate femora and tibiæ moderately thickly and finely punctured.

Gyrinidæ.

Dineutes picipes, sp. n.

D. obovalis, depressiusculus, sat latus, supra nigro-olivaceus, vix cæruleo-cupreo micans, nitidulus; elytris postice rotundatis, pone apicem in mare leviter emarginatis, in fœmina externe oblique truncatis, ad truncaturæ basin dente parvo deflexo et apice dente acuto armatis; corpore subtus nigro-piceo, ano pedibusque piceis. ♂ long. $6\frac{3}{4}$ lin., lat. $4\frac{1}{6}$ lin.; ♀ long. 6 lin., lat. $3\frac{1}{2}$ lin.

Brachelytra.

Aleocharidæ.

Aleochara parvula, sp. n.

A. statura fere *A. mœrentis*, at parva, nitida, parcius pubescens; antennis pedibusque obscure testaceis antennarum articulo ultimo tibiarumque basi vix picescentibus; elytris thorace vix longioribus, cum thorace discrete distincte punctatis; abdomine discrete distincte punctato, ano piceo-testaceo. Long. $\frac{5}{6}$ lin.

Antennæ stout, scarcely longer than the head and thorax taken together; the first, second, and third joints elongate, subequal, the fourth joint a little broader than long; the fifth to tenth joints becoming gradually broader but not longer; the eleventh joint as long as the two preceding taken together, bluntly acuminate. Head rather broad, sparingly and scarcely visibly punctured. Thorax gently convex, twice as broad as long, narrowed in front, not thickly but distinctly punctured. Elytra a trifle broader than the thorax, and a little longer, distinctly but not thickly asperate-punctate. Abdomen distinctly, evenly but not thickly punctured; the punctuation of the fifth segment is scarcely less distinct than that of the preceding.

The thorax is relatively rather broader than in *A. mærens*; and the punctuation is less close, as is also that of the elytra.

Homalota destituta, sp. n.

H. statura et colore *H. boletobiæ*, Th. (*nigritulæ*, Kz.), at antennis paulo brevioribus. Nigra, subnitida, subtiliter punctulata, flavo-sericea; antennarum basi, elytris pedibusque luteo-testaceis, elytris regione scutellari angulisque posticis obsolete infuscatis, thoraco obscure piceo; abdomine discrete subtiliter punctulato, segmentis apice piceis. Long. $1\frac{2}{5}$ lin.

Very closely allied to *H. boletobia*, Th., but is a trifle more parallel-sided, the antennæ are a little shorter and stouter, the elytra are relatively a little shorter; the punctuation is throughout slightly finer, especially that of the thorax, which is also less close; that of the abdomen is more even (being scarcely less close on the fifth and sixth segments than on the previous ones). The three basal joints of the antennæ are elongate, subequal, testaceous; the third more slender; the fourth joint is twice as broad as long, shining, pitchy testaceous; the fifth to tenth joints gradually but distinctly broader, transverse; the eleventh joint nearly as long as the two previous joints taken together, obtusely acuminate. Head sparingly and scarcely perceptibly punctured. Thorax pitchy, very nearly as broad as the elytra, not quite twice as broad as long, gently rounded at the sides and base, with a shallow longitudinal impression in front of the scutellum, finely but not thickly punctured. Elytra a trifle longer than the thorax, finely and not thickly punctured. Abdomen with the apex of each segment pitchy, very finely but not closely punctulate; the punctuation is less close and distinctly finer than on the elytra.

Pæderidæ.

Lithocharis occulta, sp. n.

L. ferruginea; antennis, elytris pedibusque flavo-testaceis; capite thoraceque subopacis, sat crebre fortiter punctatis; elytris thorace $\frac{1}{5}$ longioribus, nitidis, sat crebre punctatis; abdomine nitido,

acutis retrorsum directis; elytris thorace haud angustioribus at duplo longioribus, humeris obtusis, lateribus arcuatis, angulis apicalibus exterioribus bene rotundatis, apicibus arcuatis. Long. $1\frac{1}{6}$ lin.

PROBÆNUS, gen. nov.

Mentum somewhat transverse, suddenly narrowed in front, the extreme apex truncate; on either side of the narrow portion (but on a lower plane) there is a somewhat triangular projection; the ligula is not prominent, but its anterior angles are produced into two delicate, subcylindrical, slightly curved projections, nearly as long as the palpi. Labial palpi short and thick; the basal joint round, scarcely visible; the second and third equal, slightly elongate, subcylindrical. Lobe of the maxillæ slender, ciliated, with a distinct sharp tooth nearly on a level with the basal joint of the palpus. Maxillary palpi with the second joint twice as long as broad, narrowed at its base; the third joint a little shorter, a little longer than broad, the apical joint one third longer than the previous one, slender, a little narrowed at the apex. Mandibles very prominent, completely visible from above, impressed, broad at the base, narrow and pointed at the apex. Head transverse, slightly lobed over the base of the antennæ; eyes prominent. Antennæ very long, basal joint very large; second joint elongate, cylindrical, inserted near the apex of the basal joint; the third to eighth joints a little longer than the second, of the same form; the ninth rather shorter and broader than the previous joint, the tenth scarcely transverse, the eleventh oblique truncated. Thorax transverse, broader behind, scarcely narrowed in front. Elytra oblong. Pygidium visible from above. Legs robust; tarsi short, the basal joints slightly dilated, strongly ciliated. Pro- and mesosternum constructed as in *Mystrops*.

This genus is closely allied to *Mystrops*, from which it differs in the form of the mandibles, the form of the head, the basal joint of the antennæ, and in the elytra nearly covering the abdomen.

I am unacquainted with *Mystrops dispar* from Madagascar, except from description; but I think it probable that it may have to be transferred to the present genus.

Probœnus longicornis, sp. n.

P. oblongus, leviter convexus, testaceus, nitidus, crebre distincte punctatus; capite sat magno transverso, leviter convexo, antice impresso, utrinque supra antennarum basin parum elevato; oculis prominentibus, nigris; mandibulis porrectis, leviter curvatis, apice acuminatis, basi supra parum concavis; antennarum articulo primo magno, elongate; thoraco capite $\frac{1}{4}$ latiore, longitudine fere duplo latiore, leviter convexo, antice vix angustato, angulis anticis obtusis, lateribus levissime arcuatis, marginatis, angulis posticis rectis, basi fere recta; scutello sat magno; elytris thoraco vix angustioribus, at $\frac{1}{3}$ longioribus, apicem versus parum angustatis, lateribus levissime arcuatis, marginatis, apicibus arcuatim truncatis. Long. $1\frac{1}{4}$ lin., lat. $\frac{3}{4}$ lin.

Epuræa ophthalmica, sp. n.

E. oblonga, obscure ferruginea, opaca, dense pubescens; capite lato, transverso, ante oculos angustato, subtilissime coriaceo, sat crebre distincte punctato; labro transverso, lateribus rotundatis, antico medio anguste profunde triangulariter excise; oculis magnis prominentibus, nigris; antennis capite paululo longioribus, clava picea; thorace capite $\frac{1}{3}$ latiore, longitudine $\frac{2}{5}$ latiore, leviter convexo, antice vix angustato, coriaceo, sat crebre evidenter punctato, margine antico leviter emarginato, angulis anticis obtuse rotundatis, lateribus tenuiter marginatis, levissime arcuatis, angulis posticis fere rectis (summo ipso obtuso); elytris thorace hand angustioribus, vix duplo longioribus, medio vix ampliatis, coriaceis, minus crebre evidenter punctatis, apice truncatis, angulis externis paulo rotundatis; abdomine supra subtiliter hand crebre punctulato, brevissime flavo-pubescente. Long. $1\frac{1}{3}$ lin., lat. $\frac{2}{3}$ lin.

The eyes in this species are rather unusually prominent; and there is not the usual impressed line along the inner margin. The thorax is broadest at the posterior angles, which are rectangles with the extreme point blunted.

Colydiidæ.

Ascomma, gen. nov.

General build of *Endophlœus*, but with the head not widened in front of the eyes. Eyes partly clothed with erect scale-like setæ. Mentum square; ligula very nearly as broad as the mentum and about half the length, sides parallel, front margin gently arcuate, the angles consequently slightly obtuse; the front margin fringed with dense stiff hair, so dense that it

ieee separate from the ligula; the
ed from each other at the base;
slightly acuminate at the apex, a
The outer lobe of the maxillæ

rather widened and truncate at the apex; the palpi are short and thick and do not differ materially from those of *Endophlœus*. Antennæ eleven-jointed, the third joint rather elongate; the tenth and eleventh joints form a distinct broadly ovate club.

Ascomma horrida, sp. n.

A. oblonga, convexiuscula, opaca, ferruginea, nigro varia, breviter echinata; capite deplanato, antice rotundato, postice angustiore; oculis nigris, sat prominentibus; antennis capite paulo longioribus, nitidis, piceis, clava fere rotundata; thorace capite fere duplo latiore, longitudine $\frac{1}{4}$ latiore, convexo, postice paulo angustato, margine antico utrinque sat fortiter emarginato, medio lobato, angulis anticis acutiusculis, lateribus deplanatis leviter rotundatis, serratis, angulis ante basin fere rectis, basi medio late lobata, disco impressione oblonga; scutello parvulo, rotundato; elytris basi thorace haud latioribus, postice vix ampliatis, fere parallelis, apice rotundatis, singulis elytris tricostatis; tibiis echinatis. Long. $2\frac{1}{3}$–3 lin., lat. $\frac{3}{4}$–$1\frac{1}{6}$ lin.

ENDOCOXELUS, gen. nov.

Mentum slightly transverse, a little narrowed in front; ligula about half the width of the mentum and of the same length, parallel at the sides, rounded and ciliated in front; labial palpi somewhat elongate and acuminate; outer lobe of the maxillæ short, triangular, truncate and ciliated at the apex; apical joint of the palpi twice as long as broad, as long as the two preceding joints taken together, truncate at the apex. Head nearly parallel at the sides, gently sinuate at the eyes, and a little narrowed behind; eyes slightly prominent. Antennæ eleven-jointed, as long as the head, the first and second joints stouter than those following, scarcely longer than broad; the third to fifth a little elongate, sixth to ninth moniliform, the tenth and eleventh joints forming a distinct club, the eleventh considerably smaller than the tenth. Thorax convex, a little broader than long, slightly narrower behind, distinctly margined all round, but especially at the sides, which are gently arcuate (microscopically serrate), all the angles obtuse. Scutellum very small. Elytra at the base scarcely broader than the thorax, slightly broader posteriorly, twice as long as broad.

Closely allied to *Coxelus*, but with the head not wider in front of the eyes, antennæ with a more distinct club, thorax narrowly but distinctly margined, &c.

Endocoxelus variegatus, sp. n.

E. oblongus, antice paulo angustatus, leviter convexus, opacus, niger, squamulis pallidis adspersus; elytris testaceo variegatis; tibiis testaceis. Long. $1\frac{1}{4}$ lin., lat. $\frac{3}{5}$ lin.

Dull pitchy black, the clypeus and the middle of the front

Murmidius segregatus, sp. n.

M. ovalis, convexus, nitidus, piceo-niger, punctatus; thorace rufo-piceo, antennis pedibusque obscure testaceis; capite sat crebre subtilissime punctulato; thorace crebre subtiliter punctato, circa angulos anticos punctis nonnullis magnis, fortiter transverso, antice leviter emarginato, angulis anticis acutis, sub angulis rotundato-exciso, lateribus arcuatis marginatis, basi marginata utrinque oblique bisinuata; elytris convexis, sat crebre distincte punctatis, postice paulo ampliatis, basi flexuosis, apice rotundatis. Long. $1\frac{1}{4}$ mill.

Cucujidæ.

Læmophlœus palpalis, sp. n.

L. elongatus, convexiusculus, niger, nitidus, palpis tarsisque testaceis, tibiis piceis: capite sat convexo, crebre fortiter punctato, post oculos sulco transverso leviter impresso; oculis prominulis; antennis capite $\frac{1}{3}$ longioribus, sat crassis, articulis duobus basalibus crassioribus, 3° minore latitudine paulo longiore, 4° quadrato, 5°–8^{um} moniliformibus, 9° et 10° latioribus, transversis, 11° fere globoso; thorace capite vix latiore, latitudine paulo longiore, coriaceo, crebre fortiter punctato, antice posticeque truncato, basin versus vix angustato, lateribus fere rectis, marginatis, dorso utrinque carina longitudinali; elytris thorace paululo latioribus et fere triplo longioribus, convexiusculis, sàt fortiter striatis, humeris obtusis, lateribus vix arcuatis (fere rectis) ad apicem arcuatim angustatis, striis parce obsolete punctatis, interstitiis parce punctatis. Long. $\frac{9}{10}$ lin., lat. $\frac{1}{4}$ lin.

PALPICORNIA.

Hydrophilidæ.

Berosus mixtus, sp. nov.

B. statura fere *B. affinis*; oblongus, convexus, sordide flavo-testaceus, vix nitidus, subtus niger; capite thoraceque sat crebre distincte punctatis, clypeo subtilissime punctulato; elytris fortiter striatis, striis crebre punctatis, interstitiis planis, sat crebre distincte punctatis, apice truncato, angulo externo breviter unidentato. Long. $2\frac{1}{2}$ lin., lat. $1\frac{1}{4}$ lin.

Form of *B. affinis* but rather broader behind. Head distinctly and rather closely punctured; clypeus very finely and delicately punctured, a little more distinctly at the sides. Thorax relatively broader than in *B. affinis* and less convex, less deflexed at the sides, the anterior angles much rounded; punctuation very distinct and moderately close. Scutellum with a few fine punctures.

LAMELLICORNIA.

Aphodiidæ.

Rhyssemus tarsalis, sp. n.

R. fusco-niger, nitidus, fronte granosa, vertice subtilins granuloso; thoraee transversim quadricarinato; elytris punctato-striatis, interstitiis biseriatim granulatis. Long. $1\frac{1}{2}$ lin., lat. $\frac{3}{4}$ lin.

Extremely close to *R. germanus*, and only differs in being more shining, in having the projection in front of the eye nearly rectangular (scarcely obtuse), the granulation of the elytra a trifle less fine; the basal joint of the posterior tarsi is as long as the spur, whereas in *R. germanus* it appears to be always a little shorter.

Melolonthidæ.

Lachnosterna gradaria, sp. n.

L. oblonga, convexa, brunnea, sat nitida; capite sat magno, collo lævi, fronte planiuscula crebre distincte punctata; clypeo confertim fortins punctato, marginato, medio vix sinuato; thorace longitudine fere duplo latiore, convexo, minus crebre punctato, ante medium paulo angustato, margine antico fere recto, angulis anticis obtusiusculis, posticis obtusis; scutello lævi; elytris basi thoracis latitudine postice paulo ampliatis, convexis, ad apicem rotundatis, haud crebre punctatis, marginibus incrassatis pieeis; pectore longe flavo-pubescente; abdomino amplo parce punctato; pygidio sat crebre fortiter punctato. Long. $9\frac{1}{2}$ lin., lat. $4\frac{1}{2}$ lin.

Lachnosterna Rodriguezi, sp. n.

L. oblonga, leviter convexa, nitida, pallide brunnea*, sat lata; capite lato, sat crebre fortiter punctato; clypeo brevi, fortiter transverso, reflexo-marginato, crebre punctato, medio paululo producto, utrinque leviter sinuato; oculis sat magnis; thorace longitudine duplo latiore, leviter convexo, sat crebre distincte punctato, margine antico leviter flexuoso, angulis anticis obtusiusculis, lateribus arcuatis, angulis obtusis, basi utrinque sinuata, modio parum lobata; scutello lævi; elytris thoracis latitudine at $3\frac{1}{4}$ longioribus, post medium paululo ampliatis dorso depressiusculis, ad apicem rotundatis, minus crebre punctulatis, sutura parum elevata. Long. $10\frac{1}{2}$–$12\frac{1}{2}$ lin., lat. 5–$6\frac{1}{4}$ lin.

Dynastidæ.

Oryctes minor, sp. n.

O. oblongus, niger, nitidus; capite antice angustato, rugoso, medio vix nodoso; thorace longitudine $\frac{1}{3}$ latiore, nitido, parce subtiliter

* Two dead specimens, possibly bleached.

punctulato, antice medio impressione rotundata rugosa et utrinque plaga parva rugosa notato, lateribus leviter rotundatis; elytris thorace haud latioribus, postice ampliatis, fortiter lineato-punctatis; pedibus rufo-piceis. Long. $11\frac{1}{4}$ lin., lat. $5\frac{1}{2}$ lin.

The elytra are covered with rather large horseshoe punctures, among which may be traced the usual two pairs of punctured lines; the surface between the large punctures has small punctures scattered here and there.

MALACODERMATA.

Melyridæ.

MALTHACODES, gen. nov.

Maxillæ with two lobes, membranous, the internal smaller and narrower than the external; apical joint of the maxillary palpi strongly securiform; mandibles bifid at the apex. Antennæ with the first joint elongate, the second smaller and shorter, the third a little longer than the second but not so long as the first; the fourth to tenth about as broad as long, narrowed at their base; the eleventh oblong. Eyes prominent. Thorax transverse, broadest at the base. Elytra scarcely broader than the thorax and twice and a half as long. Tarsi with the basal joint a little elongate, second to fourth joints subequal, shorter than the first; claws with a membranous lobe beneath each. Body pubescent.

The species upon which this genus is founded resembles *Haplocnemis*, but is of a shorter form, the head is short, and the apical joint of the maxillary palpi is very strongly securiform. *Pelecophorus* is described as having the basal joint of the tarsi very short, shorter than the second; this I cannot apply to the insect here described, or I should have placed it in that genus.

Malthacodes pictus, sp. n.

M. oblongus, leviter convexus, nigro-æneus, griseo-pubescens; antennis nigris, articulo basali piceo; thorace longitudine duplo latiore, sat crebre subtiliter punctato, lateribus arcuatis, tenuissime flavo marginatis, basi utrinque leviter sinuato; elytris thorace vix latioribus at $2\frac{1}{2}$ longioribus, crebre sat fortiter punctatis, fasciis duabus flexuosis rufo-testaceis; femoribus piceis, tibiis tarsisque pallide testaceis. Long. $1\frac{3}{4}$ lin., lat. $\frac{3}{4}$ lin.

Ptinidæ.

XYLODES, gen. nov.

General form nearly that of *Hedobia*. Antennæ rather thick, not approximate at the base; the basal joint oblong, the second

fortiter punctato, margine antico leviter arcuato, supra caput vix superante, angulis anticis omnino rotundatis, lateribus leviter arcuatis, reflexo-marginatis, angulis posticis obtuse rotundatis, basi marginata; elytris thorace vix latioribus, at $2\frac{1}{4}$ longioribus, convexis, ad apicem arcuatim attenuatis, sat crebre fortiter punctatis; antennis pedibusque piceis, tarsis testaceis. Long. $1\frac{1}{6}$ lin., lat. $\frac{1}{2}$ lin.

This species has the elytra rather unusually narrowed at the apex; the punctuation is very distinct, thick but not crowded; in the middle of the forehead there is a small, almost imperceptible fovea; the elytra are covered with a slightly metallic bloom.

Cis sexcarinatus, sp. n.

C. oblongus, ater, vix nitidus, fortiter confertim rugoso-punctatus; capite piceo; antennis testaceis, clava picea; thorace longitudine $\frac{1}{4}$ latiore, lateribus fere parallelis (vix arcuatis), angulis obtusis, basi bisinuata; scutello lævi; elytris basi thorace haud latioribus at duplo longioribus, lateribus fere rectis ad apicem obtuse rotundatis, sutura parum elevata, singulo elytro ad apicem carinis tribus instructo; corpore subtus haud crebre fortiter punctato: pedibus piceis. Long. $1\frac{1}{2}$ mill., lat. $\frac{3}{4}$ mill.

HETEROMERA.

Cistelidæ.

Cistela brunnea, sp. n.

C. oblongo-ovalis, parum convexa, sat nitida, brunnea, breviter aureo-pubescens; capite triangulari, crebre distincte punctato; antennis thorace duplo longioribus; thorace obscuriore, longitudine fere duplo latiore, antice arcuatim parum angustato, confertim fortiter punctato, angulis anticis omnino rotundatis, posticis rectis, basi recto-truncata, medio solum vix lobata; elytris thorace vix latioribus at $3\frac{1}{2}$ longioribus, ad apicem arcuatim attenuatis, irregulariter crebre punctatis. Long. 4 lin., lat. $1\frac{4}{5}$ lin.

RHYNCHOPHORA.

Anthribidæ.

BALANODES, gen. nov.

Head as long as broad; rostrum a trifle narrower, very short. Antennæ placed close to the eye, a little longer than the head and thorax together, very slender; the first and second joints scarcely stouter than the following; third to seventh a trifle longer than the second, subequal, the eighth rather shorter but a little elongate; the ninth to eleventh subequal, forming an elongate, slender, loose club. Eyes a little prominent, slightly ovate. Thorax nearly semicircular, truncate in front for the width of the head; the basal ridge very slight, scarcely separated from the posterior margin, only visible near the shoulders. Scutellum minute. Elytra at the base scarcely as broad as the thorax, but a little more than twice as long, gradually narrowed towards the apex, which is rounded, punctate-striate. Tibiæ cylindrical, not widened at the apex; the anterior pair rather long and curved beyond the middle, minutely denticulate beneath the base. Tarsi moderately broad, the basal joint a little elongate, the second transverse, the third short, bilobed; claws with a distinct mesial tooth. Body evenly convex, thickly clothed with pubescence.

Closely allied to *Aræocorynus*, but, besides the difference of form, differs in having slightly narrower tarsi and the tibiæ not widened at the apex.

Bulanodes tomentosus, sp. n.

B. ovalis, convexus, dense breviter flavo-griseo-pubescens, obscure piceus, elytris pedibusque brunneis; thorace creberrime haud fortiter punctato, angulis anticis obliteratis, posticis rectis, basi utrinque vix sinuata; elytris fortiter striato-punctatis, interstitiis alternatis vix latioribus, subtilissime coriaceis; antennis articulis tribus apicalibus piceis. Long. $2\frac{3}{4}$ lin., lat. $1\frac{1}{2}$ lin.

The pubescence on the elytra is slightly interrupted by the rows of punctures, which gives them a striped appearance.

Caranistes annulipes, sp. n.

C. oblongus, nigro-picens, dense piceo-tomentosus, flavo variegatus; pedibus pallide brunneis nigro annulatis. Long. $2\frac{1}{4}$–3 lin., lat. $1\frac{1}{6}$–$1\frac{1}{2}$ lin.

Front of the head and the rostrum clothed with yellowish pubescence, that on the vertex brown; eyes rather widely separated above, very slightly emarginate in front. Antennæ obscure testaceous, the club only dark, twice as long as the thorax; the third to eighth joints very slender and gradually diminishing in length; the ninth to eleventh elongate, forming a distinct but slight club. Thorax very finely granular, nearly one third broader than long, much narrowed in front, the sides nearly straight, rather narrowed behind the basal ridge, which is very distinct, well separated from the base (especially at the sides); the pubescence is brownish. Scutellum yellowish. Elytra as broad as the thorax, one fourth longer than broad, not very convex, rounded at the apex, rather strongly punctate-striate, the interstices very slightly convex; the pubescence is yellowish, interrupted by small brown square spots; a few of these spots are larger and darker than the others; and the yellow pubescence has a tendency to form a sutural spot behind the middle. The legs are very pale brown; a ring on the femur, two on the tibia, the apical half of the basal tarsal joint, and nearly all the second joint blackish. Some large punctures are scattered over the flanks of the prosternum and the metasternum.

Curculionidæ.

Cratopus inornatus, sp. n.

C. elongatus, niger (vel nigro-piceus), nitidus, setis albidis brevissimis parce adspersus; antennis piceis; rostro basi sat crebre, apice parcius lævius punctulato, fronte discrete distincte punctata; oculis oblongis, haud prominentibus; thorace longitudine $\frac{1}{3}$ latiore, antice angustato, vix crebre sat fortiter punctato; scutello lævi; elytris thoraco paulo latioribus at $3\frac{1}{2}$ longioribus, ad apicem regulariter acuminatis, fortiter striato-punctatis, interstitiis vix irregularibus, punctis parvis adspersis, apice tuberculis parvis obsitis, marginibus dimidio basali distincte carinatis, ad apicem serrulatis; pectore breviter griseo-pubescente; femoribus anticis subtus dente parvo armatis. Long. 5–$6\frac{1}{2}$ lin., lat. 2–$2\frac{1}{2}$ lin.

Cratopus virescens, sp. n.

C. elongatus, picens, dense virescenti-pubescens; capite rostroque crebre sat fortiter punctato; oculis vix prominulis; thorace longitudine vix latiore, antice angustato, crebre irregulariter granulato, lateribus arcuatis; scutello viridi-albo tecto; elytris thorace paulo latioribus at $3\frac{1}{4}$ longioribus, apice angustatis, sat fortiter striato-punctatis (punctis rotundatis, medio tuberculo minuto instructis), interstitiis haud convexis, parce subtilissime asperate-punctatis, marginibus haud carinatis; femoribus anticis subtus dente magno armatis. Long. 5–6 lin., lat. 2–$2\frac{2}{5}$ lin.

Cratopus magnificus, sp. n.

C. elytris piceo-niger, dense squamulis rotundatis parvis tectis; squamulis læte viridi vel aurato vel cupreo nitentibus; sutura lævi. Long. $5\frac{1}{2}$ lin.

Two elytra only known.

Pentarthrum Rodriguezi, sp. n.

P. nigro-piceum (vel rufo-piceum), convexum, subcylindricum;

XII.—*On a small Collection of Lepidoptera from Cape York and the South-east Coast of New Guinea.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

THE following species were recently obtained by the British Museum from the Rev. J. S. MacFarlane. Several of them are new to science; and others have hitherto been poorly represented in the collection. Excepting where New Guinea is mentioned, the species are from Cape York.

RHOPALOCERA.

Family **Nymphalidæ**.

Subfamily *DANAINÆ*, Bates.

Genus DANAIS, Latreille.

1. *Danais archippus.*

Papilio archippus, Fabricius, Ent. Syst. iii. 1, p. 49 (1793).

2. *Danais affinis.*

Papilio affinis, Fabricius, Syst. Ent. p. 511 (1775).

Genus EUPLŒA, Fabricius.

3. *Euplœa Angasii.*

Euplœa Angasii, Felder, Reise der Nov., Lep. ii. p. 343 ("1865").

We have a long series of this species; it only occurs in Australia.

4. *Euplœa sylvester.*

Papilio sylvester, Fabricius, Ent. Syst. iii. 1, p. 41 (1793).

Genus CALLIPLŒA, Butler.

5. *Calliplœa niveata.*

Calliplœa niveata, Butler, Trans. Ent. Soc. Lond. p. 2 (1875).

Genus HAMADRYAS, Boisduval.

6. *Hamadryas zoilus.*

Papilio zoilus, Fabricius, Syst. Ent. p. 480 (1775).

Subfamily *SATYRINÆ*, Bates.

Genus HYPOCYSTA, Westwood.

7. *Hypocysta adiante.*

Neonympha adiante, Hubner, Zutr. ex. Schmett. figs. 545, 546 (1825).

Subfamily *Nymphalinæ*, Bates.

Genus Doleschallia, Felder.

8. *Doleschallia australis.*

Doleschallia australis, Felder, Reise der Nov., Lep. iii. p. 405, pl. 51. figs. 1, 2 (1867).

Genus Neptis, Fabricius.

9. *Neptis consimilis.*

Limenitis consimilis, Boisduval, Voy. de l'Astrolabe, Lép. p. 133. n. 5 (1832).

Not previously in the Museum. It is quite distinct from the Aru species *N. affinis* of Felder.

10. *Neptis mortifacies.*

Neptis mortifacies, Butler, Trans. Ent. Soc. p. 5 (1875).

Only one example of this species, from Queensland, was previously in the collection of the British Museum.

11. *Neptis latifasciata.*

Neptis latifasciatus, Butler, Trans. Ent. Soc. p. 4 (1875).

The same observation applies to this species as to the preceding.

Genus Rhinopalpa, Felder.

12. *Rhinopalpa parva*, n. sp.

Wings above dark brown, with a broad central ochreous band from costa of primaries to near anal angle of secondaries; outer border paler brown, bounded within and intersected by a line of black; primaries with a tawny spot in the cell, just above the origin of the first median branch; a subapical series of decreasing pale ochraceous spots: wings below pale olive-brown, with a broad central creamy band; basal area externally edged with dark brown, and crossed by brown-edged pale bands; external area crossed by a series of blind ocelli; outer border creamy, varied with brown, and intersected by a lunulate brown submarginal line in both wings and by two in the secondaries. Expanse of wings 2 inches 7 lines.

This is the smallest *Rhinopalpa* that I have seen; it is very different from any other species known to me.

Genus DIADEMA, Boisduval.

13. *Diadema nerina* (♂ ♀).

Papilio nerina, Fabricius, Syst. Ent. iii. 1, p. 509 (1775).

Smaller than usual; otherwise perfectly typical.

14. *Diadema alimena* (♂ ♀).

Papilio alimena, Linnæus, Mus. Lud. Ulr. p. 291 (1764).

Also var. *P. velleda* of Cramer (pl. 349. f. C, D).

Genus CETHOSIA, Fabricius.

15. *Cethosia imperialis*, n. sp.

Wings above black-brown, distinctly shot with purple; basal area broadly scarlet; a discal series of indistinct reddish lituræ; fringe white-varied; primaries with a broad quinquefid snow-white subapical patch; three or four subcostal discoidal spots; secondaries with an ill-defined submarginal lunated line. Below paler than above: primaries with basal half reddish tawny, transversely marked on costal half of cell and at base of median interspaces with black strigæ margined or intersected by grey lines; subapical white patch as above; submarginal area and veins red-brown; a discal series of more or less fusiform white-margined black spots; outer margin black; a submarginal lunated white line: secondaries with several red spots on basicostal area; a subbasal transverse grey band, enclosing a double series of black strigæ; an irregular series of grey-edged black spots across middle of wing; a discal series of more or less reniform grey-edged black spots; outer margin black; a submarginal lunated white line. Expanse of wings 3 inches 10 lines.

Four examples.

We previously only possessed two specimens of this species, which, owing to their general similarity to *C. damasippe*, I was unwilling to describe. There can now be no doubt that the species does not vary.

Family **Lycænidæ**.

Genus DANIS, Fabricius.

16. *Danis* close to *D. damis*; perhaps a variety. In poor condition.

Heterocera.

Family **Sphingidæ**.

Genus Chœrocampa, Duponchel.

27. *Chœrocampa argentata.*

Chœrocampa argentata, Butler, Proc. Zool. Soc. p. 8, pl. 2. fig. 3 (1875).

Only one example, in poor condition.

Family **Agaristidæ**.

Genus Agarista, Leach.

28. *Agarista neptioides* (♂ ♀).

Agarista neptioides, Butler, Ann. & Mag. Nat. Hist. xv. p. 138 (1875).

Family **Zygænidæ**.

Genus Euchromia, Hübner.

29. *Euchromia ganymede.*

Glaucopis ganymede, Doubleday, Lort's Disc. Austr., App. i. p. 519, pl. 3. fig. 3.

Family **Arctiidæ**.

Genus Areas, Walker.

30. *Areas punctipennis*, n. sp.

Wings white; primaries with the costa scarlet, its front edge blackish; secondaries with a small spot at the end of the cell and three on the outer margin, as also a point at apex, greyish black; head white, scarlet behind; collar with two large central brown spots, rosy along its margins; abdomen scarlet, with dorsal and lateral black spots; body below white, anterior coxæ and front margins of femora scarlet; venter with lateral black spots. Expanse of wings 1 inch 7 lines.

Allied to *A. Moorei* and *A. roseicostis*.

Family **Lithosiidæ**.

Genus Themiscyra, Walker.

31. *Themiscyra varicosa*, n. sp.

Primaries sulphur-yellow; the veins, two oblique bands, and several irregular transverse lituræ vermilion-red; secondaries pale glossy vermilion-red; head and thorax sulphur-yellow, reticulated with vermilion; abdomen vermilion, spotted with black; wings and body below glossy vermilion, front coxæ yellow. Expanse of wings 1 inch 3 lines.

Allied to *T. lætifera*, but without grey bands or lines in primaries.

Subfamily *Hypsinæ*, Butler.

Genus Damalis, Hübner.

32. *Damalis alciphron.*

Phalæna-Attacus alciphron, Cramer, Pap Exot. ii. pl. 133. fig. E (1779).

New Guinea.

Family **Chalcosiidæ**.

Genus Dysphania, Hübner.

33. *Dysphania chalybeata*, n. sp.

Hyaline greyish; markings arranged as in *D. numana* (*Euschema helenetta*, Walker); borders and spots purplish black; submarginal spots barely indicated above, excepting the subapical oblique series in primaries; thorax orange-yellow; abdomen golden yellow, whitish above. Expanse of wings 3 inches 4 lines.

It is just possible that this may prove to be the male of *D. numana*; but I know of no parallel instance of dissimilarity in the sexes. I think it more probable that it is the Australian representative of that species.

Genus Præsos, Walker.

34. *Præsos mariana.*

Eusemia mariana, White, Voyage of the 'Rattlesnake.'

Family **Hyblæidæ**.

Genus Hyblæa, Fabricius.

35. *Hyblæa puera.*

Phalæna-Noctua puera, Cramer, Pap. Exot. ii. pl. 103. figs. D, E (1779).

Family **Ommatophoridæ**.

Genus Patula, Guénée.

36. *Patula MacFarlanei*, n. sp.

Allied to *P. macrops*; larger, greyer in colouring, the ocellus and the dark bar beyond it much more oblique, the subbasal bands of primaries converging towards costa, ill-defined, and scarcely irregular; no defined transverse bands below the ocellus, the latter with dull clay-coloured zone; submarginal macular band not undulated, each spot lunate; bands of secondaries much wider apart, less strongly defined, more continuous; underside of wings greyer, darker; discal series of white spots smaller, those towards costa of primaries placed more obliquely; outer series obsolete. Expanse of wings 5 inches 8 lines.

A very distinct and well-marked species. Unfortunately only one example was sent, the secondaries of which are somewhat damaged.

Family **Ophiusidæ**.

Genus Ophisma, Guénée.

37. *Ophisma umminia.*

Phalæna-Noctua umminia, Cramer, Pap. Exot. iii. pl 267. fig. F (1782).

Family **Spilomelidæ**.

Genus Phalangiodes, Hübner.

38. *Phalangiodes*, n. sp. (near to *P. neptalis*).

The single example is in poor condition, being much rubbed.

Family **Hyponomeutidæ**.

Genus Atteva, Walker.

39. *Atteva niviguttella.*

Corinea niviguttella (part.), Walker, Cat. Lep. Het. xxviii. p. 542. n. 1 (1863).

This species was confounded with examples of *Atteva niveigutta*, placed by Walker among the Lithosiides. The genus seems to be most nearly allied to *Cydosia* and *Eggyna.*

XIII.—*On a new Victorian Graptolite.* By Frederick M'Coy, Professor of Natural Science in the University of Melbourne, &c.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,

As the study of Graptolites seems to have suddenly acquired a new interest in England, and many valuable papers, tending to form soon a good monograph, have lately appeared in your

are nearer the base or the apex), each with a row of broad, acutely angular cell-denticles, seven in the space of 3 lines; the upper edge of each cell slightly convex and nearly at right angles with the back, and rather longer than the undivided portion, the lower edge two thirds uncovered by the next cell, and making an angle of about 45° with the back; from the point of one cell to the next about equal to the width from the same point to the back. The whole polypidom, of about forty stems, forms a slightly quadrate circle or rounded square about 2 inches in diameter.

Rare in the black and red slates, of the Llandeilo-Flag age, of the Bendigo goldfield, Sandhurst, Victoria.

I name this species after the discoverer, M. Thureau, of Sandhurst, who first brought it under my notice. The regular zigzag bendings of the four branches of the funicle, from which the stems arise, easily distinguish it from any other with which I am acquainted. For those writers who prefer to break up the genus *Didymograpsus*, the name *Goniograptus* might be suggested for such types as the present, in which the branches of the funicle (for which I would suggest the name stolons) are angularly bent at the points of budding into the celluliferous stems.

I have, &c.,

FREDERICK M'COY.

University of Melbourne,
May 18, 1876.

XIV.—*Observations on Dr. Severtzoff's "Mammals of Turkestan" (translated by F. Carl Craemers)**. By G. E. DOBSON, M.A., M.B., F.L.S., &c.

THE thanks of zoologists are due to Mr. Carl Craemers for having made known to them by his translation the highly interesting observations of Dr. Severtzoff on the mammals of Turkestan; for Russian is practically an unknown language to most zoologists of Western Europe, and Turkestan almost an unexplored region as regards its fauna. As I have lately published a monograph of the Asiatic Chiroptera†, and am at present engaged in preparing descriptions of the Chiroptera collected by the late Dr. Stoliczka during the expedition to Western Yarkand, I wish to make some observations on the nomenclature adopted by Dr. Severtzoff, and on his determinations of some of the species.

* See 'Annals and Magazine of Natural History,' July 1876, p. 40.

† Monograph of the Asiatic Chiroptera. London: Trubner & Co. 1876.

1. *Vesperugo turcomanus*, Eversm. (Severtzoff), = *Vesperugo serotinus*, Schreber.

V. turcomanus, Eversm., was founded on a specimen of *V. serotinus* with buff-coloured fur. Individuals of this species, of *V. Kuhlii*, *V. pipistrellus*, *Plecotus auritus*, and of other species of bats inhabiting dry sandy districts have the fur of a permanently pale colour, imitating, as it were, the prevailing light colour of the ground. The same remark seems to apply equally well to other species of mammals and to birds.

Specimens of this species were obtained by Dr. Stoliczka in Kashmir.

3. *Vesperugo Blythii*, Wagner (Severtzoff), = *Vesperugo abramus*, Temminck.

The name *V. Blythii* was given by Wagner to a specimen of *V. abramus*, Temm., very imperfectly described by Blyth, which he (Wagner) had not seen, but which he nevertheless thought Blyth had confounded with another species.

4. *Vesperugo akokomuli*, Temm., var. *almatensis*, Severtzoff, = *V. abramus*, Temm.

This variety appears to have been founded on colour alone—a very unreliable character, as I have frequently pointed out, in determining the species of Chiroptera.

The species most probably alluded to under the above two names (nos. 3 & 4) by Dr. Severtzoff is *V. pipistrellus*, of which many specimens were collected by Dr. Stoliczka at Yangihissar. It is readily distinguished from *V. abramus* by the deep emargination in the upper half of the outer margin of the ear. *V. abramus* has not been found, so far as I can determine, north of the Himalayas.

5. *Plecotus auritus*, var. *brevimanus*, Jenyns (Severtzoff), = *P. auritus*, L.

P. brevimanus, Jenyns, was founded on an immature specimen of *P. auritus*, L., in which the extremities of the phalanges were not completely ossified and the shafts had not attained their full length.

6. *Plecotus leucophæus*, n. sp., Severtzoff, = ? *P. auritus*, L.

No description accompanies this name; but, judging from the etymology of the specific title, the species appears to depend, in some degree at least, upon the colour of the fur. I have referred above to the slight importance of this character in determining species; and the following remarks occur in my description of *P. auritus* (at p. 84, 'Monograph of the Asiatic Chiroptera'):—"Examples from Northern Africa and sandy districts in the neighbourhood of the Mediterranean and Caspian seas are much paler in colour throughout than those from moister countries. This I have frequently observed in specimens of bats brought from desert regions."

Many specimens of a *Plecotus* with very light-coloured fur, but not otherwise distinguishable from *P. auritus*, were obtained by Dr. Stoliczka at Leh.

7. *Rhinolophus euryale?* (Severtzoff), =?*R. ferrum-equinum*, Schreber.

Rhinolophus euryale, Blasins, has not yet been recognized by other zoologists from any part of Asia north of the Himalayas; but *R. ferrum-equinum*, which it resembles very closely, is abundant in the Himalayan region. Therefore I would suggest that this species, which has been recognized as *R. euryale*, with doubt, by Dr. Severtzoff, is probably *R. ferrum-equinum*.

XV.—*Notes on some Genera of Nudibranchiate Mollusca, with Notices of a new Genus and of some hitherto undescribed Species, in the Collection of the British Museum.* By P. S. Abraham, M.A., B.Sc., F.R.M.S., F.Z.S.

[Plates VI. & VII.]

Calycidoris, gen. nov.

Corpus subdepressum: pallium ultra caput et pedem extensum, papillis gracilibus obtectum: tentacula dorsalia laminata intra foramina retractilia; branchiæ simplices, laminatæ, in cavitatem subretractiles, anum circumdatæ, medialiter in dorso postico positæ; tentacula labialia in velum conjuncta; lingua angusta, ordinem uncinorum unum undique in longum exhibens.

The body is rather depressed; the mantle ample, extending over the head and the foot and bearing soft conical papillæ. The dorsal tentacles are short and laminated, and retractile within sheathless cavities. The branchiæ are simply laminate, form a cup round the anus, together with which they are contained in a common mantle-cavity, the wall of the latter being not completely contractile over them. The oral

tentacles are united into a thick, fleshy, triangular veil, narrow from before backwards, but laterally extending to the anterior side angles of the foot. To the latter the base of the veil is attached for its whole length, with the exception of a small portion of the extreme pointed ends. The foot is triangular in shape, broad and truncate in front, then gradually narrowing to the posterior rounded end, which reaches as far as the hinder mantle-edge. The border is a little expanded and flattened. The mouth enters, from below, a chamber with slightly rugose walls, from which leads, anteriorly and above, the constricted opening of a muscular, smooth-walled gizzard, more resembling that of *Lamellidoris* than the homologous arrangement in *Acanthodoris*. At the back of the chamber is situated the anterior vertical portion of the narrow odontophore. This organ is without central spines, but is furnished with numerous transverse rows, each containing two bicuspid uncini or lateral spines (one each side), which are set diagonally. The inner and anterior cusp, in the well-developed tooth, is prolonged and recurved. The spirit specimens present a pinkish tint on the back, becoming darker and of a violet tinge on the sides and between the tentacles, and shading off into a light brown or flesh-colour, which extends all round the border. The darker tint is due to a minute and close purplish speckling which is seen, under the magnifier, between the papillæ, and upon them except at their apices. The dorsal tentacles and the branchiæ are opaque yellowish. The under surface is of a uniform flesh-colour.

Dimensions (in spirit)—length 28 millims., breadth 21, height (or greatest thickness between the pedal and the dorsal surfaces) 10.

Hab. not stated. The specimens were obtained from the Haslar-Hospital collection.

The species has been named after Dr. Albert Günther, to whose courtesy the author is indebted for the opportunity of examining the Nudibranchiate Mollusca in the collection of the British Museum.

HEXABRANCHUS, Ehrenberg.

Body more or less depressed, soft; mantle usually extended laterally and posteriorly, and with undulating border. Dorsal tentacles laminate, kneed, sharply bent, retractile within marginated cavities. Branchiæ generally small and numerous, plumose, non-retractile, arranged in six to eight tufts, and set in a circle at some distance around the anal opening. Oral tentacles large, fleshy, ovoid, with crenulate edge. Mouth generally with corneous jaws; odontophore broad, with numerous lateral spines in each transverse row.

The genus was constituted by Ehrenberg in 1831 *, to include *H. prætextus* described by him, and *Doris lacera* of Cuvier †. The following may also be referred to the genus:—*Doris marginata* and *D. flammulata* (?), described and figured by Quoy and Gaimard ‡; *D. sanguinea*, Ruppell §; *D. sandwichensis*, Souleyet ‖; *H. Adamsi*, Gray ¶; and *D. superba*, *D. cardinalis*, and *D. sumptuosa* of Gould **. It is more doubtful whether *Heptabranchus Burnettii*, Adams, and *Doris* (*Rhacodoris*) *Krebsii*, Mörch ††, should also be included in the genus. According to Adams's description and figure ‡‡, the former would seem to have all the more important characters of the Hexabranchs, with the exception of having the branchial bundles arranged round the anus "in a broad lunate series," instead of in a circle—an appearance which may have been due to the state of contraction of the specimen, and which, at any rate, is not, of itself, of sufficient importance to constitute a genus. M. Mörch has proposed "*Rhacodoris*" as a subgenus of *Doris*, to include the Mollusca of the type *D. lacera*, Cuvier, which he considers to have been wrongly referred to *Hexabranchus*, Ehr. He states that in the latter the branchial plumes are separately retractile in cavities as well as collectively into a common branchial cavity—an idea which also obtains in Adams's 'Genera &c.' In most of the descriptions, including those by Cuvier, Ehrenberg, and Rüppell, the non-retractibility of the branchiæ is given as a character. Of the twenty-nine specimens (representing five or six species) in the British-Museum collection, none shows any trace of retractile branchiæ. Judging from the imperfect description, *Rhacodoris Krebsii* will probably prove to be a species of *Doridopsis* §§.

* 'Symbolæ Physicæ'—Animalia evertebrata exclusis insectis.

† Annales du Muséum, vol. iv. p. 453, pl. lxxiii. f. 1–3.

‡ Voyage de l'Astrolabe, vol. ii. pp. 255 & 257, pl. xvii. f. 1–5, 6–10.

§ Atlas von E. Ruppell, 'Neue wirbellose Thiere des rothen Meers,' p. 28, T. viii. f. 1.

‖ 'Voyage autour du Monde sur la Bonite,' Zoologie, tom. ii. p. 451, pl. xxv. f. 1–4.

¶ 'Figures of Molluscous Animals,' vol. iv. p. 104, tab. 219. f. 1.

** 'Otia Conchologica,' pp. 228, 229.

†† In 'Journal de Conchyliologie,' vol. xi. p. 34.

‡‡ 'Genera of Recent Mollusca,' vol. ii. p. 59, pl. lxiii. f. 10

§§ Since the above was in type, the author has found that *D. Krebsii* has recently been dissected and described by Bergh (in 'Journal des Museum Godeffroy,' Heft viii. p. 87), and shown to be a *Doridopsis*.

Hexabranchus pellucidulus, sp. nov. Pl. VI. figs. 2, 2 *a*–2 *c*.

H. ellipticus, gibbus, pellucidulus, subgelatinosus, albus; pallio haud multo expanso, ad dorsum lateraque lævi vel subpustuloso, pone interque tentacula dorsalia corrugato, margine integro undulato; tentaculis dorsalibus obtusis, laminatis, pediculatis, flectis, opacis, prorsum confertisque positis, et in vaginulas retractilibus; branchiis parvis, ramosis, opacis, non-retractilibus, in sex cristis anum haud propinque circumdatis; tentaculis labialibus crassis, planis, foliiformibus, margine crenato; pede angusto, postice acuminato, margine anteriore transverse diviso, cum lamina posteriore fissa.

The general shape is elliptical, convex on the back, rather gelatinous. The mantle is comparatively not much expanded; it is smooth or irregularly subpustulose on the back; anteriorly, behind and between the dorsal tentacles, the surface is less gelatinous, and is finely and distinctly puckered into opaque pustules. The lateral expansions of the mantle, which, especially in small specimens, are not very wide, are fleshy and have the margin wavy, subcrenulate, and more or less reflexed in parts. The dorsal tentacles are short and thick, kneed somewhat backwards, laminated minutely and diagonally, with blunt rounded apices, retractile through short sheaths set far forwards and near together. The branchiæ are small and bipinnate, and form six, more or less irregular, non-retractile tufts at some little distance around the slightly raised anal opening. The oral tentacles are free, leaf-shaped, fleshy lobes, with crenate edge, and are set upon short peduncles. The foot is narrow: in front it is transversely slit, the anterior lamina being thin and entire, while the posterior is rather thicker, somewhat lobulate, and mesially divided. The mouth opens into the smaller end of a long, conical, muscular pharynx with longitudinally plicated wall. The odontophore is large, broad, and bilobed; the lobes are applied together; and their touching surfaces are supplied with numerous transverse rows of elongated, conical, recurved spines, none of which are central or of different shape. The colour of the spirit specimens is a transparent white, with the anterior pustules, the edge of the mantle-border, the dorsal tentacles, the branchiæ, and the foot yellowish and opaque.

The dimensions (in spirit) are—length 27 millims., breadth 21, height 12.

Hab. unknown.

H. lacera and *H. pellucidula* form a well-marked section of the genus. They resemble each other and differ from all the other species of *Hexabranchus* in having the body raised and

spirit specimens, is a uniform light brownish, the tint becoming darker on the pallial expansion, on the dorsal tentacles, the branchiæ, and on the foot.

Dimensions (in spirit)—length 100 millims., breadth 82, thickness 21.

Hab. The Red Sea.

Two other species of *Hexabranchus* have been found in the Red Sea, *H. prætextus* and *H. sanguineus*. Irrespective of coloration and markings, the former differs from *H. suezensis* in having a more elongate outline, in being more depressed, in having no interval underneath between the foot and the mantle, and in having slenderer dorsal tentacles; the latter, in the shape of the tentacles, and in the larger, more slender, and less dendritic branchiæ.

PLOCAMOPHERUS, Rüppell & Leuckart.

Body limaciform. Mantle represented by a supracapital veil, bearing tuberculate or branched appendages on the margin, and by two or three tubercular processes upon each side of the back. Dorsal tentacles laminate and retractile. Branchiæ few, plumose, non-retractile, anteriorly surrounding the anus. The tail bears dorsally a wavy crest. Mouth with flat oral tentacles; odontophore with the spines near the middle bicuspid, but none median: an incomplete buccal collar.

The genus "*Plocamopherus*" was instituted by Rüppell and Leuckart* in 1828 for the reception of *P. ocellatus*, a mollusk from the Red Sea. The generic name was misquoted by Cuvier † as *Plocamoceros*; and this word was afterwards adopted by D'Orbigny and others. It has, however, been generally written *Plocamophorus*. In the 'Proceedings of the Zoological Society' for 1861, Mr. Pease has enunciated a supposed new genus "*Histiophorus*," which, from his description, would appear to have the same characters as *Plocamopherus*.

The species hitherto described are:—

P. ocellatus, Rüpp. & Leuck. *loc. cit.*
P. ceylonicus, Kelaart (sp.) and Ald. & Hanc. in Trans. Zool. Soc. vol. v. p. 133, pl. xxxii. f. 4–6.
P. imperialis, Angas, in Journal de Conchyliologie, vol. xii.
P. maculatus, Pease (sp.), *loc. cit.*

* Atlas von E. Ruppell, 'Neue wirbellose Thiere des rothen Meers,' p. 17, T. v. f. 3.

† "Règne Animal' (nouvelle édition, 1830), tom. iii. p. 52.

Plocamopherus nævatus, sp. nov. Pl. VI. figs. 4, 4 *a*.

P. elongato-ovatus, in regione branchiali prominens, hac longitudinis totius $\frac{2}{3}$ a capite sita, candidulus, irregulariter labeculis inequalibus fuscis maculatus, quæ prope branchias, post tentacula dorsalia, in margine pallii capitis atque ad latera caudæ confertæ sunt; margine pallii capitis processibus brevibus tuberculatis instructo; tribus appendicibus conicis, sparse et minute tuberculatis, utrumque ad dorsi latus positis, quarum posterior major est; tentaculorum dorsalium parte laminata conica reflectaque, intus fusca, extus pallida, horum pediculis pellucidis, intra vaginas, quarum margo minute crenulatus, retractilibus; branchiis 5, anteriore centrali, reliquis utrumque ad latus ani positis, ex pediculo orientibus, ubique conferte maculatis, margine excepto; ano tubulato; tentaculis labialibus planis, ovatis, parce maculatis, margine crenulatis, capiti conjunctis, parte extrema laterali tantum libera; pede lineali, antice lato rotundatoque; cauda brevi, fastigio verticali, expanso, fimbriato.

The body is oblong, rounded in front, swollen and raised towards the middle, and acuminated behind. The dorsal surface gradually slopes from above the head up to the branchial region, which is situated at rather more than two thirds of the total length from the head to the tail. The supracapital veil has a short, free, upturned border, edged with short, sessile, tuberculated processes. The dorsal surface bears three pairs of lateral conical processes. The two anterior pairs are minutely and rather sparingly tuberculated. The better-developed hindmost ones, situated at some distance behind the branchiæ, have the bases swollen and with minute tubercles, while the apices are large, rounded, smooth, and opaque. The dorsal tentacles have the upper half conical, laminated, kneed in front, and recumbent, pointing backwards and inwards. The laminæ are thirty-six to forty in number, and half of them go completely round the tentacle. They are retractile through short sheaths, which have minutely crenulate edges. The branchiæ are five in number, short, thick, and tripinnate; they are placed one centrally in front of the tubercular anus, and two at each side, arising from a short, broad, lateral pedicle. The mouth is subterminal, opening rather downwards. The oral tentacles are large, flat, ovoid or leaf-shaped lobes, with subcrenulate edges, and are adherent to the head except at the extreme lateral ends. The foot has in front a shallow, semicircular, transverse groove; it soon narrows and becomes linear for the greater part of its length, and extends to the end of the tail. A longitudinal groove runs down the centre, across which the wavy lateral edges can be applied together. The tail is laterally compressed, and bears above a dorsally expanded, fimbriate, longitudinal crest, the margin of which is tuberculate or denticulate. Upon the sides of the body are a few minute rugose tubercles, similar to those upon the lateral processes; they are more numerous and larger behind the last pair of processes near the base of the tail. The general colour in the spirit specimen is whitish and semitransparent, irregularly spotted with small, brown, unequal blotches and speckles, especially close and dark around the branchiæ, behind the dorsal tentacles, on the upper border of the supracapital veil, and on the sides of the tail. They are small, close, and numerous on the sides of the foot. The bases of the lateral processes are spotted with brown posteriorly, the rest of the process being minutely dotted with opaque white. The large rounded apices of the last pair are opaque yellowish. The laminæ of the dorsal tentacles are brown posteriorly or below, and shade off into brownish white above; the pedicles are semitransparent and white. The branchiæ are closely speckled with dark brown, except on the margins. The extreme edge of the oral tentacle is unmarked; then comes a row of minute, dark, close speckles, within which the surface is sparingly dotted. The lower surface of the foot is yellowish and free from spots.

Dimensions (in spirit)—length 35 millims., breadth 12, height 14.

Hab. New South Wales.

P. nævatus differs from all the other described species of the genus in not having the branchiæ on the centre of the back. It resembles *P. ocellatus* alone in having the lateral dorsal processes unbranched, and *P. imperialis* in having sessile marginal appendages to the frontal veil.

CERATOSOMA, Adams & Reeve.

Body elongate, prismatic, smooth or nearly so, ending in a bluntly pointed tail, the dorsal surface passing into a protuberance behind the branchiæ; mantle obsolete; dorsal tentacles laminate, generally retractile within cavities. Branchiæ plumose, with the roots more or less coherent, in front of and partially around the tubular anus, retractile within a smoothly margined cavity. Mouth subterminal, with a small deep pit at each side. Pedal surface long and linear, extending to end of tail, without free border, but with the edges contractile across the median groove. Odontophore broad, with numerous rows of simple spines, none of which are central; a spinous buccal collar.

from a common base in front of, and partially sheathing, the broad, tubular, fimbriate anus. The central plume is distinct and the longest; after giving off two long lateral branches, at about half its length, it becomes bifid. The other plumes, about ten each side, arise from a lateral arm of the base, produced and incurved posteriorly; they diminish in size and become more crowded backwards, and many of them divide once or twice dichotomously; they are all pinnate, with delicate, overlapping, lateral laminæ. Together with the anus, they are retractile within an anteriorly lipped circular cavity, which is situated a little behind the central point of the body. The mouth is large and, when contracted, a longitudinal fissure, opening rather downwards. There is a semicircular transverse furrow above, and, at each side, near the foot a deep rounded pit. The pedal surface is a long and linear deep groove, extending to the end of the tail; the lateral edges are crenulate and can be approximated together across the middle line, but there is no free border; anteriorly it is rounded, with the margin inwardly fleshy and lobulate. The general colour of the animal is a brownish cream, with small, scattered milky spots and faint, reticulating, ocellated markings; the stalks of the branchiæ are sparingly spotted or lineated with opaque white.

Dimensions (in spirit): length 65 millims., breadth 14, height 18, length of the tail 29.

Hab. unknown.

C. tenue differs from *C. trilobatum* and *C. gracillimum* in wanting the latero-dorsal lobation and in having a comparatively shorter tail.

Ceratosoma brevicaudatum, sp. nov. Pl. VII. fig. 6.

C. oblongum, levatum, sublæve, cervinum, ocellis albis tubercularibus sparse maculatum; cauda brevi; dorso vix lobato; tumore postbranchiali parvo, rotundate, supra plano; tentaculis dorsalibus obtusis, rotundatis, laminatis, intra vaginas breves retractilibus; branchiis brevibus, gracilibus, ramosis, ex sex radicibus orientibus, ante anum semicirculariter positis, et in foramen commune retractilibus.

The body is elongate, but compact and raised. The dorsal surface is oblong, indistinctly trilobed in outline, curving upwards from above the mouth, the highest part being in front of the branchiæ. Behind the latter the outline abruptly acuminates and passes into a small, rounded, nodular protuberance, flattened above. Beneath this the body-wall falls nearly perpendicularly, and then ends in a short, laterally compressed, conical tail. The dorsal tentacles are clavate, the upper half flatly rounded at the apex, being bent back and bearing about twenty-five laminæ; they are retractile within cavities, the margins of which are produced into short sheaths. The branchiæ are small, slender, bushy, dividiug dichotomously, and arising from six roots, three being at each side of the anus; there is a considerable interval between the anterior roots; and the posterior ones bear numerous and smaller plumes. The anus, situated almost between the last, is wide and tubular, and has the posterior wall more produced than the anterior. The common cavity, into which the branchiæ and anus are retractile, has the margin raised. The mouth is subterminal, opening rather downwards; on each side is a conspicuous pit, into which it is possible that a small tentacle may be retractile by invagination. The foot is linear, with a wavy edge, anteriorly lobulated inwards. The colour of the spirit specimens is a brownish cream or pale fawn, sparingly marked with whitish, tubercular, or slightly raised, unequal, rounded, ocellated spots, which are rather more numerous on the sides; a row of five or six of these spots extends along the mediodorsal line from in front of and between the dorsal tentacles; the margins of the branchial and tentacular cavities are surrounded by a row of such spots.

Dimensions (in spirit): length 48 millims., breadth 15, height 18, length of tail 9.

Hab. Australia.

C. brevicaudatum presents many points of resemblance to the following species (*C. oblongum*).

Ceratosoma oblongum, sp. nov. Pl. VII. figs. 7, 7 *a*, 7 *b*.

C. elongato-oblongum, prismaticum, læve, fuscum, nigrescentibus maculis rotundatis sparse ornatum; dorso oblongo, non lobato et non levato; tumore postbranchiali parvo, rotundato, nodulari; cauda brevi; tentaculis dorsalibus parvis, conicis, acutis, arrectis, lateraliter compressis, in cavitates retractilibus; branchiis 18 +, ramosis, ex sex radicibus orientibus, ante anum circulariter positis, in foramen commune retractilibus; pede lineari.

The body is oblong, smooth, prismatic, not raised in the branchial region; the dorsal surface is rather curved, and shows but little trace of constriction or lateral lobation. The postbranchial protuberance is small, rounded, and nodular; and between it and the origin of the short subconical tail there is but a very small interval. The dorsal tentacles are conical and pointed, laterally flattened, diagonally laminated, directed rather forwards and outwards, and retractile within cavities. The branchiæ are about eighteen in number, slender, and placed in a semicircle in front of the anus; those at the sides are rather longer. The four anterior, with an interval between the two foremost, arise separately; the others, six on each side, form a kind of spreading fascicle. They are all more or less ramose, dividing dichotomously. The anus, situated between the posterior branches, is tubular, broad and short. Branchiæ and anus are contained in a common pallial chamber. The mouth is directed rather forwards, and is bounded by thick exsertible lips; on each side is a pit, into which a soft appendage appears to be retractile. The foot is linear, rather enlarged and rounded in front, where it is transversely grooved, somewhat fleshy, and inwardly lobulated. The colour is a uniform dark umber-brown, with sparing and indistinct, dusky, rounded and ocellated spots, some of them very slightly raised, on the sides, and with a few on the back.

Dimensions (in spirit)—length 51 millims., breadth 16, height 16, length of tail 11.

Hab. West Australia.

The short tail and the nodular postbranchial protuberance differentiate *C. oblongum* from all the other species except *C. brevicaudatum*. From the latter it principally differs (without regarding the colour) in the form of the dorsal tentacles, in the comparatively depressed branchial region of the back, and in the small interval between the postbranchial protuberance and the origin of the tail.

TREVELYANA, Kelaart.

Body limaciform, rather swollen or raised in the central region. Mantle obsolete. No appendages. Dorsal tentacles laminate and retractile. Branchiæ pinnate, non-retractile, placed around the anus almost on the centre of the back. Mouth without oral tentacles or veil, and without collar or jaws. Odontophore broad, bearing simple spines.

The genus was instituted by Kelaart in 1859 for the species *T. ceylonica*, described by him*. Another species, *T. bicolor*, was added by Alder and Hancock†, by whom a better definition of the genus was given. Since then *T. morosa* has been figured by Bergh‡. "*Doris limacina,*" Quoy & Gaim.§, and "*Doris impudica,*" Rüpp. & Leuck.‖, may be referred to this genus.

* Ann. & Mag. Nat. Hist. ser. 3, vol. i. p. 257; and Journ. Asiatic Society.

† Transactions of the Zoological Society, vol. v. p. 132, pl. xxix. f. 11 & 12.

‡ Semper's 'Reisen im Archipel der Philippinen,' Theil 2, Band ii. Heft 5, tab. 25. f. 9.

§ 'Voyage de l'Astrolabe,' vol. ii. p. 252, pl. xvi. f. 8 & 9.

‖ Atlas von Ruppell, 'Neue wirbellose Thiere des rothen Meers,' p. 33, T. x. f. 2.

PLATE VII.

Fig. 5. *Ceratosoma tenue.* 5 *a*, Seen from below. 5 *b*. Seen from above.
Fig. 6. *Ceratosoma brevicaudatum.*
Fig. 7. *Ceratosoma oblongum.* 7 *a*. Seen from below. 7 *b*. Seen from above.
Fig. 8. *Trevelyana concinna.* 8 *a*. Seen from above. 8 *b*. Seen from below.

XVI.—*On* Anthracosaurus Russelli (*Huxley*). By Thomas Atthey.

[Plates VIII.–XI.]

In the 'Quart. Journ. Geol. Soc.,' 1863, vol. xix. p. 56, Prof. Huxley has described and figured the palatal aspect of the skull of *Anthracosaurus Russelli* from the Lanarkshire coal-field, 12 miles east of Glasgow.

In the 'Annals and Magazine of Natural History,' September 1869, there is a description of a large portion of another cranium and the anterior extremity of a mandibular ramus, together with a large sternal plate, of this powerful Labyrinthodont, from Newsham, Northumberland.

Also, in the February number (1871) of the 'Annals,' there appear a description and figure of a considerable portion of a mandibular ramus of the same animal, from the new ironstone shale of Fenton, Staffordshire, by my late lamented friend Mr. Albany Hancock and myself.

In the present communication I propose to describe and figure the upper and under surfaces of the cranium, the right and left rami of the mandible, the teeth with microscopic sections of the same, several ribs and vertebræ, one bone of an extremity, and some scutes, all belonging to one and the same *Anthracosaurus*, obtained about two years ago from the black shale overlying the Low-Main seam of coal at Newsham, near Blyth, Northumberland, by one of the workmen, of whom it was purchased through Mr. T. P. Barkas of this town. It was in a very rough state and much broken when it came into my hands, and has required for the redevelopment of its principal features an amount of minute work, care, and time that can be appreciated only by those who have been engaged in similar undertakings.

Further, there are certain things here to be mentioned as still obscuring or hiding more or less the upper surface of the skull. First, there is a crack or fissure across the anterior end, a short way behind the snout, through the nasal bones, and lying over the position of the great palatine teeth; secondly, the anterior end of the left ramus of the mandible lies transversely across portions of the jugal, supratemporal, quadrate-jugal, squamous, and parietal bones of the right side of the cranium; thirdly, in the left side of the cranium has been imbedded a small vertebra, probably of the neck (this vertebra seems to have been thrust forcibly in between the bones of the upper wall and those of the under wall or floor of the cranium); fourthly, the posterior part of the left palate-bone overlies, on the same side, parts of the jugal, quadrate-jugal, and supra-temporal bones. The rest of the upper surface of the skull is uncovered, and can be well seen.

The skull of *Anthracosaurus* is much broader in proportion to its length, and altogether stronger, than that of *Loxomma*; and both of these are much larger and stronger than that of *Pteroplax*, these three being the only large Labyrinthodonts as yet found in our coal-field.

The upper surface of the skull of *Anthracosaurus* is represented in Plate VIII. It is broadly triangular, with rounded anterior and posterior angles, deeply concave between the posterior angles, and slightly convex on the sides. It is not quite perfect. Its right side or border, however, is so; whilst from its left side the maxillary bone has been displaced, and was found imbedded in the same slab of shale at a short distance from its proper position in the skull. Further, a portion about an inch in breadth and three inches in length of the inner posterior border of the right maxillary extension, and an inch of the posterior angle of the same extension of the left side, are deficient. Moreover the right and left angles of the occiput are also slightly deficient.

The length of the skull along the median line, from the tip of the snout to the posterior edge of the occiput, is 13½ inches, and from the same point to the ends of the maxillary prolongations 17 inches. The greatest breadth, 14 inches, is at 1½ inch in front of the ends of these prolongations. Over the posterior ends of the orbital vacuities the breadth is 12 inches, over the anterior ends of the same 10¼ inches, and at 3 inches behind the snout 5¾ inches, inclusive of the breadth of the left maxillary bone, which at this part is absent but has been estimated at the same breadth as that of the right maxilla.

The pitted sculpturing on the surface of the bones is more irregular and more closely crowded about the snout than it is on the skull of *Loxomma*; and it is rougher and deeper on the anterior than on the posterior region of the cranium. The surface altogether has a rougher appearance than in *Loxomma*. No glandular openings have been discovered at the bottoms of the pits or hollows, such as are found in the corresponding parts of *Loxomma*, this discrepancy pointing very probably to some as yet unrecognized difference in the state of the integument in these animals.

The nostrils are openings of about half an inch diameter, and slightly oval in outline. They are bounded in front by the premaxillaries, internally by the nasals, externally and posteriorly by the maxillaries. They are $2\frac{1}{2}$ inches apart; and a line drawn across the nasal region between the middles of their internal margins is one inch behind the mid point of the snout. They are only half an inch distant from the margin of the jaw, and are placed much further forward than the nostrils of *Loxomma*.

The mucus-grooves are two pairs. The anterior pair run backwards and inwards along the inner side of the naso-lacrymal suture as far as the posterior margins of the nasals; the posterior are deeper, and appear in two disconnected portions along the outer margins of the jugal and quadrate-jugal bones. The anterior pair of grooves are less deep and less distinct than those of *Loxomma*; the posterior are deeper, wider, and rougher than those of that Labyrinthodont.

In *Anthracosaurus* there is only one pair of mucus-grooves in front, instead of two pairs as in *Loxomma*; whilst in the former only these posterior grooves exist.

In *Anthracosaurus* the anterior grooves lie, as far as can be seen, entirely on the nasals; in *Loxomma* the anterior grooves lie nearly altogether on the premaxillaries, and the posterior on the maxillary and lacrymal bones.

The orbital vacuities, broader in front than behind (in fact, somewhat heart-shaped), are placed $8\frac{3}{4}$ inches behind the snout, are 2 inches long and $1\frac{3}{4}$ inch broad; at their anterior margins are two concavities (the inner rather smaller than the outer), having a sharp prominence between them; this, with a similar but smaller projection at the posterior margin of the vacuity, seen best on the right side, shows where the ligament bounding the true orbit on the outer side had been attached.

The inner margin of each orbital vacuity is slightly arched, the concavity looking outwards; the outer margin is also arched, and looks inwards and slightly forwards. These end posteriorly in a small concavity, the inner extremity of which, coming forwards, joins the inner margin of the vacuity, forming with it the posterior projection above mentioned.

The true orbit and the rest of the vacuity are very much smaller, and placed further back than in *Loxomma*. The eye, therefore, of *Anthracosaurus* must have been very much less than that of *Loxomma*; the part of the vacuity not occupied by the eye points outwards instead of forwards.

frontals for three fourths of their length, and to the postfrontals for the remaining posterior fourth.

The prefrontals are much broader than the frontals, by which they are bounded along the whole of their inner borders; the lacrymals bound them in front, and the jugals on their outer borders; they rest upon the postfrontals behind by spaces not greater than $\frac{2}{10}$ inch. The remaining parts of their posterior borders form three fourths of the anterior margins of the orbital vacuities, including the greater part of the two marginal concavities already noticed.

The postfrontals, rather shorter and much narrower than the last, which they join in front by a long process, articulate by their inner edges for equal distances with the frontals and parietals. Their anterior and outer borders form $1\frac{6}{10}$ inch of the posterior inner borders of the orbital vacuities, including the posterior marginal prominence above mentioned. They are bounded externally by the postorbitals and a small portion of the supratemporals, and behind by the squamous bones.

The squamous, of an irregularly square form, somewhat concave internally and convex externally, are bounded internally by the parietals, anteriorly by the postfrontals, externally by the supratemporals, and posteriorly by the epiotics and a small portion of the so-called supraoccipitals. Their posterior outer angles contribute the curved inner border of the channels leading to the internal ears.

The postorbitals are also of a somewhat irregularly square outline, and their anterior borders form 1 inch of the posterior and outer concave margins of the orbital vacuities. They are united internally to the postfrontals, externally to the jugals, and behind to the supratemporals.

The jugals form large irregular triangles, the bases of which lie along the maxilla, the truncated apices supplying about an inch of the outer margins of the orbital vacuities, the posterior angles being cut off by the quadrate-jugals. They are $7\frac{1}{2}$ inches in length, articulating anteriorly and internally with the lacrymals and prefrontals, internally and posteriorly with the postorbitals, the supratemporals, and, lastly, with the quadrate-jugal bones.

The supratemporals, of irregularly elongated form, lying obliquely between the jugal and quadrate bones, and with them constituting a good part of the lateral extensions of the cranium, articulate anteriorly and internally with the postorbitals, externally with the jugals and quadrate-jugals; posteriorly they overlap and articulate with the quadrates, and on their inner sides join, first, the postfrontals, and afterwards the squamous. It may be noticed that, although the matrix is entirely cleared away from both the upper and under surfaces of these bones, there is no indication of a supratemporal foramen, which is said by Professor Huxley to exist.

The quadrate-jugals, of somewhat rhomboidal outline, lie on the outer convex side of the maxillary extensions, of which they furnish 4½ inches. The posterior extremities of these bones are peculiar. They are bounded by two lines, meeting together at an obtuse angle looking backwards: the outer line begins at a tubercle on the outer border, and runs backwards and inwards; the inner runs from the angle directly inwards, and ends against the quadrate; it is the margin of a rough space which forms the anterior boundary of a fissure that extends down through the bone, and at the underside of the cranium is seen to divide the condyle into two parts—one (the larger) on the under surface of the quadrate-jugal, the other (the lesser) on the corresponding part of the quadrate bone. On the upper surface of the cranium the fissure separates, at that part, the quadrate-jugal from the quadrate. It was, perhaps, filled with cartilage in the living state.

The quadrate bones are both imperfect, somewhat narrow, being 1½ inch across on their upper surface, but broader below, and elongated, lying along the inner margins of the lateral cranial or maxillary extensions, of which, with the quadrate-jugal, they form the blunt extremity that overhangs the condyle for the articulation of the mandible; of the end of the extensions the quadrate forms two thirds, and the quadrate-jugal one third. The inner ends of the quadrate bones articulate with the squamous and the epiotics. The bone of the right was 5¼ inches in length; for the space of an inch of the anterior and one of an inch and a quarter of the posterior end have been preserved, and remain *in situ*, whilst between these pieces the bone is deficient. What remains of the bone of the left side measures 3 inches in length and 1½ inch in breadth. The posterior margin is thin and free; and the anterior articulates with the supratemporal. The upper surfaces of the bones have each a longitudinal ridge, in front of which are the channels leading to the auditory openings.

The parietals form together an ovoid or subcircular figure, broad behind, flattened and somewhat more pointed in front. They lie immediately behind the frontals, to which they are united by suture; externally they join the postfrontals and the squamous, and behind the so-called supraoccipitals. The parietal foramen, ⅛ inch in diameter, lies at about an equal distance from the anterior and posterior borders of the bones.

The so-called supraoccipitals are about twice as broad as they are long, united on the median line, bounded by the parietals in front, by the squamous and then the epiotics externally, by the true occipitals beneath the posterior border of the cranium; and they form, with the epiotics, the posterior concave border of the occiput.

The epiotics, somewhat rhomboidal, with the posterior external angles produced backwards and outwards, forming the external angles of the true cranium, and broader than long, are sutured in front to the squamous, internally to the so-called supraoccipitals, and externally for a third of their length to the quadrates, the outer two thirds being free. Behind and beneath they are united by suture to the upper surface of the occipitals. A small portion of the outer and posterior margins of each of these bones is wanting, having been broken off.

I have not ventured to mark out, even by dotted lines, what I consider to have been the original outline of these parts.

Under surface of the skull (Plate IX.).—This entire surface, excepting the premaxillary part, has suffered great vertical depression. The median suture, uniting the premaxillaries, is distinct, and is seen to be continued further back between, first, the vomers and then the pterygoids. On the right side of the median line the palate is nearly perfect; on the left, the maxillary bone is wanting. Nearly the whole of the præmaxilla, the nasal channel, the entire palatal tooth, a portion of the palate-bone, and the corresponding part of the maxilla of the right side are unfortunately covered by the angular bone of the right mandible, which has been thrown obliquely along that part of the inferior surface of the cranium.

The above parts are all exposed and well seen on the left side. Besides this, the posterior piece of the left palate-bone, which bears a series of small teeth, has been shifted from its natural position, and lies on the posterior part of the upper surface of the same side of the cranium, as was noticed in the description of the upper cranial surface.

Owing to the absence of this portion of the palate-bone, with a portion of the corresponding pterygoid, from its natural site, a portion of the left orbital vacuity can be seen through from below; also the under surfaces of the lacrymal, prefrontal, and jugal bones can be seen united by their sutures. On the right side a good many of the posterior teeth of the maxilla are *in situ*, and parallel to them are seen the teeth of the posterior division of the palate-bone. On this side, also, a small portion of the orbital vacuity is seen through from below, and the under surface of its inner margin is well defined.

The supratemporal arch of the right side shows part of the under surface of the supratemporal and the whole of that of the quadrate-jugal bone, the sutures of which are nearly all, on

breadth. They are bounded internally by the vomers, and behind by the palate-bones. Their upper surface is formed by the nasals; and they appear open below, but would doubtless be closed in during life by membrane, cartilage, or bone. One of these openings is noticed by Prof. Huxley, in 'Quart. Journn. Geol. Soc.' vol. xix. p. 59, fig. 1, 1863, as the anterior palatine foramen.

In the plates annexed to the Report of the Committee of the British Association on the Structure and Classification of the Labyrinthodonts (1874)—namely, in plate iv. fig. 2 (*Mastodonsaurus*), plate iv. fig. 4 (*Trematosaurus*), and plate vii. fig. 4 (*Archegosaurus*)—the posterior nares are indicated at a short distance behind the external nasal orifices, internal to and very near the outer margin of the cranium, though internal to the maxillary bone; whereas in *Anthracosaurus* the channel from the external nasal orifices leads inwards and backwards towards the middle line, and appears to have been carried further backwards under the pterygoids to near the posterior end of the presphenoid.

The large palatine foramen of the above-named Labyrinthodonts does not exist (as already noticed) in *Anthracosaurus*.

With respect, however, to the backward position of the nares, it may be as well to leave this for the present an open question, until a specimen is found with the bones of the under surface of the skull better disposed for advantageous observation. With all the respect due to the opinion of so learned and skilful a palæontologist as Professor Huxley, my humble opinion is that the posterior nares will be found as far back as the posterior end of the presphenoid.

Indeed I may add that I have a very interesting specimen, comprising the whole of the right nasal bone of *Anthracosaurus*, showing both the upper and under surfaces, and measuring 4 inches in length. The external angle of its anterior end shows a part of the margin of the external nasal orifice; and the roof of the channel leading inwards and backwards from it is distinctly visible along the whole length of the bone. Now, as no opening exists on the under surface of the roof of the mouth, the nasal channel must be continued on to the back of the palate.

The right maxilla is narrow and $11\frac{1}{2}$ inches long, and extends from the præmaxilla to $2\frac{1}{2}$ inches from the posterior angle of the quadrate-jugal. It bears 15 teeth. For 3 inches at the anterior end there are no teeth visible, owing to the right ramus of the mandible lying over them. Behind this space the position of six teeth can be made out; they are $\frac{2}{10}$ inch apart, and are all broken, but project nearly through the mandible, having been forced into it. The other nine teeth are all about ½ inch in length, a little worn at their apices, and placed at irregular distances.

The left maxilla.—The same force which separated and displaced the rami of the mandible has also transferred this maxillary bone to the right margin of the skull, on which it lies imbedded in the matrix, with its anterior end overlying for a short distance the posterior upper border of the right mandible. Ten and a half inches of its inner surface are exposed; and about an inch of its anterior end is wanting. It contains 28 teeth, nearly all entire, and about ½ inch long. They decrease slightly in length backwards, and are irregularly disposed in the jaw.

The palate-bones are about 9 inches long; a transverse suture divides each into two nearly equal parts. The anterior borders of the foremost pieces form the posterior margins of the channels leading from the external nasal orifices, and are bounded internally by the vomers and externally by the maxillaries. These anterior pieces have implanted in them the large palatine tusks: that on the right side is covered, as before noticed, by the angular bone of the right mandible; and that on the left side is broken off at $\frac{6}{10}$ inch above its large expanded base, and is $\frac{6}{10}$ inch thick. Behind this, on each side, is a large depression nearly an inch in diameter, analogous to that existing in the vomerine bones of *Loxomma.*

These depressions have been noticed by Prof. Huxley (Quart. Journ. Geol. Soc. vol. xix. p. 58, 1863) as the posterior nares. The posterior pieces or halves of the palate-bone, 4½ inches long with an average breadth of 1 inch, are sutured inwardly and backwardly to the pterygoids and outwardly to the maxillaries. At an inch behind the transverse palatine suture is a deep depression, 1 inch long by ½ inch broad, at a short distance behind which the outer margin of the bone is raised up into an alveolus 1¼ inch long, containing seven closely set teeth. The first, fifth, sixth, and seventh are all broken off at their apices; the second, third, and fourth are perfect, and measure ½ inch in length. The last inch of the bone bears no teeth. The whole surface of the palate-bones is deeply pitted, instead of being tuberculated like the vomers, as has already been said.

In another specimen of the anterior portion of the palate-bone of *Anthracosaurus*, in my cabinet, two large palatal teeth or tusks are developed. One occupies the position of the tusk shown in the figured specimen; the other springs, as it were, from the depression behind it. In the specimen figured, the posterior tooth has been shed; and the depression shows the position it had once occupied.

Since the paper on *Loxomma* appeared, I have met with a similar occurrence of two teeth in the right vomer of that Labyrinthodont.

The pterygoids are long bones united in front to the vomers; and if the skull had not been so severely crushed, they would probably have been seen united by suture along nearly the whole of their inner margins. As it is, they have been dislocated; and their well-preserved margins can be observed pressed up to the level of the upper edge of the presphenoid, which projects between them on the median line. By their outer borders they articulate with the palate and jugal bones; and their posterior margins form the anterior and inner borders of the supratemporal arches.

The presphenoid is a long narrow ridge of bone on the median line, extending forwards from the anterior end of the basisphenoid, to which it is united by a transverse suture for seven inches. It is articulated above to the under surfaces of the nasals and frontals; from the posterior end of the upper border, $1\frac{1}{2}$ inch in depth, an ascending process on each side passes up to the under surface of the parietals. Its inferior margin is, for two inches posteriorly, rounded off; it is there nearly $\frac{1}{2}$ inch in width; and the anterior end of the bone is $\frac{1}{10}$ inch in width. At the distance of half an inch from its posterior end the bone is fractured longitudinally for $2\frac{3}{4}$ inches. At three quarters of an inch from its upper border the lower half inch is pressed up above the upper. The two halves, when united, are $1\frac{1}{4}$ inch in depth. The bone at this fracture measures $\frac{3}{10}$ inch in breadth. For two inches in front of the fracture the presphenoid is perfect, and is 1 inch in depth; and from this point to the anterior end it rapidly diminishes to $\frac{1}{10}$ inch in depth, as above stated.

From under the inner margins of the above pieces, which have been widely separated, there curves inwards and backwards, on each side, a short strong piece of bone, which ends in a truncated extremity that is somewhat concave. These bones are very distinct, difficult of determination, and may have been for muscular attachment or osseous articulation. Their ends are parallel with the suture connecting the pre- with the basisphenoid.

The supratemporal or pterygoid arches, as seen from below, are $2\frac{1}{2}$ inches in length, by about 3 inches in width, bounded anteriorly and internally by the pterygoids, externally by the quadrate-jugal, and posteriorly by the quadrates.

The basisphenoid is united in front to the posterior margin of the median ridge or presphenoid, and behind, by a transverse suture, to the apex of the basioccipital. Its outer borders

and nearly $\frac{1}{2}$ inch in breadth; it is small in proportion to the size and strength of the jaw.

The mandibular ramus of *Anthracosaurus* consists of four elements, viz. the dentary, the articular, the angular, and the splenial.

First, the dentary, bearing the teeth, is long and narrow, extending for nearly two thirds of the length of the ramus; its anterior end, which is attenuated, forms one half of the symphysis; its posterior, much broader, joins with the articular piece; by its inferior edge it articulates with the splenial posteriorly and with the angular anteriorly. Its surface is covered all over with closely set and pointed tubercles.

Second, the articular, the most massive piece of the ramus, is united to the dentary in front; from its upper margin arises a low, rather rounded, coronoid process, and from its upper and posterior part the articular process, bearing the glenoid cavity for the reception of the condyle of the cranium. This cavity is supported by the descending process, which forms the posterior edge of the ramus, and articulates below by a broad surface with the angular piece. The articular cavity faces upwards and somewhat inwards and forwards; it measures $2\frac{1}{4}$ inches in length, an inch in width, and $\frac{2}{10}$ inch in depth. Its neck is strong and devoid of postarticular processes.

Third, the angular. This, from its suture with the articular, extends along to the anterior end of the ramus, forming its lower border and the remaining half of the symphysis. It articulates by its upper edge with the splenial behind and at about the middle of its length, and with the dentary in front.

Fourth, the splenial. This lies along a great part of the inner surface of the ramus, attached along the upper edge to the articular and the dentary pieces; below, both behind and in front, it is connected with the angular, in conjunction with which it forms two unequal elliptical openings, the anterior much less than the posterior, which during life were filled by membrane; these openings are separated by a long obliquely descending process of the splenial, which articulates with a small upward projection of the angular: thus the splenial has three connexions with the angular piece.

The inner surface of the right ramus of the mandible is represented in Plate X. fig. 1, one third of the natural size.

It measures 16 inches in length, and, at 4 inches in front of the posterior margin, $4\frac{3}{4}$ inches in breadth. It bears 19 teeth, nearly all of which are in a good state of preservation. The first in front is $\frac{1}{2}$ an inch in length; the second and third are a little longer; and the following thirteen are $\frac{3}{4}$ inch, the last three being somewhat shorter than that.

The teeth succeed each other as follows: the first is $\frac{1}{4}$ inch behind the anterior termination of the ramus, the second $1\frac{1}{4}$ inch behind the first; at the same distance from the second are the third and fourth, which are in contact with each other; half an inch behind them are the fifth and sixth, also close together; and these are distant from the seventh $\frac{1}{10}$ inch; from this to the eighth is $\frac{2}{10}$ inch; and there is the same distance between the eighth and the two next (the ninth and tenth), which are also close together; these are $\frac{2}{10}$ inch apart from the eleventh; the twelfth and thirteenth, likewise in contact, are at the same distance behind the eleventh; at $\frac{2}{10}$ inch further back are the fourteenth, fifteenth, and sixteenth, at short distances from each other; and at an interval of $\frac{3}{10}$ inch from the sixteenth are seen the seventeenth, eighteenth, and nineteenth, which are in contact and somewhat smaller than the others; these are placed near the posterior end of the dentary bone, terminating the series.

The outer surface of the left ramus of the mandible is given in Plate X. fig. 2. This bears 15 teeth, nearly all of which have been worked out on their inner surface and are therefore not represented in the figure, their outer surface being covered by the matrix as far as the margin of the alveolar border: portions of six teeth are seen near to the symphysial end on this side, and are irregularly placed. On the inner surface the teeth are more uniformly disposed, and stand out nearly half an inch above the alveolar border, which is very strong and slightly concave from end to end of the ramus. The dentary piece is united below to the angular, which forms the inferior convex border of the ramus from the symphysis to its articulation behind with the articular piece. This, from its union with the angular, curves gently upwards, forming the posterior border of the ramus, and is surmounted by the articular cavity; it sends out backwards no postarticular process.

The coronoid process or rising is broad and elongated, projecting above the level both of the articular cavity and the dentary bone; a deep channel or mucus-groove runs along the inferior margin of the ramus from the anterior to the posterior end of the angular piece; it then curves upwards and forwards for a short space, and ends below the posterior margin of the dentary bone.

The teeth are arranged in a double series (maxillary and palatal) on each side of the upper jaw, and in a single series on each side of the lower jaw. They are of pretty uniform size and shape throughout, excepting the palatal tusks. Those of the mandible are anchylosed externally to the alveolar margin; and a thin lamina of bone, running continuously over their inner sides, invests them as in *Loxomma*. They are, at their bases, oval in outline, the long diameter of the oval being placed transversely to the line of the jaw. Above the alveolar margin they are circular up to near their apices, where a ridge exists on each side, giving the teeth a double edge. They are longitudinally grooved, with flattened ridges between from the alveoli up to near their apices. The whole surface of the teeth is coated with a layer of enamel, which is thickest at the apex.

Vertebræ.—Thirty-six vertebræ were found in connexion with the skull:—first, a small one, which has been pressed in upon the skull between the supratemporal and the pterygoid bones, and belongs probably to the upper part of the neck. The remaining thirty-five are imbedded in two separate slabs of shale: the smaller slab shows six vertebræ, all in a connected series; one of these is figured in Plate X. fig. 4. The larger slab has twenty-nine vertebræ, also in a connected but contorted series, and lying nearly in their natural order, with their dislocated and broken processes around and several ribs lying beside them.

The vertebræ are alternately large and small, well ossified and preserved; and the anterior and posterior surfaces of their bodies are both somewhat concave.

The bodies are broadly rounded and project downwards; and the space between the anterior and posterior surfaces is concave from side to side, grooved, and pitted in the grooves; the under margin of the body is thicker than the margin bounding the vertebral canal; so that the spinal column at that part must have been convex on its abdominal aspect: moreover the bodies are peculiar in having the upper borders of their anterior surfaces projecting forwards in the form of a ridge, whilst the lower borders of their posterior surfaces project in a similar form downwards. The sides of the bodies are level with each other: no facet is visible on the sides of the vertebral bodies for the articulation of the heads of ribs; but the facet on the transverse process is distinct and large, but is not divisible into an upper and a lower part. The neural canal is remarkably small for the size of the vertebra. The transverse and zygomatic processes and the spinous processes arise, in the specimen figured, from the sides and top of the arch; they are all massive and of considerable size; the transverse processes have a length of $1\frac{1}{2}$ inch, a breadth of $\frac{9}{10}$ inch, and a thickness of $\frac{2}{10}$ inch. The direction of the transverse process is almost directly outwards; that of the anterior pair of zygapophyses, which are rather concave, is upwards and slightly inwards; the posterior face downwards and outwards, and are somewhat smaller than the anterior pair.

are deviated to the left and at right angles to the others. The upper end has been broken off obliquely, together with the bones on which it rests. It is 4 inches in length as it lies; the lower end strongly resembles the lower end of a femur, and has been compressed from side to side. The shaft has been longitudinally broken in upon its cavity, and is therefore irregular; and the upper end or head is entirely wanting.

Plate XI. fig. 1 is a transverse section of a maxillary tooth of *Anthracosaurus*, from a specimen in my collection, other than that figured in the former Plates. It is made at a line a little below the apex and above the top of the pulp-cavity. It is rather more elliptical than circular in outline, having two slight ridges corresponding to the ends of the long diameter; these ridges show the position of the two cutting-edges of the tooth. The dentine pervades the whole area within the enamel, a thickish layer of which encloses the dentine. It does not appear that this part of the tooth has undergone any flattening or other injury.

Fig. 2 is a transverse section a little below fig. 1 and just below the top of the pulp-cavity. The outlines of the tooth and of the pulp-cavity are oval, that of the former broadly so. No coating of enamel is visible, except at one part, where a portion of matrix is adherent to the tooth; a stellate appearance, which strikes the eye at once, arises from the arrangement of fifteen fusiform bodies of light-coloured dentine around the pulp-cavity, radiating from it to the circumference; the internal apices project slightly into the pulp-cavity and give to its outline an undulating appearance; their external and more pointed apices reach quite to the circumference of the tooth, where a narrow peripheral band passes from the outer margin of the tooth directly into each of them, extending for a short distance towards the pulp-cavity. The dentinal tubes of the fusiform bodies all pass into this narrow infolded band, which is dark-coloured, not light as in *Loxomma*. The light-coloured fusiform bodies appear as if imbedded in dentine of a dark colour, which is owing to the tubules of it being black; and this dark dentine is broadest at the periphery of the tooth, in each interval between the spindles. The dentinal tubes in this dark part pass from its middle, radiating outwards towards the periphery of the tooth.

Fig. 3. is a transverse section a little below fig. 2, but still above the termination of the radiations of the pulp-cavity. Its form is more elliptical than that of the former sections; the same radiating fusiform bodies of light-coloured dentine, but of a larger size, are seen, encroaching upon the external darker dentine; the narrow infolded peripheral band runs inwards here

for two thirds of the length of the light-coloured spindles; it is therefore longer, is more distinct, and very sinuous.

The dentinal tubes radiate as before from the whole margin of the pulp-cavity into both the light and dark dentine; those passing into the former, after the most beautiful wavy windings, end in the sides of the infolded peripheral band; those of the latter radiate to the periphery. No granular layer of dentine is seen in this section.

Fig. 4 is a transverse section a little below the alveolar border, a portion of which is attached to the section. The tooth has at this part been crushed, and parts of the dentine are here and there displaced; but it can be seen that the full complexity of the tooth is here displayed, and that the cavity is elliptical. The dark dentine of the exterior of the tooth is much less in proportional size than the light. The spindle-shapes of the latter are no longer visible, but are represented by tracts passing in from the dark exterior and folding upon themselves as they pass towards the pulp-cavity, the outline of which is far from distinct, owing to the breakage of the parts around. Into each of these tracts enters, from without, the narrow peripheral band noticed under fig. 3 as being very light-coloured and sinuous. In fig. 4 this narrow band is much more sinuous, and follows the windings or convolutions of the light dentinal tracts to near their extremities, which are frequently continuous with each other; but the infolded narrow tracts are not so, keeping separate. The narrow bands are here dark instead of light in colour, and granular. The folded tracts are here and there separated from each other by clear but irregularly shaped spaces, which are parts of the offsets of the pulp-cavity.

There are, intervening between the commencements of these long winding tracts at the peripheral layer of dentine, others which are very short, rudimentary, and mammillary, projecting into the outer ends of the divisions of the pulp-cavity. These also have a narrow dark band of granular dentine in their interior. The same arrangement occurs in the teeth of *Loxomma*.

The dentinal tubes all radiate from the margins of the central pulp-cavity and its ramifications; most of them pass through the light-coloured dentine of the sinuous tracts, and end in the narrow dark band running through them; those, however, which radiate outwards from the ends of the offsets of the pulp-cavity are spread out in a fan-like expansion, and, after passing through a series of finely arched lines crossing them, reach the exterior of the tooth.

The teeth of *Anthracosaurus* are, in fact, like those of *Loxomma*, formed of a series of toothlets surrounding the pulp-cavity; the offsets from this are the pulp-cavities of the toothlets; the part between the extremity of the offset and the exterior of the tooth, consisting of radiating tubules and imbedding dentine, forms the crown of the toothlet; whilst the fangs are formed by the sides of the offset of the pulp-cavity—that is, by one half of a sinuous tract of light dentine, the narrow, dark, granular, infolded band indicating the line of separation between the toothlets, or their line of union, according to the view taken of the matter.

Of these toothlets there are about twenty-four, large and small together; and their crowns form the ridges seen on the exterior of a tooth.

In *Loxomma* the dentinal tracts or plicæ are much less tortuous than the corresponding parts in *Anthracosaurus*; but the infolded band, which is dark in the latter, is light in the former.

The arrangement of a compound tooth is really the same in both these animals. Enamel is visible; but certainly none is infolded into the plicæ or elsewhere. No cementum is anywhere visible.

In my cabinet, the following separate bones of *Anthracosaurus* from our coal-shale, and not already noticed, occur:—

One right maxilla.—This lies in the matrix with its inner surface exposed, and measures $8\frac{1}{2}$ inches in length by $1\frac{1}{4}$ inch in breadth at $3\frac{1}{2}$ inches behind its anterior end; from this point it diminishes slightly forwards, but much more rapidly backwards. It bears 19 teeth, all of which are perfect and, with the exception of the last, measure $\frac{3}{4}$ inch in length from the base at the alveolar border to the apex. They are oval at their base in the transverse direction of the jaw, in which they are arranged as follows:—The first four are placed at a short distance behind the anterior end, and are in contact with each other; the fifth is $\frac{2}{10}$ inch behind the fourth, and the like distance in front of the sixth and seventh, which are in contact with each other; $\frac{2}{10}$ inch separate the seventh from the eighth, which is the same distance in front of the ninth, tenth, eleventh, and twelfth, which are in contact with each other; after an interspace of $\frac{2}{10}$ inch come the thirteenth and the other six, which are all nearly $\frac{1}{4}$ inch apart from each other. Their surfaces appear to be eroded, which gives to the teeth a ridged appearance. The seventeenth tooth has been extracted; and the microscopic sections represented on Plate XI. figs. 1, 2, 3, 4 were made from it.

One quadrate-jugal bone, in a good state of preservation, showing both its surfaces. The upper surface shows the deep depression or mucus-groove along its outer margin, as figured in Plate VIII. fig. 1, also the tubercle with the line from it

In referring to the description of *Pteroplax*, H. & A., in the 'Annals,' ser. 4, vol. i. plates xiv. & xv. fig. 2, I find it necessary to correct what now appears erroneous in that paper. The sternal plates, figured and described as belonging to *Pteroplax*, I now think cannot properly be attributed to that animal. That they may have belonged to *Anthracosaurus* or *Loxomma* is more probable; but even that is doubtful. Fig. 3 of plate xiv., called præmaxilla of *Pteroplax*, does not belong to *Pteroplax* at all, but is a præmaxilla of *Loxomma Allmanni*. Plate xv. fig. 2 is named as a vertebra of *Pteroplax*, but is in reality a vertebra of *Anthracosaurus*; and in our description of it we noticed its resemblance to the vertebra figured in Qu. Journ. Geol. Soc. vol. xix. p. 63, 1863, as that of *Anthracosaurus* by Prof. Huxley.

Three crania (one in the Leeds Museum and two in my cabinet) are all we know as yet of this rare amphibian. On one of these latter lie two ribs which most probably belonged to the same animal. That on the upper surface is entire and much like a rib of *Loxomma*, but smaller; both head and tubercle are well shown: that on the under surface cannot well be described, as it is not sufficiently exposed. All three specimens are from Newsham, near Blyth, Northumberland.

The general configuration of the under surface of the skull is much the same in *Loxomma* and in *Anthracosaurus*, but is very different in *Pteroplax*. The vomers pass much further forward in *Anthracosaurus* than in *Loxomma*. Their anterior margins in the latter are just in front of the vomerine tusks, and are sutured to each other on the median line; by their outer margins they join the maxillaries, and behind the palate-bones; whilst in *Anthracosaurus* the anterior end of the palate-bone lies in between the vomers and the maxillaries. The posterior part of the palate is much the same in *Anthracosaurus* and *Loxomma*, but, so far as I can ascertain, is probably very different in *Pteroplax*.

Whether *Anthracosaurus* possessed epiotic horns like *Loxomma* and *Pteroplax* is not determinable, the specimen being deficient at these parts.

The teeth of *Anthracosaurus* differ much from the teeth of *Loxomma*; they are slightly oval in outline and altogether stronger than the latter, which are much flattened. The teeth of both in section show most beautiful Labyrinthodont structure. The teeth of *Pteroplax* have not as yet been found.

The vertebræ and ribs in *Anthracosaurus* and *Loxomma* are of large size, very strong, and most difficult to distinguish from each other when found separate. None of the vertebræ of *Pteroplax* have ever been discovered.

EXPLANATION OF THE PLATES.

Plate VIII.

Fig. 1. Upper surface of cranium of *Anthracosaurus Russelli*, one third the natural size; *P.max*, præmaxilla; *M.g*, mucus-groove; *A.n o*, anterior nasal orifice; *N*, nasal bone; *Max*, maxilla; *L*, lacrymal bone; *Ju*, jugal; *Qu ju*, quadrate-jugal; *Qu*, quadrate; *S.t*, supratemporal; *O.V*, orbital vacuities; *Fr*, frontals; *Pr.fr*, prefrontal; *Pt.fr*, postfrontal; *Pt.O*, postorbital; *P*, parietals, with parietal foramen; *Sq*, squamous; *S.O?*, supraoccipital, so called; *E*, epiotic; *T.F*, temporal fossa; *S.O*, supraoccipital; *E S*, exoccipital; *Mand*, anterior end of left mandible overlying part of skull; *P.B.* palate-bone, posterior end of right side displaced.

Fig. 2. Upper, and fig. 3 under surface of a dermal scute: *a*, anterior end.

Plate IX.

Under surface of same cranium, one third the natural size. *P.max*, præmaxilla; *V*, vomer; *N.C*, nasal channel; *Max*, maxilla; *Pal*, palate-bone; *P.T*, palate-tusk; *P.t.p*, palate-teeth, small posterior series; *O.V*, orbital vacuities; *Pter*, pterygoid bone; *B.sph*, basisphenoid; *Pr.sph*, presphenoid; *Pr fr*, prefrontal; *L*, lacrymal; *Ju*, jugal; *Qu.ju*, quadrate-jugal; *B.oc*, basioccipital; *Qu*, quadrate; *Mand*, right ramus of mandible overlying part of right side of skull.

Plate X.

Fig. 1. Inner surface of right mandible of same, one third the natural size. *Ar*, articular piece; *D*, dentary; *S*, splenial; *An*, angular; *Sym*, symphysis.

Fig. 2. Outer surface of left mandible, one third the natural size. *Ar*, articular piece; *D*, dentary; *An*, angular; *Mg*, mucus-groove.

Fig. 3. Dorsal rib, two thirds the natural size.

Fig. 4. Dorsal vertebra, natural size, entire.

Plate XI. *Sections of teeth of* Anthracosaurus.

Fig. 1. Transverse section of maxillary tooth near to apex and above pulp-cavity, magnified 12 diam. *E*, enamel; *D*, dentine.

Fig. 2. Transverse section just below top of pulp-cavity. *E*, thin enamel; *D.l*, light dentine; *D.d*, dark dentine; *P*, pulp-cavity; short infoldings of peripheral bands (*Pl*) into apices of fusiform light dentine are seen, also rudimentary radiations of pulp-cavity.

Fig. 3. Transverse section a little below fig. 2 and above the radiations of the pulp-cavity, the rudiments of which are indicated as in fig. 2. *D.l*, light dentine; *D.d*, dark dentine; *P*, pulp-cavity, the infolded peripheral bands (*Pl*) extend inwards two thirds of the distance towards the pulp-cavity.

Fig. 4. Transverse section a little below the level of the alveolar border. *D.l*, light dentine; *D.d*, dark dentine; *P*, pulp-cavity; *Pl*, peripheral band infolded; *P*, irregular radiations of pulp-cavity.

Fig. 5. Portion of fig. 4. magnified 48 diameters; *t t t*, toothlets; *D l*, light dentine; *D d*, dark dentine; *Pl*, peripheral band infolded and sinuous; *P P P*, pulp-cavity.

XVII.—*The Mammals of Turkestan.* By Dr. N. Severtzoff.

[Continued from p. 57.]

59. *Lagomys rutilus*, n. sp.*

The summer as well as the winter dress may be described from an adult specimen in change of fur, which was obtained in the end of May in the mountains of Vernoe. The winter hair is tolerably long, greyish yellow, with a black admixture commencing from the nape; the roots of the hair are dark lead-colour. It differs from *L. rufescens*, Gray, in having no white at all on the head, the middle of the neck, the belly, and the inner sides of the legs; all these parts are pale yellow (*fulvescentes*). Sides, throat, and the outer side of the legs yellowish brown; the ears are large, rounded, and covered with harsh yellowish grey hair; *the whiskers are yellow*, with a few black hairs among them; the claws are black. Length 8½ inches.

Summer dress. The whole upper part of the body light fiery brown; the throat chestnut-colour.

Young. The upper parts of the body are yellowish grey, yellower than they are in the adult in winter; the forehead light reddish brown. I obtained an old and a young specimen in the end of May 1867 in the mountains near Vernoe, at an altitude of about 7000 to 8000 feet. I also got an example in the spring change of dress, previous to the two above mentioned, in the rocks about the river Kara-bur, south of Aulje-ata, in the end of June, about 6500 feet above the sea, consequently further south and lower than the others; but it was still moulting: this specimen I lost afterwards.

The full summer dress is apparently attained at different times, from the middle of June until the middle of July. When moulting they are pied, with wide equal spots of the bright reddish brown colour; these spots, as I remember, were smaller on the Kara-bur specimen than on the one from Vernoe (which is now in the Moscow Museum); but in both these patches are very irregular.

It frequents places covered with juniper trees, and is not particularly watchful, all the three specimens obtained having been shot at very short range.

* [*Cf.* the recently described Central-Asian species, *Lagomys ladacensis* and *L. macrotis*, Günther, Ann. & Mag. Nat. Hist. ser. 4, xvi. p. 231; *L. auritus* and *L. griseus*, Blanford, Journ. Asiat. Soc. Beng. xliv. p. 111. —E. R. A.]

becomes wider on the outer side of the ear, expanding into a large black spot 1½ inch in length and 6 lines in width. But this extension of the black edge on the outer side of the ears is also tolerably frequent in *L. Lehmanni*, but not beyond 1½ line or, at the utmost, 2 lines in width.

For a comparison of the skulls of *L. Lehmanni* and *L. tolai* I do not possess any material; but according to the above-mentioned characters of the former, the skulls of both species must be compared with *L. timidus*.

L. Lehmanni inhabits all the localities of the Thian-Shan mountains which were explored by me, ascending to a height of 10,000 feet, *i. e.* almost up to the utmost limit of the juniper bushes, but only sporadically. It is very numerous in the plains of the Chilik and its tributaries; whilst south of Issik-kul, on the Suok-Tube and Kir-djal, in the Alexandrowsk mountain-chain, and near Merke, it was not found by me, and it does not appear to inhabit the Karatau. On the other hand, it is numerous on the steppes of Ilev, as also on the Syr-Darja steppes as far as the Karatau, and further west as far as Lake Aral. Its range is bounded on the west by the Caspian, as it has only been found on the eastern shores of that sea. I have named it after the traveller who first obtained examples of this species.

61. *Camelus bactrianus.*

Throughout Turkestan; in summer it ascends even to the utmost summits of the mountains.

62. *Camelus dromas.*

Occurs only in the western parts of Turkestan, and even there only in the lowest plains; I myself did not see it at any elevation above 1000 feet.

β. hybridus is found in exactly the same localities as the preceding.

63. *Antilope subgutturosa**.

Resident throughout Turkestan in those localities which do not exceed the altitude of 4000 feet; but it is commonest on the plains of about 1000 feet.

* [According to Mr. Blanford, Turkestan examples differ from the typical form in their darker face-markings and the much less open curve of their horns; but as intermediate specimens occur in Persia, he only separates the Turkestan antelope as a variety, *yarkandensis* (Journ. As. Soc. Beng. xliv. p. 112).—E. R. A.]

64. *Antilope saiga.*

I never met with this species, except in winter, when it is tolerably common throughout Turkestan, with the exception of the Zarevshan districts and the Kisil-kum steppes, extending as far as the sea of Aral. For the summer it leaves this country for the north.

65. *Ovis Karelini*, sp. n.

I met with this species in the high mountains of the north-eastern portion of Turkestan, where it kept all the year round. (*Cf. infrà.*)

66. *Ovis Polii*, Blyth.

Inhabits the summits of the mountains of North-eastern Turkestan, and does not descend below about 10,000 feet, keeping mostly just below the range of perpetual snow. (*Cf. infrà.*)

67. *Ovis Heinsii*, sp. n.

At the same altitude as *O. Karelini*, only south of the localities inhabited by the latter. (*Cf. infrà.*)

68. *Ovis nigrimontana*, sp. n.

In the western Thian-Shan mountains and the Karatau this animal is a resident in the larch-wood and apple- and ash-grove district, about 6000 feet altitude. (*Cf. infrà.*)

69. *Ovis aries*, var. *steatopyga.*

Is kept throughout Turkestan up to a height of 7000 to 8000 feet above the sea, and in summer even to the range of perpetual snow. (*Cf. infrà.*)

Ovis Karelini, Sev. *Ovis Polii.* *Ovis Heinsii*, Sev. *Ovis nigrimontana*, Sev.

Before describing and comparing the different characters of the above species of Turkestan sheep discovered by me, I think it desirable for clearness to explain the different distinctions of the species forming the genus *Ovis*, many of which are introduced by me here for the first time.

The specific characters of sheep consist in the different size and shape of the horns and the various parts of the skull, the shape of the whole head, the mane of the neck, the difference in colour, and the size of the animal. The general form of the body and the proportions of the animal's bones to each other are very similar in most of the species of this genus.

The most striking characters are those of the mane (in such species as possess one) and the horns; but whilst these are only fully developed in old male specimens, the characters of the skull and the marking of the skin are available in both sexes and at all ages. The characters of the horns have already been successfully used by Blasius for the easy and exact separation of the different sheep. But in those species recognized by him he has not noticed all the peculiarities of the horns which are constant, and therefore may be used for the more easy separation of the different species. Having discovered some new species, I was consequently obliged to find some new characters of the horns, which had not been used by Blasius, and thus to complete the geometrical list of their variations.

The horns of an adult sheep present a double spiral. 1st, the inner margin of the horn describes a spiral, which would fit on an inserted cone, called the *axil spiral*, which offers some characteristics of which Blasius had not taken any notice. 2nd, round the horn-core, even if it were straight, run three edges each describing one spiral along the whole length of the horn-core; this is the *edge spiral*, which has been used by Blasius in defining specific distinctions.

The whole spiral of the inner margin is divided into three curves: 1st, the *basal curve* ascends; 2nd, the *median curve* descends; 3rd, *terminal* or *final curve*, which again ascends.

The directions of these curves from the vertical section of the skull may be represented by straight lines or chords; the angles formed by these chords and the axis of the vertical section of the skull serve also as characters for distinguishing the different species. Furthermore, the horns of all sheep present three surfaces separated by more or less rounded edges, of which latter the two exterior are the "*nuchal edge*" and "*fronto-orbital edge*," and the third the interior or "*fronto-nuchal edge*." Of the three sides or surfaces of the horns, the two most interior may be called the "*frontal surface*" and "*nuchal surface*" (which meet at the fronto-nuchal edge), and the third the exterior or "*orbital surface*."

The edges, the surfaces, and the imaginary chords of the horns offer very good specific distinctions. The differences in the horns, as already mentioned, are completely visible only in adult male specimens; and the younger the animals the more similar are their horns. The form, the separation, and articulation of the different bones of the skull are most distinctly seen in young specimens—that is, as long as the separate bones

from the island of Cyprus; a species closely allied to the former, from Asia Minor; *M. orientalis*, Gmel., from Northern Persia; *M. Vignei*, Blyth, from Chorosan; *M. arkal*, Br., from Turcomania; and *M. Burchelli*, Blyth, from the Himalayas.

This genus, in the shape of the horns, shows an approach to the goats; and the above-named species of *Ammotragus* and *Ægoceros* are closely allied to it. The former, being built like a sheep and having horns exactly like *Musimon cyprius*, wants the lacrymal fossæ of the goats in front of the orbit in consequence of the small development of that bone; there is also no ridge on the nose. The only species inhabiting Africa is the *tragelaphus*. The latter, besides the want of the lacrymal fossæ, differs also in its structure, being built like a goat, in the short skull and the beard which is found on male specimens; in the shape of the horns only does it resemble *Musimon*. These latter are almost smooth, in which this form differs from the sheep as well as from the goats; it is the Caucasian species *Æ. Pallasii*, Rouill. Another species, which also possesses a beard and ovine horns, occurs in Cabul (Journ. Asiat. Soc. of Bengal, 1840, p. 440; Wagn. Fortsetz. v. Schreb. 1844, Suppl. iv. p. 540, note).

Having in this way fixed (by help of comparative diagnosis) the position of the Turkestan sheep in systematic classification, I think it will be well to state their specific differences before going on to their more detailed description.

[To be continued.]

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

March 9, 1876.—Dr. Günther, M.A., Vice-President, in the Chair.

'On the Development of the Crustacean Embryo, and the Variations of Form exhibited in the Larvæ of 38 Genera of Podophthalmia." By C. Spence Bate, F.R.S.

The author states that, although the general forms of several genera of Podophthalmous Crustacea are known, yet the details of their structure have been so unsatisfactorily figured and described, that the value and importance of hereditary elements are incapable of being studied and appreciated.

Through Dr. Carpenter he received from Mr. Power an offer of a considerable number of larvæ of exotic species, together with the parents from which they had been obtained; in relation to which Mr. Power wrote:—

"Dear Sir,—I have to thank you for your kindness in answering my letter to Dr. Carpenter, and for the memoirs.

"My collection of Crustacea and the microscope-slides of the larvæ are at present, and have been, packed up in Fort Louis. Now I am again on detachment; and if left here in peace for a few months, I shall arrange my specimens and finish up the microscopic drawings.

"All my larvæ are hatched in basins (the only kind of aquaria my nomad life allows me to use); so each crab or prawn &c. whose larvæ I possess is identified with its young. And this reminds me that on reading Fritz Muller's paper in the 'Annals' (1864, vol. xiv. p. 104), I was much astonished, as none of the prawns or prawn-allies whose young I have hatched show any such *Nauplius* form as shown in figures 1 & 3, &c., but all I have observed as yet are born like fig. 8, or near it.

"I have been quite unable to rear any crab-larvæ beyond a day or two after birth; whether they require moving water or not I do not know; but certainly, though I have kept the parents alive for several weeks in basins (the water changed once or twice in 24 hours) of salt water, the same method would not succeed with the larvæ. I then tried small aquaria, and signally failed again.

"I have not been in the neighbourhood of fresh water as yet, so have had no opportunities of observing the freshwater Crustacea, though there are a good many crab and shrimp forms. I have found two kinds of that curious parasitic crustacean which adheres like a little polypus, a mere bag with a peduncle, but containing hundreds of young Crustacea whose genus I do not know, as I cannot find any account of them in Van der Hoeven's 'Zoology'*.

"If I succeed in getting posted to one of the regiments here, my life will be more stationary, and I shall have far better chances of working my crab-hatchings.

"In Fritz Muller's paper before referred to, I fancy that he has not hatched the different larvæ mentioned. After reading the paper very carefully, I could not help fancying that the various stages of development were not hatched through, but specimens were captured at different times, and perhaps larvæ of totally different species have been given as stages of the same animal. I say this with great doubt; but reading the paper will, I think, bring every one to the same conclusion. Thus he says, 'the unaltered *Nauplius* form, probably the same in which the animal escapes from the egg, came under notice only once;' again, 'This larva (taken on the 13th of January) is closely approached by four others, probably *belonging* to the same swarm, which were taken at the same time (24th January);' and so on.

"To tow a net in these tropical seas and to examine all the microscopic Crustacea would give a most extraordinary assemblage

[* New genus allied to *Sacculina*, which hatch larvæ in the cirriped pupa stage.—C. S. B.]

of forms; but I doubt if it is so useful as tracing the steps of individuals. * * * * * *

"I have not yet hatched the land Hermit-crabs, though I suppose they are much as the ordinary sea specimens, and they certainly spend their larval life in the sea.

"Pray excuse my rambling letter, and please let me know of any way in which I can be of any use to you in my humble dips into natural history. "Yours very truly,

"WILMOT HENRY POWER,

"*Staff-Surgeon, 44th Regt., Lt. Inf.*"

Some time afterwards the author received the promised collection, together with Mr. Power's drawings and notes. These have enabled him to identify the parent forms of some known larvæ, and also to determine those of several unknown genera.

It has also led him to the conviction of a unity of character throughout the various forms and changes of Crustacea; that variety in form is never inconsistent with homological truth; that parts suppressed or rendered abortive for want of use are never absolutely lost, and may be reproduced under conditions that may require them.

The eyes of those Crustacea, such as *Alpheus*, that inhabit dark places are reduced in power according to the condition of their habitat. But these organs are, in their larval state, as well developed, if not more so, as any of those whose life is passed in the bright sunshine of the surface of the ocean.

The blind *Didamia* brought from the depth of four miles below the surface of the Atlantic by the dredges of the 'Challenger' differs in no respect from *Polycheles*, taken by Heller in the comparatively shallow Adriatic sea. In the blind prawn from the Mammoth Cave of America, and the sightless *Nephrops* of Formosa, the organs of vision are reduced to the smallest condition consistent with their retention; and in the Cirripedes the eyes are represented by their nervous apparatus only.

The several forms of larva have not, in the prawn-allies, shown any approach to the *Nauplius* state, as mentioned by Fritz Muller; so that the author believes that it must be confined to the genus *Peneus* alone among the Podophthalmia. Nor should it be forgotten that the *Nauplius* form has only been observed as a free-swimming animal.

The author has taken this opportunity of making a close examination into the earlier stages in the development of the embryo, and comparing the progress within the ovum of some of the larvæ that arrive at or near maturity before being hatched, with those of the larval forms that are hatched in a more immature condition; and he states that, as soon as the protoplasm assumes any thing like a definite plan, distinct lobes, corresponding in position with those of the several appendages in the *Nauplius*, together with an embryonic or ocular spot, are present—that in the *Nauplius* forms they exist as deciduous appendages only, and are soon cast aside and replaced by others more adapted to the wants of the adult existence.

April 6, 1876.—Dr. J. Dalton Hooker, C.B., President, in the Chair.

"On the Structure of a Species of *Millepora* occurring at Tahiti, Society Islands." By H. N. Moseley, Naturalist to the 'Challenger' Expedition.

In a paper treating mainly of the structure of *Heliopora cærulea*, communicated to the Royal Society in the autumn of 1875, some account was given of results arrived at from the examination of two species of *Millepora* obtained at Bermuda and at Zamboangan, Philippines; and in that paper a summary of the literature concerning the tabulate corals generally was given. The present paper, to be considered to a certain extent a continuation of the last, gives an account of the structure of a species of *Millepora* obtained at Tahiti, Society Islands. The author commences by expressing his obligations to his colleague Mr. J. Murray, who obtained living specimens of the *Millepora* and handed them over to him with the zooids in the expanded condition for examination, and who further, having devoted some time to the study of the coral, gave him valuable information with regard to several points in its structure.

No *Millepora* appears to have been hitherto known to occur at Tahiti. The name of the species of the one the structure of which is described in the paper was not ascertained. It resembles *M. tuberculosa*, as described by Milne-Edwards*, in outward form, but differs from it in having the calicles of two kinds disposed on the surface of the corallum in regular separate systems, in this respect resembling more closely *M. plicata*, *M. foliata*, and *M. Ehrenbergii* as described by the same author.

The coral was examined in the fresh condition, and also preserved in alcohol, chromic acid, and glycerine, and treated with osmic acid. Hardened specimens were decalcified and examined by means of sections. The corallum is a spongy mass composed of more or less contorted trabeculæ of calcareous matter, which is disposed in a series of thin layers following the contours of the surface, and representing successive additions by growth. Within these layers ramify a series of canals which give off branches and subbranches, the whole ramifications being intimately connected with one another, and with the calicular cavities, by a network of smaller channels. The main canals are sometimes large enough to be easily seen by the naked eye, and run for as great a distance on the surface of the corallum as 1½ inch. This system of branching canals is held to be characteristic of the coralla formed by the hydroid genus *Millepora*, distinguishing it from all other coralla. The calicles are of two kinds, small and large. They are disposed on the surface of the corallum in irregularly circular systems. A large calicle occupies the centre of each system, and is surrounded by a ring of smaller calicles, usually from five

* Hist. Nat. des Coralliaires, pl. F 3. figs. 1*a*, 1*b*

to eight in number. In histological structure, as also in chemical composition *, the coralla of the genus *Millepora* seem to show no marked differences from Anthozoan coralla.

The zooids are of two kinds. The one, short and stout, occupies the larger central calicles of the systems, has from four to six short knobbed tentacles, and is provided with a mouth and certain gastric cells, closely resembling those figured by Allman as occurring in *Gemmaria implexa* †. The other kind occupies the smaller calicles, is longer and more slender than the mouthed zooid, has from five to twenty tentacles, and no trace of a mouth. The usual number of tentacles in the mouthless zooid is about twelve to fifteen. The tentacles are larger than in the mouthed zooid, and disposed at irregular intervals along the body. They show the transverse striation, or apparent septa, so characteristic of the tentacles of hydroids. They have spheroidal heads composed of masses of thread-cells.

The zooids of both kinds are provided with well-marked longitudinal muscular fibres, which are disposed in bundles, and are attached inferiorly to the vessels of the hydrophyton which join the somatic cavity at the base of the zooids. Circular muscular fibres are possibly also present. As in *Heliopora*, only a thin layer at the surface of the coral is living.

The soft parts of the hydrophyton consist of a network of canals and vessels occupying the corresponding canals in the corallum. The canals are composed of an ectoderm and an endoderm. The ectoderm rests on a thin layer of membrane. It is mainly composed of fusiform finely granular cells with an oval nucleus, but is much modified in certain regions. In the upper part of the living layer its cells are abundantly converted into the parent cells of thread-cells, and on the actual surface into a layer of prismatic cells showing at the very surface hexagonal outlines. This layer is believed to be continuous over the whole outer surface of the coral. It is continued down into the calicular cavities, and in the contracted condition almost closes their orifices. The endoderm consists of two elements—yellow pigmented cells closely simiar to those of other hydroids, and small transparent highly refracting globules. The pigmented cells are abundant in the somatic cavities of the zooids, and in the canals and vessels of the hydrophyton.

They impart a bright yellow colour to the tips of the tubercles of the living coral. The canal-system of the hydrophyton anastomoses most freely with the somatic cavities of the zooids, and establishes a free communication between them. Two kinds of thread-cells are present. The one is of the peculiar form occurring only in Hydrozoa, viz. that which has in the expanded condition a short, wide, bladder-like structure at the base of tho thread next

* Structure and Classification of Zoophytes, by J. D Dana (Philadelphia, 1846), Appendix, p 130. Corals and Coral Islands, *ejusd* (London, 1872), p. 105

† Gymnoblastic and Tubularian Hydroids, pl. viii fig. 5

the cell, which bladder is armed with three spines set in one whorl. In *Millepora* the spines are unusually long and set at right angles to the thread. This kind of thread-cell alone occurs in the tentacles; it occurs also more sparingly in the hydrophyton.

The other kind of thread-cell is larger and ovoidal in form, closely resembling that figured by Allman as occurring in *Gemmaria implexa*. These thread-cells are confined to the hydrophyton. They form densely set zones around the bases of the zooids.

The other species of *Millepora* examined appear to agree in all essential particulars with that occurring at Tahiti. They have mouthed and mouthless zooids, but these are not arranged in regular systems. They have the same two kinds of thread-cells, with a similar distribution. The Tahitian *Millepora*, like the others examined, is infested by a parasitic fungus, which exists in the soft superficial tissues, as well as in the substance of the corallum, and has a decided green tint.

GEOLOGICAL SOCIETY.

March 22, 1876.—Professor P. Martin Duncan, M.B., F.R.S., President, in the Chair.

"On the Triassic Strata which are exposed in the Cliff Sections near Sidmouth, and a note on the occurrence of an Ossiferous Zone containing Bones of a *Labyrinthodon*." By H. J. Johnston Lavis, Esq., F.G.S.

The author described the base of the cliffs east of Sidmouth as composed of the Marl which is the uppermost subdivision of the Trias in South Devon, capped in Littlecomb Hill and Dunscomb Hill by Greensand and Chalk, and in Salcombe Hill by Greensand alone. In the valley of the Sid it is largely exposed at the surface. Close to the mouth of the Sid the Upper Sandstone crops out beneath the marl, forming a cliff overhanging the river. To the west of Sidmouth there is a low projecting cliff, the Chit rock, formed also of the Upper Sandstone; and at the western end of this is a fault which has given the Chit rock an upthrow of at least 40 and perhaps of 80 feet, since it has no marl capping it, and in its lithological character it resembles the middle part of the Upper Sandstone. To this point the dip is to the east; but westward of the fault the dip is at first to the west for about half a mile, when the sandstone reappears with an easterly dip, having formed a synclinal curve. It is overlain by Marl and Greensand in Peake and High-Peake Hills, which are capped with Chalk gravels. West of High-Peake Hill the Sandstone forms the whole cliff. The author described the general characters presented by the Triassic beds in the section under notice, and mentioned the occurrence at about 10 feet from the top of the Sandstone of a peculiar series of beds, composed of coarse sandstone, containing scattered nodules of marl from the size of a pea to that of a hen's egg, together with numerous

considered by him to be a new species of the genus *Melonites*, hitherto regarded as peculiar to America. The author proposed to call this species *Melonites Etheridgii*; and he described it as possessing a more or less spheroidal test, about 7 inches in diameter, composed of very thick plates, arranged in five ambulacral and five interambulacral areas, all the plates being ornamented with minute tubercles for the support of spines. The interambulacral areas were probably about twice as broad as the ambulacral, and composed (at the equator) of about nine ranges of plates, the marginal ones pentagonal, the rest hexagonal, articulating with each other by faces varying from a right angle to one of 30°. The ambulacral areas were broad, each formed of two convex ribs separated by a meridional depression running from mouth to anus, and each rib (half-area) composed of 6 or 7 ranges of irregular plates, each perforated by a pair of simple pores. The tubercles are minute, imperforate, without boss, and of two orders, the larger surrounded by a smooth areola, bounded by an elevated ring. The spines are small, tapering, coarsely sulcate, with a prominent collar round the articular end. A second specimen exists in the British Museum. The species differs strikingly from the North-American *Melonites multiporus* in the characters of the ambulacral areas, which have 12–14 ranges of plates and are divided by a meridional furrow in the new species, and only 8 ranges of plates, with a median ridge formed of plates twice as large as the rest, in *M. multiporus*.

April 5th, 1876.—Prof. P. Martin Duncan, M.B., F.R.S., President, in the Chair.

"The Bone-Caves of Creswell Crags." By the Rev. J. Magens Mello, M.A., F.G.S.

In this paper the author gives an account of the continuation of his researches upon the contents of the caves in Creswell Crags, Derbyshire. The further exploration of the Pin-hole cave described in his former paper *, furnished a few bones of Reindeer, *Rhinoceros tichorhinus*, and other animals, but no more remains of the Arctic Fox, which were particularly sought for. Operations in this cave were stopped because the red sand, in which the bones were found towards the entrance, became filled with limestone fragments, and almost barren of organic remains. The author then commenced the examination of a chambered cave called Robin Hood's cave, situated a little lower down the ravine on the same side. The section of the contents of this cave showed:—a small thickness of dark surface-soil, containing fragments of Roman and Mediæval pottery, a human incisor, and bones of sheep and other recent animals; over a considerable portion a hard limestone breccia, varying in thickness from a few inches to about 3 feet; beneath this a deposit of light-coloured cave-earth, varying in thickness inversely to the breccia, overlying a dark-red

* See Quart Journ. Geol Soc. vol. xxxi. p. 679

sand about 3 feet thick, like that of the Pin-hole, but with patches of laminated red clay near the base, and containing scattered nodules of black oxide of manganese, and some quartzite and other pebbles, which rested upon a bed of lighter-coloured sands containing blocks of limestone, probably forming part of the original floor of the cavern. The hard stalagmitic breccia contained a great many bones (chiefly of small animals, but with some of Reindeer), and teeth of *Rhinoceros tichorhinus*, Hyæna, Horse, Water-vole, and numerous flint flakes and chips, and a few cores. Some of the flakes were of superior workmanship. A few quartzite implements were also found in the breccia. The cave-earth contained a few flint implements; but most of the human relics found in it were of quartzite, and of decidedly palæolithic aspect. There was also an implement of clay-ironstone. The animal remains chiefly found in the cave-earth were teeth of Horse, *Rhinoceros tichorhinus*, and Hyæna, and fragments of both jaws of the last-mentioned animal. Bones and teeth of Reindeer, and teeth of Cave-Lion and Bear also occurred. The red sand underlying the cave-earth contained but few bones, except in one place, where antlers and bones of Reindeer and bones of Bison and Hyæna occurred. At another part a small molar of *Elephas primigenius* was found. A large proportion of the bones had been gnawed by Hyænas, to whose agency the author ascribed the presence of most of the animal remains found; but he remarked that no coprolites of Hyænas had been met with. The following is a list of the animals whose remains occurred in this cavern:—*Felis leo* (var. *spelæa*), *Hyæna crocuta* (var. *spelæa*), *Ursus arctos, U. ferox, Canis familiaris, C. lupus, C. vulpes, Elephas primigenius, Equus caballus, Rhinoceros tichorhinus, Bos bison*, var. *priscus, Bos longifrons, Capra hircus, Sus scrofa domesticus* and *ferus, Cervus megaceros, C. tarandus, Arvicola amphibius*, and *Lepus timidus*.

"On the Mammalia and Traces of Man found in the Robin-Hood Cave." By W. Boyd Dawkins, Esq., M.A., F.R.S., F.G.S., F.S.A., Professor of Geology and Palæontology in the Owens College, Manchester.

The author noticed the various species of animals discovered by Mr. Mello during the researches, the results of which are given in the preceding paper, and drew certain conclusions from their mode of occurrence as to the history of Robin Hood's Cave. He considered that the cave was occupied by Hyænas during the formation of the lowest and middle deposits, and that the great majority of the other animals whose remains occur in the cave were dragged into it by the Hyænas. That they served as food for the latter is shown by the condition of many of the bones. During this period the red sand and clay of the lowest stratum was deposited by occasional floods. The red loam or cave-earth forming the middle stratum was probably introduced during heavy rains. The occupation of the cave by Hyænas still continued, but it was disturbed by the visits of Palæolithic hunters. The remains found in the breccia indicate that the cave was inhabited by man, and less frequently visited by Hyænas than before. The presence of vertebræ of the Hare in the breccia would imply that the hunters who occupied the cave had not the dog as a domestic animal. After a discussion of the relations of the animals forming the fauna of the cave, the author proceeded to describe the traces of man found in it, which consist of fragments of charcoal, and implements made of antler and mammoth-tooth, quartzite, ironstone, greenstone, and flint. The distribution of these implements in the cave represents three distinct stages. In the cave-earth the existence of man is indicated by the quartzite implements, which are far ruder than those generally formed of the more easily fashioned flint. Out of 94 worked quartzite pebbles only 3 occurred in the breccia, while of 267 worked flints only 8 were met with in the cave-earth. The ruder implements were thus evidently the older, corresponding in general form with those assigned by De Mortillet to "the age of Moustier and St. Acheul," represented in England by the ruder implements of the lower breccia in Kent's Hole. The newer or flint series includes some highly finished implements, such as are referred by De Mortillet to "the age of Solutré," and are found in England in the cave-earth of Kent's Hole and Wookey Hole. The discovery of these implements considerably extends the range of the Palæolithic hunters to the north and west, and at the same time establishes a direct relation in point of time between the ruder types of implements below and the more highly finished ones above.

May 10, 1876.—Prof. P. Martin Duncan, M.B., F.R.S., President, in the Chair.

"On some Fossil Reef-building Corals from the Tertiary Deposits of Tasmania." By Prof. P. Martin Duncan, M.B., F.R.S., President.

The species described by the author were *Heliastræa tasmaniensis*, sp. n., *Thamnastræa sera*, sp. n., and a second species of *Thamnastræa*. Both these genera are composed of reef-building Corals; and the species here described undoubtedly belonged to that category. They required the natural conditions peculiar to coral reefs. The author noticed the facts as to the distribution of land and water in the Australian region in Lower Cainozoic times, which are revealed by the deposits belonging to that age, and indicated that, although the insular distribution of the land may have been favourable to the growth of coral reefs, the existence of a suitable sea-temperature in the latitude of Tasmania is insufficiently explained. A single relic of the old reef-building Corals survives on the shores of Tasmania in the *Echinopora rosularia*, Lam.; but all the other forms have died off. The Coral-isotherm would have to be 15° lat. south of its present position to enable reefs to flourish south of Cape Howe; and this could be caused only by a change in the arrangement of land and sea, and in the position of the polar axis. The author

and described as new the following species—*Sigaretus excentricus*, *Cancellaria epistomifera*, *Murex cornurectus*, *Turbinellus ædificatus*, *Cypræa Gabbiana*, and *Phorus delectus.*

May 24, 1876.—Prof. P. Martin Duncan, M.B., F.R.S., President, in the Chair.

"Evidences of Theriodonts in Permian Deposits elsewhere than in South Africa." By Prof. R. Owen, C.B., F.R.S., F.G.S.

In this paper the author noticed some described Reptilia which he believes to belong to his order Theriodontia. In 1838 Kutorga described as probably mammalian the distal end of a humerus showing a perforation or canal above the inner condyle. The specimen was from the Permian of the Western Oural; and Kutorga gave it the name of *Brithopus priscus*. Under the name of *Orthopus primævus* he described the proximal part of the humerus of the same species, perhaps of the same bone. There is thus evidence of an extinct reptile in the Permian deposits of the Oural with a humerus showing the characters of the Theriodont Reptiles of the Karoo series of South Africa. The British Museum possesses a cast of the first-mentioned fragment, labelled by Krantz "*Eurosaurus uralensis*, H. von Meyer, *Brithopus priscus*, Kutorga." The genus *Eurosaurus* was founded in 1842, by Fischer von Waldheim, upon some fragments of bone, including a humerus with a broad proximal end as in Kutorga's *Orthopus*; and Fischer also noticed a humerus showing characters like those of Kutorga's *Brithopus*, from the same locality as the portion of a jaw described under the name of *Rhopalodon Wangenheimii*, Fischer, which contained nine molar teeth, with thick, pointed, subcompressed crowns, with trenchant and serrate borders. In 1858 H. von Meyer described a skull from the Permian of the Oural, under the name of *Mecosaurus uraliensis*, as a Labyrinthodont; and Eichwald referred this genus, with Kutorga's *Brithopus* and *Orthopus*, to Fischer's *Eurosaurus*. The author regarded *Mecosaurus* as truly Labyrinthodont; whilst the Permian forms constituting Kutorga's genus were referred to the Theriodont order. From the same locality as the above, Kutorga describes *Syodon biarmicum* as probably a Pachyderm. Its teeth resemble those of *Cynodraco*. Eichwald's *Deuterosaurus biarmicus* is founded upon the fore part of both upper and lower jaws of a Reptile, containing teeth with denticulate or crenulate trenchant borders, the canines being large, especially in the upper jaw. *Deuterosaurus* closely resembles *Cynodraco*, and still more the *Lycosaurus* of the Karoo beds of the Sneewberg range. All the above are from the Permian beds of the Oural; and the author regards them as furnishing suggestive evidence of the Palæozoic age of the Karoo series, in which the Theriodont Reptiles are best represented.

The author further noticed a Theriodont allied to *Lycosaurus*, from a red sandstone, probably of Permian age, in Prince-Edward Island. The remains include the left maxillary, premaxillary, and nasal bones; the teeth, implanted in distinct sockets, have subcompressed, recurved, conical, pointed crowns, with minutely crenulated borders. The foremost tooth in the maxillary is a canine; and in other points the dentition shows Theriodont characters. This fossil has been described by Dr. Leidy under the name of *Bathygnathus borealis.* Thus, supposing the affinities of the fossils from the Oural and Prince-Edward Island to be correctly determined, the Reptilia distinguished by Mammalian characters are shown to have had a very wide range. Further, the author thinks that the Theriodont Reptiles of the Bristol Dolomitic Conglomerate may also prove to constitute a family in the Theriodont order.

MISCELLANEOUS.

Parkeria *inferred to have been a Species of* Hydractinia. By H. J. Carter, F.R.S. &c.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—Having lately received, again through the kindness of my friend Mr. W. J. Sollas, several specimens of *Parkeria* from the Cambridge Greensand, my attention has been directed to their structure, which so closely resembles that of the Hydractiniidæ that a parity of organization between the two may be fairly inferred, the particulars of which I hope to communicate to you on a future occasion.

I am, Gentlemen,
Yours faithfully,
Henry J. Carter.

London,
July 20, 1876.

On Saccharomyces cerevisiæ. By MM. Francisco Quiroga y Rodriguez and Enrique Serrano y Fastigati.

The resumption of our experimental researches upon the influence exerted by various agents and the combination of different conditions upon the various inferior organisms has led us to the study of these influences upon beer-yeast. Our observations were made with the same Verick microscope which we used in our investigations of blood, and giving an amplification of 780 diameters. The number of observations and measurements has been 465, made upon 126 different preparations.

The results obtained are as follows:—

1. In all the preparations made, at the end of five or six days, with the *Saccharomyces* placed in distilled water and exposed freely to the air, light, and surrounding temperature, or in solutions of various phosphates and chloride of ammonium, or placed under the same conditions as the preceding after desiccation, we have observed an infinite number of more or less spherical yellowish corpuscles, in no case exceeding in diameter the thousandth of a millimetre,

which float among the normal cells of the yeast, unite sometimes, and appear also to be enveloped by a membrane. These granules resemble in appearance the masses into which we find the cell-contents divided in some cells; and we think we may affirm that their number is greater in the preparations in which we observe several cells which have folds or are ruptured, than in those which do not present this condition.

2. We have always observed in the vacuoles of the cells one or two shining corpuscles, of a more or less deep yellow colour, and endowed with an oscillatory movement. These corpuscles resemble at the same time the other granules which, as already stated, float freely in the exterior liquid and the protoplasmic granules which occur in the cells outside the vacuoles.

3. In yeast placed in water we have observed at the end of five days cells folded in various fashions—some with the folds normal to the larger axis of the ellipse, others forming acute angles and in a direction divergent from the centre to the periphery. Some cells were constricted in a singular manner, forming a hood and resembling in appearance those blood-globules which were formerly supposed to have an aperture.

4. The action of heat causes the inflation of the cells even to the rupture of some of them, the contents of which escape divided into several parts, filling the field of the microscope with granules. At the first moment of this action the volume of the vacuoles increases by the union into a single one of the two or more that may be contained in the primitive cell. We have also observed some cells in which the torn edges of the enveloping membrane might be very clearly seen.

5. When the preparations of *Saccharomyces cerevisiæ* are treated with concentrated sulphuric acid, we observe, leaving out of consideration the rupture and natural destruction which is produced in most of the cells, that the vacuoles swell very rapidly, the cells acquire a homogeneous appearance and become diaphanous, also becoming nearly spherical, and there is a production of gas.

When this action is completed, at the end of twenty-four hours, the cell consists of a portion of cell-contents contracted into a yellow, homogeneous mass of almost spherical form, of an enveloping membrane, which is more distinctly marked than before, and of an annular space, which is observed between the latter and the yellowish mass, and which has not the appearance of the vacuoles, nor that of the homogeneous or granulated substances which fill the other cells.

6. With phenol in fusion we see the cell-contents acquire sometimes a homogeneous appearance, sometimes that of a mass with a few small granules. In all the cells we find a double contour, which is due to the condensation of the phenol around the enveloping membrane. The cells have a tendency to become spherical or nearly so.

7. *Saccharomyces* deprived of light presents the most remarkable alterations. It is this that we have most carefully studied; and the results obtained seem to us to merit most confidence.

Notes on a Collection of Geological Specimens from the Coasts of New Guinea, Cape York, and neighbouring Islands, collected by William Macleay, Esq., F.L.S., President of the New-South-Wales Linnean Society, Sydney. By C. S. Wilkinson, Government Geologist. (Read before the Linnean Society, Sydney, 28th February, 1876.)

I have lately examined a small collection of geological specimens brought from the coast of New Guinea by the President of this Society, Mr. William Macleay, and which were collected by him when on his recent tour of exploration in the Chevert.

These specimens consist of:—

1. Quartz porphyry (Palæozoic) from Cape York; found underlying beds of Tertiary ferruginous sandstone.
2. Vesicular basalt and brecciated volcanic tufa (Upper Tertiary) from Darnley Island.
3. Small concretions of limonite, with polished-looking surfaces, dredged up off the coast of New Guinea.
4. Specimens of chalcedony and flint, from Hall's Sound.
5. Oolite limestone (Tertiary), very friable, from Bramble Cay.
6. Yellow calcareous (Tertiary) clay, from Katau River.
7. Yellow and blue calcareous clays (Tertiary), from Yule Island and Hall's Sound.

It is with reference more particularly to the fossiliferous clays that I would offer a few remarks.

These clays, as indicated by the fossils contained in them, belong to the Lower Miocene Tertiary period.

So far as I am aware, this is the first notice of such fossils having been discovered in New Guinea; and this discovery of Mr. Macleay's is the more interesting inasmuch as the Miocene *marine* beds, which occupy a considerable area in Victoria and South Australia, have nowhere been found on the eastern coast of Australia north of the Victorian border (Cape Howe). Referring to this fact, the Rev. W. B. Clarke says that "throughout the whole of Eastern Australia, including New South Wales and Queensland, no Tertiary *marine* deposits have been discovered."

The comparison of this Miocene fauna from a locality so near the equator with that from higher latitudes will be important work for a palæontologist.

Professor M'Coy has already gone far to prove, from the comparison of certain Miocene fossils, that the fauna of the Older Tertiary period in Australia was not so restricted in its geographical range as it now is, but was then closely related generically, and even specifically, to that of many parts of Europe and America; and I think that perhaps even the few fossils now before us may afford some additional evidence in confirmation of the views of that eminent palæontologist.

The Miocene clay-beds of New Guinea, judging from the specimens collected by Mr. Macleay, are exactly similar in lithological character to the Lower Miocene beds near Geelong and on the Cape-Otway coast in Victoria.

The fossils from Hall's Sound are unfortunately not in a good state of preservation, being mostly imperfect casts; but amongst them appear to be the following:—

Voluta macroptera (a small specimen), *Voluta anticingulata*, *Ostrea*, *Cytheræa*, *Crassatella* (?), *Pecten*, *Turritella*, *Natica*, *Triton* (?), *Dolium* (?), *Astarte*, *Corbula*, *Leda*, *Venus*, *Cypræa*, two Echinoderms.

Most of the above I have found in the Victorian beds; and two of them have been figured and described by Prof. M'Coy in his Decade No. 1 of the 'Palæontology of Victoria.'

The small specimen of calcareous clay from the Katau river, on the west side of the Gulf of Papua, contains only a few broken fragments of shells; but it appears to be of the same formation as the clay beds of Hall's Sound or Yule Island.

The Oolitic limestone of Bramble Cay I believe to be also of the upper beds of this Miocene formation.

Mr. Macleay, in his letter to the 'Sydney Morning Herald' of October 11, 1875, describes the formation of Yule Island as a sedimentary rock, nearly horizontal on the sea-face, but with a great dip inwards. The rock itself is calcareous, and composed of corals, shells, *Echini*, &c.—in fact a concrete of fossils resembling the Coral-rag of Oxford. Mr. D'Albertis also gives a similar description of the formation of Yule Island, and mentions the occurrence of basaltic trap in the valleys, and that the higher portion of the hills (which attain a height of 700 or 800 feet above the sea-level) are composed of coralline limestone. It is worthy of remark that in Victoria the Miocene strata occur in a similar manner—yellow and blue calcareous clays full of fossil shells, overlain by thick beds of coralline limestone consisting of an aggregate of comminuted fragments of corals, shells, and echinoderms.

The discovery of these Miocene beds on the southern coast of New Guinea is one of considerable importance. Their occurrence, I believe, suggests the former land-connexion of New Guinea with the Australian continent; and this belief is further borne out by the fact of the shallowness of the intervening sea. I am not aware that any Miocene rocks have yet been identified as such on the northern coast of the Cape-York peninsula; but it is not improbable that the ferruginous sandstone described by Mr. Macleay as overlying the porphyritic granite at Cape York, and perhaps other Tertiary deposits which may occur in that locality, may be correlated with the Miocene beds on the opposite coast of New Guinea.

Wallace, referring to this subject in his very interesting and valuable work 'The Malay Archipelago,' says:—"It is interesting to observe among the islands themselves how a shallow sea always intimates a recent land-connexion.. . . We find that all the islands from Celebes and Lombock eastward exhibit almost as close a resemblance to Australia and New Guinea as the western islands do to Asia." And again:—"Australia, with its dry winds, its open plains, its stony deserts, and its temperate climate, produces birds and quadrupeds which are closely related to those inhabiting the hot damp luxuriant forests which everywhere clothe the plains and mountains of New Guinea."

Baron von Mueller's remarks on some of the Papuan plants collected by Mr. Macleay are also evidence in favour of the former land-connexion of New Guinea with Australia; so that our geological evidence is supported by that of zoology and botany.

From geological data it is believed that this continent has not been submerged to any great extent since the Lower Pliocene period; and we know that it has risen a little since the Upper Pliocene epoch, at least in Victoria; for the lava-flows of that age, now forming the Werribee Plains, were *submarine* flows. And Mr. Daintree, formerly Government Geologist of Queensland, shows in his pamphlet 'On the Geology of Queensland' that little upheaval of this portion of Australia has taken place since the volcanic outbursts of a late Tertiary epoch. Now, it is in the Upper Pliocene or Pleistocene deposits that are found the remains of the gigantic marsupials *Diprotodon*, *Macropus titan*, *Nototherium,* and others; and as their allied representatives now occupy both Australia and New Guinea, it is not improbable that those gigantic animals whose bones are found in Northern Queensland also roamed in both those countries. And, further, as the luxuriant vegetation and climatic conditions which we suppose to be favourable for the support of those immense marsupials still exist in New Guinea, is it rash to conjecture that some of these large creatures may be living there at the present time? Further researches may prove this.

I will conclude with the following very apposite extract from Wallace's 'Malay Archipelago':—

"From this outline of the subject, it will be evident how important an adjunct natural history is to geology, not only in interpreting the fragments of extinct animals found in the earth's crust, but in determining past changes in the surface which have no geological record. It is certainly a wonderful and unexpected fact that an accurate knowledge of the distribution of birds and insects should enable us to map out lands and continents which disappeared beneath the ocean long before the earliest traditions of the human race. Wherever the geologist can explore the earth's surface, he can read much of its past history and can determine approximately its latest movements above and below the sea-level; but wherever oceans and seas now extend, he can do nothing but speculate on the very limited data afforded by the depth of the waters. Here the naturalist steps in, and enables him to fill up this great gap in the past history of the earth."—*Sydney Morning Herald,* March 8, 1876.

On a new kind of Psorospermia (Lithocystis Schneideri), *parasitic in* Echinocardium cordatum. By M. A. GIARD.

If the test of an *Echinocardium* be opened in an equatorial plane, we find almost constantly in the general cavity of that Echinoderm a parasitic production of singular appearance. This is met with

course of formation and arranged round a central residual mass. This residue is finally reduced in many spores to 2 or 3 granules of strong refractive power, and may even completely disappear at maturity.

The white crystalline point is formed of crystals belonging to the clinorhombic system, and frequently grouped in macles of great beauty. These crystals are entirely insoluble in acetic acid, but soluble in nitric acid; they are broken up at the maturity of the cyst, forming at first a sort of network which appears to perform a part analogous to that of the *capillitium* of the Myxomycetes in the dissemination of the spores.

As regards the plasmodial masses, their coloration is due to a great number of pigment-granules of very unequal dimensions; the smallest of these are animated by a very brisk Brownian movement. I believe that these granules are obtained by the parasite from the pigment-cells of the urchin. Hofmann has shown that these pigment-cells are very abundant in the liquid of the general cavity of the Spatangidæ. In the midst of these granules we find a prodigious quantity of Amœbæ emitting pseudopodia and agglutinating the grains of pigment. These Amœbæ present a nucleus which it is often difficult to see. Although amœboid cells have been described in the cavitary liquid of the urchins, I find it impossible not to admit that the Amœbæ in question are genetically related rather to the cysts than to the tissues of the Echinoderm. I regard them as originating from the falciform corpuscles, which lose their form slowly under the microscope; and I believe that by their union and growth these Amœbæ constitute the pigmented plasmodia. It is interesting to remember here that M. Balbiani remarked that the Psorospermiæ of fishes are in general developed on the course of the blood-vessels, and that their presence causes a considerable diminution of the number of the red globules in the blood of those animals.

I have found nothing resembling Gregarinæ, and the whole of the facts observed lead me to approximate the parasite not to the lower animals but to the lower plants (Myxomycetes and Chytridineæ); on the other hand, the spores being identical with those described as originating from the cysts of Gregarinæ, it may be a question whether the relations of the Psorospermiæ to the Gregarinæ are not relations of parasitism rather than genetic.

The presence of the parasite sometimes causes the formation on the inner surface of the test of the urchin of small nodosities, which may perhaps enable us to recognize traces of similar Protista in fossil Spatangidæ.

From the characteristic masses of crystals I give this parasite the name of *Lithocystis*; and I dedicate the species to M. Amatus Schneider, who has recently studied some analogous productions.

These researches were made at the laboratory of Wimereux during the months of April and May.—*Translated from a separate impression communicated by the Author.*

Notice of a new Suborder of Pterosauria. By Prof. O. C. Marsh.

The first Pterodactyle discovered in this country was found by the writer, in 1870, in the Upper Cretaceous of Kansas; and during the next year two other species were obtained in the same region*. These three species were referred provisionally by the writer to the genus *Pterodactylus* of Cuvier, with which the remains then described essentially agreed. An examination of the large series of specimens of this order now in the Yale Museum shows, however, that some of these fossils possess characters widely different from all forms known in the Old World, and indicate a new and highly interesting type. The distinctive feature in this group is the *absence of teeth*; and hence the order may be called Pteranodontia, and the family Pteranodontidæ, from the typical genus described below.

Pteranodon, gen. nov.

This genus is readily distinguished from any Pterodactyles hitherto described by the cranial characters, which are well shown in a nearly perfect skull and portions of others in the Yale Museum. The cranium preserved is very large, and the facial portion greatly elongated. There is a high sagittal crest which projects backward some distance beyond the occipital condyle; the latter is directed backward and somewhat downward. The quadrate is long and inclined well forward. The orbits are large, as are also the antorbital and nasal apertures. The maxillary bones are closely coossified with the premaxillary; and the whole forms a long slender beak, which in the specimens examined tapers gradually to the pointed apex. There are no teeth or sockets for teeth in any part of the upper jaws; and the premaxillary shows some indications of having been encased in a horny covering. The lower jaws, also, are long and pointed in front, and entirely edentulous. The rami are closely united by a symphysis which extends from the apex backward to beyond the posterior extremity of the dentary bone, thus resembling the mandible of *Rhynchops* and some other birds. In several other respects the jaws in this genus are more like those of birds than of any known reptiles.

The vertebræ in the present genus are similar to those in European Pterosaurians; and the atlas and axis are united. There are four phalanges in the wing-finger; and the metacarpal that supports it is longer than one half the antebrachium. In one specimen which probably belongs to this genus there are four slender bones, apparently all metacarpals, which are pointed above and do not reach the carpus. Another specimen, which is described below,

* Silliman's 'American Journal of Science and Arts,' vol. i p. 472, 1871; vol. iii pp. 241 and 374. 1872.

and probably belongs to this genus, has five vertebræ in the sacrum.

The nearly complete skull mentioned above may be regarded as the type of the genus *Pteranodon*. Its principal measurements are as follows:—

	millim.
Length from occipital crest to end of premaxillary, about 30 inches, or	760·0
Transverse diameter of occipital condyle	8·4
Distance from occipital condyle to distal end of quadrate	105·0
Length of lower jaw, about 23 inches, or	584·0
Greatest depth	62·2
Depth at articulation for quadrate	23·2

The species represented by this specimen is well marked, and may be called *Pteranodon longiceps*. It is somewhat larger than *P. occidentalis*, Marsh, which apparently has more slender jaws. The Yale collection contains portions of a skull indicating a much larger species, which is probably *P. ingens*, Marsh. If this skull was of the same proportions as that just described, its length would be no less than four feet!

The smallest American species yet found is represented in the Yale Museum by several bones of the wing, a number of vertebræ, and the nearly complete pelvis. The wing-bones preserved are elongated and very slender. The pelvis is unusually small; and there are five vertebræ in the sacrum; the last of the series indicates that the tail was short. The following are the principal dimensions of this specimen:—

	millim.
Length of ulna	187
Length of metacarpal of wing-finger	300
Antero-posterior diameter of outer condyle at distal end	15
Transverse diameter of shaft, above condyles	13
Length of first phalange of wing-finger	347
Extent of five vertebræ of sacrum	57

This species, which may be called *Pteranodon gracilis*, was about two thirds the size of *P. velox*, Marsh. It probably measured about ten feet between the tips of the expanded wings.

All the specimens here mentioned are from the Upper Cretaceous of Western Kansas. It is an interesting fact that the localities and geological horizon of these specialized toothless Pterodactyles are precisely the same as those of the Odontornithes, or birds with teeth; and the two doubtless lived together in the same region.—*Silliman's American Journal*, June 1876.

thoroughly the freshly deposited eggs attached to the ventral surface. These were placed in an inodorous oil, where they continued their development for a time; so that I was enabled to attain a satisfactory notion of the rapid process of development (the so-called segmentation) of the egg, and of the first formation of the blastoderm. The eggs and embryos hardened in absolute alcohol also furnished very good objects of observation.

In this preliminary communication I will only call the reader's attention to the most interesting points, without entering into details, reserving the detailed description of the entire process of development, with figures of the particular formative phases, for a later publication.

In general we must distinguish three principal phases in the development of *Chthonius*. The first of these embraces those egg-formations which take place in the body of the mother; the second includes the metamorphosis of the fresh-laid eggs up to the complete development of the blastoderm—that is, to the first change of skin; and the third and last phase is presented by those changes which occur in the newly hatched larvæ (analogous to the *Nauplius* stage) on the ventral surface of the mother.

In this preliminary communication we shall take into consideration only the first and second phases, as these have not been described by Metschnikoff with the same accuracy as the third phase, the larval stage of *Chelifer* *.

The ovary forms an unpaired gland, which has already been correctly described and figured in the Chernetidæ by Menge †; the individual ova, which become larger and more and more fitted for deposition the nearer they are to the paired oviduct, give to the ovarian gland a racemose form. As has already been correctly remarked by Menge ‡, the female genital organs open by two orifices at the second abdominal segment; the apertures are placed very near together. A depression situated in front of them serves to provide the deposited eggs with a sticky mass, secreted by a gland which opens here.

The youngest ovicells are found imbedded in the interior of the ovary. During the further development of the ovicell (consisting of protoplasm, Purkinje's vesicle, and germinal spot), which takes place in the same way that has already been described by Metschnikoff in the eggs of the scorpion §, the wall

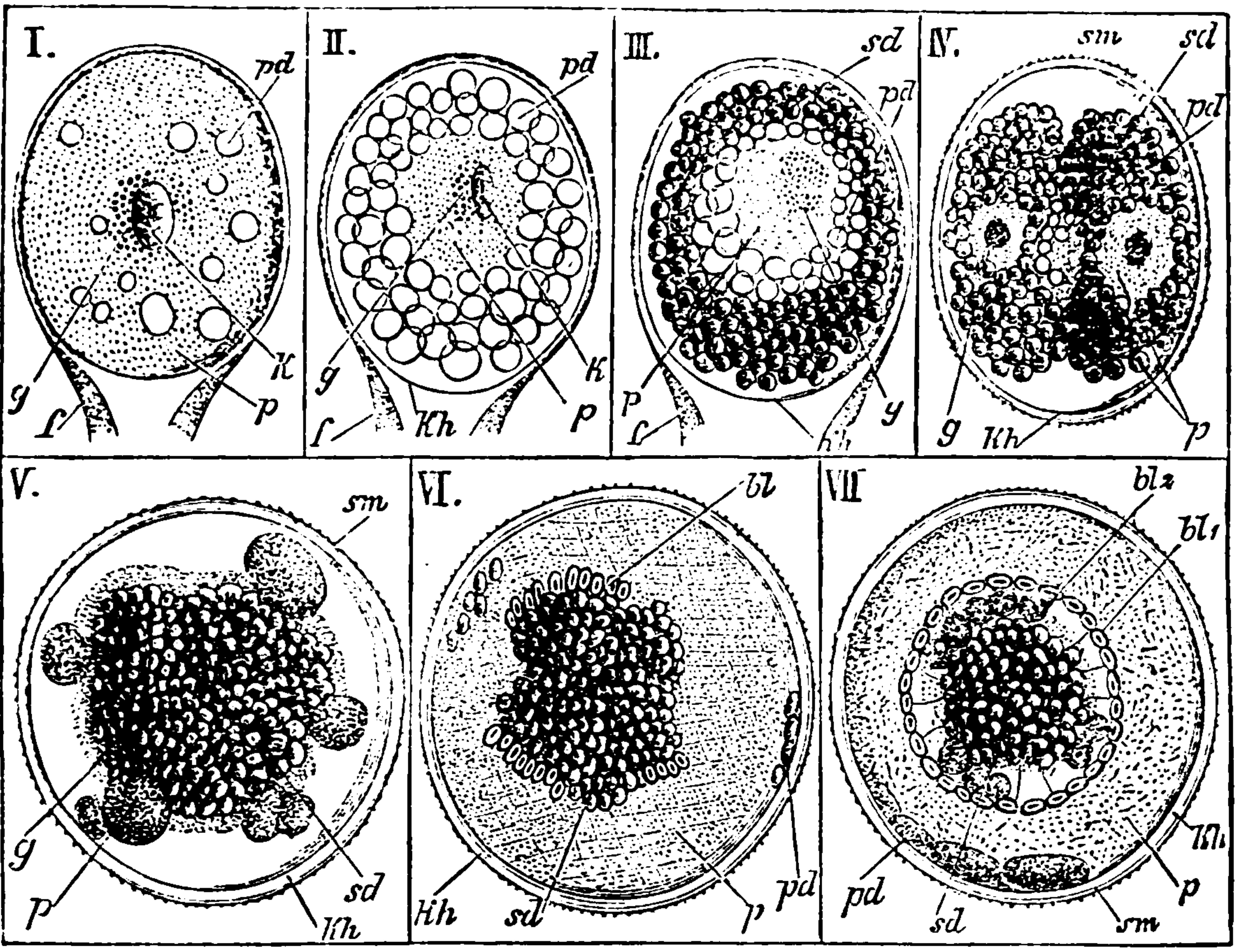
* Metschnikoff, *l. c.* pp. 518–522.

† A. Menge, "Ueber die Scheerenspinnen, Chernetidæ," Neueste Schriften der naturf. Gesellsch. zu Danzig, v. (1855), 2, p. 17, pl. 2. fig. 10.

‡ Menge, *l. c.* p. 17.

§ Metschnikoff, "Embryologie des Scorpions," Zeitschrift für wiss. Zool. Bd. xxi. (1871), pp. 204–232, pls. xiv.–xvii.

of the ovary is pushed outwards in the form of a round eminence, giving rise to the peculiar racemose form of the ovary. As the development of the ova advances, the wall of the ovary is pushed still more outwards, so that then each ovum is enclosed in a perfectly homogeneous follicle * (therefore without any epithelial layer), the basal section of which appears in the form of a short pedicle lined with nucleated cells arranged in a spindle-like form.



Embryonal development in *Chthonius*, represented in seven successive stages: bl_1, blastoderm (first layer); bl_2, mesodermic cells (?); *f*, follicle; *g*, coarser granules of the protoplasm; *k*, Purkinje's vesicle; *kh*, vitelline membrane; *p*, protoplasm; *pd*, primary deutoplasm-spheres; *sm*, secondary membrane; *sd*, secondary deutoplasm-spheres (nutritive vitellus).

The ovum is now developed chiefly by a rapid increase of volume of the protoplasm, in which we must distinguish two kinds of granules, coarser and finer. The coarser granules

* Von Wittich, 'Observationes quædam de Aranearum ex ovo evolutione,' Diss. inaug. Halls Saxoniæ, 1845; and *id.* "Die Entstehung des Arachnideneies im Eierstock, die ersten Vorgange in demselben nach seinem Verlassen des Mutterkorpers," Muller's Arch. fur Anat. und Physiol. 1849, pp. 112–150, pl. iii. (see p 116).

collect by degrees around the germinal vesicle (fig. I., *g*); whilst the finer ones are uniformly distributed in the whole mass of protoplasm, the true formative vitellus. The ovum is enveloped by a simple structureless membrane, the vitelline membrane; an external secondary membrane only makes its appearance subsequently. Even before this stage the ovum, *i.e.* the protoplasm-mass of the ovum, becomes occupied by large, clear globules of albuminous appearance (figs. I.–IV., *pd*), which appear first at the pedicular pole, but then rapidly accumulate round the germinal vesicle, which is situated in the middle of the ovicell. Whether these spheres, which we may call *primary* deutoplasm-spheres, originate from the syncytium (Häckel) of the ovary *, is more than I can say, as, notwithstanding all my endeavours, I could not trace their formation; the whole process takes place so rapidly, that the whole ovum seems to be at once completely filled with these deutoplasm-spheres. At the same time the limpid germinal vesicle acquires a fusiform shape, until at last it is completely surrounded by the primary deutoplasm-drops. A section (fig. II.) through the ovum when in this stage will convince us that around the vesicle of Purkinje (which, it may be remarked in passing, gradually diminishes and finally disappears altogether) a portion of protoplasm filled with numerous fine granules has accumulated. In the middle, almost in the place of the vanishing germinal vesicle, a round brown spot now becomes visible, composed of the coarser granules of the protoplasm; this explains the concentration of the coarser granules of the protoplasm from their first appearance in the ovicell.

In this stage of development a new, peculiar process commences. A portion of the primary albuminoid deutoplasm-drops gradually coalesce and become converted into a number of strongly refractive deutoplasm-drops of fatty appearance (we may characterize these formations as *secondary* deutoplasm-spheres), which are, indeed, smaller than the primary deutoplasm-spheres, but soon so multiply that, even in a very short time and whilst the volume of the ovum increases, it appears completely crammed with the secondary deutoplasm-drops (fig. III., *sd*). A section made through the middle of the ovum (fig. III.) would now show its composition to be as follows:—In the middle of the ovum, instead of the Purkinjean vesicle, which has entirely disappeared, there is the round brown nucleus consisting of coarser protoplasm granules, which, as we shall see hereafter, play a very important part

* Dr. Bertkau, "Ueber den Generationsapparat der Araneiden," Archiv für Naturg. Bd. xli. (1875) pp. 235–262, pl. vii. (see p. 245).

the peculiar round bodies (spheres) which, as he says*, occur in the protoplasm of the spider's ovum, are wanting in *Chelifer* (as in the ovum of the true scorpions). But I believe that in the secondary deutoplasm-spheres we may see an analogue of the spheres observed by Claparède †, Zalensky ‡, Balbiani §, and others, but first correctly understood as deutoplasm-spheres by Ludwig ||, and which afterwards become the peculiar flakes (*Schollen*).

The freshly deposited egg, attached to the ventral surface of the mother, measures from 0·095 to 0·12 millim., is of an elongate ovate form, and presents, besides the so-called vitelline membrane secreted by the ovicell while still in the ovary, a secondary layer, which was separated from the protoplasm layer of the ovarian tube ¶ during the deposition of the egg (at least this is the only possible explanation of it). Like the secondary external membrane of the eggs of *Philodromus* investigated by Ludwig **, this is divided into rounded areas, which give the entire membrane an elegant cellular appearance, and are produced by the fine granules of the protoplasm-mass being arranged in circles. They were observed and figured by Metschnikoff ††, who, however, says nothing about their origin.

The egg in this stage is now subjected to a new and very important process: the segmentation, which closely resembles that of *Chelifer*, commences; and here also the nutritive vitellus undergoes a total segmentation (*amphigastrula*, Häckel ‡‡).

* "Entw. des *Chelifer*," *l.* c. p. 575; "Embr. des Scorpions," *l. c.* p. 208.

† E. Claparède, "Recherches sur l'évolution des Araignées," Utrecht 1862, in Natuurk. Verb. Utrechtsch Genootschap van Kunsten en Wetensch. Deel i.

‡ Zapiski Kieffskaro Obshtchestva Estestvoispitatelei, tom. ii. (1871) pp. 1–72, with 3 plates.

§ Balbiani, "Mémoires sur le développement des Aranéides," Ann. des Sci. Nat. 5e sér. Zool. tome xviii. (1873) art i., with 15 plates.

|| Hubert Ludwig, "Ueber die Bildung des Blastoderms bei den Spinnen," Zeitschr. fur wiss. Zool. Bd. xxvi. (1876) pp. 470–485, pls. xxix., xxx.

¶ The inner wall of the ovary in *Chthonius* is lined by a layer of homogeneous protoplasm-mass in which numerous nuclei are imbedded, but without the individualization of any special portions of protoplasm around the nuclei (*syncytium,* Hackel).

** Ludwig, *l. c.* p. 471, pl. xxx.

†† Metschnikoff, "Entw. des *Chelifer*," *l.* c. p. 516, pl. xxxviii.

‡‡ E. Hackel, "Die Gastrula und die Eifurchung der Thiere," Jenaische Zeitschr. fur Naturw. Bd. x. (1876) pp. 61-167, pls. ii.–viii. (see pp. 67 and 83 *et seqq.*).

Hackel well remarks that the unequal segmentation occurs in by far the greater number of Arthropoda, but in most cases has not been accurately enough observed.

The segmentation takes place quite regularly and very rapidly; the nutritive vitellus breaks up into two, then into four, and finally into eight segments (segmentation-spheres). The division takes place by the formation of invaginations at the two poles of the egg, appearing first at the pedicular pole. It is true that I have found an ovum with invaginated poles even in the ovary; but the first indications of the process of segmentation, in by far the greater number of cases, are only to be met with on the ventral surface of the mother, so that the segmentation in *Chthonius* is a process occurring in deposited eggs. With the division of the nutritive vitellus, the brown nucleus, which is pushed a little to one side, also breaks up into two halves, one of which pertains to each segment; but with this at the same time a division of protoplasm is closely connected, and, indeed, the protoplasm divides into three portions; one part occupies the cavity between the two segmentation-spheres and remains there, surrounded by a layer of the primary deutoplasm-spheres, throughout the whole process of segmentation. Of the rest of the protoplasm, nearly equal portions collect round the nuclei of the two vitelline segments. We have then in *Chthonius* an internal cavity which is at the same time a reservoir of protoplasm, to be afterwards separated from this cavity in order to surround the nutritive vitellus (fig. IV.).

Now a further division of the two spheres of segmentation into four takes place, being effected by a transverse invagination of the two vitelline cells. Both in this and in the following stage, in which the vitellus is divided into eight segments, the nucleus, and consequently also the protoplasm, likewise divides into four and then into eight parts, so that in the last-mentioned stage eight segmentation-spheres, each with a nucleus which is surrounded by a layer of protoplasm, may be distinguished. The structures detected by Metschnikoff* in the eggs of *Chelifer* with four so-called spheres of segmentation, namely the round brown spots consisting of fine granules (representing the cell-nuclei according to Metschnikoff), are therefore to be regarded as equivalent to the nuclei composed of the coarser protoplasmatic granules.

When the vitellus has passed through the process of segmentation up to this point, a new and very important process commences—namely, the separation (*Ausscheidung*) of the protoplasm, which is, so to speak, a preparatory process to the formation of the blastoderm. After the vitelline membrane has removed considerably from the large vitelline cells situated in the centre of the egg, several protoplasm-spheres, which,

* Metschnikoff, "Entw. des *Chelifer*," *l. c.* p 515. pl. xxviii. figs. 4–7.

when examined under a high power, appear to be filled with very fine granules, become perceptible in the egg. The protoplasm-spheres increase more and more, until at last they form a continuous voluminous layer around the vitelline spheres, which are greatly reduced in volume (fig. V.). At the same time we have an equally important process to mention, namely the gradual dissolution of the nuclei contained in the spheres of segmentation; under the microscope we can very well follow the breaking-up of the individual nuclei into a great number of granules.

With regard to the origin of the protoplasm-balls, which gradually increase in the egg, I agree with Metschnikoff: I believe that these have separated from the large spheres of segmentation; only I may remark that by this I understand not the protoplasm-mass occurring in the individual spheres, but the protoplasm collected in the reservoir, which has separated itself. An analogous formation, a separation of protoplasm, occurs also in many Gasteropoda, Ctenophora, Planariæ, &c.* It is possible that in these animals also the whole process takes place in the same way as in *Chthonius*—namely, that in them also a portion of protoplasm is preserved through the whole course of segmentation in a central cavity, and afterwards separated therefrom.

With the separation of the protoplasm the spheres of the primary deutoplasm confined in the central cavity also come into view, with their form indeed a little altered, but still quite recognizable in their origin as primary deutoplasm-spheres. These collect at the periphery of the egg, where they gradually constitute an albuminous-looking layer composed of a great number of small spherules (figs. VI. & VII., *pd*). This is the same layer which was indicated by Metschnikoff† "as perhaps a kind of embryonal envelope;" with regard to its origin Metschnikoff says nothing further. It seems to me improbable, however, that this layer represents an embryonal envelope, and, indeed, for the same reason which is given in passing by Metschnikoff. What function pertains to this structure, which is apparently constant in the Chernetidæ, is partially revealed

* See Ray Lankester, "Observations on the Development of the Pond Snail," Quart. Journ. Micr. Sci. vol. xiv. 1874; Carl Rabl, "Die Ontogenie der Süsswasser-Pulmonaten," Jen. Zeitschr. fur Naturw. Bd. ix. (1875) pl. vii.; W. Flemming, "Studien in der Entwicklungsgeschichte der Najaden," Sitzungsb. Wien. Akad. Bd. lxxi. (1875); A. Agassiz, 'Embryology of the Ctenophora,' Cambridge, Mass., 1874; and A. Kowalevsky, "Embryologische Studieu an Wurmern und Arthropoden," Mém. Acad. St. Pétersb. tom. xvi. (1871).

† Metschnikoff, "Entw. des *Chelifer*," *l. c.* p. 216, pl. xxxviii. figs. 7 & 8, *al.*

plasm-spheres; these collect round the germinal vesicle, which is situated in the centre and surrounded by a layer of protoplasm. The germinal vesicle disappears. The primary deutoplasm-spheres become secondary ones—the true nutritive vitellus, which contains in its interior first a brown nucleus consisting of granules separated from the protoplasm, then a layer of protoplasm, and lastly a layer of untransformed primary deutoplasm-spheres. Now the segmentation takes place, and is total: the nutritive vitellus divides into two, four, and finally eight large vitelline cells; at the same time the nucleus and the protoplasm also divide. An internal cavity also is formed, in which a portion of the protoplasm is preserved; after the completion of the segmentation this separates outwards and envelops the nutritive vitellus. With the protoplasm the primary deutoplasm-spheres confined in the same cavity also come into view; and these then form an albuminous-looking layer at the periphery of the egg. Next the nuclei of the individual vitelline spheres break up partially into a number of granules, and work, with the protoplasm surrounding them, out of the vitelline cells, which are constantly more and more reduced, arrange themselves superficially, become individualized as independent cells, and thus form the blastodermic vesicle.

If we now compare these details, especially with respect to the formation of the blastoderm, with the results of Ludwig's investigations of the formation of the blastoderm in the egg of *Philodromus**, we at once see the great analogy that exists between the two processes; for Ludwig's deutoplasm-spheres, which unite into columns and afterwards develop into the peculiar flakes (*Schollen*), correspond to the secondary deutoplasm-spheres of *Chthonius*. The nuclei originating in the central substance of the rosettes (the protoplasm of *Chthonius*),

* We may be permitted here to recapitulate briefly Ludwig's extremely interesting results (*l. c.* p. 479):—"The germinal vesicle disappears; the deutoplasm-spheres unite to form columns, which group themselves radiately around a central protoplasmatic substance and are held together by it; this rosette divides binarily into several rosettes of division; nuclei originate in the central substance of the rosettes; the nuclei with the protoplasm surrounding them work out of the rosettes, which during their division are constantly pressed more and more towards the periphery, arrange themselves superficially, and form by mutual approximation and limitation the blastodermic vesicle; the portions of deutoplasm which have become flakes (*Schollen*) sink back into the interior of the egg."

are not they a distinct analogue of the nuclei of the vitelline cells separated from the protoplasm in *Chthonius?* As in *Philodromus*, so also in *Chthonius*, and we may fairly assume in *Chelifer* likewise, a portion of the broken-up granules with the portions of protoplasm surrounding them work out of the vitelline spheres to their surface, whilst the other part, with the deutoplasm, becomes the entoderm.

In *Chthonius*, as in *Philodromus*, a total and, indeed, "unequal" segmentation takes place, such as we also meet with elsewhere. For if we consider the amphigastrula of *Purpura* (according to Selenka *), or the amphigastrula of *Petromyzon* (according to Schultze†) and of *Bombinator* (according to Götte ‡), or, lastly, the amphigastrula of *Fabricia* or *Trochus* (according to Häckel §), and compare them with the amphigastrula of *Chthonius* (see fig. VII.) or *Chelifer* (according to Metschnikoff ||), the close resemblance of all these structures is at once perceptible.

Thus we find an agreement between the amphigastrula of Chthonius, *or rather of the Chernetidæ, and the corresponding embryonal structures not only of the Vermes and Arthropoda, but also of the Mollusca and Vertebrata.*

In the amphigastrula of *Chthonius*, indeed, I have been unable to observe the primitive mouth; possibly it is stopped by a vitelline plug, as is the case in the amphigastrula of *Bombinator* according to Götte.

The eggs of the Chernetidæ therefore furnish a new and good contribution to the formation of the amphigastrula; and we must once more repeat Häckel's words, "that the unequal segmentation is tolerably widely diffused among the Arthropoda, but in most cases has not yet been accurately observed." Moreover, by these results the investigations of Van Beneden and Bessels¶ are again confirmed; according to them, in the different segmentations of the egg of the Arthropoda an extended series of transition forms occurs leading from one mode of segmentation to the other. *The segmentation of* Chthonius, *although "unequal," yet in many respects resembles the "superficial."*

Heft 2, pl. xvii.

† M. Schultze, 'Entwicklungsgeschichte von *Petromyzon*,' Haarlem, 1856, pl. iv. figs. 5 & 7.

‡ Gotte, 'Keimesgeschichte der Unke,' Leipzig, 1875, pl. ii. fig. 33.

§ Häckel, *l. c.* pl vii. figs. 100 & 110.

|| Metschnikoff, "Entw. des *Chelifer*," *l. c.* pl. xxxviii. fig. 9.

¶ E. van Beneden et Emil Bessels, "Sur la formation da Blastoderme chez les Crustacés," Bull. et Mém. de l'Acad. Belg. 1868, 1869.

XIX.—*The Mammals of Turkestan.* By Dr. N. SEVERTZOFF.

[Continued from p. 174.]

THE genus *Ovis*, even in the restricted sense here adopted, may be divided into two groups—namely, the northern and the southern. The horns of the northern group in proportion to their thickness are shorter than those of the other group, and are thicker in comparison with the size of the animal; and consequently this group-form has a more massive head and a wider skull. The horns of very old specimens are twice and a half to three times as long as the skull, measuring the latter from the root of the fronto-nuchal edge of the horn down to the free extremities of the præmaxillæ. In the southern group the head is proportionally smaller and the horns are more elongated; their length is at least three times and even more than four times as great as that of the skull, measured in the same way as before.

The following species belong to the northern group:—

1. *Ovis nivicola* (Eschsch.?).

From Kamtschatka. This species is justly identified with *O. montana*, Geoffr., from North America. The horns begin to get narrower from the base, so that each horn diminishes regularly from the root down to the end; the frontal and nuchal surfaces are convex, the fronto-nuchal and nuchal edges of the horns are rounded; the orbital edge is only partly rounded, and if looked at from the side it forms a sharp edge, which is separated from the convex portion above the eye by an elongated groove. The length of the horns (which are very thick) is twice, at the most twice and a half, as great as that of the skull. The frontal surface of the horns is wider than the nuchal surface; the cross ridges of the same are very indistinct.

The head is large and massive; *the profile of the nose is straight, not convex.* There is no mane on the neck. The general colour is greyish brown, with a dark line along the back; the belly, the inner sides of the legs, the posterior portion of the haunches, the patch round the tail, the lower part of the chin, and a spot on the throat are white; *the front part of the legs is blackish brown, darker than the line which runs all along the vertebral column.*

Length to the root of the tail 5½ feet, height at the shoulders 3½ feet; length of the horns sometimes up to 2½ feet.

Very close to *Ovis nivicola* comes another, not yet quite

The southern group:—

3. *Ovis Karelini*, nob.

The horns are moderately thick, with rather rounded edges; the frontal surface of the horn is very convex, whilst the orbital surface is flat, getting narrower only in the last third of its length. The horns are three times as long as the skull. *The basal and terminal chords rise parallel with each other*; the axil spiral of the horn fits on a cone with the base towards the skull. *The præmaxillæ and maxillaries do not articulate with the nasals*; the same is the case with the lachrymals, which latter are *large and square*, being rather *wider than the malar*, and are partly separated from the latter by a protuberance of the maxillary.

The neck is covered with a mane of a white colour, shaded with greyish brown. The light brown colour of the back and sides is separated from the yellowish white belly by a wide dark line; the light brown colour gets gradually lighter towards the tail, till it becomes greyish white, not forming a sharply defined round patch. On the back there is a sharply marked dark line running from the shoulders down to the loins. I did not find any soft hair under the long winter hair in October.

Length 5 feet 10 inches to 6 feet, height at the shoulders 3 feet 6 inches; length of the horn 3 feet 8 to 3 feet 9 inches.

Obs. The figures of the skull of *Ovis argali* given by Blasius (Säugeth. Deutschl. p. 468) in the elongated form of the horns resemble *O. Karelini*; but by the orbital surface of the horns, which gets regularly narrower from the base to the end, they can only be referred to *O. argali.* His diagnosis contains only such characters as are common to both species.

4. *Ovis Polii.*

The horns are very large, laterally compressed, the edges (except the nuchal one) being rounded; the orbital surface is concave, and commences to get narrower only at the last third of its length. *The horn is more than four times the length of the skull*; the basal and terminal chords are not parallel, the latter being more horizontal than the former; the axil spiral of the horn is cone-shaped, *gradually narrowing till it reaches the skull.* The præmaxillæ do not articulate with the nasals, whilst the maxillaries are separated from them by small bones. The lachrymals are very large, and protrude a little further forwards than the malars; the anterior edges of both articulate with the maxillaries by serrated sutures.

The form of the head is prismatic, high and narrow. All round the neck is a pure white mane; and along the vertebral column from the shoulders to the loin there is a dark line. *The light greyish brown colour of the sides shades off into white on the belly; there is a white patch round the tail, which is bounded above by a rather dark line; but downwards the white extends largely over the hind part of the thighs, and shades gradually into the brown colour of the legs.* I did not observe soft under-hair below the long winter hair in the month of October.

Length 6 feet 7 inches, height 3 feet 10 inches; length of horn 4 feet 9 inches.

5. *Ovis Heinsii.*

The horns are not massive; they are laterally compressed, and have three sharp edges; the inner spiral would fit on an inverted cone, with the base towards the skull. The maxillaries are separated from the nasals by a small bone; the præmaxillæ articulate only with the maxillaries, and do not touch the nasals at all. The anterior edge of the lachrymal is rounded between the maxillary and malar, where a small process is visible; the malar in front finishes in three rather rounded processes; the middle one is the largest, and is about as large as the process of the lachrymal, which latter, like the malar, is broad and short.

This species is known only from skulls of middle-aged specimens with not completely developed horns. Specimens seen by me at rather a great distance appeared to be greyish brown; but I could not exactly define the colour. The height, judging from the skulls, would be a little less than that of *Ovis Karelini.*

6. *Ovis nigrimontana.*

The horns are not massive; the nuchal edge is very sharp, and the two other edges are not much rounded; the frontal surface is narrow, the two other surfaces are rather concave; the orbital surface commences to get narrower on the last third of the horn, which is three and a half times as long as the skull. The basal and terminal chords are not parallel, the latter being more horizontal; the inner spiral of the horn is cone-shaped, getting a little narrower towards the point of the horn. The præmaxillæ articulate with the nasals, which are separated from the maxillaries by the small bone between them. The lachrymal is elongated, somewhat narrow, *with one rounded* process, and comes more forward than is the case with the malar; the front edge of the latter is straight, and joins the lower edge in a sharp angle; a process of the maxillary fits in between the two above-mentioned bones.

The head is pyramid-shaped, broad and blunt.

Of this species also only skulls were obtained, among which was one of an adult male. Through a telescope I saw that the colour of the animal is light greyish brown, with a white belly and rump. It is considerably smaller than *Ovis Karelini.*

7. *Ovis aries.*

I am sorry to say I have no materials here to make comparisons between the Turkestan domestic sheep, the wild ones of that country, and the European sheep; the few skulls I collected I left in Tashkent. Some remarks regarding this will be made later on.

To complete the comparative diagnosis I here give some comparative measurements.

	O. Polii, adult ♂.	*O Karelini,* adult ♂.	*O. Heinsii,* 5 years ♂.	*O. nigrimontana,* adult ♂.
	′ ″ ‴	′ ″ ‴	″ ‴	′ ″ ‴
Length from the nose to the tail	6 7 0=1	5 11 0=1	....	4 9 0=1
Height at the shoulders	3 10 0=0·58	3 6 5=0·60	....	2 10 0=0·60
Length of horn	4 9 0=0·72	3 8 0=0·62	33 2	3 2 0=0·67
Distance between the tips of horns	3 6 0=0 53	2 8 0=0·45	31 4	2 5 5=0·52
Width of the orbital surface of horns	6 0	5 4	4 2	4 0
„ nuchal surface of horns....				
„ frontal surface of horns....				
Length of the skull	1 1 0=1	1 1 3=1	11 4=1	10 8=1
The greatest width of the skull	8 0=0·57	7 0=0·52	6 7=0·58	6 0=0·56
Width at the posterior molars	4 2=0·30	4 4=0·33	3 7=0·33	3 8=0·35
„ middle molars..	4 2=0·30	3 7=0·28	3 5=0·31	3 5=0·32
„ anterior molars	2 7=0·19	3 1=0·23	2 4=0·20	2 5=0·23
„ anterior part of maxillæ	2 4=0·17	2 5=0·19	2 4=0·20	2 1=0·19
„ præmaxillæ....	1 [illegible]=0·[illegible]	1 [illegible]=0 [illegible]	1 [illegible]=0·[illegible]	1 [illegible]=0·12
Length of skull to A........	2 =	3 =0	2 =	2 = 20
„ „ B........	5 =	6 =0·	4 =	4 = 40
„ „ C........	8 =	7 =0·	7 =	6 = 64
„ „ D........	9 =	9 =0·	8 =	8 = 78
„ „ E........	10 =	10 =0·	9 = ·	9 = 85
„ „ F...... ..	1 0 =	1 0 =0·	10 =	10 = 94
Ridge round the base of the horn..................	1 3 0			

In this list the measurements of the general size of *Ovis nigrimontana* are calculated from the skull and by the proportion of the length of the skull to the length of the body as far as the base of the tail. These proportions are nearly the same in *O. Polii* as in *O. Karelini*, in which these calculations agree with the actual measurements.

From these Tables it will be noticed that the cross measurements of the skull, taken separately, show the specific distinctions only in adult specimens; and even then they are not important or considerable, except the sharp projections of the lachrymals of the adult *Ovis Polii*. But the proportions (or the measurements stated in decimal numbers) are constant in all ages, although they are not so distinct in young animals as they are in adult.

As regards the different species, *O. Heinsii* by the general shape of the skull is nearer to *O. Polii* of equal age than to *O. Karelini*, and differs from the former very little; but, as already stated, the shape of the different parts of the skull separately and the spiral of the horns of *O. Heinsii* and *O. Polii* furnish the most striking differences.

The alteration of the skull according to the age depends principally upon the development of the horns; and consequently the decimal numbers of the measurements in the different ages of one species do not alter so considerably as their measurements in inches do. As all the measurements of the skull alter according to the animal's age, the diameters of the skull even diminish in their proportion to the length of same, as the frontal grows rather more quickly than any other parts.

The changes of the different parts of the skull according to the different ages are most numerous in *O. Polii*; and I will just mention how useful these changes are in determining the age of the animal by means of the gradual development of its horns and the different parts of its skull. The former are the more trustworthy, because in growing the horns do not lose their annulations, but retain them, sharing their gradual development. The horns are separated from the skull by an annulation, which does not disappear but is gradually pushed forward by the one that is growing next to it; and this is the way in which the sulcations are formed, which are deepest on the frontal surface of the horn.

The growth of the horns is not equally quick at all seasons of the year; in winter they grow more slowly and weakly, whilst in spring with the fresh food they again grow very fast and strong. In spring the annulation at the base of the horns grows more quickly than it is able to elevate the one before it; and consequently the space between them forms a sharp impression round the horn. These impressions indicate the annual increase of the horns, and enable one to count by them the number of years the animal has lived. There are, however, some circumstances which render the reckoning liable to error; and these are the following:—

1st. The annulations of the horns are not always separated by these furrows with uniform distinctness. Frequently, from want of food or from illness, narrow annulations are formed round the horn besides those caused by the annual interruption of their growth in winter, which they much resemble.

2nd. In addition to these irregular annulations there are other secondary annulations, separating those indicating the annual increase of the horns. The furrows formed by these differ from those dependent on the annual increase of the horns in their not being so deep and in their not extending all round the horn. They are, when present, nearly always distinguishable.

3rd. Finally, the rings formed whilst the animal is young are not so distinct as those formed when it is adult, as with advanced age the rings get thicker. These early rings, in getting towards the end of the horn, sometimes get rubbed off and the horn itself gets blunt with advanced age; this is the ease in particular with *O. Polii*, because of the inner spiral of the horns getting wider towards the end of the horn; consequently only the minimum of the animal's age can be fixed—for instance, that the animal is not younger than ten or twelve years, but how much older is doubtful. In specimens which are not above ten years old the age can usually be correctly ascertained, although sometimes this cannot be done without difficulty. Very little confidence can be placed in the determination of an animal's age by the ankylosis of the different bones of its skull, this latter being an uninterrupted process.

The proportions between the development of the horns and the ankylosis of the skull-bones give also specific characteristics which are in most cases constant, although some specimens of one and the same species differ slightly in that respect; but this is more or less the case with all mammals.

In examining the skulls of different species I find that the bones of the skull of an *O. Polii* about two and a half years old are more firmly ankylosed than those of specimens of *O. Karelini* and *O. Heinsii* of about four and a half or five years of age. The above specimens of *O. Polii* and *O. Karelini* are complete, so that the age can be checked by the horns as well as by the general size of the animal; and this shows that *O. Polii* has not nearly reached its full size, whilst *O. Karelini* has fully done so; but notwithstanding this, from the examination of the skull alone, the latter would have appeared to be the youngest.

It cannot be admitted that *O. Karelini* and *O. Heinsii* grow twice as quickly as *O. Polii*, and that at the same time the bones of their skulls ankylose more slowly: the one seems to disprove the other. It is more likely that the parts of the skull of different species ankylose at different ages; and this corresponds with the development of the horns—that is, with the specific differences in their size and weight.

The larger the horns are, the sooner do the different bones of the skull ankylose, of which I convinced myself in comparing *O. Polii*, *O. Heinsii*, and *O. Karelini*, all of the same age, viz. about four to five years; consequently it may be said that the ankylosis of the different parts of the skull is in proportion to the size of the horns. This is shown also in the above list of measurements.

The same skulls also show that the horns begin to grow massive and the forehead to develop only after the animal becomes adult—namely, when it attains an age of four and a half years, which period of its development is also marked by other circumstances. In examining the skulls which one often finds among the rocks and even in the plains about Narin and Aksay, I noticed that most of them belonged (according to the horns) to beasts of from four to six years of age, very seldom to younger or older individuals, and exclusively to the male sex. This shows that these skulls belonged to sheep which did not die on account of their great age, but from violence; nor is it likely that they were killed by wolves, as these latter would most probably concentrate their attacks upon the young or female animals. Here the question arises, why do they die principally at that age, and only male specimens?

The answer to this is best given by the consideration of the locality where the skulls are usually found—namely, in pairs under steep cliffs, from which the animals in all probability fell and killed themselves whilst fighting: this would, of course, be most generally the case with the young, weak-horned males, which had only lately reached an adult age.

The females and young do not fight; and should an old and a young male have an encounter, the former, in most cases, naturally conquers.

In all cases where two skulls are found together, one is older than the other; this shows that whilst fighting not only the one that was beaten fell from the cliff, but also that its stronger antagonist overbalanced itself whilst charging its enemy.

I have also found single skulls, and that not rarely; these belonged to younger males (generally, however, over four years of age); they show that the victor was an old male with much larger horns than the animal killed.

About Narin the skulls are generally found under precipices; a few, however, also on the plains. The latter have

chords of the horns are almost parallel, and form with the other chords the following angles—the basal chord 45°, the terminal chord 52°; and the median chord is parallel with the axis of the skull. The inner side of the horn would fit on an inserted cone with the point towards the outside, slightly inclining forwards and downwards. The sulcations on the horns are meandering but parallel and pretty regular; the horn with advanced age does not project much forward over the forehead, but only becomes rather rounder in accordance with the horn-core. The facial portions of the frontals are rounded; anteriorly they present three forward projecting processes, the centre of which is wide and forms half the anterior rim of the orbit, pointing towards and fitting in between the nasal and lachrymal bones.

The length of the forehead is a little less than its width measured between the orbits. The nasals are very wide at their base, and at about half their length get half as narrow; after that their sides run parallel to each other almost down to their ends, where the bones form a sharp angle; the profile of the snout is gibbous.

The lachrymal forms the anterior rim of the orbit, and extends almost over its entire floor; the lower rim of the orbit, however, is formed by the malar.

The malar is considerably smaller than the lachrymal, and forms a rounded process projecting forward in the maxilla, which on its part sends upwards a small process fitting in between the lachrymal and the malar; the latter bone is rather thin.

In adult specimens the maxillary is separated from the nasals by a small bone, which in time, however, ankyloses with the nasals. In young animals this little bone separates only the anterior part of the maxillary, whilst the other end articulates with the nasals and also with the præmaxillæ. When the animal gets older the occipital ridge rises and becomes larger, the forehead gets wider by the outward extension of the orbits, and consequently also the lachrymal grows in proportion. The maxillaries get rather higher between the grinding-teeth and the nasals, which latter become more convex.

These alterations take place in all species; and being dependent upon the development of the horns, this process continues until extreme age, not stopping at the time when the animal becomes adult. Almost all the different bones of the skull ankylose in the above mentioned-manner, and, although late, always simultaneously.

The mane, which extends all round the neck, is short, and only grows when the animal becomes adult; it looks almost more like thick wavy hair than any thing else; its length does not exceed 3 to $3\frac{1}{2}$ inches. This mane spreads all over the front part of the shoulders; on the back of the neck the hair is shorter, not exceeding 2 to $2\frac{1}{2}$ inches.

The forehead, the front portion of the head to half its length, and the cheeks are brownish grey; the spot above the eye and the lower portion of the head are pure white; the muzzle is black; the horns are greyish brown, shaded with yellow. The nape is blackish brown; the line along the spine is of an earth-brown colour; the mane is white, intermixed with greyish hair. The breast and legs are white; the back, the shoulders, sides, and thighs are light brownish; on the sides close to the shoulders there is a white spot; and on each leg there are two brown lines from the body down to the feet on the hind legs, and down to the knees on the front legs.

As regards the light-brownish colour, it is purest on the back on each side of the spine, commencing almost from the shoulders and reaching to the loins; on the front part of the shoulders below the mane it fades into greyish brown; and on the sides behind the white spots it is shaded with an olive-colour which is darker than on the back, but is slightly mixed with white. On the thighs this brown colour commences to get white, the hind parts of which are pure white. The belly is yellowish white, which colour is separated from the sides by a wide blackish-brown line. The tail and a small patch round it are also yellowish white, this colour gradually shades off into brown on the sides; above the tail there is a small dark spot.

The female is similar to the male and has also the characteristic dark lines on the sides. Her horns are rather shorter than her head and have more-rounded edges; the curve of the horns forms only one third of a circle; and they diverge towards their points. She is smaller than the male, measuring 5 to $5\frac{1}{4}$ feet in length, and is 3 feet high at the shoulders.

O. argali, with which species it always has been confounded, is altogether different from the present species in the shape and structure of the horns and the skull; but the most striking differences are in the colour and in the mane; besides these there are also some other differences. But as *O. argali* is neither a new species, nor does it inhabit Turkestan, I shall mention here only the following characteristics: the skull-bones behind the orbits ankylose very early; but the front parts are not ankylosed even in specimens of from seven to eight years of age, whilst the different parts of the skull of *O. Karelini* ankylose simultaneously.

O. Karelini inhabits all the Semiretchje Altai and also the Saplisky Altai, but is not so common there as it is in the mountains between Turgeli and Kaskelen; it has been lately driven out of the latter locality by the Cossack sportsmen, and has gone to a higher elevation, namely the Kebin steppe above the range of trees. East of Turgeli, on the bare mountains and plains near the rivers Chilik and Keben, *O. Karelini* is still very abundant, except in localities which are covered with trees, extending from Chilik as far as Lantash. Further, it inhabits all the neighbourhood of Issik-kul; it is rather rare on the northern part of the Thian-Shan, which is thickly covered with trees. I also met with numerous flocks in the steppes of the Narin, where they find such an abundance of food on the meadows and shelter among the rocks; these localities are about 12,000 to 13,000 feet above the sea-level.

O. Karelini is sometimes also met with on the mountains separating the Narin from its tributary the Atpash, as far as the plains between the rivers Kurtka and Chatir-kul; but from the eastern sources of the Atpash down as far as the Chatir-kul it is only found in company with *O. Polii.*

O. Karelini does not inhabit the rocks and mountains exclusively, like the genus *Capra*; it is also not satisfied, like the latter, with the small tufts of grass on the rocks, but wants more extensive feeding-grounds, and is therefore driven out of certain localities more easily than is the case with *Capra.* In the neighbourhood of Copal, for instance, goats are abundant in the central steppes of Kara, whilst the sheep have been driven out from these places and only visit them late in the autumn. In places where good meadows and rocky places are found, sheep can be met with at any elevation from about 2000 or 3000 feet in the southern portion of the Semirechje Altai, near the river Ilia, to about 10,000 feet at the rivers Lepsa, Larkan, Kora, Karatala, and Koksa, and even to 11,000 or 12,000 feet in the neighbourhood of the Upper Narin. They are found at a much lower elevation in winter, whilst in the summer they withdraw again to the highest mountains. I do not know if the sheep which are so abundant in the hills on the western shores of the river Chu, opposite the Tokmack, belong to the present species or to *O. Heinsii.*

Ovis Polii.

This species was founded upon horns obtained by Wood at the sources of the Amu-Darja, on the high plains near Lake Serikul, at an elevation of about 16,000 feet—consequently about the same locality where Marco Polo mentions that he met with some large wild sheep. To the same species

The edges of the nasals are almost parallel at their base, and only at their free extremities form a sharp angle; the nose is convex.

The lachrymals are more developed than in any other speeies of sheep; they occupy all the front part of the orbit, filling up the front and bottom of it, and articulating with the anterior process of the malar. There are three Wormerian bones; the upper one joins the occipital process of the frontal bone (if there is one); all these three bones are turned towards the interior of the orbit, in which they form a wide irregular polygon with a serrated suture. The uppermost is the narrowest, but alters much in width and usually ends in a sharp point; the middle one fits into the maxillary by two points, and one is attached to the lower jawbone; the lachrymal itself is in the middle flat bone.

The malar varies in its size; but its facial portion is always large, sometimes, however, only half the width of the lachrymal; and, reckoning from the orbit, it is a little shorter; its front edge is toothed and has two or three processes; these, however, are usually very short. The malar itself is thick. The maxillary is separated in old specimens completely, and in young only partly, from the nasals. This species differs from *O. Karelini* in the alterations of the skull according to age, as well as by the development of the frontals, also by the fact that whilst the head grows higher the lachrymals do not grow in width, but only in length.

The different parts of the skull ankylose simultaneously; and, as already mentioned, this process takes place very early; and in connexion with this it may be noticed that the alterations of the skull according to age take place only up to the time when the animal becomes adult, after which period only the horns continue to grow and the forehead becomes rather more convex, although this latter is hardly perceptible.

The mane of adult specimens covers the same parts as it does in *O. Karelini*, viz. the throat, the sides of the neck, and the front of the shoulders; it is, however, much longer, the hair being from 6 to 7 inches long; on the spine it is from 3 to 4 inches in length, and gets shorter as it approaches the nape. The distribution of the white and the dark colour is on the whole the same as in *O. Karelini*; but the colour of the head is more blackish brown, and all other light-brown parts of *O. Karelini* are darker in the present species (namely, of a greyish brown colour shaded with red); the sides are darker and more grey than the back, intermixed with some white hair; the upper front portion of the shoulders close to the mane is light-coloured; the white spots on the side of the shoulders are like those of *O. Karelini*; also the blackish brown nape and rather lighter spine are similar in both these species. The white spots about the eyes are wider in *O. Polii*, and extend to the front of the lower eyelids; the mane is snowy white, without any mixture of brown hair in it; the belly is white, which colour gradually shades off into a greyish brown on the flanks, without a black line separating the two colours from each other; the white colour of the hinder portion of the body extends over the hind legs and the tail, on which latter neither a black nor a brown spot is to be seen. The reddish colour of the loins is marked by a wide greyish brown line, which separates it from the white colour of the back part of the body, as well as to some degree from the greyish brown thighs, on which latter and the sides it can be seen that the brown hair is mixed with some white; along the spine there is a dark line from the shoulders to the loins.

Such is the coloration of *O. Polii* in winter during the month of October, whilst in summer it appeared to Mr. Semenoff, who saw these sheep at Han-tengri, to be darker.

A young male, two and a half years old, is greyish-brown on the upper portions of the body, without the reddish tint of the adult animal; in the remaining parts it fully resembles the adult, with the exception of the greyish brown colour extending further on the loins; and the sides and neck are also of this colour. At this age there is no mane, and only on the nape and partly also between the shoulders the hair is rather longer and of a blackish brown colour; there is also no dark line on the spine; but the marking of the loins resembles that of the adult.

When the animal has attained the age of two and a half years, the horns already form half a circle; all the edges are sharp and the sides flat.

The female is unknown.

O. Polii was met with by Mr. Semenoff on the high plains near the snow-covered summits of the gigantic mountains of Han-tengri, at the sources of the rivers Karkara, Tekes, and Sari-jaws. These places form the most northern limits of its range, which, to the south-west, extends as far as the Narin, the upper Syr-Darja, and the tributaries of the Kashgar-Darja at the frontier of Turkestan. I found skulls of *O. Polii* within a distance of from 10 to 12 versts to the north of the above-mentioned rivers, at the Ulan, about the mountains of Atpash; here it lives together with *O. Karelini*, but only in very limited numbers; and these localities form the narrow line where these two species are found together.

On the high plain of the Aksay only *O. Polii* is to be met with, and is very abundant there; here it usually keeps in the mountains of Bos-adir, on the left or north shore of the Aksay, and feeds on the hilly meadows situated close to the above place; further north it has not been obtained yet.

This animal is not a regular inhabitant of the mountains and rocks, but of high-situated hilly plains and meadows, where the *Festuca*, *Artemisia*, and *Salsoleæ* form its principal food. It only takes to the mountains for concealment, but even then avoids the more rocky localities, as, for instance, the Kok-Ria near the Aksay, where I only found the *Capra skyn.*

The lowest elevation where it is to be met with on Han-tengri is about 10,000 feet, namely in the Kar-Rara and Tekes; but even here it is rare, mostly inhabiting the more level parts of Han-tengri, which are covered with grass, near the range of perpetual snow, about 11,000 feet above the sea-level. On the Aksay the limits of its range are formed by the river of the same name, between the mountains of Kok-Ria and Bos-adir, at an altitude of 9500 feet; to about the same height it descends also in the Atpash, going, however, as high as the perpetual snow, about 13,000 to 14,000 feet. Mr. Wood found the horns of this species about the river Amu-Darja, at an elevation of about 16,000 feet.

I do not know its distribution beyond the above localities; some information regarding this might perhaps be obtained from the zoological portion of the work by the Brothers Schlagintweit. It is probable, however, that *O. Polii* does not go further than the Karakorum mountains, between the Indus and the Tarim, as south of the Karakorum the range of the Himalayan sheep commences. As yet I cannot fix how far it occurs towards the east.

Wherever *O. Polii* has been met with it has been found inhabiting the same localities during the summer and winter; the latter season, though cold, is remarkably free from snow, the winter clouds being intercepted by the lower mountains before reaching the elevations inhabited by the sheep. I saw this species on Han-tengri and Aksay in small scattered flocks of from five to ten individuals—unlike *O. Karelini*, which species I have seen in flocks of hundreds in the neighbourhood of the Narin. Old males are often met with singly, separated from the flock, not wandering to a great distance, but keeping within sight of the herd they belong to, to which they apparently act as sentinels.

An old specimen obtained by me was thus separated from the flock on the look-out. The herd itself often goes about scattered and not at all so close to each other as is the case with

XX.—*Descriptions and Figures of Deep-Sea Sponges and their Spicules, from the Atlantic Ocean, dredged up on board H.M.S. 'Porcupine,' chiefly in* 1869 (*concluded*). By H. J. Carter, F.R.S. &c.

[Plates XII.-XVI.]

In July 1871 Prof. (now Sir) C. Wyville Thomson asked me if I would undertake to describe the sponges dredged up on board H.M.S. 'Porcupine' in 1869, to which I consented, when I had finished arranging the collections of sponges in the British Museum about which I was then engaged. In June 1872 Prof. Thomson sent me 108 jars containing these sponges in spirit, besides some small boxes containing dried specimens. Most of the former had labels on them; but the latter were without any. Prof. Thomson was then busily engaged in preparing for the expedition of H.M.S. 'Challenger;' and all that he had time to state was that the jars were labelled in accordance with the numbers of the stations and depths on the Charts which accompanied the "Preliminary Report of the Scientific Expedition of the Deep Sea in H.M.S. 'Porcupine' during the summer of 1869" (Proceed. Royal Soc. no. 121), and that I might use them as I liked for the purpose mentioned, only leaving them in "some kind of order" when their descriptions had been completed.

On their arrival, I first numbered all the jars and dried specimens with a running number of my own, which they still bear. Then every specimen, both fragmentary and entire, was sketched and examined microscopically, and the sketch and microscopic detail placed under these numbers respectively. After this, whatever figures the labels on the jars bore were added to their respective numbers. Thus, having secured a memorandum of all that I possessed in this way in case of accident, the whole was laid aside for deliberate examination when the opportunity offered—that is, when I had finished my examination and arrangement of the collections of sponges in the British Museum.

Soon it became evident to me from the latter that I must make a "classification" for myself; for nothing that had been produced would suffice for this purpose; and hence I was obliged to postpone describing the greater part of the sponges dredged up on board H.M.S. 'Porcupine' until this was completed and printed ('Annals,' 1875, vol. xvi. p. 1 &c.).

Meanwhile, in 1873, I published a paper on two *Gummineæ*, one of which came from the 'Porcupine' ('Annals,' vol. xii. p. 17); then a paper on the Hexactinellidæ and Lithistidæ, in 1873, wherein the specimens of *Aphrocallistes Bocagei*, *Farrea occa*, &c., from the same source, were described (*op. cit.* vol. xii. p. 445). After this several of these sponges were described and illustrated in 1874 (*op. cit.* vol. xiv. p. 207 &c.); and now I have to offer the remainder,—dredged up on board the 'Porcupine' in 1869 and 1870.

As regards the form and measurements of sponges, whether entire or fragmentary, and as regards that of their spicules, nothing can be more variable. They all grow from small to large, and all may *vary* more or less in every respect during the course of their development; so that what I have stated in this paper must be understood to be what the sponges dredged up on board the 'Porcupine' *only*, present.

Thus, then, as the spicules in particular grow from small to large, and are successively developed, they will be found to be of all sizes in the sponge to which they may belong. Hence their average largest size respectively has been taken for description, measurement, and illustration.

The measurements are all in parts of an inch; and for the convenience of the student they are given in accordance with the divisions of my micrometer eye-piece, viz. in 1800ths or 6000ths of an inch, under a magnifying-power approximately of 85 and 266 diameters; while for the detail other powers (of 120 and 375 approximately) have been employed.

As the numbers *alone* are given in the descriptions, they must be understood to refer to the *greatest diameters* of the *average largest* size of the spicule, without this being expressed. Thus the description of an acerate or linear form may have appended to it, "100-1800ths by 2-1800ths inch," which means 100-1800ths inch long and 2-1800ths inch broad in its *greatest diameters*. By this the student will at once be able to draw the spicule to any scale; or if he chooses to reduce the fractions to their ultimate value,—he would get in this instance 1-18th by 1-900th inch.

Again, a spicule may be attenuatingly or abruptly pointed—that is, drawn out gradually to a sharp point or abruptly terminating in one which, if altogether omitted, would give a round end. This is the meaning of these expressions.

Lastly, as regards colour. It should be remembered that all the specimens have come to me in spirit or dry respectively, and therefore that, as the colours of sponges are in some instances permanent and in others evanescent, I can only give that colour which these sponges *now* present to me. *Aplysina nævus* still retains its dark red-purple tint; but most of the rest present different shades of what may be termed "sponge-colour," viz. tawny, light yellow, grey, or whitish; at the same time, these are the colours which sponges usually have.

An "Addendum" will be appended, in which a list of *all* the sponges dredged up by the 'Porcupine' during her cruises in 1869 and 1870, with their respective localities generally, will be given; then a list of all the *dried* specimens without numbers which have been handed over to me; finally, a few "Memoranda" on some minute organisms which accompanied the sponges—to wit, *Polytrema*, *Xanthidium*, and Coccoliths, together with a note on the "black grains" often seen in great abundance in the Globigeriniferous sand.

Halisarca cruenta, n. sp.

General form film-like, spreading, with irregularly undulating margin. Colour madder-brown, crimson, becoming crimson-black on the surface when dry. Surface smooth, corresponding with the irregularities of the object on which it may be growing; consisting of a delicate sarco-fibrous layer. Pores and vents not recognized. Internal structure madder-pink, composed of areolar sarcode in which are imbedded the ampullaceous sacs and, when present, also ova, which are known by their spherical form and deeper colour; traversed by the branched excretory canal-system. Ampullaceous sacs about 10-6000ths inch in diameter; spongozoa about $\frac{2}{3}$-6000th, and ova about 4-6000ths inch in diameter. Size of specimens varying, under 2 inches in horizontal diameter.

Hab. Marine, on the surface of *Corallistes Bowerbankii*, Johnston; *Stelletta pachastrelloides*, n. sp., and *Pachastrella abyssi*, Sdt., extending into and tinging with its red colour for a certain distance the structure on which it may be growing.

Loc. Station 25=374 fathoms—that is (as the "station" and "depth" are inserted together on the "Chart"), a few miles north of Cape St. Vincent.

Obs. This sponge has very much the appearance of spots of venous blood, especially when dry; and the colour is deepest where the specimen is charged with ova, from the dark crimson colour of the latter. It looks very much like *Hildenbrandtia rubra* at first sight, on account of its thinness and dark blood-red colour; but the absence of the algal cell and the presence of ova distinguish it from the cellular structure charged with conceptacles bearing tetraspores and paraphyses in the latter. As the specimens are not favourable for description, the above observations must to a certain extent be taken provisionally. It is at all times difficult to make out the minute structure of *Halisarca*, which can only be most advantageously examined

madder-red. Surface rising into thorn-like processes, from each of which projects a single hair-like horny filament about $\frac{1}{8}$ inch in length, of a dark amber-colour, that often sends off a minor branch at its exit, and thus becomes bifurcated. Covered with an incrustation of minute foreign bodies, disposed in a reticulate form with depressed interstices. Foreign bodies consisting of a heterogeneous mixture of sand-grains, fragments of sponge-spicules, minute Foraminifera, and the like, which, on becoming dry, presents an opaque pinkish grey colour that conceals the dark red fleshy portion of the interior. Pores in the interstices of the incrustation (fig. 2, *b*). Vents not observed. Internal structure soft, fleshy, consisting of a thin layer of compact areolar sarcode traversed perpendicularly by thick, horny, hair-like filaments of a dark amber-colour (fig. 2, *a*), which, rising singly and separately from an expanded circular disk respectively on the basal layer of the sponge (fig. 2, *c*), that attaches the latter to the hard object on which it may be growing, pursue a perpendicular course towards the surface, where they respectively issue from the ends of the thorn-like processes, as before stated. Horny filament hollow, conical, ending in an attenuated form externally, where it is frequently bifurcated or divided into two portions of unequal length, as above mentioned. Sarcode charged with minute bodies (? spongozoa or pigment-cells) of a red colour, which thus give the characteristic colour to the sponge generally in the fresh or undried state. Size of specimens about $\frac{3}{4}$ inch in their longest horizontal diameter.

Hab. Marine, growing over hard objects.

Loc. Between the north of Scotland and the Faroe Islands, and a little north-west of the Shetlands, in 345 and 312 fathoms respectively.

Obs. For an account of the Aplysinida see 'Annals,' 1872, vol. x. p. 101. Specimens of this sponge exist in two jars numbered (Stations) 65 and 82 respectively, which give the localities and depths above mentioned. The former has spread itself over part of the upper valve of a Terebratule (fig. 1, *c*), and the latter round a fragment of a branch of stony coral (fig. 2). It has been designated "*nævus*" specifically, from the surface being like a raised red "mother's-mark," hairy and papillated; while the interior is characterized by single, separated horny filaments, which traverse the interior of the sponge perpendicularly, and do not give off any branches until arriving at their point of issue from the summits respectively of the thorn-like processes of the surface, when they frequently, but not always, become divided into two branches of unequal length. The reticulated appearance of the incrustation, which is only observed in the dry specimens, indicates that, as usual, the accumulation of the foreign objects is confined to the lines of the subjacent, in this instance subcorneous, dermal reticulated structure.

On the 29th March last the Rev. A. M. Norman sent me another species of this genus, for which he proposes the specific name of "*incrustans*." It only differs from that above described in the papillæ of the surface not being so prominent and thorny, and in its structure being areolar and sandy *throughout* like that of *Dysidea fragilis*, and of a light yellow instead of a pink cream-colour when dry. *Loc.* "Shetland, 170 fathoms," on hard objects.

Spongia officinalis. (Pl. XII. fig. 1, *d.*)

General form unequally lobate, spreading, sessile. Colour light brown. Surface irregularly lobed and minutely divided into polygonal spaces by the dermal horny reticulation, which supports and thus shows itself through the transparent dermal sarcode, projecting from the latter at the knots or points of union of the lines respectively in attenuated, minute, horny filaments, which give the surface a hairy appearance. Pores in the interstices of the dermal reticulation. Vents large and irregular both in size and situation. Internally consisting of a densely reticulate, anastomosing, horny, transparent, tough, brownish fibre, which gives the brown colour to the sponge; supporting transparent areolar sarcode, which is traversed by the excretory canal-system, often running in a branched form for some distance just below the dermal sarcode before opening at the vents mentioned. Size 1¼ inch in its largest diameter.

Hab. Marine, on hard objects.

Loc. Same as that of *Aplysina nævus*, viz. station 65.

Obs. This, which is a genuine specimen, although small, of *Spongia officinalis*, is only found in the jar numbered 65, where it has partly overgrown the upper valve of the same Terebratule as that on which *Aplysina nævus* has spread itself (fig. 1, *d*), presenting between them a small portion of *Dysidea fragilis* (fig. 1, *e*).

tioned, it is itself fixed to a pebble (fig. 1, *a*) which bears in addition two small specimens of *Phakellia infundibuliformis*, Johnst. (fig. 1, *fff*), also the basal fragment of a cylindrical calcareous worm-tube over which *Latrunculia cratera*, Bocage, has grown (fig. 1, *gg*), and at the foot of this on the pebble a little patch of *Microciona longispiculum*, n. sp. (fig. 1, *h*); so that the pebble and the Terebratule together bear six species of sponges. In the same jar also are specimens of *Dictyocylindrus abyssorum*, n. sp.; *Phakellia infundibuliformis*; *Halichondria Hyndmani*, Bk.; *Wyville-Thomsonia Wallichii*, Wright, = *Tisiphonia agariciformis*, Wy. T.; and *Pachastrella abyssi*, Sdt.

HIRCINIA (*Polytherses*, Duchas. de Fonb. et Mich.).

A small cubical fragment, about two inches in diameter, of coarse structure and brown colour, in which the sarcode has been entirely replaced by the alga *Spongiophaga communis*.

Loc. Station 25, in 374 fathoms, near Cape St. Vincent.

Spongelia pallescens, Sdt. (Adriat. Spongienf. p. 30, Taf. iii. fig. 8).

In jar 84, depth 155 fathoms, there is a finger-shaped fragment or lobe of this sponge about 2 inches long and ½ inch in diameter, now of a light whitish grey colour. It appears to have been torn off from a larger specimen. The surface presents a uniformly reticulated structure, in which the knots consist of sharp monticular eminences, and the interstices are depressed as is usual in all the Psammonemata, with here and there a large circular vent. It is sandy throughout, but differs from the following (viz. *Dysidea fragilis*) in possessing a more definite form, which arises, perhaps, from the horny element being more developed, both around the sandy cores and as simple fibre throughout the structure generally. There is an arenaceous sponge in the British Museum of a greyish brown colour, massive and lobed, with large vents, which seems to be an intermediate species. It comes from Port Jackson in Australia; and the variety of spicules amongst its sand-grains is very remarkable, as indicating the number of different sponges that must be in that locality. Of course, the nature of the foreign contents depends entirely upon the kind of material at hand for the sponge to build with.

Dysidea fragilis, Johnst.

Small amorphous fragments of this sponge were dredged up at stations 65 and 82, in 345 and 312 fathoms respectively.

Dictyocylindrus abyssorum, n. sp. (Pl. XII. fig. 3, and Pl. XV. fig. 25, *a*, *b*.)

General form dendritic, branched dichotomously three or four times on the same plane. Hard. Branches round, somewhat

the whole of the stem is very hard and the structure of the axis becomes extremely dense from the closely impacted state of the spicules of which it is composed; while the excretory systems, being numerous and short-branched, are consequently diminutive in form, so that neither the vents nor the pores are very conspicuous in sponges of this kind; again the acuate spicule is here, as generally in this order, more or less suddenly curved excentrically—that is, towards the large end, which thus, together with the inflation of this extremity, frequently resembles the hilt of a pistol.

Dictyocylindrus simplex, n. sp.

I have applied this name to small amorphous fragments of a sponge occurring here and there by itself and on other sponges dredged up between the north of Scotland and the Faroe Islands, which only differs from *D. anchorata* in the absence of anchorates. This is all the information that the specimens afford.

Dictyocylindrus virgultosus, Bk. (Mon. Brit. Spong. vol. ii. p. 113, and vol. iii. pl. xix. figs. 14–18). (Pl. XII. fig. 5, and Pl. XV. fig. 27.)

General form pyramidal or conical, elongated, sharp-pointed, expanded at the base; pyramids grouped. Colour yellowish white. Surface hirsute, even, covered with small eminences consisting of tufts of spicules radiating from points respectively, where their ends are gathered together and fixed in the dermal sarcode around the base of a large spicule. Pores and vents not evident, from the smallness of the specimens. Internal structure compact throughout, becoming most so towards the centre, composed of bundles of spicules in close approximation, arranged longitudinally and diminishing in number towards the apex of the cone; imbedded in cancellated sarcode, which is, no doubt, traversed by the excretory canals. Spicules of two kinds, viz. skeleton- and flesh-spicules. Skeleton-spicule of two forms, viz.:—1, large, acuate, smooth, sharp-pointed, curved suddenly or bent towards the large extremity, 132- by 1½-1800ths inch (Pl. XV. fig. 27); 2, subskeleton-spicule small, acerate, curved, sharp-pointed, 32- by ½-1800ths inch (Pl. XII. fig. 5, *d*). Flesh-spicules of one form only, viz. acuate or club-shaped, sharp-pointed, bent and inflated at the large extremity, uniformly spined throughout, spines short and vertical, 11- to 14-1800ths inch long (fig. 5, *c*). The large acuates are chiefly found in the body of the sponge, where they are arranged longitudinally or in vertical bundles; but the largest traverse the dermal sarcode obliquely and form respectively the centre of each group of the small, subskeleton, acerate spicules (fig. 5, *d*), which thus give the surface its hirsute, tufted character. The flesh-spicules do not traverse the dermal sarcode, but are arranged, feather-like, and sparsely, around the acuates of the interior, varying much in size. Entire specimen consisting of a group of three cones, each of which is about 8-12ths inch long, and 3-12ths inch in diameter at the base.

Hab. Marine, on hard objects.

Loc. The North-Sea side of Shetland in 64 to 75 fathoms.

Obs. This sponge has been named, described, and illustrated by Dr. Bowerbank, as above indicated, from "Shetland, in the cabinet of the Rev. A. M. Norman;" but as the specimens were dry and mine is wet, it has seemed to me desirable to describe and figure it again from the latter. The figures on the jar are "67 and 68," which give the locality and depths above mentioned. On one of the cones has grown a specimen of *Grantia ciliata*, ? var. (fig. 6), and a small one of *Tethya cranium* (fig. 5, *a*). This is all that is in the jar. The *Grantia* will be described hereafter.

In the British Museum, among the specimens dredged up on board the 'Norna' on the coast of Portugal, is a sponge of a similar conical form, also grouped, but with a tuberculated surface, each tubercle of which is supported on a bundle of spicules that radiate from a solid, conical, central axis. Here, however, there is only one kind of spicule, viz. acuate, smooth, and sharp-pointed; so that it does not belong to the Ectyonida, but, belonging to the Axinellida, might be called "*Ciocalypta* (Bk.) *tuberculata*," seeing that, like other species of this group about to be mentioned, it will probably have to come under the order Echinonemata.

Another similar (*i. e.* conical) form has been described and named by Dr. Bowerbank *Ciocalypta penicillus* (Mon. Brit. Spong. vol. ii. p. 81, and vol. iii. pl. xiii. figs. 2–4); but this is a massive one, in which the characteristic conical heads, at first grouped, soon pass into a common body from which the characteristic ends alone project. There is a specimen of this kind in the British Museum, 6 inches in diameter, which, from its white surface and yellowish interior, might be taken for *Halichondria panicea*, Johnst. It also has only one form of spicule, viz. acuate, smooth, sharp-pointed.

A third species has been named "*C. Leei*" by Dr. Bowerbank (*op. cit.* vol. iii. pl. lxxxvi. figs. 1–3); it, again, has only one form of spicule, viz. acuate.

And a fourth the same author has named "*C. Tyleri*" (Proc. Zool. Soc. 1873, p. 21, pl. iv. figs. 9–12, from "Port

Elizabeth, Australia" [? Cape]). There is also a specimen of this in the British Museum from Port Elizabeth in S. Africa; but in this species the spicule is acerate, curved, and sharp-pointed (not acuate); still all present the same conical pyramidal forms, growing in groups like a pine-forest; and all but the first present the snow-white colour on the surface, with the light tawny-yellow colour interiorly, by which they so much resemble *Halichondria panicea*, that at first sight they might be taken for varieties of this sponge, as before stated.

Plumohalichondria microcionides, n. sp. (Pl. XII. fig. **11**, and Pl. XV. fig. 30, *a*, *b*.)

General form, now, globular, sessile at one point. Colour yellowish white. Surface smooth, irregularly mamillated on the free side. Pores and vents? Internal structure, radiating in plumose branches closely approximated from the point of attachment upwards. Spicules of two kinds, viz. skeleton- and flesh-spicules. Skeleton-spicule of two forms, viz.:—1, large, acuate, attenuatingly pointed, globularly inflated and suddenly curved at the large end, which is thickly spined, smooth in the rest of its extent, 68- by $1\frac{1}{2}$-1800ths inch (Pl. XV. fig. 30, *a*); 2, acerate, smooth, fusiform, attenuatingly pointed at each end, nearly straight, 38-1800ths inch long (Pl. XV. fig. 30, *b*). Flesh-spicules of two forms, viz.:—1, acuate, globularly inflated at the large end, attenuatingly pointed at the other, thickly spined throughout, 17-1800ths inch long (Pl. XII. fig. 11, *a*); 2, equianchorate, navicular in form; shaft long and slightly curved; arms long and slightly expanded, falcated, with half their extent thus webbed to the shaft, 28-6000ths inch long (Pl. XII. fig. 11, *b*). The acerate skeleton-spicules are confined to the fibre of the sponge, which is echinated with the large skeleton- and small spined acuates, while the equianchorates are dispersed generally. Size of specimen $\frac{1}{2}$ an inch in diameter.

Hab. Marine.

Loc. Between the north of Scotland and the Faroe Islands, in 440 fathoms.

Obs. This little specimen is in a jar by itself, labelled 51, which gives the locality and depth above mentioned. It appears to me to be a rolled fragment of a larger sponge, while its thickness, combined with the presence of the acerate spicule, seems to ally it more to *Halichondria plumosa* than to *Microciona*, which is laminiform; still the character of the large acuate is peculiarly like that of *Microciona*; and hence the appearance of this spicule resembles that of a gradational form between these two sponges.

40-1800ths inch long (fig. 31, *b*). Flesh-spicule short, acuate, straight or slightly curved, inflated at the fixed extremity, spined throughout (fig. 31, *c*). As usual in *Microciona*, the whole of the spicules are arranged *vertically*, side by side, in the thin lamina of which the sponge is composed. Size of specimen about $\frac{1}{2}$ an inch in horizontal diameter, and probably not more than 1-96th inch thick.

Hab. Marine, spreading over hard objects.

Loc. At station 65, in 345 fathoms.

Obs. This specimen is on the pebble bearing the Terebratule over which *Aplysina nævus* has grown (Pl. XII. fig. 1, *h*), at the base of the calcareous worm-tube covered with *Latrunculia cratera*, Boc., which is also thin, spreading, and laminiform, as will be hereafter noted.

Microciona plana, n. sp.

General form thin, laminar. Colour tawny. Surface hirsute. Pores and vents not seen. Spicules of two kinds, viz. skeleton- and flesh-spicules. Large skeleton-spicule simple, acuate, curved most towards the fixed end, smooth throughout, 65-1800ths by $1\frac{1}{2}$-1800th inch. Subskeleton-spicule the same, but not more than half this size. Flesh-spicules of two forms, viz.:—1, acuate, bulbous at the large end, spined throughout, 15-1800ths inch long; 2, equianchorate, navicular, shuttle-like, 7-6000ths inch long. The skeleton-spicules are arranged vertically side by side, the spined acuates feather-like around the bases of the long spicules respectively, and the anchorates scattered irregularly throughout the lamina of which the sponge is composed. Size of specimen about 1 inch in horizontal diameter.

Hab. Marine, spreading over hard objects, laminiform.

Loc. At station 25, in 374 fathoms, near Cape St. Vincent.

Obs. This specimen is on the upper surface of a rough, flat, slate-like stone, which also bore the living specimen of *Macandrewia azorica* that will hereafter be mentioned. The thin lamelliform state of the Microcionina effectively precludes an evident appearance of both pores and vents, which, although, of course, present as part of the structure of a sponge, can only be followed here with the microscope.

Microciona intexta, n. sp. (Pl. XV. fig. 43, *a*, *b*, *c*.)

As *Pachastrella intexta* (which will be described hereafter) grows in among the spicules of dead *Corallistes Bowerbankii*, extending from the surface downwards, so this *Microciona* grows, causing a brown discoloration of the *Corallistes*, which discoloration, when placed under the microscope, is found to arise from the presence of sarcode charged with two kinds of spicules, viz. one skeleton- and one flesh-spicule. Skeleton-spicule acuate, straight, but with the large end suddenly bent to one side (like the head of a walking-stick), and terminating attenuatingly in a point at the other end, sparsely covered with short vertical spines throughout, 80- by 3-6000ths inch (Pl. XV. fig. 43, *a*). Flesh-spicule a simple bihamate, much curved, and more or less tortuous (fig. 43, *b*). The skeleton-spicules are sparsely imbedded among the flesh-spicules, which are exceedingly numerous and thrown together confusedly, so as to form the greater part of the mass (fig. 43, *c*). Pores and vents not seen. Size of portion of discoloration in the *Corallistes* about ¼ inch in diameter.

Hab. Marine, on *Corallistes Bowerbankii.*

Loc. Station 25, in 374 fathoms, near Cape St. Vincent.

Obs. This sponge is chiefly remarkable for the form of its skeleton-spicule and the mass of bihamates in which it is imbedded. Being parasitic among the spicules of *Corallistes*, I, of course, can give no description of its form: I am not quite certain that it should be called a *Microciona*, and therefore only give this generic name provisionally.

Microciona pusilla, n. sp. (Pl. XVI. fig. 51, *a*, *b*, *c*, *d*.)

I have met with another *Microciona* of the same kind, growing on *Polytrema utriculare*, not dredged up on board the 'Porcupine' (Ann. 1876, vol. xvii. p. 210), but probably from the tropics. (Dr. Bowerbank has figured a similar spicule from *Oculina rosea*, *op. cit.* vol. i. pl. xi. fig. 243.) In my instance, however, the skeleton-spicules are smooth, and the bent portion of the large end has a tendency to a spiral twist (*a*, *b*); while they grow erect on the surface of the *Polytrema*, with fine acuates between them (*c*), and minute bihamates (?) scattered throughout the structure, which are almost too small to be satisfactorily described under a ¼-inch object-glass (*d*). The thick skeleton-spicule with bent large end is hardly more than a quarter the size of that of *Microciona intexta*, although somewhat similar in form, being about 36- by 1-6000ths inch in its greatest diameters.

Phakellia ventilabrum, Bk., = *Halichondria v.*, Johnston.

Fragments of this sponge appear in jars 61–63, 64, 65, and 84, which, being the numbers of the stations where they were dredged up, indicate a depth varying between 155 and 640 fathoms, and a locality extending north of the Butt of Lewis to

Thorshaven in the Faroe Islands, and the Haaf banks on the east of Shetland; also in jar No. 25=374 of 1870, near Cape St. Vincent. The finest and most perfect specimens that I have ever seen are those from the Haaf banks, presented to the British Museum by Dr. Bowerbank.

Phakellia (Bk.) *infundibuliformis*, C., =*Halichondria inf.*, Johnston.

Entire specimens and fragments of this sponge appear in jars 65, 78, and 83, which, being the numbers of the stations where they were respectively dredged up, indicate a depth varying from 290 to 345 fathoms, with a locality between the Orkney, the Shetland, and the Faroe Islands.

This sponge in general form is very like, although much inferior in size to, *Phakellia ventilabrum*—indeed just as Johnston has described it; and I can see no reason for altering any thing but Johnston's generic name to "*Phakellia*," and not to "*Isodictya*" as Dr. Bowerbank has done. The spicules are essentially those of *Phakellia ventilabrum*, viz. an acuate and an acerate; but they are shorter, stouter, and straighter than those of the latter, the acerate being simply curved, and not undulating as in *P. ventilabrum*. Outlines of two specimens of *P. infundibuliformis* in its fan-shaped form may be seen *in situ* on the pebble on which they have grown (Pl. XII. fig. 1, *fff*).

[To be continued.]

XXI.—*On a Collection of Lepidoptera from Port Moresby, New Guinea.* By ARTHUR G. BUTLER, F.L.S. &c.

THE following species were recently received from Mr. W. Y. Turner of the London Medical Mission at New Guinea, and form a very interesting little collection. Most of the named species were previously known from Aru, only one or two of the commoner and more widely ranging species being identical with those of Australia.

RHOPALOCERA.

Family **Nymphalidæ**.

Subfamily *DANAINÆ*, Bates.

Genus DANAIS, Latreille.

1. *Danais ferruginea*, n. sp.

Allied to *D. mytilene*, but the transverse, oblique, subapical

6. *Euplœa lugens*, n. sp.

Wings above deep piceous with purple reflections; external area paler; costal area of secondaries broadly greyish brown; primaries with a falciform series of nine chalky-white discal spots; the fourth, fifth, seventh, and eighth larger than the others, the ninth bifid; secondaries with a subangulated discal series of ten chalky-white spots, the first three increasing in size, rounded, and widely separated, the remainder larger, oval, in pairs: wings below olive-brown; primaries with the interno-discal area blackish, a bluish dot in the cell and two on the median interspaces; white spots as above; secondaries with a bluish dot in the cell, and an angular series of five dots beyond it; white spots as above: body black, white-spotted. Expanse of wings 3 inches 2 lines.

One male.

Seems to belong to the *E.-pelor* group; but it is very differeut.

Genus CALLIPLŒA, Butler.

7. *Calliplœa violetta*, n. sp.

Wings above piceous, shot with purple, paler towards the outer margins; primaries with a waved series of eight discal lilac spots with diffused white centres, the first three and the last small, the fourth largest; secondaries sometimes with two subapical white dots parallel to the outer margin: wings below bronzy olive, becoming brownish plum-coloured towards the outer margin; primaries with the discal series of spots white and smaller than above; a bluish dot in the cell, and three in a nearly straight line beyond it; eight submarginal white dots in pairs; a white interno-median streak; secondaries with a bluish dot in the cell, and six in an angular series beyond it; two or three subapical, and two smaller submarginal white dots: body black, white-spotted. Expanse of wings 3 inches 1 line.

Two females.

Subfamily *SATYRINÆ*, Bates.

Genus MELANITIS, Fabricius.

8. *Melanitis taitensis*.

Cyllo leda, var. *taitensis*, Felder, Verb. zool.-bot. Gesellsch. in Wien, xii. (1862).

A male.

Genus Mycalesis, Hübner.

9. *Mycalesis medus.*

Papilio medus, Fabricius, Syst. Ent. p. 488 (1775).

Both sexes.

10. *Mycalesis daidis.*

Mycalesis daidis. Hewitson, Exot. Butt. iii. *Myc.* pl. 4. fig. 22 (1862).

One female.

11. *Mycalesis flagrans*, n. sp.

Allied to *M. terminus*, from which it differs above in having the primaries much more deeply coloured, the ochraceous patch surrounding the inferior ocellus much smaller, the outer border less irregular; secondaries greyish brown, the ocelli and marginal lines as in *M. terminus*: wings below much more grey in colouring, the ocelli slightly larger, bounded within by greyish instead of clear pale buff; the submarginal lines less undulated, the outer line closer to the margin and consequently further from the inner line. Expanse of wings 2 inches.

One female.

Although this species upon the upper surface merely looks like a deeply coloured variation of *M. terminus*, the grey coloration of the under surface with the differently disposed submarginal lines at once decide it to be a distinct species.

Subfamily *Nymphalinæ*, Bates.

Genus Neptis, Fabricius.

12. *Neptis Brebissonii?*

Limenitis Brebissonii, Boisduval, Voy. de l'Astrol. Lép. p. 132. n. 2 (1832).

One male.

The only point in which this differs from the description is in that the upper discal white patch of primaries is divided into two spots as in *N. venilia*; the outer series of white spots on the under surface of secondaries is also obsolete; but this is certainly a male character; the female would have them well-defined as in *N. venilia*.

Genus Diadema, Boisduval.

13. *Diadema nerina.*

Papilio nerina, Fabricius, Syst. Ent. iii. 1, p. 509 (1775).

One male, two females.

Genus JUNONIA, Hübner.

14. *Junonia albicincta.*

Junonia albicincta, Butler, Trans. Ent. Soc. p. 5 (1875).

One male.

Previously known only from Australia.

15. *Junonia villida.*

Papilio villida, Fabricius, Mant. Ins. ii. p. 35 (1787).

One female.

Genus CYRESTIS, Boisduval.

16. *Cyrestis achates.*

Cyrestis achates, Butler, Proc. Zool. Soc. p. 481 (1865).

One female.

The type was from Mysol.

Genus MESSARAS, Doubleday.

17. *Messaras Turneri*, n. sp.

Wings with basal area red-brown; central area occupied by a broad, sharply defined, bright ochreous band (from costa of primaries to abdominal margin of secondaries), sometimes enclosing a black dot on first median interspace of primaries; external area broadly black-brown, with two barely visible lunulate submarginal black lines: wings below intermediate in character between *M. prosope* and *M. madestes*, buff, with the basal area greyish or sordid (not edged with brown); external area red-brown, interrupted by a discal series of black spots, bounded by whitish lunules on each side; a submarginal series of whitish lunules; a nearly marginal ochraceous line: body brown above, buff below. Expanse of wings 2 inches 5–6 lines.

A pair.

We had this species previously from Mysol and Dorey; the example from Mysol is rather paler.

Family Lycænidæ.

Subfamily *LYCÆNINÆ*, Butler.

Genus MILETUS, Hübner.

18. *Miletus epicletus.*

Thecla epicletus, Felder, Wien. ent. Mon. iii. p. 324, pl. vi. fig. 3 (1869).

A pair.

with a spot at end of cell, a subcostal spot, a transverse subapical band, and a sinuated chain-like marginal band, indicated by white marginal lines, the chain-like band doubled at apex; secondaries with a discal irregular transverse series of subquadrate white-edged blackish spots, six elongate-lunate submarginal black spots edged with pale blue and white, the fifth with two external metallic blue dashes, a white interrupted marginal line, fringe dark grey. Expanse of wings 1 inch 8 lines.

♀. Differs from the male in the broad black-brown borders of the wings above. Expanse of wings 1 inch 8 lines.

One pair.

We previously possessed this species from Waigiou; it is larger than the allied *D. aleuas*, and differs in the want of the metallic discal lunules on the underside.

Subfamily *Theclinæ*, Butler.

Genus Hypolycæna, Felder.

23. *Hypolycæna tmolus.*

Hypolycæna tmolus, Felder, Wien. ent. Mon. vi. p. 293 (1862).

Two females.

Genus Amblypodia, Horsfield.

24. *Amblypodia micale.*

Arhopalia micale, Blanchard, Voy. Pôle Sud, p. 399, pl. iii. figs. 11, 12 (1853).

One male in poor condition.

Family **Papilionidæ.**

Subfamily *Pierinæ*, Bates.

Genus Elodina, Felder.

25. *Elodina andropis*, n. sp.

Wings snow-white, base broadly greyish brown; primaries with costa, apex, and external border dark brown, inner edge of outer border zigzag, trisinuate, the second sinus feebly bisinuate; secondaries with a broad internally subsinuated dark brown marginal border, diffused at anal angle; body blackish: primaries below silvery white, the costal and outer margins narrowly grey; a broad bisinuated subterminal transverse blackish band; basal area pale sulphur-yellow; secondaries silvery white, the base of costa sulphur-yellow; body below white. Expanse of wings 1 inch 9 lines.

One female.

Not nearly allied to any species known to me.

Genus BELENOIS, Hübner.

26. *Belenois latilimbata*, n. sp.

♂. Creamy white, basal area greyish; a broad and rather irregular dark brown outer border; primaries with the veins dusky; costa black, tapering towards the base; two or three subapical creamy spots; outer border deeply sinuated in the first median and the discoidal interspaces: primaries below white; outline of outer border as above, but the apical area cupreous, crossed by three bright yellow spots, basal area greenish yellow; secondaries bright yellow; external border irregularly sinuated, cupreous, darker internally. Expanse of wings 2 inches 4 lines.

♀. Primaries whiter than in the male, several indistinct additional subapical spots, the two more prominent ones distinctly yellow; secondaries with an indistinct subapical spot: underside paler. Expanse of wings 2 inches 5 lines.

One pair.

Most nearly allied to *B. nabis*, but differing considerably.

Subfamily *PAPILIONINÆ*, Bates.

Genus EURYCUS, Boisduval.

27. *Eurycus troilus*, n. sp.

Allied to *E. cressida* ♂, but with shorter and more rounded primaries, external blackish border much broader, particularly at apex; basal black area and inner discoidal black spot obsolete, indicated by pale brown as in *E. cressida* ♀, transverse white band of secondaries externally more deeply indented; discal spots very small, sordid white instead of carmine: on the underside the spots are tinted with red; white marginal spots below wanting: body altogether duller in colour, collar below pinky whitish. Expanse of wings 3 inches 4 lines.

One (apparently ♀) example.

The abdomen is too much compressed for careful examination.

Genus PAPILIO, Linnæus.

28. *Papilio sthenelus.*

Papilio sthenelus, M'Leay, King's Surv. Austr. ii. p. 457. n. 133 (1827).

Three females.

29. *Papilio indicatus*, n. sp.

Wings dark smoky brown; primaries with the discal area paler, bounded within towards costa by two to four decreasing (externally notched) creamy white spots, fringe spotted with pale yellow; secondaries becoming almost black externally; a large, sordid, creamy whitish, externally deeply bisinuated patch near apex and parallel to the outer margin; an orange spot at anal angle surrounded with black, and with a blue linear crescent above it; two anal submarginal red lituræ; fringe varied with creamy whitish: wings below paler than above; secondaries with a submarginal series of seven large black spots, crossed by dull orange stripes and sprinkled with bluish atoms; the second, third, and fourth bounded internally by irregular white lunes, being the lower margin of the whitish patch of the upperside, the remainder of which is obscured by brown colouring, and only dimly visible. Expanse of wings 4 inches 6 lines.

Two females.

Allied to *P. capaneus*, of which it is probably the representative in New Guinea.

30. *Papilio ambracia.*

Papilio ambracia, Wallace, Trans. Linn. Soc. xxv. p. 54 (1865).

One pair.

Family **Hesperiidæ.**

Genus COBALUS, Hübner.

31. *Cobalus cæsina.*

Hesperia cæsina, Hewitson, Trans. Ent. Soc. 3rd ser. p. 491 (1866)

One female.

Genus PAMPHILA, Fabricius.

32. *Pamphila augias.*

Papilio augias, Linnæus, Syst. Nat. i. 2, p. 794 (1767).

Two males.

XXII.—*On some new and remarkable North-Atlantic Brachiopoda.* By J. Gwyn Jeffreys, LL.D., F.R.S.

Among the zoological results of my cruise in H.M.S. 'Valorous' last year, on the return voyage from Davis Strait, were three Brachiopods, dredged in deep water, which require special notice. A description of them is subjoined.

Terebratula tenera *, Jeffreys.

Shell uniformly oval, with the broader end in front, compressed, of a thin and delicate texture, and of a dullish hue: *sculpture* slight, curved and parallel lines of growth, besides numerous minute tubercles which cover all the surface and are the cæcal terminations of the permeating canals: *colour* yellowish brown: *margins* even, rounded in front, and curving gradually behind: *beak* short, not prominent: *foramen* or byssal passage small, semioval, incomplete on the inner side: *deltidium* slight and delicate: *hinge-plate* broad and proportionally strong: *teeth* in the upper (or more convex) valve short and curved: *skeleton* or apophysis in the lower (or smaller) valve consisting of two thin and flexuous blades, which are slenderer and approximate more than in *T. cranium*, but have similar spurs and points; the loop is horseshoe-shaped: *inside* of lower valve furnished with two short ridges, which extend on each side from the deltidium, with a slight septum between and below the ridges. L. 0·5, B. 0·4.

Lat. 56° 11′ N., long. 37° 41′ W., 1450 fathoms, *Globigerina*-ooze and stones. Two or three perfect specimens, and several valves and fragments.

This species differs from *T. cranium* in being only half the size in exact measurement, and consequently one fourth in bulk; it is of a different shape, texture, and colour, compressed instead of convex, having a much shorter beak and smaller orifice, with not half the proportionate number of tubercles; and the blades are closer together, and do not extend so far towards the front. In the young of each species the comparative number of tubercles and prominence of the beak are distinctly marked; and the septum in the present species is shorter, although conspicuous and gnomon-shaped.

Atretia †, g. n., Jeffreys.

Shell inequivalve, triangular, imperforate, of a fibrous texture: *beak* prominent and pointed, but not incurved: *byssal orifice* elongated: *hinge-line* narrow: *skeleton* composed of

* Tender. † Imperforate.

two funnel-shaped processes, which diverge from the beak in the upper or larger valve, and of two blade-like processes besides an upright plate or septum in the upper part of the lower or smaller valve.

Its nearest ally is *Rhynchonella*, from which it appears to be distinguishable only by the straight instead of incurved beak, and by the arms or brachial apparatus not being coiled.

Atretia gnomon *, Jeffreys.

SHELL triangularly oval, compressed, thin, semitransparent, and rather glossy: *sculpture*, a very few slight and indistinct longitudinal ridges, and numerous close-set microscopic imbricated scales: *colour* white: *margins* broad and rounded in front, sloping gradually at the sides, and acute-angled behind: *beak* in the upper or larger valve somewhat prominent: *foramen* triangular and groove-like, narrow, and exhibiting inside, below the beak (as in *Rhynchonella psittacea*), a series of arched septa or laminar marks of growth: *byssus* cylindrical: *deltidium* well defined: *hinge-plate* strong: *teeth* in upper valve two, resting on a triangular funnel with its mouth or opening outwards; in the lower valve there are also two teeth, which are nearly straight, slender, and blade-like: *sockets* deep: *skeleton* composed of an erect and thin triangular crest or septum in the middle of the lower valve, like a sun-dial-stile, which is pointed at the top, besides the above mentioned processes in each valve; on either side of the septum are two slight parallel ridges which extend from the hinge, and a diverging ridge towards the lower end of the septum. L. 0·25, B. 0·2.

A single living specimen occurred in lat. 63° 9′ N., long. 56° 43′ W., at a depth of 1100 fathoms, clayey mud. It was attached by the byssus to a fragment of a tubular Foraminifer, and covered with a cluster of young *Atretiæ* in different states of growth, and a dwarf form or variety of *Truncatulina lobatula*. Valves and fragments were also found in lat. 59° 10′ N., long. 50° 25′ W., and in lat. 56° 11′ N., long. 37° 41′ W., at depths of 1750 and 1450 fathoms. Imperfect valves had been dredged by me during the 'Porcupine' Expedition of 1869, in stations 20 and 30, at depths of 1443 and 1380 fathoms, off the west coast of Ireland. This curious Brachiopod was noticed and figured by Mr. Davidson in his Supplement to the 'Monograph of the British Fossil Brachiopoda' (Publications of the Palæontographical Society, 1874), p. 7, pl. i. figs. 7–10; but the restoration from the imperfect

* Having a septum like the hand or stile of a sun-dial.

valves is not quite satisfactory, because the perfect specimen is much more triangular and compressed, the beak more pointed, and the foramen narrower than in the figures given by Mr. Davidson. He could not, however, have done better with the incomplete specimens which I had then placed in his hands.

Discina atlantica *, King.

Discina atlantica, King, Proc. Nat.-Hist. Soc. Dublin, 1868.

Body semiglobose: *arms* furnished with very long and slender setæ or stiff hair-like cilia, which project beyond the edge of the shell on every side to an extent fully equalling its diameter: *byssus* cylindrical and narrow.

Shell conical, more or less circular: *upper valve* umbrella-shaped, thin, semitransparent, and rather glossy: *sculpture*, numerous close-set and concentric minute striæ or lines of growth, which become somewhat irregular towards the outer edge of the shell, and microscopically wrinkled lengthwise in a radiating direction: *colour* pale brownish yellow: *margins* thin and sharp: *beak* or apex very small, nipple-shaped, depressed, placed nearer the dorsal margin: *lower valve* flat, thin, having near its middle a comparatively small round disk, within which is an oval slit for the passage of the byssal stalk of attachment; this disk is slightly sunk within any calcareous substance to which it is attached, as if the byssus had the power of excavation; the rest of the lower valve is free and concentrically striate, like the upper valve: *muscular* (adductor) *scars* in the upper valve club-shaped, rather close together; no scars observable in the lower valve. Not the slightest trace of a tubular or perforated structure could be detected in either valve, with one of Smith and Beck's best microscopes, under a lens of $\frac{1}{5}$ power. L. 0·2, B. 0·2.

Lat. 56° 11′ N., long. 37° 41′ W., 1450 fathoms, *Globigerina*-ooze and stones (two living specimens and several upper valves); lat. 56° 1′ N., long. 34° 42′ W., 690 fathoms, *Globigerina*-ooze. 'Porcupine Sounding,' 1862, 1240 fathoms (Capt. Hoskyns); 'Porcupine' Expedition, 1869, 1366 fathoms (J. G. J.); North-Atlantic sounding, while fishing up the deep-sea telegraph cable, 2400 fathoms (Sir James Anderson).

The surface of one of the upper valves dredged in 1450 fathoms exhibits the impressions or marks of two byssal disks, by which other specimens had apparently been attached to it, forming small circular shallow pits, with a deeper excavation for the stalk or plug. The genus *Discina*, of which the

* Belonging to the Atlantic Ocean.

2nd ser. vol. ii. p. 402), which occurs not unfrequently in the Sound near Copenhagen*. Milne-Edwards, in his great work on Crustacea, was unable to give any information about the structure of the mouth; and Kröyer's attempt to decipher it was necessarily incomplete, on account of the great difficulties of the investigation, coupled with the circumstance that he had only two specimens at his disposal. He treats only of the mandibles and the maxillipeds; but his statements are upon the whole correct as far as they go and from his point of view. He has observed the serrulate lobe of the mandible, although of course he does not recognize it as an inner lobe. His statement that the "maxillary lobe" of the maxillipeds reaches to the apex of the palpus must be explained as founded on a confused appearance of the parts caused by pressure; but it shows at the same time how far he must have been from guessing that he had a mouth constructed for suction before him.

An entirely different standpoint is occupied by Messrs. Spence Bate and Westwood in their work on the British Sessile-eyed Crustacea, inasmuch as they unhesitatingly declare that the mouth in these Crustaceans "is evidently formed for suction." But their account of its structure is too short, and conceived in too general terms, to afford materials for solving the problem now before us—viz. to understand thoroughly the special construction and mode of action of each part of the mouth by itself, as well as the connexions and the

* It is still doubtful whether this really is a different species either from *A. gracilis*, Mont., or from *A. gracilis*, Milne-Edwards. According to the description given by Messrs. Spence Bate and Westwood ('History of British Sessile-eyed Crustacea,' ii. p. 160) of the original specimen in the British Museum, the only one which they have seen, this would differ from our species by a more slender form, the last tail-segment also having parallel sides, and its posterior margin being truncate and irregularly crenulated, like that of the branches of the limbs. But these differences are precisely such as might be owing to the fact of the specimen in question being a dried one. As for the *A. gracilis* of Milne-Edwards, his description and figure of the tail (Hist. des Crust. iii. p. 136, pl. 31. fig. 35) agree very well with our species. I observe that Messrs. Spence Bate and Westwood quote *A. gracilis*, Milne-Edwards, twice:—first (p. 160), as synonymous with *A. gracilis*, Mont., and again (pp. 165 and 167) where they refer it to their *Paranthura Costana*—a circumstance which seems to require an explanation, particularly because the latter animal has, according to these authors, a long tail with free segments, whilst Milne-Edwards describes and figures the tail of his *A. gracilis* as consisting of only two pieces, namely, besides the terminal segment, only one other, formed by the coalescence of several very short ones. In order to secure as far as possible the recognition of the species examined above, I have added figures of the tail as seen from the side, from above, and below, to those representing the head and the parts of the mouth.

harmonious cooperation of all the parts of the complicated machinery to one end, and, finally, to appreciate the fundamental types which may be discerned in the conformation of the mouth in these Crustaceans. These questions can be solved only by a well planned, gradually progressing dissection under the microscope, carried out in such wise that the *natural* position of each part is observed with certainty—a process difficult in itself, and involving the sacrifice of much time and many specimens. As I shall have no other convenient opportunity in the sequel for doing so, I shall here at once briefly indicate how I interpret the figures which the authors quoted have inserted in their page 165 (vol. ii.) as representing the parts of the mouth in *Paranthura Costana*, but which are not elucidated either by references in the text or by any special explanation.

There are two figures marked *f*, of which the one to the right no doubt represents one of the maxillipeds with its two-jointed palpus, its stipes and cardo, together with the prosternum, though the relative proportion of these parts is not accurately rendered (an observation which may be made with regard to several figures in this very useful work, but which is accounted for by the consideration that the drawings evidently are mere sketches intended to assist the student in finding the parts). The other figure *f* represents, as I believe, the terminal portion of the same organ. The letter *e* denotes one of the maxillæ of the first pair (our authors seem to describe this pair as the second); fig. *d* is no doubt a mandible. The left-hand figure of the two marked with a cross I take to be drawn from a preparation including portions of the first and second pairs of maxillæ in superposition; whilst the other figure with the same mark undoubtedly represents the upper lip with the clypeus, confounded by pressure into one mass*.

* In passing I may mention that the information given by Messrs. Spence Bate and Westwood on *Conilera cylindracea* proves unmistakably that its mouth is formed for biting, and entirely agrees with that of *Cirolani*, whilst differing widely from that of *Æga*, which, as I have shown in the former part of this treatise, is formed for suction. If, therefore, we are to be guided in our systematic arrangements by the structure of the mouth, and not merely by the general external resemblance (habitus), *Cirolani*, and with them *Conilera*, must not be classed with *Æga*, but removed to the opposite extremity of the series of Isopoda. Having proved myself that *Æga* and *Cymothoa* are really sucking Crustacea, I quite agree with our authors when they place *Anthura* next to them on account of the structure of its mouth; but this argument for their classification seems hardly consistent with their own statement (vol. ii. p. 273), that in "the second subtribe of the parasitical normal group of the Isopoda [comprising Serolidæ, Ægidæ, and Cymothoida] the oral organs are formed for mastication."

17. On examining the elongate head of the *Anthura* from beneath, after having separated it from the body, we observe at once a convex, broadly ovoid part situated in the middle, and reaching from the base so far forward as to occupy about half the length by nearly half the width of the entire head. At first sight one is tempted, by the shape and position of this piece, to take it for the stipites of the maxillipeds; but on closer examination it turns out to be immovably connected with the head all round; further forward the maxillipeds, too, appear developed in all their component parts; the ovoid protuberance must therefore be the prosternum, which thus in *Anthura* is distinguished by a very unusual size. The anterior margin of this large prosternum forms a transversal line, presenting a shallow sinus on either side, in which the cardo of the maxilliped is fixed, whilst the stipites of the maxillipeds fit through a kind of articulation into two deeper indentations in the middle of this same margin. The two maxillipeds lie so close together that the interior margin of the left stipes and of the first joint of the left palpus overlaps a little the opposite edge of the right stipes and of the first joint of the right palpus. In this way the two limbs together form an oblong duct, open above and reaching forward, almost on a level with the prosternum, to the base of the mandibular lobes. The first joint of the palpus has parallel sides and is one third longer than wide; the stipes is longer than the joint just mentioned, and at the apex of equal width with the latter; but its exterior margin is considerably dilated in the middle, while contracted near the base, in consequence of which a triangular space is left between the exterior margin of the stipes and the prosternum; and this space is filled by the triangular cardo of the maxilliped. In this manner the prosternum with the cardo, stipes, and first palpus-joint of each maxilliped form together a continuous whole, a sort of semicone projecting from the under surface of the head. With this other parts are combined. The second and last joint of the palpus of the maxilliped forms a small triangular leaf, the outer margin being convex, the inner margin concave; like the first joint, it is furnished with short sparse fine hair, a few longer and stronger setæ occupying the inner side. On account of this configuration, this joint does not approach closely to the corresponding one on the other side, but an elliptic slit is left between their interior margins, whilst their anterior, rounded margins touch closely on the upper lip. This latter hangs down almost perpendicularly from the large, conoid, strongly projecting clypeus; and its anterior margin presents a broad sinus. Taken together, all these parts con-

small warts, and curved inwards against each other; the two inner lobes are so short that they do not fill the space between the two outer ones, but a split is formed between the latter, corresponding in position to the middle of the opening between the terminal joints of the palpi of the maxillipeds. This second pair of maxillæ carries no palpus; it does not quite cover the first pair of maxillæ, but only their lobes, the stipes and cardo of the latter appearing on either side. When separated from the other parts, each maxilla of the first pair is seen to consist of a large, elongate triangular cardo, a very elongate, narrow, compressed-cylindrical stipes with contracted apex, and furnished in the midst with sparse short hair. The outer lobe is adnate to the stipes, narrow, band-shaped, without spines, but divided on the inner side into seven long, pointed, somewhat incurved teeth, ranged in two rows, the lower one being formed by the long and stout terminal tooth, with the next following, which is more slender, and a small, slightly outward bent one in the inner corner, whilst the upper row is formed by four other teeth of middle size; there is no inner lobe nor palpus. When both these pairs of maxillæ are taken off, we perceive the tongue, which is flat, thin, naked, dilated, broadly rounded at the apex, and divided for more than half its length. The basal part of the split of the tongue is elliptically widened, and placed just over the middle of the opening between the maxillary lobes of the second pair, which again corresponds with the middle of the gap between the terminal joints of the palpi of the maxillipeds. Above the tongue, finally, the lobes of the mandibles appear. The outer one forms an irregular quadrangular or rather broadly falcate leaf, of which the anterior outer margin and the inner corner are somewhat thicker than the rest; the margin is rather rounded at the apex, and carries inside this, on the upper face, two broadly rounded flat teeth, one behind and above the other, giving the apex the appearance of being obtusely tridentate; the inner corner of the lobe forms a large, flat, coniform, somewhat recurved tooth. The thin, foliaceous inner lobe is fixed to the outer one, between the inner corner and the apex of the latter; its margin is curved and cut out into about twenty small recurved exceedingly sharp little teeth.

A comparison between the structure of the mouth of *Anthura*, as just described, and that of Cymothoidæ discloses a general resemblance to that we have described in *Æga*, though there are differences in subordinate points. The sucking-tube is in both cases formed by the maxillipeds with the concurrence of the upper lip, which applies itself to them; but in

Anthura the palpus of the maxilliped has only two joints, and the stipes lacks the rudimentary lobe. The first and second pair of maxillæ are essentially of similar build; but in *Anthura* the latter are joined together in their whole length, and cover only the apices of the first pair of maxillæ. The lobes of the tongue are without the little digitiform prolongation which in *Æga* twists itself round the mandibular lobes. The stipes of the mandible is much shorter in *Anthura*; it is supplied with an articular protuberance; but its outer margin is overlapped by the margin of the pleura; the inner lobe is present and developed into a saw-blade; the terminal joint of the palpus is much longer than in *Æga*, and differently constructed.

As regards the totality of the oral organs and their mode of cooperation, *Anthura* differs from Cymothoidæ by the less elaborate equipment of the aperture of the sucking-tube; the upper lip has no fringes; and instead of a close armature of hooked warts the lobes of the second pair of maxillæ have only small conoid warts, and the palpi of the maxillipeds only carry some setæ. But the greatest difference is observable with regard to the manner in which the nourishment is made to flow into the oral tube, the scratching hooks of *Æga* and the lancet-blades of *Cymothoa* being in *Anthura* replaced by completely developed sawblades, viz. the inner lobes of the mandibles; when the apical teeth of the outer lobes have taken hold, these sawblades will be able to cut off extremely small particles, their movement against each other being regulated by the inner corners of the outer lobes, which project like teeth and prevent the inner lobes from crossing each other beyond the cutting parts of the sawblades.

The formula for *Anthura* will consequently be the following:—

Anthura.

Os haustellatum.

Haustellum adversum clypeo labroque, aversum maxillis posterioribus palpisque pedum maxillarium confectum, malas mandibulares serratorias maxillaresque priores rasorias involvens.

Clypeus obconicus, pendulus.

Labrum transversum, fornicatum, late emarginatum, pendulum.

Mandibulæ stipite depresso, amplo, trapezoideo, fixo, apice palpigero, malis binis. *Mala exterior* sub labrum oblique inflexa, mobilis, in orificium haustelli eminens, falcata, basi dentata, apice obtuse serrata. *Mala interior* cum mala priore concreta, laminata, acie arcuata, acute serrulata. *Palpus* labrum amplectens, triarticulatus, articulo terminali inter antennas primi paris recepto, producto, gracili, conico, apice spinoso.

Maxillæ priores stiliformes, *mala interiore* et *palpo* carentes. *Mala exterior* cum stipite concreta, in orificium haustelli eminens, falcata, acie bifariam dentata, dentibus productis, incurvis, peracutis.

Maxillæ posteriores totæ contiguæ, malas maxillarum priorum obvolventes, cardine stipiteque concretis, palpo nullo. *Malæ* discretæ, breves, conicæ, spisse verrucosæ, orificium haustelli supra palpos pedum maxillarium claudentes.

Pedes maxillares prosterno maximo, fornicato, ad medium caput provecti, maxillas utriusque paris includentes, cardine magno, obliquo, laminato, triangulo, malis nullis. *Stipites* contigui, recti, clavati, fornicati, hypostoma productum, medio carinatum utrinque explentes. *Palpi* biarticulati, latissimi, foliacei, fornicati, toti contigui, labia inferiora haustelli formantes.

Lingua laminata, nuda, biloba, lobis late rotundatis, introrsum contiguis, rimam suctoriam includentibus.

The Danish species of *Anthura* occurs rather near to the coast in shallowish water, where usually no other fishes than some species of *Gobius* and quite young flounders occur; specimens kept in captivity work about in the mud with serpentine movements. It does not therefore seem probable that our *Anthura* lives on fishes. At the same time, however, Spence Bate and Westwood conclude their article on *Anthura carinata* (ii. p. 162) with these words:—"The following vignette represents some fishermen drawing in a seyne full of fish, on most of which these crustacea attach themselves."

18. The study of the structure of the mouth in AMPHIPODA, as in Crustacea generally, has hitherto been directed towards the most pressingly necessary object—that is, the discovery of reliable marks for the distinction of the various divisions of these animals. For this purpose it has been sufficient to examine the outline and armature of the individual parts of the mouth; and in this direction many of the zoologists to whom we owe our present knowledge of Amphipoda have made valuable contributions, most of all Kröyer, whose diligent and conscientions investigations may be said to have opened a new era in the special study of this order. But in spite of many isolated attempts, this mode of working has not sufficed to procure us an insight into the true types of the structure. The method applied in the present series of investigations, viz. the study of the parts in their anatomical connexion and their

berance fits into a socket in the pleural margin of the head; they have an oscillating movement, determined by this protuberance as a pivot and by the outer margin of the stipes. Those special arrangements for regulating the movements which will be described in the two other principal types are here wanting; and this series of Amphipoda might therefore suitably be described as *Eleutherognatha*.

In illustration of the combination which prevails among most of the *Gammarus-Caprella* type, we may take before us the structure of the mouth in *Caprella septentrionalis*, Kr. Looking at the head from the side, after having taken away the maxilliped with its strongly developed lobes and palpus armed with claws, we note first the flat and broad clypeus and upper lip; next, the epipharynx or palate, which forms a flatly rounded part in front of the opening of the pharynx; and finally, a portion of the lower lip, which appears between the mandible and the first pair of maxillæ, and which deserves particular attention as it plays a very important, hitherto overlooked, part in the mechanism of the mouth. A fuller view of it is obtained by examining the head from below, after removing all the appendages of the mouth except the mandibles, so that the hypostoma appears with the sockets in which the two pairs of maxillæ articulate; in front of these we then observe the same portions of the lower lip which we saw from the side, forming on each side a short horn, pointing backwards, and placed close under the stipes of the mandible, whilst the remainder of the lower lip, which is considerably developed, forms four cushion-like lobes round the orifice of the mouth. Two, of more oblong shape, are placed in front and extend laterally, whilst the two others, of obovate outline, are placed in the middle; but the bases of all point towards the mouth. The two foremost of these cushions fit very closely behind the mandibles; all four have a much smaller quantity of chitine and lime in their composition than the two horns of the lower lip above described; these therefore are stiffer than the cushions, yet yielding towards their outer extremity, and thus constitute a kind of spring, stiff enough to keep the mandibles up in the proper position for their oscillating movement, yet sufficiently elastic to yield to pressure when the mandibles are moved. We may, therefore, very properly describe these horns as processus mandibularii labii inferioris. The left mandible is somewhat stronger and more elaborately armed than the right one; both have a powerful and very prominent masticating process on the inner side, with elliptic rough crown, bearing inside the inner corner a single hairy filament. The broad transverse edge of the outer lobe is cleft into five short prehensile teeth; the inner lobe consists of two parts, an anterior harder portion, with a serrate edge, and a posterior bundle of hairy membranaceous lobes, three on the left, two on the right mandible. The teeth of all four lobes are arranged so as to interlock, both the shape of the teeth and the torsion of the lobes towards the under surface and towards one another being accordingly somewhat different on the left and on the right mandible. The structure of the two pairs of maxillæ, the first pair with two lobes and palpus, the second pair with two lobes, has often been described.

19. The second type is met with in most of the Amphipoda known as *Lysianassa*, *Anonyx*, and *Opis*, placed together by Dana in a separate division under the name of *Lysianassina.*

The mandibles are here narrow and high. The pivot-and-socket arrangement behind is the usual one; but besides this we find, near the apex of the stipes on the upper side in front of the palpus, a club-shaped articular process, with rounded apex fitting into a corresponding acetabulum on either side of a saddle-shaped socket or mortise in the palate, close behind the upper lip, opening towards the mouth. The movement of the mandibles is therefore regulated, not only by the mandibular springs of the lower lip, which are here always present, but besides by the two articulations mentioned, one at either end of the outer margin. This kind of movement is in accordance with the peculiar structure and corresponding use of the outer lobes. These latter do not, as in the Eleutherognatha, form prehensile tongs armed with teeth, but powerful scissors, of which the short, edgewise-set blades cross each other, their cutting parts being wedge-shaped and furnished with an exceedingly sharp edge coated with enamel as hard as glass. With reference to this combination of structure, the Amphipoda of this series may be described as *Trochalognatha.*

As a specimen of this type we take the *Anonyx lagena*, Kr. Viewed from the side, the head presents especially this difference from the head of Eleutherognatha, that the upper lip forms a projecting hump, the mandibles are much higher and, instead of a pointed triangular outline, present a longer anterior margin slanting downwards; the mandibular springs of the lower lip are also considerably longer. If we examine the head from below, after having removed the antennæ and the appendages of the mouth except the mandibles, we observe still better the peculiar shape of the thick protruding upper lip, of which the lower margin even forms a separate thicker wall or bolster. This latter covers the upper corners of the mandibular scissors, of which the left blade, furnished with a bifurcate prehensile hook in the lower corner, glides on the upper face of the right-hand blade, on which the prehensile hook is undivided and extremely finely pointed. The foremost lobes of the flat lower lip are thin and pointed; the middle lobes are roundly emarginated in front, leaving a part of the palate in front of the pharynx uncovered; the mandibular springs, on the contrary, are somewhat dilated and very stiff. If we then proceed, by taking away the upper lip and folding the entire lower lip back from the hypostoma, we observe the grinding-teeth of the mandibles, which before were covered by the middle lobes of the lower lip. In shape and structure they are peculiar, being elongate, narrow, flat, and scarcely touching each other with their crowns, which are only armed with setæ, and show a very small terminal surface. Taking, moreover, into consideration the peculiarly restricted mode of movement of the mandibles, we cannot fail to perceive that in this case they are employed rather for the purpose of carding the food and pushing it into the pharynx than as grinding-teeth. The explanation of this arrangement and of the heavy proportions of the upper lip presents itself if we examine more closely the structure of the palate, whereby it will appear, in the first place, that without the strong development of the upper lip the necessary space and support would be wanting for the articular eminence of the mandible, which in Trochalognatha is fitted into the palate; in the second place, a portion of the palate just behind the mortise for the articular process of the mandible will attract notice, being triangular, somewhat lower than the rest, with sharply defined sides, analogous to the velum palatinum of Mammalia, and carrying a small pendent flap with rounded apex, a kind of uvula, which reaches beyond the anterior margin of the pharynx. To the sides of this velum palatinum the grinding-teeth of the mandibles are closely joined; and the whole of their form is arranged to fit in with it. It is therefore evident that, as above stated, they can play no other part than that of carding the food and pushing it into the pharynx.

Amongst the other appendages of the mouth, the second pair of maxillæ and the maxillipeds offer no essential difference from those of Eleutherognatha; but the first pair of maxillæ are distinguished by the following peculiarities:—the terminal joint of the palpus is dilated, hollowed into the shape of a narrow cup, with broadly truncate apex armed with short coniform spines; the outer lobe has very powerful pectinate spines, whilst the inner lobe is very small, with only two hairy and membranaceous appendages.

Amongst Crustacea there exists one other Trochalognathe group; but it is in another order, namely Chilopoda amongst

they must play in this respect by their enormous quantity on the coasts of Greenland have been described by Captain Holböll in several contributions to Kröyer's treatises. In one place he says, "By letting down a basket containing a dead raven and a piece of the head of a shark to a depth of 75 fathoms, I have, in the course of two hours, got more than six pints of these small animals, although the basket was open and left a broad stream of animals, like a swarm of bees, that escaped during the hauling-up of the basket" (Naturh. Tidsskr. iv. p. 143). In another place the following occurs:—"The larger species of this genus (*Anonyx*) are so voracious that they do not cease eating, even if the food is taken out of the water. If several are confined together in a vessel they soon eat one another" (*ibid.* 2 ser. ii. p. 55).

[To be continued].

BIBLIOGRAPHICAL NOTICE.

Monograph of the Asiatic Chiroptera, and Catalogue of the Species of Bats in the Collection of the Indian Museum, Calcutta. By G. E. Dobson, M.A., M.B., F.L.S., &c. 8vo. London: 1876.

A few months ago we published in this journal a sketch of a new classification of Bats by the author of this work, a classification which, without departing very widely from the groupings of previous authors, certainly seems to bring the whole arrangement of these animals into a particularly intelligible form. As a reprint of the article above referred to constitutes the general introduction to the 'Monograph of Asiatic Chiroptera,' it need not be specially noticed here.

The chief characteristic of the new classification consists in the recognition, in accordance, apparently, with the doctrine of evolution, of a sort of parallelism in the families of the insectivorous Bats (*Microchiroptera* of Dobson)—the simple-nosed Vespertilionidæ and Emballonuridæ (better, perhaps, Noctilionidæ) leading respectively from supposed unknown ancestral forms to the Nycteridæ (Megadermata) and Rhinolophidæ on the one hand, and to the Phyllostomidæ on the other, the Pteropidæ being regarded (and, we think, with reason) as representing a distinct type or line of development. It is particularly interesting to find that the discrimination of these two alliances (or lines of descent) is confirmed by so minute a character as the microscopic structure of the hair—the members of the "Vespertilionine alliance" (Vespertilionidæ, Nycteridæ, and Rhinolophidæ) having the superficial scales of the hairs imbricated, while those of the "Emballonurine alliance" (Emballonuridæ and Phyllostomidæ) have them whorled and generally acute and projecting; but we cannot understand how Mr. Dobson can regard the hair of the

Pteropidæ as indicating a connexion with the Vespertilionine alliance, seeing that its structure appears to be an extreme modification of the whorled arrangement of the scales. The amount of shifting of genera caused by the adoption of the new principles of arrangement is very small, the most important change being the transfer of the subfamily Mormopes, Peters, to the Phyllostomidæ.

It is as a contribution to what we hope one day to see him complete, namely a "Species Chiropterorum," that Mr. Dobson's present work will be welcome to zoologists. Taking the Asiatic region to include the whole of that continent with its islands as far east as Mr. Wallace's boundary-line between the oriental and Australian regions, Mr. Dobson's descriptions, as he himself indicates, include, besides the Asiatic Bats, nearly all those of Europe; indeed, although the province as marked out does not possess four species of European Bats, he has added descriptions of these in footnotes, with the object of making his work a complete treatise on the European and Asiatic Chiroptera. We should have been glad, and we think he would have greatly increased the value of his work without a corresponding augmentation of his labour, had he included in it the Chiroptera of the whole Eastern archipelago; for the line taken as his eastern boundary, however good with respect to strictly terrestrial animals, does not seem to hold in the case of such creatures as the Bats, in connexion with which the term "Eastern archipelago" is still geographically admissible, and Mr. Wallace's line, however true in general, becomes an arbitrary boundary. In many places throughout the work a little more detail with respect to the geographical distribution of the species beyond the limits covered by the author, and in the synonymy of the species (without attempting to rival the elaborateness of Fitzinger's wonderful compilations), and especially in the way of references to figures, would be of advantage to the student. We may notice also the omission of the table of genera of the family Emballonuridæ.

The illustrations consist chiefly of woodcut figures of the heads and ears of the species in certain difficult groups; and they will be found especially valuable in the case of the Leaf-nosed Bats, the structure of the nasal appendages in which it is often almost impossible to describe intelligibly. A few skulls and teeth are also figured.

The Catalogue of the Chiroptera in the Indian Museum at Calcutta is really a systematic list of the Asiatic species of the order, with the addition of those species from beyond the limits of Asia, as laid down in the present work, of which specimens exist in that collection. It gives in parallel columns the number of specimens of each species, their origin and condition, with remarks upon any peculiarities displayed by the individual specimens.

Mr. Dobson's excellent little book, which is published by order of the Trustees of the Indian Museum, may, we believe, be obtained from Messrs. Trubner & Co.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

May 11, 1876.—Dr. Günther, M.A., Vice-President, in the Chair.

"On some Thallophytes parasitic within recent Madreporaria." By P. M. DUNCAN, M.B., F.R.S., Pres. Geol. Soc.

After noticing the works of Quekett, J. P. Rose, Wedl, and Kolliker on the filament-shaped parasites within recent and fossil molluscan shells and fish-scales, and his own researches into and descriptions of corresponding growths in Madreporaria from the Silurian and Tertiary rocks, the author proceeds to explain the method of investigation employed in the examination of recent corals. The range of the parasites is then stated to be, in corals from the littoral zone down to 1095 fathoms, and from Davis Straits to the tropical coral seas, and their lowest known temperature habitat is that of 31°·5 Fahr.

A list of species examined is given, and then the long slender canals with their included filamentous organisms are described. Then the method of entry of the growth is stated, and its relation to the organic basis of the coral sclerenchyma is explained. The reproduction by conidia and oospores is also explained. After noticing that the direction, branching, and size of the parasites depend upon the special peculiarities of certain corals, the author discusses the classificatory position of the vegetable form. Naming it *Achlya penetrans*, he suggests that it belongs to a group whose life-cycle is complicated by marine and subaerial conditions, and infers that *Achlya*, *Saprolegnia*, *Botrytis*, *Peronospora*, *Empusina*, and possibly *Bryopsis* are so many names of the same organism under these different conditions. Believing in the necessity of an arbitrary name, he prefers that of *Achlya*. Finally an instance of a parasite resembling what is called *Saprolegnia ferax*, Ktz., in a littoral coral is given.

May 18, 1876.—Dr. J. Dalton Hooker, C.B., President, in the Chair.

"On the Organization of the Fossil Plants of the Coal-measures. —Part VIII. Ferns (continued) and Gymnospermous Stems and Seeds." By Prof. W. C. WILLIAMSON, F.R.S., Professor of Natural History, Owens College, Manchester.

Ferns (continued).—Under the name of *Rachiopteris corrugata* a small *stem* of a fern is described, the outer surface of the bark of which is corrugated with innumerable transverse ridges and furrows. It has a vascular axis in its centre composed of several clusters of barred vessels filled with tylose, which clusters are blended together at their periphery, forming a cylinder; its centre is occupied by a cellular medulla, mingled with small vessels, which sends off radiating prolongations into the vascular cylinder, partially separating the bundles of the latter. Beside this cylinder is a second, smaller, isolated oval bundle, which soon escapes from

The author discusses the claim set up by M. Brongniart and Professor Newberry for the admission of *Sigillaria* amongst the Gymnospermous exogens, as well as Dr. Dawson's opinion that some of them, at least, have decided Gymnospermous affinities; but still believes that this determination is not justified by the facts. All the additional observations which he has made since the publication of his second and third memoirs confirm his original conclusion that no true distinction can be demonstrated to exist between the *Sigillariæ* and the higher forms of *Lepidodendra*, in which the vascular cylinder assumes the exogenous Diploxyloid organization. All the plants of which stems and branches have been found displaying an organization corresponding to that of living Gymnosperms are still comprehended within Endlicher's genus *Dadoxylon*. On the other hand, recognizing in *Trigonocarpum* all the external features of a true seed, the author cannot admit the probability of its having belonged to the Lycopodiaceous *Sigillariæ*.

Gymnospermous Seeds.—Attention is next directed to the curious seeds discovered in America, and published in Professor Newberry's 'Geological Survey of Ohio.' These, however, merely display external forms. Still more remarkable is the collection of such seeds found by M. Grand-Eury at St. Etienne in France. These exhibit their internal structure in a wonderful manner, as is shown by M. Brongniart's brief memoir published in the 'Annales des Sciences Naturelles.' M. Brongniart called attention, in that memoir, to a remarkable organization of the micropylar extremity of many of these seeds, where a peculiar cavity existed, between the micropyle and the apex of the nucleus, into which the pollen-grains obtained entrance through the micropyle, and were thus brought into contact with the nucleus. In a more recent memoir on the fertilization of the ovules of some species of recent Cycads (*Ceratozamiæ*), M. Brongniart showed that a mammillar prolongation of the apex of the nucleus projected into the micropyle, which it filled; but that during fertilization the cells of this prolongation became disorganized, and a cavity was produced into which the pollen-grains found their way, the apex of the nucleus below this cavity becoming covered over by true perispermic membrane. These structural peculiarities so far accord with what he observed in M. Grand-Eury's seeds, as to lead him to surmise that the latter had Cycadean rather than Coniferous affinities.

The author has found a number of remarkable seeds of a similar type to those from St. Etienne in the Oldham nodules, and he has been indebted to his friends Mr. Butterworth and Mr. Nield, of Oldham, and to Captain Aitken, of Bacup, for a few others.

The first of these is a very small, nearly spherical seed, which the author names *Lagenostoma ovoides*, about ·16 of an inch in length and ·1 in breadth. It has a solid testa, within which can be recognized two distinct membranes—an inner or "perispermic" one, which has enclosed the endosperm, and an outer or "nucular" one, which has been in close contact with the perispermic one throughout the greater part of the seed, but which splits up at its apex into two portions, the inner one of which forms a remarkable flask-shaped cavity, which the author designates the lagenostome. Its base has rested upon the apex of the perisperm, and its upper extremity has been continuous with the micropyle. Within this lagenostome is a little delicate parenchyma, which has shrunk up towards the centre of the cavity, leaving a surrounding space in which, in some examples, the author has found the objects regarded by M. Brongniart as pollen-grains—an opinion in which the author concurs. External to the lagenostome the second or outer division of the nucular membrane forms a remarkable "canopy," which hangs down from the micropyle, enclosing the lagenostome within ten sharply defined and regular crescentic folds, the concavities of which are directed outwards. The walls of this lagenostome and of the "canopy" correspond with the nucular membrane in consisting of flattened prosenchymatous cells. The perispermic membrane, on the other hand, looks structureless, save that it appears to have had imbedded in it an innumerable multitude of minute crystals, like those observed by Dr. Hooker on the spicular cells of *Welwitschia.*

A second species the author designates *Lagenostoma physoides.* In this the apex of the endospermic sac contracts into a mammiliform prolongation, overlapped by the base of the lagenostome, which overhangs it as a bladder half-full of water might be made to overhang the neck of a soda-water bottle upon which it rested. This species has other distinctive structural peculiarities.

For a second genus of new seeds the author proposes the name of *Conostoma. C. oblonga* from Oldham is about ·18 of an inch in length. Here, again, we have an endosperm enclosed in a perispermic membrane, and this in turn is encased within a nucular one, the whole being invested by a dense testa. The lagenostome is again formed out of divisions of the apical part of the nucular membrane; but it assumes a funnel-shape at its base, whilst its upper extremity is continuous with the micropyle. A second species, named *C. ovalis*, is from the Burntisland deposit, and is more ovate than *C. oblonga.* In it the lagenostome assumes a remarkably funnel-shaped contour. The same deposit has furnished a third species, *C. intermedia.* To another remarkable seed from Oldham the author gives the name of *Malacotesta oblonga*, of which the maximum length, exclusive of its funiculus, has been about ·25· Its exotesta has been soft and parenchymatous, with a prosenchymatous inner (nucular?) membrane. The micropyle has been remarkably wide with incurved margins at the exostome, and enclosing a mass of delicate parenchyma through which a canal passed.

The author has obtained a fine series both of longitudinal and transverse sections of *Trigonocarpum olivæforme*, the seed long ago made the subject of a valuable memoir by Dr. Hooker and Mr. Binney. So far as the longitudinal sections are concerned, the results obtained correspond closely with those already arrived at by these two authors, except that a modified form of lagenostome is shown to have existed at the apex of the nucleus. The transverse sections show that the two layers of the testa, an outer soft parenchymatous exotesta and an inner sclerotesta, present some striking features. The exterior of the latter has exhibited three principal, acute, prominent, longitudinal ridges, between each two of which are three intermediate ones, the centre of these three being rounded, and the two flanking ones acute. The internal cavity of the endotesta is prolonged like a narrow fissure only into each of the three principal ridges. The ordinary sandstone specimens of *Trigonocarpum olivæforme* commonly seen in cabinets do *not* represent, as has hitherto been supposed, the *exterior* of these seeds, but are casts of the *interior* of the sclerenchymatous endotesta, the three thin, longitudinal, wing-like appendages being merely casts of the three slit-like extensions of that interior just referred to. These slits extend upwards into the prolonged micropyle, the interior of which displays a triangular section, each of the sides of which is convex, the convexity projecting inwards.

The nomenclature of this type of seed is in great confusion, owing to specific differences being based on mere differences of size, many of which are probably nothing more than varieties due to age and development.

Casts of seeds with six longitudinal wings are described, corresponding with Brongniart's genus *Hexapterospermum*. They are more oblong than *Trigonocarpum olivæforme*, but apparently identical with the *T. Noggerathi* of the 'Fossil Flora.' The author doubts the wisdom of Brongniart's establishment of a separate genus for these seeds.

Several species of the important genus *Cardiocarpum* have been obtained displaying the internal organization of these remarkable seeds. They all agree in possessing a central endosperm which is remarkable for the very large size of its conspicuous parenchymatous cells. This is invested by a perispermic membrane, the whole being enclosed within a testa composed of two very distinct and separate layers. A thin inner one, which may be identical with the uucular membrane of other seeds, is entirely composed of delicate prosenchymatous cells, and is prolonged into an elongated micropyle, into which the endosperm is not prolonged. Externally to this is an exotesta composed of a denser parenchyma. In some species this latter tissue is uniform throughout, in others it is separable into a dense endotesta and a more lax parenchymatous exotesta. The first species described is apparently identical with the *C. anomalum* of Carruthers, and has a trigonous endosperm invested by the two layers of testa(?), both of which are prolonged into a slender tapering beak, half the entire length of the seed, and which contains the elongated micropyle. Another species, designated *C. compressum*, has its apparent testa composed (as just described) of two continuous layers. In it the micropyle is comparatively short, and its apical extremity is patulous or trumpet-shaped. To a third very beautiful little cordato-lanceolate species with a peduncle or funiculus equal in length to the seed, the author

a small parcel of shells dredged by him and Mr. Crispo, of his ship, in Bass's Straits. Amongst them I was greatly interested to find a fresh living specimen of the *Trigonia acuticostata*, which I described some years ago as one of the most abundant of our Miocene Tertiary species in some localities. The discovery that it still lives, although an excessive rarity in our seas (only the one example being known), will be welcomed by conchologists as well as geologists, from the very small number of living species of *Trigonia* known. This specimen shows, in even greater clearness than the fossil ones, the total distinction of the ribs from those of the hitherto known living species. The nacre of the interior is pearly white.

I have, &c.,

FREDERICK M'COY.

On the Reproduction of the Diœcious Volvox. By M. L.-F. HENNEGUY.

Only two species of *Volvox* are known, *Volvox globator*, L. (*V. stellatus*, Ehr.), and *Volvox minor*, Stein: the former is monœcious (*Volvox monoicus*, Cohn); that is to say, the male and female elements are united in the same individual; the second is diœcious (*Volvox dioicus*, Cohn).

Cohn has just published (Beiträge zur Biologie der Pflanzen, 1875) a new monograph of the *Volvox monoicus*, in which he describes the reproduction of this species. I have been enabled, on my part, to trace the mode of evolution of the *Volvox dioicus*, and to observe some facts which have not yet been noticed.

Each *Volvox* is a colony (*cœnobium*) formed of small unicellular algæ, furnished with vibratile cilia, and regularly disposed in the thickness of the gelatinous wall of a hollow sphere. There are four kinds of cœnobia:—1. Some consist only of vegetative cells enclosing in their interior young cœnobia, or daughter-colonies, each one originating by the division and multiplication of a vegetative cell; 2. A large number of these cœnobia contain at the same time male elements, or androgonidia, situated in the thickness of the gelatinous wall; 3. Others only present with the vegetative cells some androgonidia, and do not produce daughter-colonies; 4. The female cœnobia contain only gynogonidia, or oospheres, placed in the interior of the sphere.

The androgonidia are formed at the expense of a vegetative cell, which acquires a slightly larger volume than the others and divides into parallel segments. Each of these segments is in the form of an elongated cone: its thickest extremity is green; the other, transparent, presents a small red spot and two vibratile cilia. The bundle of antherozoids displays in the antheridium a constant oscillating movement.

The gynogonidia are, in like manner, produced by the differentiation of a vegetative cell. This becomes much more voluminous than the androgonidia, and filled with a large quantity of starch and chlorophyl granules, which give to the oosphere thus formed a deep-green appearance.

At the time of fecundation the bundles of antherozoids are set at liberty by the dissolution of the wall of the antheridium; they move rapidly in the water, and hasten to fix themselves on the female cœnobia. There they break up to allow the antherozoids to fecundate the oospheres; but I have been unable hitherto to observe the moment of their penetration.

After fecundation the oospheres surround themselves with a thick membrane with a double contour, which until then was invisible, and rapidly change colour: from a dark green they become yellowish green, then orange. They then contain a red oily matter and a large quantity of starch. It is this orange colouring which led some observers to believe that there was a third species of *Volvox* (*Volvox aureus*, Ehr.).

The *Volvoces*, male, female, and neuter, seek light, either solar or artificial, and keep near the surface of the water. As soon as the female cœnobia are fecundated and the oospores change colour, they are seen to avoid the light and to depart from the surface of the water. It is easy to observe this phenomenon in a glass pan or in a watch-glass; the green *Volvoces* stay on the light side, the others on the diametrically opposite. If the glass is turned they change places respectively; and this transfer is effected in a very short time. The *Volvoces* with orange oospores move much more rapidly from the light than the others towards it. The displacement of the *Volvoces* is owing, as is well known, to the movement of the two vibratile cilia with which each vegetative cell is provided, and which project beyond the gelatinous sphere. No change of colour or form can be observed in these cells after fecundation; we are therefore led to think that it is by a sort of attraction exerted on the green matter that the *Volvoces* are drawn towards the light, and that it is by a sort of repulsion exerted on the red matter of the fecundated gynogonidia that these same *Volvoces* afterwards seek obscurity.

When the *Volvoces* begin to appear in the waters where they are found, scarcely any but neuter cœnobia are met with—that is to say, cœnobia enclosing only vegetative cells giving birth by segmentation to daughter-colonies. When some time has passed the number of daughter-colonies contained in each cœnobium diminishes; but there then appear in many *Volvoces* some androgonidia, which represent abortive daughter-colonies. At this moment we only find a few female *Volvoces* not containing any daughter-colonies. When the *Volvoces* have thus reproduced themselves for a certain time by daughter-colonies, the number of female cœnobia is increased, and, some exclusively male cœnobia, destitute of daughter-colonies, appear, while the neuter cœnobia become very rare.

It results from these facts that during a certain period the *Volvox* is multiplied by asexual generation, by scissiparity of a vegetative cell, which by successive segmentations produces a colony of individuals similar to the mother-colony to which this cell belonged. But a time comes when the vegetative cell no longer possesses the property of reproducing itself thus; it can still divide into segments, and give birth to a colony of little cells which acquire a sexual character; that is to say, they are incapable of living separately and of reproducing themselves. This abortive daughter-colony constitutes the male element, endowed with movement and still enjoying a certain activity. Soon the vegetative cell becomes incapable of segmenting; it can only increase in volume: it is the female element deprived of motion, which requires, in order to reproduce itself, to fuse with the male element.

Sexuality in *Volvox* appears then by degrees, the male sex appearing before the female sex as fast as the species exhausts itself by asexual reproduction.

We must compare this fact with what takes place in the animal kingdom in the animals which are reproduced by parthenogenesis. Professor Balbiani has observed that certain Aphides and the *Phylloxeræ* degenerate when they are reproduced during a certain time by parthenogenesis; their genital and digestive organs tend to become atrophied. There is a time when the parthenogenetic individuals thus degraded give origin first to male individuals, then to female individuals, which require to be fecundated to reproduce new parthenogenetic individuals.—*Comptes Rendus*, July 24, 1876, p. 287.

On the Fur-Seal of the Islands of St. Paul and Amsterdam. By Prof. W. Peters.

Last year (Monatsberichte, 1875, p. 393) I had the honour of making a communication to the Academy upon a fur-seal from Kerguelen's Land which constitutes a species with a peculiar cranial structure. It was described from a complete young female specimen and the skin of an adult male. I remarked that unfortunately there was no skull with the latter; but I had the less doubt as to its belonging to the same species, as the coloration was similar and the place of origin appeared to be the same, seeing that it was packed in the same vessel with sea-elephants from Kerguelen's Land without any special note. Nevertheless, from a communication made to me by Dr. Studer since his return, there has been an error in this respect, inasmuch as the skin of the male animal originates not from Kerguelen's Land, but from St. Paul or Amsterdam Island. It now became of the greatest importance to me to ascertain by the examination of the skull whether this species agrees with that from Kerguelen's Land, or with the *Otaria Forsteri* of New Zealand, which has lately been carefully investigated by Mr. Clark, of Cambridge. By the great kindness of Prof. Milne-Edwards I have been enabled to make this examination; and it appears therefrom that the fur-seal of St. Paul and Amsterdam agrees neither with *O. gazella* from Kerguelen's Land, nor with *O. Forsteri* of New Zealand, at least so far as can be ascertained by comparison with the figure and description of the skull of the latter. The fur-seal of St. Paul and Amsterdam is quite different in colour from *O. Forsteri*; and in its cranial structure it seems to be intermediate between this and *O. gazella*. I therefore propose for the fine eared seal of St. Paul and Amsterdam the name of *Otaria (Arctophoca) elegans*, and will venture shortly to make a more detailed communication upon this subject.—*Monatsber. der k. preuss. Akad. der Wiss. zu Berlin*, May 1876, p. 316.

'Geographical Distribution of Animals,' whilst agreeing in some respects with that of the Vertebrata, presents some very singular anomalies.

Views more or less coinciding with my own have been subsequently expressed by the late Mr. Blyth * and Dr. Stoliczka †, and by Herr A. von Pelzeln ‡; but, except by the latter, no details have been given. Mr. Elwes §, on the other hand, whilst adopting my principal divisions, considered that I had overrated the importance of the African element and underrated the general distribution of Malay genera. Mr. Elwes's paper referred solely to the distribution of birds—which had one advantage, that more had been published about the class than about any other, and at least one disadvantage, viz. that birds, being all more or less vagrants and having greater facilities for moving long distances than the vast majority of the members of other classes, are enabled to colonize isolated spots (such as hill-tops) far from their own region. The Indian hill-tops afford a pleasanter climate than the plains, and are much utilized by Anglo-Indians as sanatoria; consequently their fauna is frequently far better known than that of the plains around them.

The appearance of Mr. Wallace's great work on geographical distribution will, it may be hoped, form an epoch in the study of this most important and much neglected branch of zoological science. The subject has never before been treated in an equally thorough manner, and it is difficult to overrate the obligation of all naturalists to the author. I very greatly regret that the pressure of other work has prevented me from hitherto publishing a number of details with reference to the fauna of India, which would, I think, have greatly modified Mr. Wallace's views. With only the facts procurable from museum catalogues and other published works, I know from experience that it is impossible to ascertain correctly the details of distribution; the numerous errors committed by the older naturalists, by whom the term India was used in the very loosest and vaguest sense, have but rarely been eliminated; and it is constantly the practice in monographs and catalogues to quote species and genera as found in two localities—the old and erroneous one, and the real locality subsequently discovered. Moreover, even in works of so high a class and so

* Nature, 1871, March 30, p. 427; Catalogue of Mammals and Birds of Burma, J. A. S. B. 1875, pt. ii. extra number, Introduction, p. xv.

† J. A. S. B. 1869, pt. ii. p. 202; 1870, pt. ii. p. 280; Proc. A. S. B. 1871, p. 84.

‡ "Afrika-Indien," Verb. k.-k. zool.-bot. Gesellsch. Wien, 1875, p. 33.

§ P. Z. S. 1873, pp. 652, 669, &c.

accurate as Jerdon's 'Mammals' and 'Birds' generally are in questions of distribution, some geographical expressions are very loosely used. Thus when Jerdon uses the term Central India, he sometimes means the country near Nágpúr, sometimes the region known politically as Central India, comprising Rájpútána, Indore, and Gwalior, sometimes Chutia Nágpúr, a tract of country with a very different fauna.

I regret to say that I have not now time to give even the details I have accumulated on the subject; all I can do is to attempt a meagre criticism of Mr. Wallace's lists of the fauna of India; but I think I can show that there really is better reason than Mr. Wallace supposes for inferring a distinct relationship between the fauna of the greater part of India and that of Africa. Were the African affinities of the Indian fauna so small as would be inferred from the details given in the 'Geographical Distribution of Animals,' vol. i. pp. 321–326, I should have to confess that I had committed a great error, and that Messrs. Blyth and Stoliczka were equally mistaken in insisting on the strong Ethiopian affinities of the Indian fauna. A little consideration will, I think, show that in some cases Mr. Wallace is mistaken, and that a careful analysis of the whole question will lead to a different conclusion.

Before proceeding to criticise Mr. Wallace's lists I have two remarks to make. I will preface them by saying that nothing is further from my wish than to express an unfavourable opinion of Mr. Wallace's work. I believe that he has done his best to arrive at an unbiassed conclusion, and that where he has failed, as in this instance I think he has, the fault is chiefly that of the authorities on whom he had to depend.

The first remark I have to make is this:—India is in connexion with the Indo-Malay countries; and wide-ranging species, of mammals and birds especially, find no impediment in extending themselves throughout. This acts in two ways. It hinders a tendency to the formation of distinct types through isolation; and when a species by ranging to a distant region becomes modified the links in the chain of modified forms are more or less well preserved. If the whole of Burma, the Malay peninsula, Siam, Sumatra, Java, and the other countries between India and China, south of the limits of the Palæarctic region, and as far east as the parallel of Canton, had been buried beneath the sea since, at all events, a period long antecedent to the glacial epoch, if, moreover, a belt of well-wooded country extended across the Indian Ocean and connected Eastern Africa with India, we should probably find that the fauna of India would differ from that of Eastern China or of Borneo far more than it now does, and we should then have a fairly parallel example of the differences now existing between India and Africa. Consequently, if we wish to form a true conception of the relations between the fauna of Africa and that of India, we must be prepared to take into consideration the alliances between distinct subgenera and sometimes between different genera. The question cannot be determined by ascertaining what forms are common in a list of such mammalian genera as were adopted, for instance, by Dr. Gray, many of which are not accorded more than specific rank by most naturalists, because in all probability Africa has been separated from India long enough for the same or allied species in the two regions, even if they had not varied at the time of separation, to have become sufficiently distinct to be classed in different subgenera. This is emphatically the case when, as happens in several instances, the living Ethiopian representatives of Oriental genera are confined to Western Africa.

The second remark is, that although I concur with Mr. Wallace in separating from the rest of India a Ceylonese, or, as I have generally called it, a Malabar province or subregion, I cannot agree with the limits laid down in the map at p. 315, vol. i. of the 'Geographical Distribution of Animals.' I am also inclined to modify several of the other boundaries laid down. I have traversed so large a portion of the Indian peninsula that I have had unusual opportunities for ascertaining the limits of the different subregions; and I see no ground for changing the views I expressed in 1870 *. The divisions I then proposed were the following:—

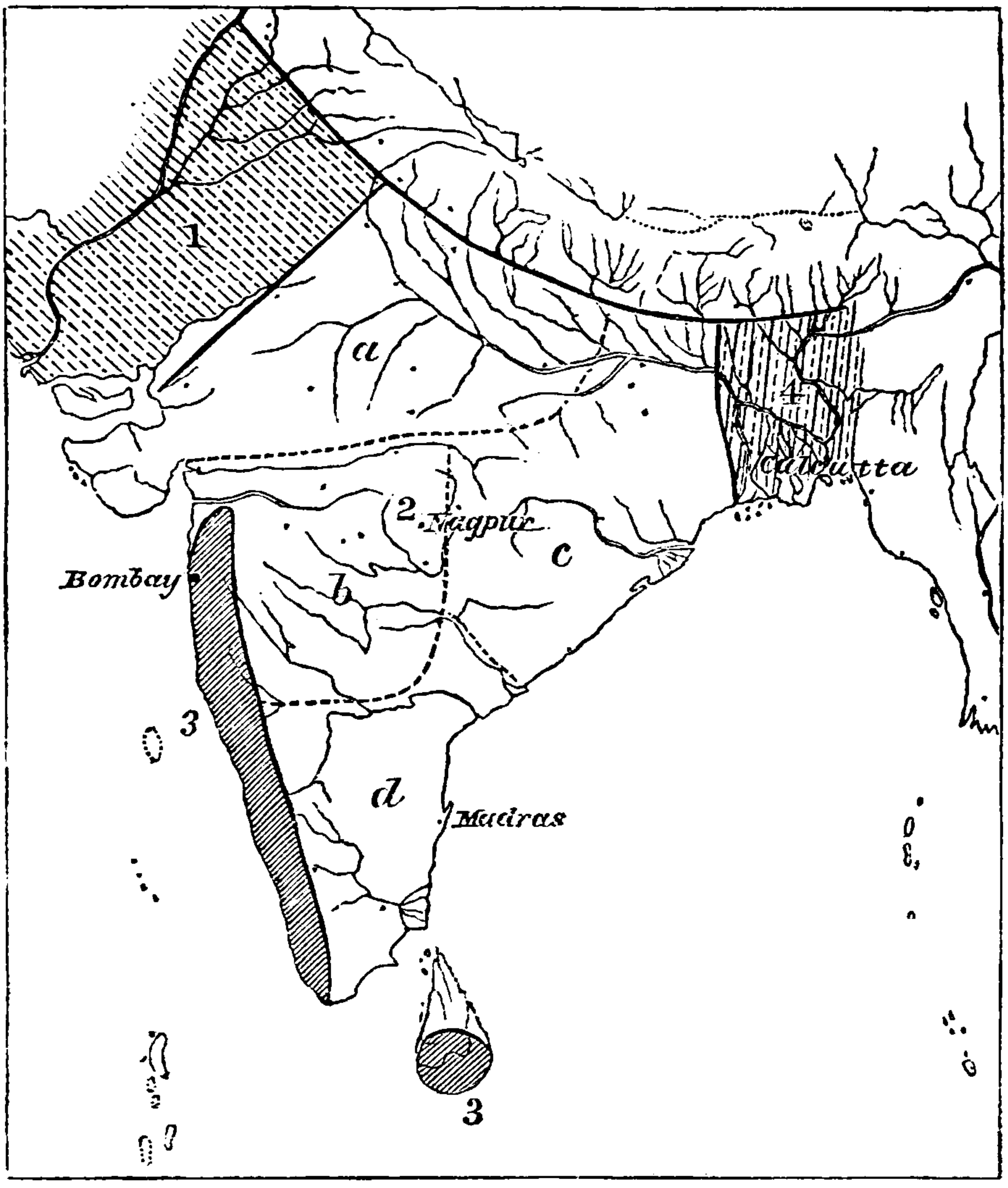
1. The Panjáb province or subregion, including the Panjáb, Sind, Cutch, and Western Rájpútána.

2. The Indian province or subregion—the peninsula generally, with the exception of the Panjáb and Malabar provinces, but with the addition of Northern Ceylon.

3. The Malabar province or subregion with Southern Ceylon. This corresponds generally to Mr. Wallace's Ceylonese subregion—a name I should willingly adopt, but that part of Ceylon does not belong to it, whilst the whole of Malabar does. This province comprises the low country on the west coast of India from Cape Comorin to a little north of Bombay, and the range of hills near the same coast as far north probably as the Tapti river. It also includes the hill tract of Southern Ceylon, but not the plains in the northern part of the island. Its fauna is represented, more-

* J. A. S. B. 1870, pt. ii. p. 336.

Bengal province is part of the Indo-Malay region to the eastward; the Panjáb province, the limits of which were quite unknown to me in 1870, I now find to be part of a very well-marked province or subregion which extends along the shores



1. Panjáb province or subregion.
2. Indian province: *a*, Gangetic subprovince; *b*, Deccan subprovince; c, Bengal subprovince; *d*, Madras subprovince.
3. Malabar province.
4. Eastern-Bengal province.

of the Arabian Sea and to the head of the Persian Gulf, and contains throughout a curious mixture of Palæarctic and Indian forms with a prevalence of desert types of animals and plants. Its approximate limits to the westward coincide with those of *Gazella Bennetti*, and are shown in a little map published in the 'Proceedings of the Zoological Society' *.

* 1873, p. 314. I may mention that I have since ascertained that the only species of *Gazella* found in Sind and the desert country to the eastward is *G. Bennetti*.

I may add that I now doubt whether there is any difference between the fauna of the Gangetic and Deccan subprovinces sufficient to justify the retention of the distinction. The only importance attached to these subprovinces is that Malay forms are more numerous in the Bengal and Madras subprovinces than elsewhere. The Malabar forms are closely affined to Malay types as a rule, although some are peculiar. I will mention one instance of the distinctions which have led me to suggest the formation of these subprovinces. The families *Cyclophoridæ* and *Diplommatinidæ*, amongst the terrestrial Mollusca, are remarkably well represented throughout the Oriental region. Both abound in the Himalayas and in Malabar, the *Cyclophoridæ* being even more richly represented in the latter province. In the Madras subprovince *Diplommatinidæ* are found on the hills with a Malabar fauna but not elsewhere; and they have not, so far as I am aware, been found in the Bengal subprovince, nor elsewhere in the Indian province. Forms of *Cyclophoridæ* are found throughout the Bengal and Madras subprovinces; but none are known in the Gangetic and Deccan subprovinces. A Cylostomoid genus *Cyclotopsis* is found in the Deccan and Gangetic subprovinces; but the family of *Cyclostomidæ* has a totally different geographical distribution from that of the *Cyclophoridæ*, and the only other known species of *Cyclotopsis* occurs in the Seychelle Islands *.

With these few preliminary remarks I pass to the review of Mr. Wallace's lists. The first is the list of genera of Mammalia which inhabit the subregion of Hindustan †. These are 38 in number; and Mr. Wallace remarks that "8 have so wide a distribution as to give no special geographical indications. Of the remaining 30, whose geographical position we have noted, 14 are Oriental only, 5 have as much right to be considered Oriental as Ethiopian, extending as they do over the greater part of the Oriental region; 2 (the hyæna and gazelle) show Palæarctic rather than Ethiopian affinity; 7 are Palæarctic and Oriental, but not Ethiopian; and only 2 (*Cynælurus* and *Mellivora*) can be considered as exclusively Ethiopian."

The genera not mentioned by Mr. Wallace are chiefly bats,

* It is as well to point out that the classification usually adopted for terrestrial Mollusca is largely artificial, and founded on characters of secondary importance. The value of trifling peculiarities in the operculum in especial has been much overrated; and the order Pulmonifera of most writers comprises forms belonging to two distinct orders.

† *L.* c. p. 322.

the Ethiopian affinities of which are quite as strong as their Malayan relations, and certain rodents, *Leggada* and *Golunda*, which are said to have Ethiopian representatives, and which have certainly not hitherto been traced into the Malay countries. I will omit these; but, in justice to Mr. Wallace's views, I must add a very important genus to the list. *Tupaia Elliotti* has recently been found both in the Bengal and Deccan subprovinces of the Indian subregion, and it must therefore be added to the Indian fauna. As the distribution and affinities of the Mammalia are better known than those of any other class, I shall go into a few details; and to show the affinities of the 38 genera I will take them seriatim with Mr. Wallace's remarks on each between brackets.

1. *Presbytes* (Oriental only). Replaced throughout the Ethiopian region by the allied genus *Colobus*.
2. *Macacus* (Oriental only). One species occurs in Northern Africa. Allied genera are found in the Ethiopian region, e. g. *Cercopithecus*; but the alliance is perhaps less close than in the case of *Presbytes*.
3. *Erinaceus* (Palæarctic genus). Found also in Central and Southern Africa, but absent and not replaced by any closely allied genus in Malayasia. *Gymnura* is placed in the same family by Mr. Wallace, but by others it is classed with *Tupaia*, and is certainly not a near ally of *Erinaceus*.
4. *Sorex* (widely distributed). The subgenera require further study before their distribution can be considered determined.
5. *Felis* (almost cosmopolitan).
6. *Cynœlurus* (Ethiopian and S. Palæarctic). I am not sure that this is fully entitled to generic rank.
7. *Viverra* (Ethiopian and Oriental to China and Malaya).
8. *Viverricula* (Oriental only). This is at the most a subgenus of *Viverra*, and has no title to generic rank.
9. *Paradoxurus* (Oriental only). The species found in Western Africa, *P. binotatus*, has been made a distinct genus by Gray; but it appears doubtful if the distinctions pointed out are of sufficient importance to justify generic separation. In any case *Nandinia*, as the African form is called, is very closely allied.
10. *Herpestes* (Ethiopian, South-Palæarctic, and Oriental to Malaya).
11. *Calogale* (Ethiopian, Oriental to Cambodja). This does not appear to be more than a subgenus of *Herpestes*; and, so far as the Indian species are concerned, even this rank is doubtful, it being even a question how far one Indian

21. *Tragulus* (Oriental). A representative genus, *Hyomoschus*, in West Africa. *Tragulus* in India is confined, I believe, to the Malabar province, the Bengal subprovince of the Indian province, and perhaps the Madras province. I have never been able to hear of its existence in the Gangetic or Deccan subprovinces.
22. *Cervus* (Oriental and Palæarctic; family not Ethiopian).
23. *Cervulus* (Oriental; family not Ethiopian). Very local in India except in the Malabar province.
24. *Bibos* (Palæarctic and Oriental). Only a subgenus of *Bos*. *Bubalus*, which is omitted, has, Iybelieve, at least as good claims to be considered a Central-Indian form as *Tragulus*. It is aboriginally wild in the Bengal subprovince, part of the Madras subprovince (Northern Ceylon), and in Assam; probably feral only in Malayasia; but this is not certain, so I omit it. The original form, *B. palæindicus*, occurs fossil in the Nerbudda valley. It is a thoroughly African genus.
25. *Portax* (Oriental). Indian only; unknown east of the Bay of Bengal, and, so far as I am aware, in the Malabar province. It is a distinctly Ethiopian type, represented by allied genera (*Oreas*, *Tragelaphus*) in Africa.
26. *Gazella* (Palæarctic and Ethiopian). Unknown in any part of the Oriental region east of the Panjáb and Sind, except the Indian province, and therein confined to the Gangetic and Deccan subprovinces.
27. *Antilope* (Oriental).
28. *Tetraceros* (Oriental). } The same as *Portax*; Ethiopian types unknown east of the Bay of Bengal.
29. *Elephas* (Oriental species). The genus, however, is Ethiopian.
30. *Mus* (cosmopolite nearly).
31. *Platacanthomys* (Oriental). Erroneously ascribed to the Indian province. It has only been found in the Malabar hills.
32. *Meriones* (very wide range). Palæarctic and found throughout the Ethiopian region. Unknown out of Indiagin the Oriental region. I do not know whether it occurs in Malabar.
33. *Spalacomys* or *Nesokia* (Oriental). Palæarctic as well: one speeies in Baluchistan, another just described from Eastern Turkestan; one of the Indian species inhabits Káshmir. Not known east of India. The only reported occurrence in Burmah, P. A. S. B. 1866, p. 240, requires confirmation.
34. *Sciurus* (almost cosmopolite).

35. *Pteromys* (Palæarctic and Oriental to China and Malaya).
36. *Hystrix* (wide range).
37. *Lepus* (wide range). Unknown in Malayasia.
38. *Manis* (Ethiopian and Oriental to Malaya).

It will be seen that two genera are incorrectly classed as belonging to the Indian province exclusive of Malabar, viz. *Tæniogale* and *Platacanthomys*; and I exclude three others as undeserving of generic rank, viz. *Cynælurus*, *Viverricula*, *Calogale*; on the other hand I add *Tupaia*. These changes reduce the Indian genera to thirty-four. Of these, fourteen are either common to the Ethiopian region (India and Malayasia), or replaced by closely allied forms in one or the other, viz. *Presbytes*, *Sorex*, *Felis*, *Viverra*, *Paradoxurus*, *Herpestes*, *Lutra*, *Sus*, *Tragulus*, *Elephas*, *Mus*, *Sciurus*, *Hystrix*, *Manis*.

The following, eight in number, are Oriental forms, being represented by identical or closely allied species, or nearly affined generic types in Malayasia, and not represented by allied forms in Africa—*Macacus*, *Tupaia*, *Cuon*, *Melursus*, *Cervus*, *Cervulus*, *Bibos*, *Pteromys*. Every one of these is more or less Palæarctic also, except *Cervulus* and *Tupaia*.

The following, ten in number, are Ethiopian forms, being represented by allied species or genera in the Ethiopian region, whilst they are not similarly represented in the Malay countries—*Erinaceus*, *Hyæna*, *Canis*, *Mellivora*, *Portax*, *Gazella*, *Antilope*, *Tetraceros*, *Meriones*, *Lepus*. Of these, *Mellivora*, *Portax*, *Antilope*, *Tetraceros* are unrepresented in the Palæarctic region.

I think, bearing in mind that India has probably for ages been separated from Africa and united to the Malay countries, it could hardly be expected that stronger African affinities would be found in the fauna. I think it is evident that, so far as the Mammalia are concerned, the Ethiopian affinities of the Indian province are stronger than the Oriental.

Birds.—Mr. Wallace says that "the naturalists who have adopted the 'Ethiopian theory' of the fauna of Hindustan have always supported their views by an appeal to the class of birds." I think Mr. Wallace is mistaken. I do not think I have ever especially quoted the evidence of the birds; nor do I consider it quite so strong as that of the mammals, though I think I shall be able to show that the number of Oriental forms in the Hindustan fauna is much overrated, and some important Ethiopian affinities overlooked, by Mr. Wallace.

In the first place, Mr. Wallace's lists consist chiefly of Passeres; and there are few orders throughout the animal kingdom, so far as I know, in which the accepted generic distinctions are slighter and the generic affinities more complicated. Secondly, the power of flight gives birds peculiar facilities for extending their range; and it is only natural that many forms should straggle into the province from the neighbouring Himalayas, the Assam hills, and the Malabar region. Hence in parts of the Bengal and Madras subprovinces a few Malay forms are found which do not occur elsewhere in India. Moreover certain species are to be met with, on hills which rise to a considerable height, even in Central India. Thus *Myiophonus Horsfieldi* has been found in Sirgúja on Main Pat, at Chikalda in Berar, at Pachmari, and at Mount Abú, all of them hills rising to about 4000 feet or more above the sea. At one of these localities, Chikalda, *Hypsipetes ganeesa* was also shot, and it is said the typically and peculiarly Malabar genus *Ochromela* was seen. To include the birds found on these very few isolated hill-tops in a list of the general fauna of the surrounding country gives a completely false idea. Is *Fregilus graculus* to be included in the forms characteristic of the Ethiopian fauna because it inhabits the mountains of Abyssinia? I have not time at present to enter into the subject of these isolated remnants of a fauna which once in all probability was more extensively diffused, though I by no means think it inhabited the whole of India. It certainly, however, must be omitted in estimating the fauna of the surrounding country.

Mr. Wallace gives a list of eighty-four Oriental genera of birds found in Central India. Now, of these, twelve, viz. *Layardia*, *Garrulax*, *Trochalopteron*, *Alcippe*, *Hypsipetes* (with the exception mentioned above), *Irena*, *Arachnothera*, *Hemicircus*, *Mulleripicus*, *Nyctiornis*, *Batrachostomus*, and *Collocalia*, have never been found, so far as I am aware, in the Indian peninsula, except in the Malabar province; three others, *Hemichelidon*, *Niltava*, and *Perdix* are not known to occur south of the Himalayas, the last named, as generally restricted, being found no nearer than Tibet, and not being an Oriental genus at all. Mr. Wallace probably includes *Perdicula* in *Perdix*. This, however, is, so far as known, a form peculiar to India and Ceylon, the Timor *P. Raalteni* being apparently but dubiously affined.

Of the remaining genera, twenty-one, viz. *Abrornis* (one species only, *A. cantator*), *Larvivora*, *Hemipus*, *Pellorneum*, *Dendrophila*, *Chibia*, *Chaptia*, *Nectarophila*, *Dicæum*, *Eulabes*, *Nemoricola*, *Gecinus*, *Tiga*, *Micropternus*, *Rhopodytes*, *Surniculus*, *Harpactes*, *Ceyx*, *Hydrocissa*, *Carpophaga*, and *Chalcophaps*, are not, to the best of my knowledge, found outside the Bengal and Madras subprovinces; and I suspect *Megalurus*

may occur in other parts of the Indian peninsula. If these migratory forms are taken into consideration, why are the *Saxicolæ*, with their strong African affinities, omitted? I have shot two species of *Saxicola* at Nágpúr.

I thus am obliged to exclude no less than forty-six out of eighty-seven Oriental genera, either because they are not found in the portion of Central India in which the proportion of African forms is most marked, or because they are not characteristically Oriental forms.

Of the forty-eight genera of wide range I have very little to say, except that *Calandrella* and *Ammomanes* are not found to the east of the Bay of Bengal, whilst both are represented in the Ethiopian region, *Calandrella* being certainly allied to some forms of *Megalophonus*; whilst the only species of *Coccystes* (*C. jacobinus*) is Ethiopian, being found even in Southern Africa. It extends to Upper Burmah, where it consorts with a few other Indian forms with African affinities, e. g. *Crateropus gularis* and *Francolinus Phayrei* vel *sinensis*; but it is not, so far as I am aware, found in Malayasia. Mr. Hume has not apparently received it from Tenasserim.

The list of Palæarctic genera occurring in Central India might perhaps be increased; but, as nearly all are migratory, they are of trifling importance.

Lastly we come to the Ethiopian genera. By the omission of the Raptores and Grallæ, seven of the most striking and remarkable cases of African forms found in India and unrepresented east of the Bay of Bengal are omittèd; these are *Neophron*, *Chicquera*, *Rhinoptilus*, *Cursorius*, *Sypheotides*, *Eupodotis*, and *Phœnicopterus*. *Neophron*, *Cursorius*, and *Phœnicopterus* extend, it is true, into the southern portion of the Palæarctic region; but the Palæarctic species of *Cursorius* is confined to the Panjáb province in India, and the Indian province is inhabited by a peculiar species. *Sypheotides* appears to me congeneric with the African *Lissotis*. In both genera the males undergo the same peculiar change of plumage, becoming black in the breeding-season. The case of *Rhinoptilus* is very remarkable. The Indian species is very rare, and only known to occur in part of the Madras subprovince. If we had only this one species, it would be impossible to deny the existence of a distinct African element in the Indian fauna. Another African form unrepresented to the eastward is *Cercomela*.

I regret that I cannot now go more thoroughly into this matter and classify the birds as I have attempted to do the mammals. Before doing so it would be necessary to compare a large number of African genera with Indian. I notice in

Mr. Wallace's lists that the only families of birds found in India which are not Ethiopian are the *Certhiidæ*, *Phyllornithidæ*, and *Artamidæ*, each of which is represented by but a single species in Central India. In the Himalayas and in the countries immediately to the eastward of India, five additional non-African families are found, according to Mr. Wallace's classification, viz.:—*Panuridæ*, *Liotrichidæ*, *Pachycephalidæ*, *Eurylæmidæ*, and *Podargidæ*. The following Ethiopian families are also Indian, but not found in any other part of the Oriental region so far as I know—*Pteroclidæ*, *Otididæ*, *Cursoridæ*, *Phœnicopteridæ* *; so that there are actually more families of birds found in India which are not found in Burmah even, than there are which are not also represented in Africa. In Mr. Blyth's lists of Burmese birds (J. A. S. B. 1875) the following families are included which are not found in the Indian province—*Henicuridæ*, *Garrulacidæ*, *Liotrichidæ*, *Pipridæ*, *Eurylæmidæ*. It should be remarked that Mr. Blyth's families differ materially from Mr. Wallace's; but the result in this respect is the same. If, now, we proceed to calculate the number of species belonging to the families, and to limit to the true characteristic subprovinces the area of the Indian province compared, the result will be far more startling.

	Families.		Species.
1. Found in the typical subprovinces of India, but unknown in Africa . . N.B. Of these three families, one, *Artamidæ*, is principally Australian; another, *Certhiidæ*, is chiefly Palæarctic, and is only represented to the east of India by one species in the Philippine Islands.	3	comprising	3
2. Found in the same subprovinces and common to Africa, but unknown east of the Bay of Bengal even in Burmah (*Pteroclidæ* 3 species, *Otididæ* 3 species, *Cursoridæ* 1 species, *Phœnicopteridæ* 2 species) . . .	4		9
3. Found in Burmah†, but unrepresented in the typical subprovinces of India (*Trogonidæ* 2 species, *Henicuridæ* 4, *Garrulacidæ* 15, *Liotrichidæ* 10, *Pipridæ* (*Calyptonema*) 1, *Eurylæmidæ* 8)	6	,,	40

* *Gruidæ* might be added if India be compared with Malayasia; but cranes are said to occur in Upper Burmah and in China.

† Taken from Mr. Blyth's lists, *l. c.*

Moreover the following are the relative number of species of some peculiarly characteristic Indo-Malayan families in Burmah, according to Blyth's list, and in the above named subprovinces of India:—

	Burmah.	Deccan and Gangetic subprovinces.
Bucerotidæ . . .	6	1
Alcedinidæ . . .	12	3 or 4
Picidæ	29	4
Pittidæ	6	1
Timeliidæ . . .	31	3

The last list is very important, because it shows in a striking manner the most prominent difference between the Malay countries and India—the extremely rich fauna of the one as compared with that of the other, and the great disproportion of representatives of the same families. The truth is that the characteristic Oriental genera are not nearly so abundant or so well represented in India as is generally supposed.

I pass on to the Reptilia; and here I must say that Mr. Wallace's information appears to have misled him. He states, (p. 326) that *Tropidococcyx* is peculiar to the subregion, and *Aspidura*, *Passerita*, and *Cynophis* to the peninsula and Ceylon. Now *Tropidococcyx* and *Aspidura* have not, so far as I know, ever been found in the subregion at all; the only localities I can find for the former are North Canara and the Nilgiri hills, both in the Malabar subregion; whilst *Aspidura*, so far as I can judge from the evidence, is confined to Ceylon, though it also is probably found in Malabar. *Cynophis Helena* I suspect to be a Malabar form also, although it may be found in the Madras subprovince; *Passerita* is common enough in the Bengal subprovince, but is certainly not known in the Deccan or the Gangetic area.

Next, Mr. Wallace gives, as characteristic genera and characteristically Oriental, *Dipsas*, *Simotes*, *Bungarus*, *Naja*, *Trimeresurus*, *Lycodon*, and *Python*. I cannot admit that the list is either accurate or complete. To the best of my belief *Simotes* and *Trimeresurus* are only found in the Bengal and Madras subprovinces; and I strongly suspect the same might be said of *Python*, though I may be mistaken. *Naja* may be characteristically Oriental; but it is quite as characteristically Ethiopian; and one species is Palæarctic, *Tomyrus oxiana* having been shown, if I am not mistaken, to belong to the genus. *Dipsas*, too, is found in Africa.

Then *Eumeces*, *Pentadactylus*, *Gecko*, *Eublepharis*, and *Draco* are characteristically or wholly Oriental, according to

fossil fauna of the Sevaliks, and of a *Rhinoceros* belonging to the African type (*R. deccanensis*, Foote) in the Deccan. In the Pleistocene fauna of the Nerbudda buffaloes are found with a species of round-horned *Bos* (*B. namadicus*), now replaced in the same region by the flat-horned Malayan *Bos* (*Bibos*) *gaurus*. Of course the round-horned bovine is not African; but neither is it Malay. My belief is that the vertebrate fauna of India contains three elements, derived at three different periods from countries which were or had been in connexion with Africa. The first of these consists of the forms common to the Ethiopian and Oriental region. These are in India the bulk of the fauna. It is scarcely necessary to quote examples; but the *Viverridæ*, *Tragulidæ*, *Manididæ*, *Megalæmidæ*, *Bucerotidæ*, and *Pycnonotidæ* will serve as characteristic illustrations. The second consists of forms common to the Ethiopian region and India, but which do not extend to the eastward of the Bay of Bengal; nor are they represented in the portion of South-western Asia now lying on the direct line between India and Africa: such are *Mellivora*, *Antilope*, *Portax*, *Tetraceros* amongst mammals, *Sypheotides*, *Rhinoptilus*, *Chicquera*, *Thamnobia* amongst birds. The third is composed of species with Ethiopian affinities, which may have wandered into India from Arabia and Baluchistan: such are *Gazella Bennetti* and *Neophron percnopterus*. In the case of many Ethiopian forms inhabiting India, e. g. *Pyrrhulauda grisea*, *Eupodotis Edwardsi*, &c., it is not easy to say to which of the two latter classes they belong, as they are represented by closely allied forms in South-western Asia. But there can be very little doubt of the animals of the second group having entered India by a line of communication which no longer exists (some of them, *e.g.* *Tetraceros* and *Rhinoptilus*) being forest forms not found in open country.

I regret that want of time prevents my entering more thoroughly into this subject. I have tried to weigh the evidence fairly; and I think I have shown that my belief in the presence of a marked African element in the Indian fauna is not due to a confusion between "station" and "habitat." From what is known of the distribution of the Mollusca, Insecta, and Arachnida, I believe that the evidence afforded by the Invertebrata coincides with that of the Vertebrate fauna.

Calcutta, August 6, 1876.

XXV.—*On the Structure of the Mouth in Sucking Crustacea.* By Prof. J. C. SCHIÖDTE.

[Continued from p. 266.]

20. The third type is that of *Hyperini*—a modification of the general type of Amphipoda, adapted for life in the light (large eyes) and powerful swimming about at the surface of the ocean. A parallel to this could not be expected amongst the heavy Isopoda; but we find one amongst Ulouata, where the Odonata occupy an exactly analogous position to that of Hyperini amongst Amphipoda. Their well-known teeming variety in general external appearance, from the thick-set form resembling a bean, to the most slender and elongate shapes, as well as in the development of the limbs for prehension, climbing, and attachment, is explained by the great variety of structure and mode of life of those (mostly gelatinous) marine animals to which they attach themselves. Their true relations to these are probably not yet fully elucidated; but the following account of the structure of their mouth will show that at any rate they appear extremely well eqnipped for peeling off and gulping down little bits of the bodies of such animals.

In illustration of this type we may examine the head of *Themisto libellula*, Mandl. Viewing it straight in front, we observe at once the analogy with the head of Odonata. The front, properly speaking, carrying the two pairs of antennæ, is deeply sunk between the eyes; and below it the clypeus is seen to protrude like a hood; the terminal portions of all the appendages of the mouth are, as it were, folded together so as to form a perpendicularly descending inverted cone; the stipites of the mandibles form a slightly trisinuate frame on either side of the flat bilobate upper lip; whilst the mandibular palpi, when at rest, fit closely under the lateral margins of the clypeus, the slender middle joint of each ascending perpendicularly in the hollow of the front, and the small pointed terminal joint crossing its opposite neighbour below the upper antennæ. Below the upper lip the palpi and the apices of the stipites of the first pair of maxillæ are seen somewhat foreshortened, whilst the second pair of maxillæ are hidden behind the palpi of the first pair and the anterior ends of the lobes of the maxillipeds, which are turned upwards and forwards, constituting the downward-pointing apex of the cone formed by the oral limbs. This view already discloses that the lobes of the mandibles are entirely covered by the upper lip. If we next examine the head from the side, we observe moreover that the mandibles in the whole of their extent are of unusual height, almost as high at their apex as at their base, and consequently, in this respect, very different from what is seen in the two preceding types. We observe besides that the mandibular springs of the lower lip are so short that they by no means, as in Eleutherognatha and Trochalognatha, almost reach as far back as the inner corners of the bases of the mandibles; finally, it is seen that the second pair of maxillæ are to that extent involved by the maxillipeds that only a small strip of their middle portion becomes visible without preparation. The proportion in which the different oral limbs take part in the composition of the cone described appears still more clearly if this is examined from below, facing the apex of the cone: the lower margin of the mandibles is seen uncovered, whilst the second pair of maxillæ are entirely hidden except the middle portion, the narrow maxillipeds covering the central part of the cone with their coalesced minor lobes. If we bend the maxillipeds back, it is easily perceived that their use is to cover the maxillæ and fill out the space left between them; the upper face of the stipes is carinate and fits in between the second pair of maxillæ; the inner lobes are coalesced and close the space between the grinding-teeth of the mandibles; the outer lobes fill out the space all the way forwards to the upper lip, covering the inner parts of the first pair of maxillæ. The maxillipeds have no palpi. The second pair of maxillæ are distended, cushion-like; and only the apices of their lobes carry spines and setæ. The first pair of maxillæ have large cardines, large stipites with dilated apices, but no inner lobes; the outer lobe of each maxilla carries on its apex five powerful spines arranged in two rows, and a considerable number of stiff setæ. The palpus consists of but one joint, broad, oval, arched, with truncate apex, which is furnished with smooth and ciliated spines; whilst the inner margin is slightly curved and serrate, with a small spine in each indentation of the saw, and a short thick thorn in the inner corner. If now, finally, all the appendages of the mouth are taken away except the mandibles (as we have done in examining the previous examples), the hypostoma appears, with the articular sockets of the two pairs of maxillæ, and also the whole of the lower lip. The short and broad form of the latter reminds us of *Caprella*, whilst the inner lobes are still more reduced than in *Anonyx*; but the mandibular springs are much thicker than in either of these two types, and of a peculiar curved shape. At the same time the anterior lobes, though in shape and thickness rather recalling the same parts in *Caprella*, differ from

lobe of the right mandible fits into the cleft between the outer and inner lobes of the left; so that the cutting is done by three saw-blades—two from the left side and one from the right, which latter cuts in between the two former.

This remarkable combination obtains with small variations through the entire series of Hyperini, which otherwise presents such different forms. With reference to its principal character, the fitting of the mandibular lobes into a groove or hollow in the upper lip, the Amphipoda of this type may be called *Piezognatha*.

21. We have then the following formulas for the three types in the structure of the mouth in biting Amphipoda:—

ELEUTHEROGNATHA.

Mandibulæ trigonæ, condylo articulario antico carentes.
Labrum planiusculum, transversum, simplex.

TROCHALOGNATHA.

Mandibulæ productæ, condylo articulario instructæ antico, acetabulo epipharyngis accommodato.
Labrum crassum, conicum, simplex.

PIEZOGNATHA.

Mandibulæ productæ, condylo articulario antico carentes, mala exteriore fossæ transversæ labri accommodata.
Labrum planiusculum, transversum, duplex.

22. Amongst the series of forms exhibiting the eleutherognath type, there are several which simulate more or less strikingly the build of other types. One of the most remarkable is *Stegocephalus*, reminding us in general appearance of the trochalognath *Anonyx*, whilst its enormously developed face and the armament of the mandibles approach more to the piezognath *Hyperia*.

The clypeus, labrum, palate, two pairs of maxillæ, and the maxillipeds, as well as the mandibular springs of the lower lip, correspond in all essential respects to the general features of the type. The upper lip is bilobate, the right-hand lobe larger than the left. But the mandibles are quite without grinding-teeth, the right mandible also without an inner lobe; and though the left mandible possesses the hard branch of the latter, which has a long finely serrate margin, it lacks the membranaceous digitiform appendages; the outer lobes of both mandibles have each a long, curved, finely serratulated edge, almost as in Hyperini, but with the essential difference that all the saw-teeth are here equally large, the lower ones not being developed into prehensile hooks. Furthermore the middle lobes of the lower lip are quite missing, and the foremost ones are so small, narrow, and thin as to be unable to fill the space between the mandibles, in consequence of which the palate here, as in *Anonyx*, is quite uncovered as soon as the maxillipeds and the two pairs of maxillæ are taken away.

23. But the extremest place inside the boundaries of Eleutherognatha is occupied by the læmodipodous *Cyamus*, so peculiar by its flattened shape, hooked legs, and general equipment for attaching itself to the skin of whales, which it gnaws to pieces and gulps down. The structure of its mouth has been hitherto known only from the schematic outline by Savigny. It will be seen from the following account what considerable alterations in the shape and relative position of the appendages of the mouth have been necessary, in order to enable the animal to press the mouth against the extensive firm surface which it has to penetrate and to which it must cling. The usual arrangement of the organs (like strata, or leaves of a book), by which the oral limbs generally in Amphipoda are collected into a thick package under the head, has here been abandoned, the most active instruments for gnawing (the mandibles and the first pair of maxillæ) having been proportionately expanded and flattened; whilst the lower parts, which support and enclose the former, viz. the second pair of maxillæ and the maxillipeds, are considerably reduced in development or pushed out to the sides. Above all, the lower lip has lost the part which it has to play in other Amphipoda, as in forming a kind of spring for the mandibles; so that it corresponds entirely to the conformation of the tongue in Isopoda. Finally, the equipment with spine and setæ has almost entirely been replaced by an equipment with organs of touch.

The anterior extremity of the head presents a small oval surface, surrounded, as far as the broad, shortly bilobate upper lip, by the palpi of the maxillipeds, forming a sort of raised margin when seen from above. These palpi are long and stout, without claw, and consist of five joints, which only at their apices carry a few pointed setæ, the last but one being furnished at the apex with a larger number of thin tactile setæ; some tactile warts are observable on the apex of the last joint; and this latter also has a small comb of delicate spines on its inner margin. The broad, flat, almost quadrangular stipites of the maxillipeds are so short that they only cover the space behind the second pair of maxillæ; the lobes, moreover, are entirely absent, or only represented by the slightly expanded and rounded outer corners of the stipites, which carry a row of tactile setæ. In consequence of these circumstances, both pairs of maxillæ are uncovered unless the palpi of the maxillipeds happen to be in an inward-bent position, in which case they can cover the outer portions of the first pair of maxillæ and also the dorsal margin of the mandibles, which appear behind their outer lobes. The maxillæ of both pairs being thus uncovered, it devolves on them to cover the hypostoma, which is otherwise mostly done by the lobes of the maxillipeds; and accordingly the second pair of maxillæ assume an aspect which reminds us in a high degree of the maxillipeds in Isopoda. Their stipites coalesce entirely, forming an obovate flatly arched piece, which covers the hindmost part of the hypostoma in the middle, from the cleft between the stipites of the maxillipeds forward to the bases of the lobes of the first pair of maxillæ. The inner lobes of the second pair are placed close together in the median line of the head; and their rounded apices carry each one stout tactile seta: the outer lobes are small, triangular, and inserted on a level with the narrow bases of the inner lobes; and their rounded apices carry two rows of more slender tactile setæ—one row on the upper surface, the other on the edge. The apices of all the lobes of the second pair of maxillæ reach forward as far as the middle of the inner margin of the outer lobes of the first pair of maxillæ, and a little beyond the base of the lower lip; the second pair of maxillæ therefore cover altogether only a small space in the middle of the hypostoma, but leave the maxillæ of the first pair entirely uncovered. The covering of the hypostoma on the sides towards the pleural margin of the head, devolves consequently on the first pair of maxillæ, which to this end are equipped with cardines of enormous size, much larger than are necessary for the purpose of the articulation of the limb, being expanded outwards from the sockets into a pair of obovate flatly convex plates, placed aslant, each of which is divided a little behind the middle into two halves by a curved transverse groove on the lower face, corresponding to a ridge in the interior, on which the flexor muscles are attached; the stipites of this first pair of maxillæ are, for the same reason, of unusual width. There is no inner lobe; but the outer lobe is broad, along the inner margin armed with small hooked setæ, whilst the obliquely truncate apex carries seven stout, deeply inserted, conic, slightly incurved spines, which have a prominent serrate ridge on their lower surface, a little inside the inner margin; the spines form two rows, the upper row consisting of four, the lower of three spines. The very short and slender palpus consists of only one conic

apical face, which, viewed from above, looks as if it had three obtuse teeth; the membranaceous portion is larger than on the right mandible, but has only three digitiform lobes.

24. Finally the eleutherognath type appears in a remarkable modification in *Laphystius*, Kr., the only genus of sucking Amphipoda which I have hitherto been enabled to submit to a close examination. It occurs behind the pectoral fins of sturgeons, sharks, and the large cod; and Kröyer describes it as "unicum, quod adhuc innotuit, inter Gammarina animal parasiticum" (Naturh. Tidsskr. iv. p. 157). From his point of view and by his method of investigation, we could not expect that he should have understood that its mouth really was constructed for suction; at the same time his excellent diagnosis lays proper stress both on the broad figure of the animal, and on its hooked claws well adapted for holding on with, its "caput rostratum," the clumsy antennæ with their short stipites, the narrow mandibles, and the fact that the palpus of the first pair of maxillæ only consists of one joint, that of the maxillipeds of two.

The head is very small, with very prominent round eyes, consisting of large, strongly convex, closely collected ocelli. Viewed from the sides it presents but few features different from those of the ordinary *Gammarus*-type; nor do they at once strike the observer. The elongate-triangular dorsal face of the mandibles, the mandibular springs of the lower lip, the position and arrangement of the two pairs of maxillæ and the maxillipeds, as well as of the clypeus and labrum covering the parts of the mouth in front, present at first sight nothing to make us suspect any very remarkable peculiarities. On closer examination, however, three points will attract attention as indicating something out of the common, viz.:—first, the unusual height of the forehead and the pleural margin of the head; secondly, the circumstance that the terminal two fifths of the length of the mandibles are quite hidden by the upper lip; and, thirdly, that the lobes of the maxillipeds join the upper lip with their apices and lateral margins so closely that the lip and the lobes together form a beak-like eminence, which stands out separately from its surroundings on account of the great convexity of the lobes of the maxillipeds and the smallness of their palpi, which are so much reduced in size that they do not even reach quite to the lateral margins of the upper lip.

It is only when we examine the head from the front that its peculiar rostrate configuration becomes clearly appreciable. The outline of the face, strictly speaking, is a rhomb, enclosed by almost straight lines; the height from the apex of the small frontal horn to the apex of the lobes of the maxillipeds exceeds by about one fifth the width across the round prominent eyes. The clypeus is of about equal height and width, rather convex, rounded above, the sides being also curved outwards. The upper lip is half as long again as the clypeus, highly convex, with pointed apex, the sides being outward-curved near the base, slightly emarginate towards the apex; on either side of the upper lip a small portion of the stipes of the mandibles appears, whilst their very long and stout palpi lie close to the forehead, ascending on either side of the clypeus; their terminal joint is very long, one fifth longer than the middle joint, conical, slightly incurved, pointed, furnished with short and long setæ on the apex and along the inner side. The terminal joints of the two palpi cross each other in the margin between the two pairs of antennæ. The downward-pointing angle of the facial rhomb is formed by the outer lobes of the maxillipeds lying close to the upper lip, and rolled together one with another.

If, in the next place, we proceed to dissect the head, beginning from behind, we meet, of course, first the maxillipeds. Their cardines and stipites are prolonged, each pair by itself entirely coalescing, and all together forming a club-shaped convex peduncle for the terminal parts (lobes and palpi), with rounded base, emarginate sides, and rounded sinuate anterior margin. The outer lobes are considerably shorter than the cardines and stipites together, and lie close together, the inner margin of the left involving that of the right; they are convex, cup-shaped, with broadly rounded apex when seen together, but each by itself pointedly rounded at the extremity; the outer margin has close fine hair, whilst the anterior part of the inner margin is finely serrulated with a few shorter setæ at the apex and on the under surface. The palpi are very thin, sparsely furnished with setæ only at their extremity; they do not reach forward so far as the apex of the outer lobes, and consist of only two joints of about equal length, of which the terminal one is straight, conical. The inner lobes of the maxillipeds are very small, not half the length of the outer lobes, conical, with a couple of small setæ on the rounded apex; and they are hidden under the inner margin of the outer lobe in such a manner that they do not appear before the maxilliped is turned entirely round so as to show its upper surface. The second pair of maxillæ has the form usual in Gammarini, with two flat lobes, the outer lobe being linear, slightly outward-bent, carrying on its broadly rounded apex seven thin, pointed, slightly incurved spines, ranged in an upper and a lower row; the inner lobe is falciform, shorter than the outer lobe, and carries seven spines, scattered from the point downwards along the inner margin, of the same description as those of the outer lobe, only a little stouter and shorter. The first pair of maxillæ is especially distinguished by its rudimentary palpus, which does not reach forward beyond one fourth of the outer margin of the outer lobe, and consists of only one conical joint, with two setæ on its truncate apex. The outer lobe is narrow, falciform, and carries from the point downwards, along the anterior third of the inner margin, eight long, thin, incurved, very pointed spines arranged in an upper and a lower row, and behind them, further back, four other short and stiff scattered setæ; the inner lobe of the first pair of maxillæ is very small, with three delicate spines at the apex, and reaches scarcely so far forward as the apex of the palpus.

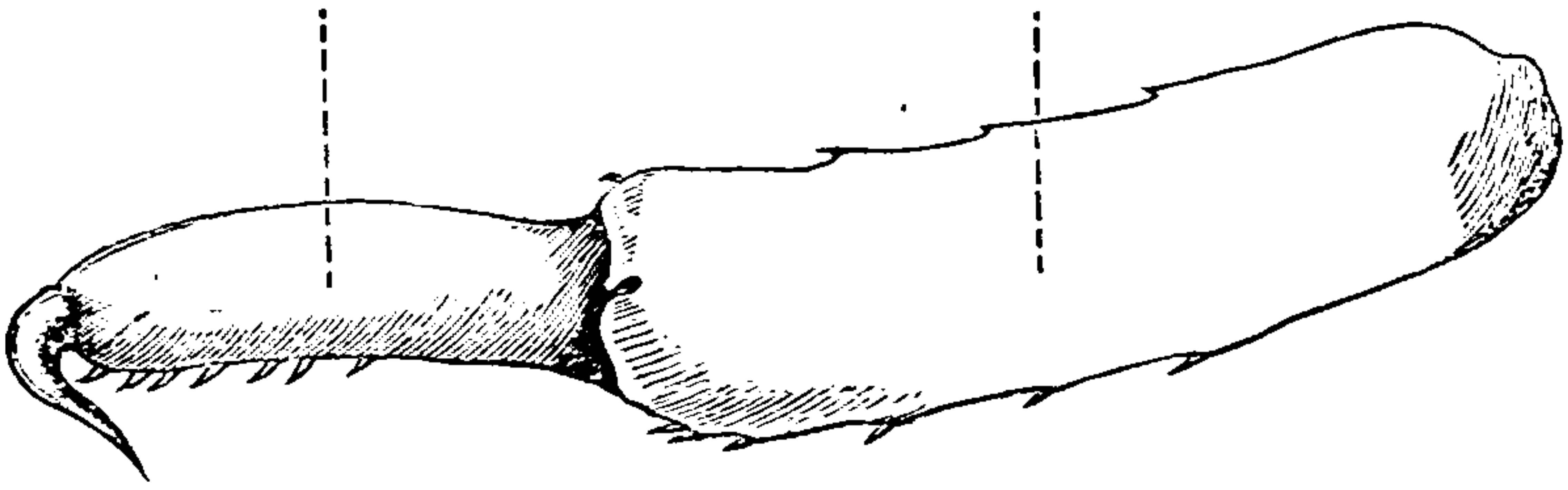
If now we finally remove all the just mentioned appendages of the mouth, the most remarkable feature of its construction appears, viz. that the middle and lateral lobes of the lower lip are not distinguishable from one another, so that there is really only one lobe on either side, the right-hand one involving to some extent the one on the left side; in front, the two short, rounded, linguiform apices diverge a little, so that the extreme ends of the mandibles appear between them; the mandibular springs of the lower lip are narrow, and their ends, which are a little outward-bent, reach not quite to the base of the mandibles. It is clear from this construction that it is here the lower lip which, by its peculiar modification of the shape usual in Gammarini, has been adapted to form the innermost enclosure of the oral tube, whilst the outer lobes of the maxillipeds supply its outer enclosure. If now, finally, the mandibles are laid bare by the removal of the lower lip, their configuration shows not a little similarity to that described in *Æga*. The stipes, on which the palpus is inserted closely in front of its outer corner, is narrow, thinner in front, gradually passing into the very narrow and long outer lobe, whose flat rounded apex carries six minute saw-teeth; the inner lobe is very small, membranaceous, narrow, terminating in three slender and pointed digitiform lobes.

A comparison between this combination and the forms of sucking-mouth described above in Isopoda discloses the remarkable difference, that the back wall of the rostrum in *Laphystius* is formed by the lower lip to the exclusion of the two pairs of maxillæ, of which, therefore, the first has been subject to very little modification, the second to none at all, as compared with the usual construction for biting-purposes; whilst in sucking Isopoda the back wall of the sucking-tube is formed by the second pair of maxillæ, whereby the first

XXVI.—*On the Mode in which the Young of the New-Zealand* Astacidæ *attach themselves to the Mother.* By J. Wood-Mason.

A few days ago I received from Dr. Julius von Haast, Director of the Canterbury Museum, a small collection of crustaceans, amongst which is a specimen of remarkable interest. It is a female of *Astacoides zealandicus**, laden with young. On attempting to remove one of these from beneath the tail of the mother, I was surprised to find that it was firmly attached thereto, so firmly, indeed, that I had to exert considerable force in order to detach it, and even then it came away leaving its two hindmost pairs of walking-legs behind. The dactylopodite of each of these legs, on examination under a low power, was found to be provided at its extremity with a strongly hooked, exceedingly acute, movable claw, and on the lower edge at the end with six or seven sharp spines, against which the claw folds, and thus forms a very efficient prehensile arrangement. With these four legs, which are at this stage the longest, strongest, and most highly indurated of all the appendages, stretched straight backwards so as to be parallel with the postabdomen, the young crayfish hangs suspended head downwards from the postabdominal appendages of the mother. The young found thus attached measure, with the postabdomen extended, 7½ millims., exclusive of the antennæ.

The accompanying figure represents the two terminal joints of one of the legs drawn by the aid of the camera lucida. I am not aware whether the young of *Astacus fluviatilis* attach themselves in this manner; certainly Rathke does not state that they do so in his admirable account of the development of the species.



The ova in the New-Zealand representatives of the genus

* = *Paranephrops setosus*, Hutton, Ann. & Mag. Nat. Hist. 1873, xii. p. 402.

Astacoides * are large and few in number; and the young undergo no metamorphosis after quitting the egg. A large female of *Astacoides zealandicus* has but 380 eggs, measuring $2\frac{3}{4} \times 2\frac{1}{4}$ millims., under the tail; and these are attached to the appendages in the manner described by Lereboullet (in Ann. des Sc. Nat. sér. 4, vol. xiv. 1860) for *Astacus fluviatilis*.

XXVII.—*Descriptions and Figures of Deep-Sea Sponges and their Spicules, from the Atlantic Ocean, dredged up on board H.M.S. 'Porcupine,' chiefly in* 1869 (*concluded*). By H. J. Carter, F.R.S. &c.

[Continued from p. 240.]

Hymeraphia vermiculata, Bk., var. *erecta*, n. sp. (Pl. XII. fig. 4, and Pl. XV. fig. 26, *a*, *b*.)

General form short, cylindrical, angular, club-shaped, becoming massive, lobed and lobulated, or compressed and expanding flabellately. Colour now yellowish white. Surface hirsute, even, reticulo-pitted, more or less furrowed; dermal structure reticulate. Pores in the sarcode tympanizing the interstices of the dermal reticulation. Vents scattered here and there on the surface. Internal structure consisting of fasciculi branching and subdividing obliquely from a central axis amidst the sarcode, which again is traversed by the branches of the excretory canal-system, that terminate for the most part in the furrows of the surface, which in their natural state are converted into canals by the dermal sarcode. Colour internally the same as that of the surface, or perhaps a little deeper. Spicules of one kind only, viz. skeleton-; no flesh-spicules. Skeleton-spicules of two forms, viz.:—1, very large, long and acuate, smooth, sharp-pointed, slightly curved towards the fixed end, which is the widest part of the spicule, but not inflated, 100- by $3\frac{1}{2}$-1800ths inch (Pl. XV. fig. 26, *a*); 2, subskeleton-, a much smaller spicule, vermiculate, acerate, acuate, or cylindrical and obtuse at the ends, 45- by 1-1800th inch (fig. 26, *b*). The large acuates at their fixed ends are imbedded in a mass of interwoven vermiculates, which thus form fasciculi round them (Pl. XII. fig. 4, *a*, *b*), while their

* *Astacoides*, Guérin, Revue Zool. 1839, p. 109; *Paranephrops*, White, in Gray's Zool. Misc. 1842, p. 78, and Dieffenbach's 'New Zealand,' 1843, ii. p. 267.

pointed ends, projecting externally, give the hirsute appearance to the dermal sarcode, where the points are so arranged in linear network as to present the reticulo-pitted aspect above mentioned. Size of sponge extending from a thin lamina up to 3 inches in height, varying in thickness with the form taken by the sponge.

Hab. Marine, attached individually to little pebbles.

Loc. Atlantic Ocean, between the north of Scotland, the Shetland and the Färöe Islands, in depths varying from 114 to 640 fathoms.

Obs. In form this species only differs from *H. vermiculata*, Bk. (which is thin, laminiform, and incrusting, fig. 4, *c*), in being erect or vertical, but in nothing else, further than that the spicules appear to be a little larger and the vermiculates a little less vermicular in *H. erecta*. In structure, both consist of large acuate spicules, whose pointed ends for the most part project externally, and are tied together internally by a mass of the vermiculates; while the less degree of vermiculation of the latter in *H. erecta*, as well as the tendency to a flabellate form, seems to point out a transition of the latter to *Phakellia ventilabrum*, where the interlacing spicules still retain a little vermiculation, until it is lost altogether in *P. infundibuliformis*, where the shape of the acuate remains, but that of the undulating or vermicular spicule has passed into a simply curved acerate, which curve, it should be also remembered, approaches in form to that of a ‘bend’ in the centre, ending with *Axinella*. Thus we have a group of sponges extending from the lowest form, viz. *Hymeraphia vermiculata*, to *Axinella*, which may hereafter be found serviceable in dividing the group Multiformia of my suborder Axinellida in the order Echinonemata. *Hymeraphia vermiculata* bears a similar relation to *Phakellia ventilabrum* that *Microciona atrosanguinea* does to *Halichondria plumosa*.

H. erecta is present in several jars, especially in No. 65, whose depth is 345 fathoms, about 40 miles N.W. of the Shetland Islands; and *H. vermiculata* is almost always found in company with it. Fragments of *Phakellia ventilabrum* and *P. infundibuliformis* also come from the same localities. At station 51 portions of *Geodia*, *Stelletta*, and *Reniera fibulata*, Sdt., were dredged up with it; and at 65, *Geodia*, *Tisiphonia*, *Donatia lyncurium*, *Trichostemma hemisphæricum*, Sars, *Polymastia brevis*, Bk., and *Phakellia ventilabrum*.

Both *Axinella mastophora*, Sdt., and *Auletta sycinularia*, Sdt. (Atlantisch. Spongienf. pp. 45 and 61, and Taf. iv. figs. 5 and 14 respectively), appear, from the form of their spicules and hirsute surfaces, to be allied to *H. erecta*.

form, while the loose structure of the internal parts, unattended by any dense axial arrangement, is more like the Halichondrina. Pending the examination of a perfect specimen, which, I expect, from the delicate structure of the internal contents in all the "histodermal" sponges, is not likely to be soon obtained, I think this sponge had better be placed provisionally in the second division of the Echinonemata. In all the specimens the protruding head being fringed out, probably by friction and decomposition, thus fails to present the original form.

Halichondria foliata, Bk. (*op. cit.* vol. iii. pl. 73. fig. 1). (Pl. XII. fig. 10, and Pl. XV. fig. 29, *a*, *b*.)

Of this sponge there is only a fragment by itself in a jar numbered 65, which station is a little N.W. of the Shetland Islands. It is about $\frac{3}{4}$ inch square and $\frac{1}{6}$ inch thick, and belonged to a compressed, erect or vertical sponge entirely composed of a reticulated, anastomosing structure, whose interstices are open from side to side—that is, directly through the sponge fenestrally. The reticulated fibre, which is ragged and hirsute from the projection of spicules, is now of a pale whitish-yellow colour. Pores and vents not evident. Spicules of two kinds, viz. skeleton- and flesh-spicules. Large skeleton-spicule acuate, smooth, sharp-pointed towards the large end, 94- by 4-6000ths inch (Pl. XV. fig. 29, *a*); small or subskeleton-spicule also acuate, smooth, sharp-pointed, inflated at the large end, scantily spined over the extremity, 78- by 1-6000th inch (fig. 29, *b*). Flesh-spicules of two forms, viz.:—1, equianchorate, navicular or shuttle-shaped, 4-6000ths inch long (Pl. XII. fig. 10, *a*); and, 2, a tricurvate, whose arms are very thin and spread out horizontally to a great extent, with a sudden bend in the centre, often converted into a loop, 140-6000ths inch long (fig. 10, *b*). It is by the projection of the large skeleton-spicules chiefly that the hirsute surface is produced. The remarkable form and size of the tricurvate are not confined to this sponge; for they are to be found in *Microciona armata*, Bk.; but here the ends are spiniferous. I learn this more particularly from a mounted specimen of this sponge which I have found here (Budleigh-Salterton).

Isodictya spinispiculum, n. sp. (Pl. XV. fig. 42.)

On the rough flat stone bearing a specimen of *Macandrewia azorica* before mentioned, with one of *Geodia nodastrella*, n. sp., to be hereafter described, is a portion of *Isodictya spinispiculum*.

The jar in which this is contained bears on its label "25, 75–374 fathoms, a few miles north of Cape St. Vincent." Here 75–374 may mean "from 75 to 374" fathoms. Besides the sponges mentioned, the jar contains *Corallistes Bowerbankii*, *Azorica Pfeifferæ*, *Pachastrella abyssi*, *Stelletta pachastrelloides*, n. sp., *Phakellia ventilabrum*, &c. The portion of *Isodictya* is laminiform, about half an inch in diameter, and 1-24th inch thick. Its surface is even and covered with holes (? pores and vents respectively), while the interior consists of an areolar structure easily crushable, and composed of sarcode charged with one kind of spicule only, which is arranged in bundles end to end, and crossing each other in accordance with the kind and form of the areolar structure common to the Isodictyosa. The spicule is straight, cylindrical, bent abruptly close to each end and rounded terminally; but while one end is turned in one direction, the other is not turned in the opposite, but laterally, so that when the bend of one end is seen the other is obscured by being in a line with the shaft; besides this, the shaft is sparsely covered throughout with short erect spines, except at the ends which are smooth, about 50- by 2-6000ths inch (Pl. XV. fig. 42). Size of entire specimen half an inch in horizontal diameter.

Hab. Marine, on hard objects.

Loc. Above mentioned.

Obs. The most remarkable point about this little specimen is the peculiar character of its spiculum.

THALYSIAS, Duchass. de Fonb. et Michelotti.

There are three small specimens of *Thalysias*, two of which are on large fragments of *Corallistes Bowerbankii* from station 25=374 fathoms near Cape St. Vincent, and the other separate in a jar numbered 6=345 fathoms N.W. of the Shetland Islands. All present the chalky-white appearance characteristic of the sponge to which Duchassaing de Fonbressin et G. Michelotti have given the name "*Thalysias*" ('Spongiaires de la Mer Caraïbe,' pl. xvii. fig. 1), and consist of two or three papillæ, open respectively at the summit; but when examined microscopically two are found to present only one kind of spicule, which is nearly cylindrical, curved, smooth, and round at the ends, 28- by 1½-6000th inch; and the other two kinds of spicules, viz. a skeleton- and a flesh-spicule; of which the skeleton-spicule also is nearly cylindrical, curved and smooth, but abruptly pointed at the ends, 45- by 2½-6000ths inch, and the flesh-spicule a fine tricurvate, 9-6000ths inch long.

This is the first time that I have found the skeleton-spicule of a *Thalysias* to be accompanied by any flesh-spicule; and hence I propose for it the name of *T. tricurvatifera*; it is one of those on *Corallistes Bowerbankii* from Cape St. Vincent. The value, however, of the presence or absence of a flesh-spicule for specific designation will, I think, as I have before stated, be found very doubtful in many instances.

Reniera crassa, n. sp.

General form irregular, massive, lobate. Colour pale ochre-yellow. Surface even, undulating with the form of the mass, provided with a beautiful dermal reticulation (composed of sarcode charged with the spicules of the species) whose free side is smooth and the other rough where it intermingles with the subjacent structure. Pores in the sarcode tympanizing the interstices of the dermal reticulation. Vents congregated in large deep depressions or holes here and there, where they open through a large cribriform dermal layer at the bottom. Internal structure massive, areolar, composed of sarcode densely charged with the spicules of the species and traversed by the branches of the excretory canal-system, which finally open at the cribriform vents mentioned. Spicule of one kind only, viz. acerate, curved, smooth, abruptly pointed, 85- by $4\frac{1}{2}$-6000ths inch, accompanied by others of all sizes, some of which are not more than 6-6000ths inch long, although of the same thickness (that is, nearly as thick as long), with rounded ends, sausage-like. Size of specimen about 6 inches long by 3 inches thick.

Hab. Marine.

Loc. A little south of the Färöe Islands, in 167 fathoms.

Obs. The number on the jar containing this specimen is "60," which station gives the locality and depth above mentioned. It is one of the coarse, large Renierida which I intend to place under the group "Crassa." They much exceed in size the Thalyosa, which they otherwise resemble in consistence and spicule, being of a chalky friable nature when dry, and, for the most part, of an ochreous yellow colour. There is one in the British Museum, which is crateriform in the centre, measuring 18 inches in diameter by 12 inches high. The coarseness in structure, arising chiefly from the greater size of the spicule, is the chief character that distinguishes the Crassa from the Thalyosa.

Halichondria forcipis, Bk., var. *bulbosa*, n. sp. (Pl. XIII. fig. 19, and Pl. XV. fig. 37, *a*, *b*.)

General form, surface, pores, vents, and excretory canal-system ——? (being a mere fragment). Internal structure can-

little doubt that the figure and spicules respectively of ours are those of *Cribrella hospitalis*. But as Schmidt has only given one of the circular or oval cribriform areæ (fig. 19, *b*) as an illustration of this sponge, I have thought it desirable to add that of the best specimen of the *entire* sponge as dredged up on board the 'Porcupine,' together with its spicules.

There are three specimens in a jar by themselves, numbered "57," which gives a depth of 632 fathoms, and a locality midway between the north of Scotland and the Färöe Islands. They have all grown on hard objects, such as small pebbles, coral, &c.; and the largest, which is irregularly pear-shaped and has been figured (Pl. XIII. fig. 18), is $1\frac{1}{2}$ inch high, $\frac{7}{8}$ inch diameter in the head, and $\frac{1}{4}$ inch diameter in the short, stem-like base.

It belongs to my group "Halichondrina," as the two skeleton-spicules, viz. one a spined acuate (Pl. XV. fig. 36, *a*), and the other a smooth acerate with rounded ends (fig. 36, *b*), together with the equianchorate spicule (which is very stout and broad, Pl. XIII. fig. 18, *d*), and general structure indicate.

Halichondria phlyctenodes, n. sp. (Pl. XIII. fig. 17, and Pl. XV. fig. 35.)

General form blister-like, convex, depressed, sessile, irregularly elliptical, fixed by its marginal circumference throughout to the object on which it has grown; presenting a funnel-shaped extension of the surface here and there, which terminates respectively in a short cylindrical tubular prolongation, slightly enlarged outwards and truncated at the extremity; tubular prolongations seven in number. Colour yellowish white now. Surface even, smooth; dermal structure textile-like, formed by spicules horizontally imbedded in the dermal sarcode so as thus to form a firm membranous covering. Pores in the sarcode tympanizing the interstices between the dermal spicules. Vents respectively at the extremities of the tubular prolongations of the dermal membrane, constricted as usual, at the free end, by a sphinctral diaphragm of sarcode. Internal structure originally delicate, now pulpy, composed of spicules held together by sarcode, in which the branches of the excretory canal-system, now broken down, originally ramified. Sarcode cream-yellow. Skeleton-spicule of one form only, viz. acerate, smooth, slightly curved and obtusely pointed, 42- by 1-1800th inch (Pl. XV. fig. 35). Flesh-spicules of two forms, viz.:—1, equianchorate, short and stout, shaft much curved, bow-like, arms falcate or webbed nearly to their ends respectively, much expanded, 8- by 3½-6000ths inch (Pl. XIII. fig. 17, *f*); 2, bihamate or fibula, simple, C- or S-shaped, subspiral, 20-6000ths inch long (fig. 17, *g*). The skeleton-spicules make up the chief part of the dermal and internal structures, both of which are plentifully charged with each kind of flesh-spicule. Size of specimen $1\frac{4}{12}$ inch long, $\frac{8}{12}$ inch broad, and $\frac{3}{12}$ inch high; tubular prolongations $\frac{1}{5}$ inch long by $\frac{1}{12}$ inch broad at the free extremity, which is rather larger than the fixed end.

Hab. Marine, on hard objects.

Loc. Atlantic Ocean, in 374 fathoms, a few miles north of Cape St. Vincent; on a fragment of *Corallistes Bowerbankii*, Carter.

Obs. There is only one specimen of this sponge; and it is fixed to the flat surface of one of the fragments of *Corallistes Bowerbankii* in the large jar bearing the figures 374 fathoms, =station 25 of the 1870 cruise.

The spicular complement approaches nearest to that of the group Halichondrina; but I have never been able to find the spined acuate spicule common to the sponges of this group, except in one mounted instance, where it appears to be accidental, as I have sought for it in vain in many other fragments both of the dermal and internal structures. This again is another of the "histodermal" sponges dredged up on board the 'Porcupine.'

Halichondria abyssi ('Annals,' 1874, vol. xiv. p. 245, pl. xiv. figs. 26–28). (Pl. XIV. fig. 24, *a*, *b*.)

Since describing and illustrating the fragment of this sponge (*l. c.*), Mr. T. Higgin of Huyton, near Liverpool, has brought to my notice that the embryonic form (*l. c.* fig. 27, *c*) is birotulate—that is, that each end terminates in a dome-shaped or umbrella-like head composed of twelve spines webbed together (Pl. XIV. fig. 24, *b*) like the birotulate of *Hyalonema* &c. That this spicule is still what I have termed it, viz. "embryonic," is proved by my having found that the fully developed spicule (*l. c.* fig, 27, *b*) presents the same kind of head when a favourable view can be obtained of it (which is rather difficult, as the matured form generally lies on its side). The shaft, too, is often evidently bent, even in the embryonic state. Lately Mr. Higgin has found a West-Indian sponge of a purple-brown colour charged with this embryonic form only, which is identical with a fragment of the same kind of sponge in the British Museum stated to have come from Blackwood Bay in Australia. As the spicules of this species somewhat differ from *Halichondria abyssi*, Mr. Higgin, who has now several good specimens from the locality mentioned, is about to describe it under the name *H. birotulata.* The locality of *Halichondria abyssi*, as before stated, is station 65,=345 fathoms, north-west of the Shetland Islands.

Esperia placoides, n. sp. (Pl. XIII. fig. 12, and Pl. XV. fig. 32.)

General form fir-cone-like, scaly, oblong, almost cylindrical, round at the summit, rising from a stipitate base composed of a hard perspiculiferous stem, which branches upwards into the interior. Colour now yellowish grey. Surface uniformly divided into plates of various sizes and shapes (Pl. XIII. fig. 12, *a a a*), separated from each other by deep grooves (fig. 12, *b b*), except at the summit, which is formed of one continuous large scale pierced with many vents; margin of the scale scarped all round and circumscribing a somewhat convex villous area (fig. 12, *a, a*); grooves between the scales concave, smooth (fig. 12, *i*); structure of the scale spiculous, consisting of a dense layer of small spicules, which project externally, giving the villous surface (fig. 12, *f*), and interlap internally with larger ones, which, in bundles, project into the sponge (fig. 12, *g*), while the two are knit together, textile-like, by a thin transverse layer at their point of contact, thus forming a plate or scale which easily comes off entire; strueture of the groove (fig. 12, *k*) sarcodic, consisting of obliquely reticulated rugæ whose interstices are pierced by the "pores" so as to form a sieve-like area, like that in *Tisiphonia agariciformis.* Pores about 1-1000th inch in diameter, situated in the sarcode tympanizing the interstices of the rugæ in the grooves (fig. 12, *k*, *l*, & *l'*). Vents chiefly on the summit, where they consist of short conical elevations, terminated respectively by an aperture about 3-48ths inch in diameter, sometimes singly, in one or more of the larger scales (fig. 12, *c c* & *m*). Internal structure consisting of the spiculiferous stem (fig. 12, *d*), which, branching out in all directions, supports the sarcode charged with the spicules of the species and traversed by the excretory canal-system, which ends in the vents mentioned. Spicules of two hinds, viz. skeleton- and flesh-spicules. Skeleton-spicule of one form, viz. sub-pinlike, almost acuate, fusiform, smooth, sharp-pointed and slightly curved, with the obtuse end less in diameter than the centre of the shaft, 60- by 1¼-1800th inch (Pl. XV. fig. 32). Flesh-spicules of three forms, viz.:—1, inequianchorate of the common *Esperia* form, separate and in rosette-like groups, 18-6000ths inch long, head 7-6000ths inch long (Pl. XIII. fig. 12, *n*); 2, bihamate

acerates, that, when separate, often present the tricurvate undulation. The entire specimen, which is not more than 5-24ths inch long by 2-24ths inch high, is situated in a small surface-depression of a large *dried* fragment of *Pachastrella abyssi*, about 3 inches square and 2 inches thick; hence it now presents no appreciable amount of sarcode; but from its striking appearance I have thought it worth illustrating, although, after all, it may be a surface portion of an *Esperia* which grows much larger and ultimately assumes a totally different aspect. No label being on the specimen of *Pachastrella*, I conclude that it came from station 25, near Cape St. Vincent, since other like specimens of the same kind of *Pachastrella* in a *wet* state are in the jar bearing on its label "374" fathoms.

Esperia cupressiformis, var. *bihamatifera*, n. sp. (Pl. XIII. fig. 14, and Pl. XV. fig. 34, *a*, *b*.)

Of this sponge there is only a fragment, viz. about $\frac{3}{12}$ inch of the head or free end, with no label on the jar, where it is in company with several specimens of *Esperia cupressiformis* ('Annals,' 1874, vol. xiv. p. 215, pl. xiv. fig. 16, &c.), and also a portion of the stem of another specimen covered with *Corticium parasiticum*, together with several specimens of *Polymastia ornata*, Bk. No difference can be seen between it and *E. cupressiformis* until examined microscopically, when the presence of a large *in*equianchorate of a peculiar shape (Pl. XIII. fig. 14, *a*), and an abundance of small bihamates or fibulæ (fig. 14, *c*), together with the absence of the forceps-tricurvate, points out that it must be made a variety of *E. cupressiformis*; and thus it has been designated "*bihamatifera*." Spicules of two kinds, viz. skeleton- and flesh-spicules. Skeleton-spicule of one form only, viz. acuate or subcapitate, smooth, fusiform, abruptly pointed, larger and less capitate in the stem than in the branchlets, 195-6000ths inch in the stem (Pl. XV. fig. 34, *a*), 133-6000ths inch long in the branchlet. Flesh-spicules of three forms, viz. two inequianchorates, small and large, and one bihamate. Small inequianchorate the same as that of *E. cupressiformis* (Pl. XIII. fig. 14, *b*); large inequianchorate of the common form, but rounded at the small end, 11-6000ths inch long (fig. 14, *a*); bihamate simple, 4-6000ths inch long (fig. 14, *c*). It is not improbable, from the presence of *Corticium parasiticum* on the portion of the stem of this species, that the whole of the contents of this jar came from the "chops" of the English Channel (see *Corticium parasiticum*, anteà).

Cladorhiza abyssicola, Sars, var. *corticocancellata*, n. sp. (Pl. XIII. fig. 16.)

General form short-branched shrubby stems, covered with a thick cancellated cortex, echinated with short, erect, spine-like processes; ends of the branches tumid, round. Colour cream-yellow in spirit. Surface irregular, cancellate, with the holes bordered by short spine-like processes, which consist of pointed bundles of spicules. Pores in the dermal sarcode covering the cancellated structure. Vents indistinct. Internal structure consisting of the axis or stem, which is hard, compact, and colourless, being composed of spicules of the species closely approximated and arranged together longitudinally and parallel to each other, tending to the formation of a spiral cord, at right angles to which bundles of spicules issue, supporting (as they branch outwards and terminate on the spine-like processes of the surface) the cancellated sarcodic substance of the cortex, traversed by the branches of the excretory canal-system, whose openings at the vents have been stated to be indistinct. Spicules of two kinds, viz. skeleton- and flesh-spicules. Skeleton-spicule of one form only, viz. acuate, fusiform, attenuatingly pointed, smooth and nearly straight, head less in diameter than the body, 100- by 1-1800th inch. Flesh-spicules of two forms, viz.:—1, inequianchorate, exactly like that of *C. abyssicola* ('Annals,' 1874, vol. xiv. pl. 14. fig. 22); 2, bihamate or fibula, simple, smooth, with nearly a straight back or shaft and a prolonged, whip-like, everted end to each extremity, 39- by 1-6000th inch (Pl. XIII. fig. 16, *a*). The skeleton-spicules are chiefly confined to the stems and branches supporting the sarcode, while the largest are in the former, and the flesh-spicules scattered profusely (especially the inequianchorate) throughout the sarcode generally. Size of entire sponge unknown, as the specimens are all in fragments.

Hab. Marine.

Loc. Between the north of Scotland and the Shetland and the Färöe Islands, in 345 and 632 fathoms.

Obs. There are four jars containing specimens of *Cladorhiza abyssicola*, Sars, and *C. corticocancellata*, all more or less fragmentary and mixed together, and all bearing the same number, viz. "57," which gives the locality and depth above mentioned: add to these another jar, No. 65, which gives a locality about 40 miles N.N.W. of the Shetland Islands in 345 fathoms, containing a single specimen of *C. abyssicola* so different in form to all the rest, that it requires the short and separate description which will be given presently.

Cladorhiza abyssicola and *C. corticocancellata* differ in the following particulars, viz. :—The former (Pl. XIII. fig. 15) is more or less slender and pinnatifid in its branching, the branches long and attenuatingly pointed, and the cortex consisting of long drooping filaments issuing from a thin stratum of sarcode at their base; while the bihamate or fibula flesh-spicule is simply C-shaped (fig. 15, *a*). The latter, on the other hand, is irregularly branched, the branches thick, short and tumid towards the free end, and the cortex thick, cancellous, and covered with short, erect, spine-like processes around the holes of the surface (fig. 16), while the bihamate or fibula flesh-spicule is an elongated C-shape, whose extremities respectively are everted and prolonged into a whip-like form (fig. 16, *a*).

Lastly the peculiar form in jar 65, to which I have alluded, is like that of a pinnatifid *Gorgonia*, in which the round stem is bordered on each side by long undivided branches, coming off somewhat irregularly on each side, but all opposite or on the same plane. The cortex is uniformly granulated and hirsute, but without filamentous prolongations, and the branches and stem round and of the same size throughout, the former obtusely rounded at the free extremity. In other respects (that is, in colour and the form of its spicules respectively, together with the structure of the cortex and stem) it is exactly like *C. abyssicola*. The specimen is imperfect, inasmuch as, both the distal and proximal ends having been broken off, it gives no idea of what the entire form of the sponge was. There are four inches of the stem left, which is $\frac{1}{8}$ inch in diameter, and the longest of the branches, which are irregular in this respect, $2\frac{1}{2}$ inches in length, with a little less transverse diameter than that of the stem. Of its being identical with *C. abyssicola* in all but form, there can be no doubt; and the form, although it may constitute a variety, cannot make a distinct species. I have thought it worth while to give a short description of this specimen, because it has evidently been placed in the jar by itself under the idea that it was a distinct species, and that hereafter it might not be taken for such.

Schmidt's *C. pennatula* (Nordsee-Exped. 1872, Spongien, p. 119, Taf. i. figs. 14, 15, and 16) seems to me to be so like *C. abyssicola*, Sars, that as Schmidt states that Sars's work, wherein the latter is described and illustrated, is not accessible to him, I cannot help thinking that with more opportunities Schmidt would have pronounced his specimen to be identical with that of Sars. Indeed Schmidt himself, a little further on, questions whether the specimens of *C. abyssicola*, Sars,

canal, although *not* inflated in the *centre*, is so at the *extremities*, which leads to an optical delusion, in which one arm appears to be twisted backwards (see Dr. Bowerbank's illustration, *op. cit.* vol. i. pl. x. fig. 240), 65- by 1-1800th inch (fig. 39, *b*, and Pl. XIV. fig. 21, *e–h*); 3, acerate, fusiform, curved more or less, evidently inflated in the centre, especially in the smaller forms, verticillately spined throughout at regular intervals, the spines becoming general towards the ends (Pl. XIV. fig. 21, *i*)—or moniliform, with smooth, elliptical inflations only, decreasing in size from the centre towards either end (fig. 21, *k*), 20-1800ths inch long. The large spicules, viz. no. 1, project singly, for the most part, from the summits of the aculeations respectively (fig. 21, *m–p*), while no. 2, the centrally inflated subskeleton-spicule, is chiefly congregated round them at their exit from the aculeation (fig. 21, *o o*); and the verticillately spined and moniliform spicules, viz. no. 3 (fig. 21, *i*, *k*), make up, in their smaller sizes, the greater part of the dermal layer (fig. 21, *n*), while the larger ones are confined to the inner sarcode. Size of specimen about $\frac{5}{12}$ inch in horizontal diameter and about $\frac{1}{12}$ inch thick in the centre, including the aculeations, which amount to half this.

Hab. Marine, on small pebbles.

Loc. Atlantic Ocean, in 345 fathoms, about 40 miles N.N.W. of the Shetland Islands.

Obs. There are three specimens of this sponge, all about the size mentioned; two are light cream-coloured and the other dark grey. The two light ones are in a jar labelled "65," whose locality and depth is that above mentioned, and the dark specimen in a jar labelled "78,"=290 fathoms, about 65 miles N.N.W. of the Orkneys. Associated with the latter is *Hymeraphia pyrula*, n. sp., and with the former *Phakellia ventilabrum*, *Tisiphonia*, *Tethya cranium*, *Desmacella pumilio*, and *Hymedesmia Johnsoni*.

This sponge has already been named, described, and illustrated by Dr. Bowerbank (*op. cit.* vol. ii. p. 145, vol. i. pl. x. figs. 238, 239, and 240, and vol. iii. pl. xxvii. figs. 1–3); but as the additional inflation towards the end of the large spicule (fig. 2) in the latter illustration and the recurvature of the third spine in fig. 240 (vol. i.) appear to me to be rather exceptional than ordinary forms, while the observation in vol. i. p. 146, that the "moniliform" is the "young state" of the verticillate spicule, is not borne out by the fact that both moniliform and verticillately spined spicules are present of all sizes, from the smallest to the largest, which are of equal length, however much the absence of the spines in the moniliform ones may be considered as "incomplete development." (If there is one thing more to be *deprecated* than another in the description of sponges, it is the figuring of exceptional forms of spicules as characteristic of the species.)

There is, however, a great diversity of form in all three kinds of spicules, since the terminal inflation of the large spicule is not only occasionally double, and that of the centrally inflated spicule also, but the extremities of the latter, although always more or less fissurate or spined, are equally varied.

Then, again, the verticillately spined and moniliform spicules vary in size from 2- to 20-1800ths inch in length, while the absence of any particular form of flesh-spicule may be supplied by the smallest verticillate ones, in which the central inflation then causes them very much to resemble the centrally inflated flesh-spicule of *Halichondria suberea* and *H. ficus*, Johnst., *Suberites domuncula*, Sdt. (Dr. Bowerbank, *op. cit.* vol. ii. p. 202, is wrong in restricting the presence of these centrally inflated flesh-spicules to *H. ficus*, inasmuch as they are equally present in both the type specimens of *H. suberea* and *H. ficus* respectively, of the Johnstonian collection in the British Museum.)

The only approach in form to the centrally inflated subskeleton-spicule with fissurate ends of *Hymeraphia verticillata*, that I know of, is in *Halicnema patera*, Bk. (vol. iii. pl. xv. figs. 31 and 32); but here the ends are sharp-pointed, although the centre of the shaft is once and sometimes twice inflated; still these spicules are congregated round the great sub-pinlike acuates of the fringe at the circumference of *H. patera*, where they thus bear the same relation to each other that the centrally inflated spicules do to the great sub-pinlike spicule in *Hymeraphia verticillata*. The double *terminal* inflation of the latter, too, is common in *Halicnema patera*, while the staple spicule of the body generally, which is smaller, consists of a curved acerate, inflated in the centre, and thickly (although not verticillately as in *Hymeraphia verticillata*) spined throughout. So that the spicule-complement of *Halicnema patera* comes nearest of all known sponges to that of *Hymeraphia verticillata*; and the former I have thought best for the present to place among the Suberitida. Perhaps *Halicnema patera* and its like may have to come there also.

It has been above stated, conjecturally, that the great sub-pinlike-spicule which projects from the summit of the aculeation is about 200-1800ths inch long (that is, $\frac{1}{9}$ inch); but as this spicule from its extreme length is generally broken off just outside the summit of each aculeation, while its inner extremity rests on the pebble, the entire length has been computed by allowing two thirds for the inner and one third for the outer portion, reckoning the total thickness of the sponge from the pebble to the summit of the aculeation as above stated. The position of the vents must also be taken as provisional; for I have never seen one with an unmistakably defined margin and only the "tubular prolongations" above mentioned, which, having been broken off at the extremities, may after all *not* have been tubularly prolonged vents.

In several sponges there is a subskeleton-spicule, which presents two or three spines at one or both ends (*ex. gr.* Pl. XV. figs. 25, *b*, 29, *b*, and 28, *a*), which so far are like the fissurate ends of the spicule in *Hymeraphia verticillata*; and this often passes into ends which are inflated and spined all over in other species. The remarkable spiculation of *Hymeraphia verticillata* has necessitated this long description.

[To be continued.]

XXVIII.—*On a new Genus and Species of Collembola from Kerguelen Island.* By Sir JOHN LUBBOCK, Bart., M.P.

AMONG the Thysanura submitted to me by Mr. Eaton was a form of the *Lipuridæ*, which I propose to dedicate to M. Tullberg, who has so largely contributed to our knowledge of this group.

Genus TULLBERGIA, n. g.

Corpus elongatum. Antennæ non clavatæ, quadriarticulatæ. Organa postantennalia transversa. Unguiculi inferiores nulli. Spinæ anales magnæ.

Tullbergia antarctica, n. sp.

White (colourless in spirit). Skin granular, and with scattered hairs. Ocelli absent (I could see none). Postantennal organ situated directly behind the antenna; it has numerous oval tubercles. Feet with only one claw, and without tenent hairs. Anal spines large and strong; their apex oblique and outwardly prolonged into a somewhat slender triangular point, not acuminate.

Length $\frac{1}{8}$ inch.

Hab. Common in wet moss on hill-sides and low g ound in the neighbourhood of Observatory Bay, Royal Soundr

and the nasals are separated from each other by a long narrow bone, whilst the præmaxillæ do not reach quite so far as the nasals, articulating with the maxillaries; this corresponds with the large nostrils, and forms one of the best characters of the present species.

The skulls of these sheep, as stated above, have been found in the Tockmack district; but no further particulars as to the exact place are known, and consequently the exact geographical distribution is uncertain. Some greyish brown sheep seen by me in the Alexandrovsk district near Merke seemed to belong to this species; they were found at an elevation of 8000 feet above the sea-level, also near the rivers Katchara and Chu, where the Kirgies tribes also informed Mr. Semenoff about these sheep; they could hardly be *O. Polii.*

The horns of *O. Heinsii* are not much smaller than those of *O. Polii* of the same age. The skull of a specimen of *O. Heinsii* aged five years measures 11 inches 4 lines, the length of the horns is 33 inches 2 lines, and the extent between the tips is 31 inches 4 lines; whilst the same measurements of *O. Polii* of a corresponding age are 12 inches 6 lines, 37 inches, and 35 inches respectively. I tried to calculate by these figures the *size* of an adult *O. Heinsii*, judging by the affinity of *O. Polii*, taking also into consideration the different directions of the horns in both species; and the result is the following:—length without the tail about $5\frac{3}{4}$ feet, height at the shoulders $3\frac{1}{2}$ feet; length of the horn 4 feet; the extent between the ends of the horns 37 to 38 inches, or a little over 3 feet.

These are the probable measurements of an adult male of *O. Heinsii.* The species might easily be mistaken by the Kirgies tribes for *O. Polii.*

Ovis nigrimontana.

I have called it by this name because of its having been found at first in the Karatau mountains (which means black mountains, or *nigri montes*).

The frontal surface of the horn is convex, the other two are concave; and in consequence the edges are sharp, in particular the nuchal edge. In the section at the base of the horn, the nuchal and orbital surfaces are almost equal in breadth, each of them being about half as broad again as the frontal surface.

The axis of the skull and the basal chord of the horn form an angle of 38°, the median and basal chords 23°, and the angle formed by the terminal ascending chord of the horn and the axis of the skull is 63°.

The spiral of the horn would fit on an inserted cone with the base pointing towards the skull; the axis of this cone points a little forwards, with a slight inclination downwards.

The ridges on the horns are very sharp, but straight, regular and parallel with each other; the horns do not extend much down the forehead.

The occipital ridge of the skull of an adult male is sharp and very little rounded; the forehead rises very steeply, beginning from the nasals; the first orbital process is narrow and fits in between the two flats of the lachrymal; the nasal process is very long.

The nasals are not so wide where they join the frontals as they are towards their lower extremities; their sharpened point is short.

The nostrils are very small, smaller even than those of *O. Karelini*; and viewed in profile the nostrils extend less than half the distance from the lachrymal to the end of the præmaxillæ. The profile of the nose is almost straight, and becomes a little convex only near its end: with advanced aget his prominence of the nose increases; but even in old specimens of *O. nigrimontana* it is not so considerable as it is in young specimens of other species. The flats of the lachrymal are situated along the front edge of the orbit, so that the lowest extends further forward than the upper one. The latter does not reach as far as the centre of the orbit; the middle one is wide and extends to the centre of the orbit.

The malar extends along the whole lower margin of the orbit; it is wide; its facial portion is about the same width as the lachrymal; its anterior border is straight, joining the inferior border at a sharp angle. The zygomatic process of the malar is long and thin, being in its whole length of equal width.

The maxillary is separated by a long narrow bone from the nasal, which does not join the lachrymal as is the case with the other sheep, but is connected with the nasal process of the frontal.

The variations of the skull according to age are unknown; all the three skulls obtained by me belong to specimens of over six years of age, with all the cranial bones ankylosed.

I gave above a description of the colour as far as I could distinguish it.

This species inhabits almost the entire Karatau; it is abundant on the summits of the Buguni, on the rocks near Marnin-saz, and on the western portion of the Teramsk hills, where the numerous steep rocks and ravines near the river Borolday afford good hiding-places to these animals. They also occur on the summits of the Chayan mountains; further in a north-westerly direction I met with them on the rocks of the Turlansky-Pereval; and, according to the native tribes living there, these sheep are abundant also on the Min-Djelkey, the highest point of the Karatau mountains; and are to be found even at the foot of these mountains, namely in the Kara-murun hills, about 1000 feet high, and the steppes not above 1500 feet above the level of the sea. These latter are covered solely with steppe-plants. In the Karatau they keep close to the grass-covered plains and meadows, sometimes descending to the steppes to feed on the salt plants.

These sheep keep in very small flocks of from three to four individuals; and often single females with a lamb are to be met with, and even single males. This cannot be attributed to the usual habits of this species; but the reason for this scattering is more to be looked for in the very rocky nature of the parts of the Karatau mountains to which this sheep is driven by the different nomad tribes of the Kirgies, with their numerous flocks and herds. This is altogether different from the case of *O. Polii*, which usually grazes on the large plains of Aksay in very small flocks, although they might easily assemble in flocks consisting of hundreds of individuals, as is done by *O. Karelini* on the plains of the Narin.

O. Polii being larger and stronger than the other sheep, does not require to form such large flocks as the others do, especially *O. nigrimontana*, which certainly is one of the smallest and weakest of the whole group of the Central-Asiatic sheep. It is also very cautious and shy; and the reason for this is easily found—namely, the way in which it is constantly driven out of its localities.

In localities situated at about 1000 feet altitude, where it is in no danger, this sheep likes to look down from some lofty rock upon what takes place below. This was the case with one which watched for over an hour the arrangement of my tent and bed on the plain of Kaed-mistay in the Karatau; and at another time a sheep watched my passing through the ravine of Buguni. At the same time it very cautiously looks out for danger, and at the slightest suspicion of the approach of such it leaves the place at once.

Ovis aries, var. *steatopyga.*

The tame Kirgies sheep I think ought simply to be called *O. steatopyga* and be taken as a distinct species. The long dependent ears and the fat tails of the Kirgies sheep (characteristics dependent of course on domestication) show the parent stock, to which also the short and irregular horns are referable;

of the long-tailed races of sheep, which, however, are known to me only from descriptions. The development of these fat tails depends principally upon the salt plants on which the animal feeds; from the want of this food the tail becomes smaller. It is, however, an hereditary character; and even newly born lambs occasionally possess such a tail. The hornless sheep as a rule have also the largest fat tails.

The changes of the tail from the change of food do not take place at once: they can be more easily appreciated on comparing the long-tailed sheep, which feed on salt plants in the country about the Syr-Darja, with the short-tailed Kirgies sheep from Karkara, which hardly ever feed on such herbs. When sheep that had been feeding on salt ground are driven on more nutritious meadows (not quite so salt as the former) they at first begin to get fatter, and only later on the tail commences to grow too. This is regularly done in the Ural and the west of Siberia, where the sheep are principally sold for the sake of the tallow. But if fed on plants without any salt substance in them, the sheep themselves get fatter, but the tail does not grow at all.

The colour of these sheep is very variable; there are white, grey, black, and blackish-brown, or even greyish-brown individuals, these latter being nearest in colour to the wild species. I also noticed that the belly in the dark animals is usually darker than the back, like *Ovis argali*, sometimes of the same colour, but never lighter, like *O. Polii*, *O. Karelini*, or *O. nigrimontana*. At the same time the last-named species is nearest to the tame sheep in an indirect way, viz. by its partial resemblances to and differences from *O. Polii*. In examining the tame sheep of Arabia, Rüppell has recognized their distinction from the European long-tailed sheep, and thought that they originally descended from *O. argali*, having only altered by domestication. A. Brehm, mentioning this supposition of Rüppell's ('Ergebnisse einer Reise nach Habesch'), agrees with him regarding these sheep's specific distinction, but thinks it doubtful that they can be descended from *O. argali*, which differs so much in size from the tame breed. Brehm did not analyze the character or value of these differences as compared with the points of resemblance between the tame sheep and *O. argali*; but the latter are of weight and will prove Rüppell's statement to be correct. Of all the wild sheep, *O. argali* is most certainly the nearest to the tame ones; notwithstanding those characters which it has in common with its wild relatives, it approaches the tame sheep in two very important points, viz. in the shortened chords of the basal curve of the horns and in its colour.

O. argali, like all tame Turkestan sheep, has the belly darker than the back—a peculiarity analogous, to a certain extent, to the black cross bands on the wings of the dovecot pigeon, to which so much importance is attached by Mr. Darwin as proving that the origin of that bird is to be sought in *Columba livia*. Also the horns of *O. argali* are close to the sides of the skull in proportion to their large size, this being the only species of all wild sheep in which this is the case.

Consequently the only difference consists in the larger size of the animal and the proportionally larger horns. Here a suggestive analogy is afforded by *O. nigrimontana*, which in its general appearance and colour partly resembles *O. Polii*, but is considerably smaller in size, and lives at a much lower elevation. It seems a very reasonable hypothesis that the wild stock of the tame sheep of Turkestan was or is very much like *O. argali*, only of a smaller size and with smaller horns, inhabiting the low mountains of Mongolia, a locality which is so very little known that a species like the one suggested may possibly yet be found there. If not, what is more likely still, it may be taken for granted that this species is extinct in the wild state, in the same way as the original of our long-tailed European sheep is not now to be found.

If the wild sheep, the original of the fat-tailed breed, was nearer to the present tame one than to *O. argali*, its increase in the tame state very likely drove the wild ones from their original grazing-places; and these latter not being admitted by the larger wild sheep into the higher mountains, were gradually exterminated.

It is also probable that the smaller sheep were more easily tamed than the larger and stronger species, and would not only be more suitable for domestication, but, on account of their being more easily captured, they were more pursued by the sportsman, which is another reason for the extinction of this species; the principal cause of this latter, however, was probably the occupation of its feeding-grounds by the tame herds.

But another question arises here—namely, whether *O. argali* as it is now existed at the time when the original stock of the present Kirgies sheep was first tamed; for this domestication would of course have some influence also on the wild breeds.

At the present time the wild sheep are driven out of the meadows which they occupied formerly, and which now are exclusively the pastures of the tame flocks; and many changes in the wild beasts find an explanation in this.

Whilst the tame sheep were undergoing alteration according to the wants of men by means of breeding from selected specimens, the wild ones were also obliged to modify in order to exist, and to avoid being driven altogether away by the tame flocks, which were looked after and watched by men.

O. argali has very coarse hair and soft underwool; the hair of the tame sheep is only moderately coarse; and the southern sheep do not possess any soft underhair at all. The existence of this soft wool is to be regarded as a proof of weakness, and is combined in the tame sheep with a comparatively much greater development of the organs of generation. Consequently it may be supposed that the weakest and smallest sheep were selected for domestication; and as they easily got fat and bred quickest, they would also be more likely to remain in a tame state, whilst the stronger and wilder individuals would be apt to run away. The increased development of fat and the organs of generation may have been caused at first by the quiet life, and then increased by artificial selection. With the wild sheep the opposite would be the case; for contest for the females would favour the development of the horns and muscles rather than that of the reproductive organs. In being driven out of the plains by the tame herds of the nomad tribes, the weaker, smaller, and less agile of the wild sheep would be killed in jumping from rocks and ledges when pursued, especially in trying to leap the ravines, over which the stronger leader of the flock had shown the way; or when they lagged behind the flock they would be killed either by the hunters or by beasts of prey; and in this way, through thousands of years perhaps, the strongest sheep would continue to exist, whilst the weaker ones with smaller horns were killed off. Such might be the explanation of the difference in size between the wild and tame sheep; and it explains also their slower growth and development as well as their less prolificness. This process is not merely hypothetical, but has its proofs in the skulls that are found lying about on the rocks and in the ravines, most of which belong to the weaker adult males.

From the above considerations I am led to agree in Rüppell's opinion, that the fat-tailed sheep and *O. argali* both descend from one original stock, having undergone some changes in opposite directions. The comparison of the wild sheep also shows another characteristic, viz. that they are larger in size and in their horns the higher the localities are which they inhabit; this can be traced from *O. nigrimontana*, through *O. Heinsii* and *O. Karelini*, up to *O. Polii*. In size the specimens of *O. Karelini* that inhabit the Narin mountains are hardly smaller than *O. Polii*, judging by the skulls; and the *O. Polii* from the Aksay are probably the smallest represen-

72. *Capra ægagrus domestica* (*Hircus*).

Is to be found all over Turkestan in the low hills, ascending in summer, when the weather is mild, to the higher regions.

73. *Capra* (sp.?).

In the south-western portion of Turkestan, in the neighbourhood of Hodgent, also between the Zarevshan and the Syr-Darja, I met with this goat, but only on the highest mountains; and I never observed it below about 6000 feet.

Capra sibirica; Capra skyn.

I will postpone the comparison of these two species, which are as yet not sufficiently known, until I obtain more material. At the present time I possess only one skin and a skull of a young female specimen, perhaps of *Capra skyn*. Skulls with very large horns, which were stated to belong to the present species by Wagner (Schreber's Säugethiere fortgesetzt von A. Wagner), were brought from Kok-kia near the Aksay. His description is very incomplete, on account of his being in want of specimens; he even does not settle the question whether *Capra skyn* is a separate species or only a variety of *Capra sibirica*. I cannot do this either, because I have not got a young specimen of *Capra sibirica*, nor could I find one either in Moscow or St. Petersburg. I can only state that the colour of my specimen (a young female *Capra skyn*) agrees completely with Wagner's description.

As the sheep are separable into *Ovis* and *Musimon*, the goats also may be divided into three groups, namely *Ibex*, *Capra*, and *Hircus*.

The *Ibex* has no beard; the horns have three sides or surfaces (the nuchal, frontal, and orbital), and also three ridges; the frontal surface of the horn has a rough surface, as, for instance, that of *Ibex alpinus* (*Capra ibex* auct.) of Switzerland.

Capra has similar horns; but both sexes have a beard (*C. sibirica*, *C. skyn*, &c.). *Hircus* has also a beard, but has horns with only two, convex surfaces, the orbital and the interior surface, and only two edges, the frontal and the nuchal; the frontal edge is sharp, and the nuchal edge blunt and rather rounded, such as those of *H. ægagrus* and *H. Falconeri*, which are both relatives of the tame goat.

The Capridæ have a very limited distribution, which is also the case with *Ovis*, *Musimon*, *Ammotragus*, *Ægoceros*, *Ibex*, *Capra*, and *Hircus*—the only exception being *Capra sibirica* (if *C. skyn* is identical with it), which has a very extended range; but should *C. sibirica* and *C. skyn* form two distinct species, then the localities inhabited by them will be separated by the Narin, as far as can be fixed now; perhaps the limit might also be formed by the plains of Aksay and Chatir-kul. *Ovis argali* was also looked upon as being an exception to the above rule; but, as I showed above, this supposition arose only from the confusion of several of the Central-Asiatic sheep with this species; this is another reason which induces me to believe that *Capra skyn* is distinct from *C. sibirica*.

According to the analogy of the sheep, I suppose that there are even more than two species of *Capra* inhabiting the Thian-Shan; this, however, yet remains to be proved. If we compare the limited range of each species of the Capridæ with the much larger distribution of other mountain-mammals (as, for instance, *Capella rupricapra*, whose range extends from the Pyrenees to the Caucasus, or the *Oreotragus saltator*, which is to be found from the Cape of Good Hope upwards to Abyssinia), we shall find that a limited distribution is not at all a general characteristic of mountain-mammals. Nor is it dependent upon the physical conditions, particularly in the mountains of Central Asia, all of which are situated near to each other; and consequently there must have been another reason for the development of so many different species. This reason is to be found in the change of the life of wild animals from the time when they were driven out from their native localities by the tame flocks. In that way the habitats of wild animals were separated from each other by some valleys or meadows, or even mountain-plains, on which the tame ones were feeding; and this separation of course has favoured the quicker development of the different species.

At the present time the wild mammals live close to the tame cattle, and have adapted themselves to the conditions of their life, and have got into the habit of avoiding and getting away from the danger; and at the same time they have learned to make use of every convenient opportunity for enlarging their feeding-localities. This they could not possibly have learned at once, but in the course of several generations, and is the result of their increase in numbers in the localities to which they were obliged to withdraw. I made the observation on *Otis tarda*, that it leaves at once those steppes in which cultivation has commenced, and withdraws to such as are yet uninhabited; but the increase in their numbers on the latter compels them to go back again to the localities they had left, and in consequence thereof to alter their habits. The same may also have been the case with the wild Capridæ.

Now, for instance, between the localities inhabited by *Ovis Polii* and *O. Karelini* there is a narrow line where the two species are both to be met with, namely near the Upper Narin: at the same place I think it possible that also *Capra skyn* and *C. sibirica* meet; it is, however, only during the last twenty years that those two species have inhabited that locality, as it is only about that time since the Kirgies left it with their tame flocks, to the wild sheep and goats. I must also add that *C. sibirica* is distributed over the range of two species of sheep, namely *Ovis argali* and *O. Karelini*, which might be in connexion with their respective avoidance of mankind, as is the case on the Kora (see above).

The goat is not so partial to the mountain-meadows; and as it climbs more and is altogether a more truly alpine animal, it has not been driven away into the mountains to the same extent as the sheep. Besides, the herds of tame goats are not nearly so considerable as those of sheep in Central Asia.

I may here remark that the range of *Capella rupicapra* is restricted now to four localities—namely the Pyrenees, the Alps, the Carpathians, and the Caucasus. Four different species have not arisen, however, as only the Alpine chamois can be distinguished from the one inhabiting the Pyrenees. Probably the reason of this is that the characters of the genus *Capella* are less liable to change than those of the sheep or goats, the latter lying mostly in the proportions of the horns and skull, and being much more marked in the males than in the females.

74. *Bos taurus.*

Is found at all seasons all over Turkestan, and at almost every elevation, only being met in summer above 7000 feet, descending lower down for the cold season.

75. *Bos indicus.*

Inhabits the south-western portion of Turkestan, including the Zarevshan valley, but does not go high into the mountains.

76. *Bos grunniens* (*domesticus*).

Is found all over the eastern half of Turkestan, comprising the basins of the rivers Narin, Chu-Talas, &c. It never or very seldom descends below 6000 feet, and in summer goes even to the summits of the mountains; it does not stop there, however, during the winter.

[To be continued.]

Length of body 121 millims.; height of head $4\frac{1}{3}$, breadth of head (measured between the extremities of the eyes) 9; length of prothorax 38, of its neck 9, breadth of supracoxal dilatation $4\frac{1}{3}$; length of abdomen 63, of cerci 13, of antennæ 39, of tegmina 59; width of tegmina 10, width of marginal area $2\frac{1}{2}$; length of anterior femora 24, of intermediate femora 26, of posterior femora 37.

The above description has been drawn up from a single specimen of the male preserved in alcohol.

Hab. Sheargaon, in the Kolapur State. Captured by Mr. A. B. Foote, F.G.S., of the Geological Survey of India.

Calcutta, Aug. 14, 1876.

XXXI.—*Shells of the Littoral Zone, and Freshwater and Land Shells, in Jersey.* By E. Duprey.

It is a well-known fact that the number and variety of shells inhabiting the littoral zone depend much on the extent and nature of the portion left dry by the receding tide. On the coast of Jersey, where the fall of the lowest spring-tides is rather more than 40 feet, and the recess where greatest (at La Rocque) about two miles, species of shells are found at low water which in other places inhabit a depth of several fathoms. This circumstance is particularly favourable for collectors, the more so as all sorts of ground, rocky, stony, gravelly, sandy, and covered with seaweeds, are to be met with on some part or other of the coast.

The following list of Jersey marine shells comprises those only which are found between tide-marks and are accessible to every searcher who can occasionally avail himself of a few hours for a pleasant low-water excursion. Except when otherwise stated, the specimens have been found living.

The nomenclature is that of Jeffreys's 'British Conchology.'

Conchifera.

Anomia ephippium, L. Attached to rocks and stones.

—— *patelliformis*, L. On stones.

Ostrea edulis, L.

—— ——, var. *deformis*, Lam.

Pecten pusio, L. Amongst the "roots" of *Laminaria*.

—— *varius*, L. Under loose stones.

—— *opercularis*, L. Under stones.

—— *maximus*, L. Amongst *Zostera* in St. Aubin's Bay and at La Rocque. One full-grown specimen I found still alive about high-water mark; a long *Laminaria saccharina* was attached to its upper or flat valve, and had been the means of its being dragged by the tide many hundred yards, to the place where it lay. The "roots" of the *Laminaria* sheltered a *Pecten varius* and several small crabs; and a young *Anomia* and small flat *Tunicata* were fixed on the lower valve.

Mytilus edulis, L. Rather small and not gregarious. Lines of increase quite distinct.

—— *barbatus*, L. Generally of a bluish colour, sometimes purple.

—— *adriaticus*, Lam. In pebbly ground these rather thin shells fasten together the surrounding small stones, as if for protection.

Modiolaria discors, L.

Nucula nucleus, L.

Pectunculus glycymeris, L. Common, but rather small, being seldom more than $1\frac{1}{2}$ inch in diameter. At very low tides I have seen this edible species picked up by hundreds. On emerging from the sandy gravel it does not leap like a *Cardium*, but crawls slowly, leaving a small furrow behind. White specimens are rare, also pinkish or mauve-coloured ones.

Arca lactea, L. Under stones, and once with *Rissoa lactea* rather deeply buried.

—— *tetragona*, Poli.

Lasœa rubra, Mont.

—— ——, var. *pallida*.

Loripes lacteus, L.

Lucina borealis, L. Small.

Axinus flexuosus, Mont. Dead shells only; separate valves rather common in St. Aubin's Bay.

Diplodonta rotundata, Mont. One valve only.

Cardium echinatum, L. Very fine specimens with spines perfect, in muddy sand in St. Aubin's Bay at low water of equinoctial spring-tides. Like many other bivalves they emerge out of the sand when the tide begins to rise. I believe they come out more numerously when a bright sun warms the surface; but if a heavy shower happen to fall, few, if any, will appear.

—— *tuberculatum*, L. Living with the preceding some years ago (Mr. Piquet); lately I have found only dead shells, but fresh-looking.

—— *exiguum*, Gmelin.

—— *nodosum*, Turt. Gregarious in sand, the white, the yellow, and the pink living together.

—— ——, var. *rosea*, Lam.

—— *edule*, L.

—— *norvegicum*, Spengl. Of a light colour at La Rocque in shelly gravel; dark olive in muddy sand in St. Aubin's Bay.

—— ——, var. *pallida*.

Astarte triangularis, Mont. Gregarious in fine shelly gravel at low water of spring-tides.

Circe minima, Mont. Valves only.

Venus exoleta, L.

—— *fasciata*, Da Costa.

Venus casina, L. In shelly gravel. The form *reflexa* in muddy sand.
—— *verrucosa*, L.
—— *ovata*, Penn.
Tapes aureus, Gmelin. The marbled variety, which is generally grey outside, turns reddish brown in boiling water, while the variety which is white with a dark blotch at the posterior end remains unaltered.
—— *virgineus*, L. In clean shelly gravel specimens are found of a bright pink colour; but in muddy sand, amongst stones, they are dirty white or nearly black, becoming ochreous after a few weeks.
Tapes pullastra, Mont.
—— *decussatus*, L.
Tellina crassa, Gmelin.
—— ——, var. *albida*.
—— *balthica*, L. White, yellow, pink, grey, and other colours.
—— *tenuis*, Da Costa. Dead shells.
—— *squalida*, Pult. Valves only.
—— *donacina*, L.
Psammobia tellinella, Lam.
—— *costulata*, Turt. I have seen a single valve picked up at La Rocque.
—— *ferroensis*, Chemn. Dead, but fresh and well preserved.
—— *vespertina*, Chemn.
Donax politus, Poli. Gregarious in fine shelly gravel.
Mactra solida, L. Common in gravel at low water, but small.
—— ——, var. *elliptica*, Brown.
—— *subtruncata*, Da Costa.
—— *stultorum*, L.
—— *glauca*, Born. In sandy gravel at La Rocque. Its hiding-place is indicated by a hole larger than that of the *Solen* its neighbour.
Lutraria elliptica, Lam. Living with the following, but less common. A specimen 3 inches broad, which I kept in a deep but narrow glass vessel of sea-water, extended its tubes 5 inches out of the shell.
—— *oblonga*, Chemn. Many roundish holes may be seen in the muddy and gravelly sand; but those of the *Lutraria* are revealed by a jet of water when approached. I have never found them two years following in the same place, nor more than 5 or 6 inches beneath the surface.
Scrobicularia alba, W. Wood. Dead shells only; separate valves are common at low water.
Solecurtus candidus, Renier. Dead only.
Solen ensis, L.
—— *siliqua*, L. In gravel.
—— *vagina*, L. In muddy sand.
Pandora inæquivalvis, L. Common in St. Aubin's Bay.
Thracia papyracea, Poli. Dead shells.
Mya truncata, L.
—— *Binghami*, Turt. Amongst the "roots" of *Laminaria*.
Pholas candida, L. One valve only.

Littorina obtusata, L. Of all colours, and sometimes with bands. In a small aquarium I have kept a specimen for some months which has three tentacles and three eyes. The middle tentacle is bifid; and the eye behind it is double or formed of two little black dots adhering to each other; the two other or normal eyes are simple.

—— *neritoides*, L.

—— *rudis*, Maton. Of all colours, with and without bands.

—— ——, var. *tenebrosa*, Mont. Living with *Lasæa rubra* amongst *Lichina*, and not more than about $\frac{1}{10}$ of an inch long. When kept with *L. rudis* of the same size, it was soon outgrown by the latter.

—— *litorea*, L. This edible species is now more rare in Jersey than *Rissoa lactea.*

Rissoa striatula, Mont. Under stones, not uncommon.

—— *lactea*, Michaud. Not uncommon in Jersey in stony ground. I have found it living at Pointe des Pas, Samarès Bay, and La Rocque; its habitat is peculiar—adhering to the under surface of stones which are buried several inches, and often very firmly, in clayey sand. *Rissoa striatula* and *Adeorbis subcarinatus* are also found with it, and rarely *Arca lactea.* It seems difficult to understand how they can live there; for often the stones, although weighing but a few pounds, are difficult to turn over, so tightly are they imbedded.

—— *costata*, Adams. Not common.

—— *parva*, Da Costa. Abundant.

—— ——, var. *interrupta*, Adams. Rare.

—— *membranacea*, Adams.

—— *violacea*, Desm. Two very distinct sizes.

—— *costulata*, Alder. Two distinct sizes and three different types:—

(1) Entirely white. Rare.

(2) Brown nearly all over (except a white rib near the mouth), of different shades and forming zigzag streaks.

(3) White, with the mouth and longitudinal furrows between the ribs brown. Common.

—— *striata*, Adams.

—— *semistriata*, Mont. Rare.

—— *cingillus*, Mont.

—— ——, var. *rupestris*, Forbes.

Barleeia rubra, Mont.

—— ——, var. *unifasciata*, Mont.

—— ——, var. *pallida.*

Skenea planorbis, Fabr. Gregarious in shelly gravel, with *Astarte triangularis*, at La Rocque.

Homalogyra atomus, Phil.

Scalaria communis, Lam. Living amongst sand and *Zostera*; lower part of the shell often buried in the sand. Coloured bands sometimes absent.

Odostomia pallida, Mont. Under stones.

—— *acuta*, Jeff. Under stones.

Odostomia unidentata, Mont.
—— *lactea*, L.
Natica catena, Da Costa.
—— *Alderi*, Forbes.
Adeorbis subcarinatus, Mont. Not uncommon. I have kept living specimens for several weeks, and offer the following description of the animal:—Body white with a pinkish hue, semitransparent, easily containable in the shell: *snout* rather long, extensile, cloven at its extremity, and of a bright red internally: *tentacles* diverging, rather long, extensile, blunt, or even a little club-shaped; upper portion white, lower half pink inside: *eyes* very small, at the outward base and somewhat behind the tentacles, under cover of the shell, and visible only when the animal is twisting itself: *foot* slightly notched in front, with rounded and widened corners, nearly square behind; white, with a pinkish stripe lengthwise along the middle: *gill* comb-like, on the right side of the body, and not always protruded.

It is not timid, and swims on its back under the surface of the water. Some shells are white; but the greater number are of an ochreous colour.

Lamellaria perspicua, L. Rather common in autumn.
Cerithium reticulatum, Da Costa.
—— *perversum*, L.
Purpura lapillus, L. White, orange, brown, banded, and various other colours.
Buccinum undatum, L. At low water, and also its egg-cases adhering to stones.
Murex erinaceus, L. Inside of the shell sometimes dark brown.
—— *aciculatus*, Lam. Common. The shell is sometimes of a light flesh-colour.
Lachesis minima, Mont.
Nassa reticulata, L. In some specimens the mouth is of a bright green colour.
—— *incrassata*, Ström.
Defrancia Leufroyi, Michaud.
—— *purpurea*, Mont. Body white, with specks of a more opaque white, and not tinged with purple or brown: *pallial tube* grey. Shell purple, sometimes with grey blotches. Length 0·8, breadth 0·33. In smaller specimens, although full-grown, length=0·45.
Pleurotoma rufa, Mont.
—— ——, var. *lactea*. Dead only.
Cypræa europæa, Mont. Plain specimens are more common than three-spotted ones. It can swim on its back.
Bulla hydatis, L. Rare. Empty shells more common.
Philine aperta, L.
Aplysia punctata, Cuvier.
Pleurobranchus membranaceus, Mont. Two young specimens. Length of shell 0·6.
—— *plumula*, Mont.
Melampus bidentatus, Mont.

CEPHALOPODA.

Loligo vulgaris, Lam. Pens only.
Sepiola Rondeletii, Leach.
Sepia officinalis, L. Shells only.
—— *elegans*, De Blainville. Shells only and broken.
—— *biserialis*, De Montfort. Imperfect shells.
Octopus vulgaris, Lam. Common. At La Rocque the heaps of empty shells around the dens of the *Octopus* are for the greater part composed of *Pectunculus* open but entire. In stony ground their hiding-places are often indicated by "débris" of the common green crab, on which they appear to feed.

FRESHWATER SHELLS.

CONCHIFERA.

Pisidium fontinale, Drap.
—— *pusillum*, Gmelin.
—— *nitidum*, Jenyns.

GASTROPODA.

Planorbis lineatus, Walker.
—— *nautileus*, L.
—— *albus*, Müll.
—— *spirorbis*, Müll.
Physa hypnorum, L.
Limnea peregra, Müll.
—— *truncatula*, Müll.
—— *glabra*, Müll.
—— ——, var. *elongata*. Apex more blunt than in the typical form; living together.
Ancylus fluviatilis, Müll. More than once I have found young specimens of this slow mollusk adhering to an active flying water-beetle, the *Acilius sulcatus*. Thus carried from one pond to another, it can be rapidly distributed throughout the country.

LAND SHELLS.

Arion ater, L.
—— *hortensis*, Fér.
—— *flavus*, Müll.
Limax marginatus, Drap.
—— *flavus*, L.
—— *agrestis*, L.
—— *maximus*, L.
Succinea putris, L.
Vitrina pellucida, Müll.
Zonites cellarius, Müll.
—— *alliarius*, Müll.
—— *nitidulus*, Drap.
—— *radiatulus*, Alder.
—— *nitidus*, Müll.
—— *crystallinus*, Müll.
—— *fulvus*, Müll.
Helix aculeata, Müll.
—— *aspersa*, Müll.

Peters (1865–1867).	*Gray* (1866).	*Dobson* (1875).
Fam. **Megadermata.**		Fam. **Nycteridæ.**
Gen. Rhinopoma.	Distributed between the families *Rhinolophidæ* and *Vespertilionidæ*.	Gen. Megaderma.
Megaderma.		Nycteris.
Nycteris.		
Nyctophilus.		
Fam. **Brachyura.**	Fam. **Noctilionidæ.**	Fam. **Emballonuridæ.**
Gen. Mystacina.	Gen. Mystacina.	Gen. Mystacina.
Noctilio.	Noctilio.	Noctilio.
Taphozous.	Mormops.	Taphozous.
Emballonura.	Phyllodia.	Emballonura.
Saccopteryx.	Chilonycteris.	Saccopteryx.
Peropteryx.	Pteronotus.	(Peropteryx,
Cormura.	Spectrellum.	Cormura,
Balantiopteryx.	Myopteris.	Balantiopteryx.)
Rhynchonycteris.	Nyctinomus.	Rhynchonycteris.
Centronycteris.	Subg. Tadarida.	(Centronycteris.)
Coleura.	Gen. Molossus.	Colcura.
Diclidurus.	Subg. Mormopterus.	Diclidurus.
Furia.	Promops.	Furia.
	Gen. Cheiromeles.	Nyctinomus.
Fam. **Molossi.**		Mormopterus.
Gen. Nyctinomus.		Molossus.
Subg. Mormopterus.		Cheiromeles.
Gen. Molossus.		Rhinopoma.
Subg. Promops: Molossops.		
Gen. Chiromeles.		

It will be seen that the family *Nycteridæ* contains two only of the four genera included under *Megadermata*, Peters, a term, however, previously used by Wagner * to denote one of the subfamilies into which he divided his family *Istiophora*, and which also included *Macrotus*, a genus of *Phyllostomidæ* from Central America. I have therefore thought it better to drop the name *Megadermata* altogether than by retaining it to add to the confusion previously existing.

Comparison of the genera of the other families shows that (with the exception of *Rhinopoma*) the genera of *Emballonuridæ* exactly correspond to those included in the two families *Brachyura* and *Molossi*, Peters, while of the eleven genera contained in *Noctilionidæ*, Gray, five only are found among the fourteen which make up the family *Emballonuridæ*, the remaining seven being partly referable to the *Phyllostomidæ*, partly to *Vespertilionidæ* †.

* Suppl. Schreber, Säugeth. v. p. 639 (1855).

† Seven of the genera included by me in the *Emballonuridæ* were previously classed by Dr. Gray among the *Vespertilionidæ*.

The name *Noctilionidæ*, Gray, must therefore be rejected altogether by those who adopt my classification; and it is evident that, as Dr. Peters's families *Brachyura* and *Molossi* are united by me in a single family, it would be very undesirable to designate the new family thus formed by either of these names, which previously indicated only a section of it.

XXXIII.—*Description of twenty new Species of* Hesperidæ. By W. C. Hewitson.

Ismene Taranis.

Alis anticis supra cinereo-fuscis: posticis fuscis, fimbria alba, ad angulum analem fulva: posticis infra fascia triangulari alba puncto atro notata, macula fulva subanali.

Upperside brown, covered more or less, and especially near the base of the posterior wing, with grey hair. Posterior wing dark brown beyond the middle: the fringe, except at the anal angle, where it is orange, white.

Underside grey-brown. Posterior wing with a large central white spot marked by a round spot of black: a triangular orange spot near the anal angle: the fringe as above. The body beautifully tessellated with orange, black, and white.

Exp. $2\frac{1}{2}$ inches.

Hab. Zanzibar.

In the collection of Dr. Staudinger.

Near to *I. Pansa*, Hew., from Madagascar.

Ismene Bixæ.

Ismene Bixæ, Clerck, Icones, pl. 42. fig. 4.

Ismene Chalybe.

Ismene Chalybe, Doubleday & Hewitson, Genera of Diurnal Lepidoptera, pl. 79. fig. 2; Donovan's Nat. Repos. v. pl. 165.

The two butterflies I have quoted above, which have been considered as one, are very distinct species, as will be seen at once on comparing Clerck's and Donovan's figures of the undersides. In *I. Bixæ* the posterior *wing is protruded* at the shoulder, and has the white spot at a distance from the margin. In *I. Chalybe* the wing is of the ordinary form, and the white spot touches the margin. I have not quoted Linnæus, because his description will apply to either species, and Clerck's figure has the priority.

Eudamus Astrapæus.

Alis supra ochraceo-rufis: ambabus singulatim maculis duabus hyalinis: anticis punctis decem, posticis punctis quinque, fuscis: posticis infra maculis undecim albis.

Upperside. *Female* rufous. Both wings with two round transparent spots between the branches of the median nervure. Anterior wing with four brown spots between the first branch of the median nervure and the submedian—two before and two after the middle: a brown spot at the middle of the subcostal nervure, and five separate spots near the apex, the middle spot transparent. Posterior wing lobed, with five undefined brown spots, one in the cell, and two on each side of the transparent spots.

Underside as above, except that the posterior wing has a spot near the base, two spots within the cell, one between them and the inner margin, and one near the costal margin, forming part of a semicircle with those described above, all marked with white.

Exp. 2 to $2\frac{6}{10}$ inch.

Hab. Amazon: Villa Nova (*Bates*) and Chanchamayo (*Thamm*).

In the collections of W. C. Hewitson and Dr. Staudinger.

Three males in the collection of Dr. Staudinger are without any transparent spots: one has two lunular white spots in the place of the transparent spots of the anterior wing, and has three of the subapical spots marked with white. Comes in the same group as *Doriscus.*

Eudamus Nicephorus.

Alis rufo-fuscis: anticis puncto ochraceo costali: posticis serie punctorum ochraceorum.

Upperside. *Male* dark rufous-brown, paler towards the base. Posterior wing slightly lobed, with a bifid spot in the cell, followed by a curved band of six ochreous spots.

Underside as above, except that there is a small ochreous spot at the middle of the costal margin of the anterior wing, and a similar spot near the costal margin of the posterior wing, forming part of the transverse band.

Exp. $2\frac{4}{10}$ inch.

Hab. Amazon.

In the collection of W. C. Hewitson.

Eudamus Phraxanor.

Alis supra rufo-fuscis: anticis macula magna tripartita in medio posita maculaque sub apicem bipartita hyalinis: posticis macula

six parts. Posterior wing black with a short tail: marked in the middle by an oblong trifid white spot: the inner margin covered with grey hair, the fringe white.

Underside as above, except that the posterior wing has (absorbing the spot described above) a continuous band of white parallel to the outer margin, and marked by two black spots.

Exp. 2 inches.

Hab. Chiriqui (*Ribbe*).

In the collection of Dr. Staudinger.

Eudamus Ægiochus.

Alis anticis supra fuscis, basi cærulea, fascia transversa quadripartita recta punctisque quinque sub apicem hyalinis: posticis rufo-fuscis: his infra basi cærulea, puncto pallido in medio posito.

Upperside. *Male* dark brown, paler on the posterior wing. Anterior wing with the base brilliant blue: crossed at the middle obliquely by a quadrifid straight narrow band of white, the first spot on the costal margin bifid, a very minute spot outside of this band, and near the apex a band of five spots, all transparent. Posterior wing lobed, with the fringe white at the apex.

Underside as above, except that the costal margin only of the anterior wing is blue, and that the posterior wing has the costal margin at the base broadly blue, and a pale spot at the end of the cell.

The *female* does not differ, except in the broader form of the posterior wing.

Exp. $2\frac{2}{10}$ inches.

Hab. Chiriqui (*Ribbe*).

In the collection of Dr. Staudinger. Comes near *E. mercatus.*

Eudamus Œnander.

Alis supra fuscis, anticis basi cærulea: his infra margine costali cæruleo, margine interno albo: posticis basi cærulea.

Upperside rufous-brown, the base of both wings blue.

Underside rufous-brown. Anterior wing with the costal margin blue from the base to the middle, the inner margin broadly white. Posterior wing lobed, darker at the middle, followed by a band of paler colour.

Exp. $1\frac{6}{10}$ inch.

Hab. Pará.

In the collection of Dr. Staudinger.

Eudamus Meretrix.

Alis supra fuscis, basi cærulea: anticis fasciis tribus fuscis: alis infra ochraceis, posticis fasciis duabus fuscis.

Upperside dark brown: the base of both wings brilliant green-blue. Anterior wing crossed by three bands of dark brown—one bordering the blue, the second between it and the outer margin, the third, which is short, near the apex. Posterior wing lobed.

Underside ochreous-brown. Anterior wing with the bands as above. Posterior wing with a small spot near the base and two transverse bands dark brown, the outer band bordered outwardly with ochreous yellow.

Exp. $2\frac{3}{10}$ inches.

Hab. Ecuador (*Buckley*).

In the collection of W. C. Hewitson. Near to *E. Anaphus.*

Eudamus Cephisus.

Alis supra fuscis: anticis fascia quadripartita centrali, puncto minuto maculaque quadripartita sub apicem hyalinis: anticis infra basi ochracea: posticis dimidio interno ochraceo, maculis fuscis notato.

Upperside dark brown. Anterior wing crossed transversely at the middle, from the costal margin to the anal angle, by a continuous band of four distinct parts, a small spot outside of this band and a quadrifid spot near the apex all transparent white.

Underside as above, except that the base of the anterior wing and the inner half of the posterior wing are ochreous. Posterior wing with two spots near the costal margin before its middle and an oblique band of spots at the middle all brown.

Exp. $1\frac{8}{10}$ inch.

Hab. Chiriqui (*Ribbe*).

In the collection of Dr. Staudinger.

Eudamus Lebbæus.

Alis supra fuscis: anticis fascia bipartita punctisque duobus (uno sub apicem posito) hyalinis: posticis infra rufo-fuscis, puncto in cellula posito punctisque quatuor (duobus albo notatis) fuscis.

Upperside dark brown. Anterior wing with a short bifid band at the middle, a spot outside of it, and a spot near the apex all transparent white.

Underside as above, except that it is paler and tinted with carmine, and that the posterior wing, which is lobed, has a minute black spot at the end of the cell, and is crossed beyond the middle by four small black spots, two of which are marked with white.

Exp. $1\frac{2}{10}$ inch.

Hab. Chiriqui (*Ribbe*).

In the collection of Dr. Staudinger.

Eudamus Thaddæus.

Alis supra fuscis: anticis maculis tribus centralibus disjunctis, punctis duobus prope angulum analem punctisque quinque disjunctis sub apicem hyalinis: posticis infra fascia alba latissima.

Upperside dark brown, rufous towards the inner margin of the posterior wing. Anterior wing with three detached spots at the middle, two smaller spots below these near the anal angle, and five at the apex, also apart from each other, all transparent.

Underside as above, except that the spots of the anterior wing are much larger, that there is a small spot at the middle of the costal margin, and that the posterior wing is crossed by a very broad band of white.

Exp. $1\frac{17}{20}$ inch.

Hab. New Guinea (*Wallace*).

In the collection of W. C. Hewitson.

Eudamus Hymenæus.

Alis supra fuscis: anticis maculis tribus centralibus disjunctis punctisque quinque sub apicem hyalinis.

Upperside dark brown, rufous towards the base. Anterior wing with a central band composed of three separate spots, and an apical band of five separate spots, three of which are linear.

Underside as above, except that there are two indistinct pale rufous spots near the anal angle of the anterior wing.

Exp. $1\frac{7}{10}$ inch.

Hab. Aru (*Wallace*).

In the collection of W. C. Hewitson.

Eudamus Migonitis.

Alis supra fuscis: anticis maculis duabus (una bipartita) maculaque sub apicem tripartita hyalinis: posticis infra dimidio basali (margine costali excepto) lilacino punctis duobus notato: fascia margineque exteriore lilacinis.

Upperside dark brown, paler towards the base. Anterior wing with two central white spots (one bifid) at the middle and a trifid spot at the apex all transparent white.

Underside. Anterior wing as above, except that it is irrorated with grey near the apex. Posterior wing with the basal half (except the costal margin, which is brown) grey-white marked by two black spots: the outer half rufous-brown, crossed by a band of grey, the outer margin irrorated with grey.

Exp. $1\frac{9}{10}$ inch.

Hab. Mysol (*Wallace*).

In the collection of W. C. Hewitson.

middle by a series of four or five brown spots, and has a large dark brown spot on the lobe.

Exp. $1\frac{6}{10}$ inch.

Hab. Cayenne.

In the collection of W. C. Hewitson.

Eudamus Litanicus.

Alis supra rufo-fuscis: anticis maculis duabus fasciisque duabus fuscis: posticis macula fasciaque fuscis: his infra macula anali fusca.

Upperside dark rufous-brown. Anterior wing with a spot in the cell, a spot below it near the inner margin, a short band beyond the middle, and a band near the apex, all dark brown. Posterior wing lobed, with a spot in the cell and a transverse band beyond the middle both dark brown.

Underside as above, except that the posterior wing is paler, has two additional spots near the costal margin, and one on the anal lobe, all brown.

Exp. $1\frac{5}{20}$ inch.

Hab. Amazon.

In the collection of W. C. Hewitson.

Eudamus Laogonus.

Alis supra griseo-fuscis: anticis maculis quatuor in medio positis maculaque sub apicem tripartita hyalinis, fascia transversa pone medium fusca: posticis macula fasciaque fuscis, margine exteriore in medio protumido.

Upperside grey-brown. Anterior wing with four separate spots at the middle: the first (very minute) on the costal margin, the second deeply sinuated: a trifid spot at the apex: all transparent: crossed beyond the middle by an indistinct band of brown. Posterior wing lobed, projecting at the middle of the outer margin, crossed by two indistinct bands of brown.

Exp. $1\frac{7}{20}$ inch.

Hab. Brazil.

In the collection of Dr. Staudinger.

Eudamus Marpesus.

Alis supra griseo-fuscis: anticis macula magna centrali quadripartita maculaque sub apicem trifida hyalinis, fascia transversa pone medium fusca: posticis fasciis duabus fuscis, margine exteriore protumido.

Upperside grey-brown. Anterior wing with a large central quadrifid spot and a trifid spot near the apex transparent white: the outer margin and a submarginal band dark brown.

Posterior wing lobed, projecting at the middle of the outer margin, crossed transversely by two bands of brown.

Exp. $1\frac{3}{10}$ inch.

Hab. Brazil.

In the collection of Dr. Staudinger. May be a variety of the last.

MISCELLANEOUS.

Note on the Phenomena of Digestion in the Cockroach (Periplaneta americana, *L.*). By M. Félix Plateau.

The Editors of the 'Annals of Natural History' have given (in volume xvi. 1875, p. 152) a summary of my "Recherches sur les phénomènes de la digestion chez les Insectes"*. In the number for April 1876, p. 333, they have reproduced, under the title "On the Functions of the Glands of the Digestive Apparatus of Insects," an abstract of the memoir of M. Jousset de Bellesme entitled "Recherches expérimentales sur la digestion des Insectes et en particulier de la Blatte" (8vo, Paris, 1875).

The publication of M. Jousset's work has called forth on my part a well-founded claim of priority†, since M. Jousset reproduced, a year after myself, nearly all my results. A discussion has also resulted, as we did not agree on certain points, of which the principal may be characterized as follows. Relying on a long series of experiments, I had put forward in my memoir of 1874 that the digestive juices of insects are alkaline or neutral, *never acid*. M. Jousset asserts the contrary, and says that in the *Blatta* the liquid of the cæca of the middle intestine is slightly acid.

The present note contains the results of a study which I have just made of the phenomena of digestion in *Periplaneta americana*. The following is an abstract of it.

The aliments when swallowed accumulate in the crop and undergo the action of the secretion (which is most frequently alkaline) of the salivary glands; there the feculent substances are transformed into glucose. This first product of digestion is absorbed on the spot, and is met with no more in the rest of the digestive tube.

The valvular apparatus (gizzard), which by no means plays the part of a trituratory organ, allows the matter in course of digestion to slide in small quantities into the middle intestine. That region receives the juice secreted by eight glandular cæca, which is ordinarily alkaline, *never acid*, neutralizing the acidity that the contents of the crop may have acquired after a long stay in that organ, transforming the albuminoids into soluble and assimilable bodies analogous to the peptones ‡, and forming emulsion of the fats.

* Mém. de l'Acad. Roy. de Belgique, tome xli. 1874.

† Comptes Rendus, 1876, vol. lxxxii. p. 340.

‡ The action of the secretion of the cæca of the cockroach on the albuminoids has been demonstrated by M. Jousset. I am happy to confirm his results; only this secretion is not acid.

Finally, in the terminal intestine the residues of the digestive operation and the secretion of the Malpighian tubes (a purely urinary secretion) are mixed together.

If this summary is compared with that deduced from all my preceding researches on the Insects in general, which concludes my memoir of 1874, it will be seen that the phenomena of digestion in *P. americana* scarcely depart from the conclusions I then laid down. They complete them, and are a remarkable confirmation of them.

The notice terminates with a detailed reply to the objections of my learned opponent.—*Bull. de l'Acad. Roy. de Belgique*, tome xli. p. 1206.

Singular Ceylonese Frogs.

[We have received the following interesting observations on Dr. Günther's paper "On the Mode of Propagation of some Ceylonese Tree-frogs," which appeared in the 'Annals' for May 1876.—Eds.]

When I began to collect our Ceylon reptiles some years ago, the spawn referred to of a tree-frog seemed so common that I did not then notice it as a curious circumstance. I have had several of these sent to me from the damp trunks of plantain trees, and especially from the perpendicular sides of the stone-quarries at Mutuwal; and about the same time I saw one on the corner of a tank close to the lake near my house in Slave Island. All these masses of spawn were firmly attached to some object, and were several inches from the water. They were several inches in length and from $2\frac{1}{2}$ to 3 inches across the rounded mass at the lower end; and I concluded they were the spawn of the most common tree-frog in Ceylon from the coast up to several thousand feet elevation. In a note from Mr. J. Catto from Illagolla, and dated 1872, he told me he had seen a good deal of this spawn, and offered to send me some of it.

Our Colombo frogs are the following; and this spawn must be the produce of one of them. 1st. The most abundant is the bright green-coloured large frog seen in such quantities on weeds, with their heads out of the water, in the Colombo lake, and not unlike the eatable frog; indeed a Frenchman who could not resist eating these pronounced them very good. It is the *Rana hexadactyla*, and adds to the concert of frogs in the lake at the commencement of each monsoon. 2nd. The *Rana tigrina*, or Ceylon bull-frog, a very large brown-spotted frog, with corrugations along his back, found in holes in damp places along the shores of the lake, rare compared with the above, and croaks so loudly that his voice resembles that of a young bull. 3rd. The *Rana cyanophlyctis*, a smaller one than either of the above, with dark spotted back and white abdomen, found in ponds and smaller bits of water, still more rare than the other two. 4th. The very common house-toad, generally found under flower-pots in Colombo: this is the *Bufo melanostictis*; and I am aware that all these four breed and spawn in the water. 5th. *Diplopelma ornatum*, a beautifully coloured small squat frog, has been brought to me from the vicinity of Colombo. 6th. *Callula pulchra*, a dark-coloured toad-like one, very rarely found near Colombo; but I never saw these, nor heard of their being found in

for which the beds are explored, appear to have had their origin from the Eocene rocks beneath; these have also contributed numerous remains of marine vertebrates, especially of squalodonts, reptiles, and fishes. Mingled in the sand and clay with the phosphatic nodules and bones of Eocene animals are innumerable remains of cetaceans, sharks, and other marine animals of perhaps the middle and later Tertiary ages. Added to these are multitudes of remains of both marine and terrestrial animals of the Quaternary period. There are found pell-mell together bones of Eocene squalodonts, animals related to the whales and seals, hosts of teeth of the great shark *Carcharodon angustidens*, myriads of teeth of the giant of sharks of the Tertiary period the *Carcharodon megalodon*, bones and teeth of whales and porpoises, and abundance of remains of elephant, mastodon, megatherium, horse, &c., and occasionally the rude implements of our more immediate ancestors.

From among a collection of fossils from the Ashley phosphate-beds, recently submitted to his inspection by Mr. J. M. Gliddon, of the Pacific Guano Company, the specimens were selected which lie upon the table. One of these is a well-preserved tooth of a megatherium; another a characteristic portion of the skull of a manatee; a third a complete tusk of the walrus, indicating a still further point south for the extension of this animal than had been previously known; fourth, a huge tooth of a cetacean allied to the sperm-whale, probably the same as those from the crag of Antwerp ascribed to *Dinoziphius*. Besides these there are the beaks of three cetaceans of the little-known family of the Ziphioids; these are porpoise-like animals, without teeth in the upper jaw, and usually with but a single pair of teeth in the lower jaw. The beaks, composed of the coossified bones of the face, are remarkable for their ivory-like density, which probably rendered them available as weapons of defence.

A fourth beak from the same locality, presented by Mr. C. S. Bement, belongs to a different species of the same family. The beaks and some associated fossils will form the subjects of a paper shortly to be presented to the Academy.

The beaks have been referred to species with the following names and brief distinctive characters:—

Choneziphius trachops.—Supravomerian canal open. Intermaxillaries coossified and forming a crest along the middle of the beak extending to the interval of the prenarial fossæ. Maxillaries with a rugged tract at the upper part of the base of the beak.

Choneziphius liops.—Beak proportionally of less length than in the preceding. Supravomerian canal and intermaxillaries the same, except that the crest of the latter in front is acute. Maxillaries without the rugged tract at base.

Eboroziphius cœlops.—A new genus as well as species. Beak above forming a broad gutter as in *Hyperoodon*, and not divided by an intermaxillary crest as in the preceding. Maxillaries with prominent lateral crests at base, convex inwardly. Right prenarial fossa occupied by a thick osseous disk. Intermaxillaries coossified. Supravomerian canal open.

Belemnoziphius prorops.—Beak solid, with all traces of the original separation of the constituent bones and the ossified mesethmoid cartilage obliterated.—*Proc. Acad. Nat. Sci. Philad.*, May 9.

Reply to some Observations by Mr. Gwyn Jeffreys on the Cruise of H.M.S. 'Valorous' in 1875. By G. C. Wallich, M.D.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—It is mentioned amongst the "British Association Notes" of the 'Athenæum' for September 16th that, in a paper read at the Meeting by Mr. Gwyn Jeffreys on the results of the voyage of H.M.S. 'Valorous' to Disco in 1875, he described "the occurrence of large and small stones in his dredgings, and said that telegraphic cables had usually been constructed too much on the supposition that the sea-bottom was always soft; consequently they are very liable to damage when this is not the case."

During the voyage of H.M.S. 'Bulldog' in 1860 to the Faroe Islands, Iceland, Greenland, and Labrador, stones and gravel were repeatedly brought up from very great depths. Moreover a living *Serpula*, within its tube, which had evidently but then been broken off from its point of attachment to a stone or rock, together with a dead *Serpula*-shell still adherent to a granitic stone of considerable size, were obtained, nearly midway between the Faroes and Iceland, under conditions which would seem to indicate the presence of a deep-seated current, or rather drift, of sufficient power at all events to prevent any material accumulation of muddy deposit in that locality.

These several facts and their extreme importance in relation to deep-sea telegraphy were on various occasions referred to by me between the years 1860 and 1864, namely:—in my 'Notes on the presence of Animal Life at great Depths in the Ocean,' 1860, pp. 30, 31, & 37; in my 'North-Atlantic Sea-bed,' 1862, pp. 2–7 & 147; in my paper read before the Royal Geographical Society in 1863 *; in my "Outline of a Scheme for a systematic Survey of the Sea-bed," laid before the Council of the Royal Geographical Society in 1863 (of which a reprint appeared in the 'Annals' for July of the present year, p. 80); and lastly, in a paper, "On the North-Atlantic Sea-bed," in the 'Quarterly Journal of Science' for January 1864.

I will confine myself to giving the following extract from the paper last referred to:—

"There is one point to which I must invite attention, inasmuch as its importance can hardly be overestimated; and yet, strange to say, it has heretofore been almost entirely overlooked.

"In some of the deeper soundings both of the North and Mid-Atlantic routes†, fragments of rock have been brought up. How is the occurrence of these to be accounted for? and what does it

* On that occasion I exhibited an instrument, which I called a *Pelimeter*, designed by me for the purpose of readily detecting the occurrence of rocky or stony bottom at any depth.

† The occurrence in the Mid-Atlantic of a few "small stones" was noted in the tabulated lists of soundings taken by Commander Dayman, R.N., in the Atlantic in 1857.

betoken? The question is an intricate one, and so far as our present information goes does not seem to admit of a perfectly satisfactory solution. This much may be said, however, that their presence on the immediate surface-layer of the sea-bed is only reconcilable with one or other of the following suppositions:—They must either have been recently dropped by some means from the superincumbent waters, have been deposited by floating ice during past periods of the earth's history, must occur in beds which were once exposed above the surface of the sea, or be drifting about the bottom through the action of ourrents.

"Now in no case hitherto recorded have these stones been of large size, probably not larger than a hazel-nut*; but they present undoubted traces of attrition. Fish, as is well known, sometimes swallow small stones and, as a matter of course, get rid of them in time; but this would not meet the requirements of the first of the above suppositions, inasmuch as it is obviously improbable that so many fish with stones in their stomachs should be moving about the ocean as would be necessary to account for the fact. It is still more improbable, if not impossible, that fish could have conveyed such substances from the distant shores where they are alone obtainable. So that, viewing this circumstance in conjunction with the fact that no floating ice now-a-days traverses the areas referred to, it is certain the matter is inexplicable on the first supposition.

"If deposited from floating ice during *past* periods of the earth's history (according to the second supposition, which is by no means impossible), it follows as an inevitable consequence that the muddy deposits are local in character, and that certain areas of the sea-bed consist of bare rock, or that they are swept away by currents as fast as they are produced. I regard the first of these causes as most conformable with the evidence; for although there is reason to believe that deep-seated currents prevail with sufficient force, in some of the shallower tracts of the Atlantic, to move the fine particles of which these deposits are for the most part composed, there is no ground whatever for supposing that they are ever powerful enough to sweep along large objects such as the stones of which I have been speaking†. It will be seen, therefore, that we are justified in laying stress on the possibility that extensive areas of exposed rock may occur along the basin of the Atlantic, which have hitherto escaped detection. The third and fourth suppositions are thus disposed of likewise." (*Loc. cit.* p. 39.)

As it is stated in the number of the 'Athenæum' already referred to by me that Mr. Gwyn Jeffreys's paper is to be hereafter reproduced in the 'Proceedings' of the Royal Society, I beg leave to bring the above facts and observations to his and your readers' notice.

I remain, Gentlemen,

Your very obedient Servant,

September 19, 1876. G. C. Wallich.

* This is not quite accurate. As stated in 'The North-Atlantic Sea-bed,' p. 3, the piece of granite to which the dead *Serpula* is attached measures about an inch square.

† See 'North-Atlantic Sea-bed,' pp. 4–7.

Length 1–2 inches. My largest specimens have been obtained at Dunedin.

The young when first born are pure white, with the antennæ slightly tinged with purple.

In appearance this species closely resembles *P. capensis*, figured in the 'Zoology of the Voyage of the Novara;' but it has two pairs of legs less, and is hermaphrodite.

The geographical distribution of *Peripatus* is interesting, species being found in the West Indies, Chili, New Zealand, and the Cape of Good Hope. We must therefore suppose that it lived on the old Antarctic continent which, I have shown*, probably existed during the Upper Jurassic and Lower Cretaceous periods.

Habits.—They live in decayed wood, under stones, or in crevices of rock. They are nocturnal, but will feed in the daytime when hungry. They feed upon animals. I have seen one shoot out its viscid fluid from the oral papillæ at a fly introduced into the jar in which it was confined, and stick it down; it then went up and sucked its juices, rejecting the whole of the integument. This viscid fluid is for offensive and not defensive purposes†. In the winter they become half-torpid, although procreation still goes on. During this time of the year I have never seen them feed, and they cannot emit their viscid fluid, or only in very small quantity. They move with deliberation, entirely by means of their legs, the body being much lengthened. When walking, the antennæ are constantly moved about as feelers. If a needle is placed upright immediately in front of one, the antenna is drawn past it without actual contact; but the points of the hairs probably touch the needle. Although viviparous, the eggs are often extruded before development is complete; but these always die. They appear to breed all the year round, as I have never opened one that did not contain embryos. Notwithstanding this, they are local and not very abundant. When divided they die very quickly; and they are easily killed by immersion in spirit. When killed in spirit, they often die bent backwards. The body shows no segments, and there are no perivisceral septa. The only account of the anatomy of *Peripatus* that I have been able to see is the abstract of Mr. Moseley's paper given in the Ann. & Mag. Nat. Hist. ser. 4, vol. xiv. p. 225;

* Ann. & Mag. Nat. Hist. 1874, ser. 4, vol. xiii. p. 100, and 'Report on the Geology of Otago' (Dunedin, 1875), p. 85.

† Mr. Belt mentions a species of Myriopod, belonging to the order Sugentia of Brandt, that discharges a similar viscid fluid from its mouth to a distance of 3 inches, by means of which it secures its prey ('Naturalist in Nicaragua,' p. 140).

consequently much of the following description will doubtless be well known; but in so rare and interesting an animal this will probably not be considered a disadvantage, and I ought to apologize more for what I have failed to observe than for recording my observations.

Integumentary System.—The integument is quite soft. The coloured epidermis is sometimes covered by a thin white cuticle, which is easily separated. I believe this to be a true moulting of the skin; but I have never observed it thrown off naturally. On the inside of the legs there is a slight longitudinal infolding of the integument, which is very prominent in specimens preserved in alcohol; but there is no opening in the epidermis, and it has no respiratory function. I have not been able to see any perforations for the double row of tracheæ which open along the back (Pl. XVII. fig. 1, *b*); but no doubt they exist. The epidermis throws off water; and the viscid fluid of the animal will not adhere to it.

Muscular System.—Consists principally of a subcutaneous layer (Pl. XVII. fig. 1, *f*), which thickens considerably above the legs, and slightly below them. It is prolonged into the legs, forming a hollow cone extending to the feet. It is firmly attached to the dermis throughout. It consists of at least three layers, in the outer of which the fibres are arranged transversely, in the inner longitudinally, and in the middle layer obliquely in two directions crossing one another. This middle layer may perhaps be double; but I have not been able to separate it. The fibres are ·001 inch in diameter, and are not striated. The ejaculatory receptacle is coated with muscular fibres arranged in a widely open spiral, which are used for projecting the viscid fluid from the oral papillæ. The anterior portion of the salivary bag, to be presently described, is thickened by a horny deposit of a yellow colour; and along this arises an adductor muscle, which is inserted in the inner margin of the teeth.

Alimentary System.—The mouth is formed by a muscular wrinkled fold of the dermis, and is admirably adapted for sucking. Inside, on the superior surface of the pharynx, two horny, hollow, falcate teeth, with brown tips, are attached longitudinally on either side. When the mouth is closed, these teeth slope obliquely inward and downward at an angle of 45°; but when the mouth is opened they are vertical; in no case do the points cross each other: their use is no doubt to hold the prey whose juices are being sucked. They are hollow, with a second tooth inside, which appears to replace the old one (Pl. XVII. fig. 2). Following the pharynx is a short œsophagus, which extends to between the first and second pairs of ambulatory legs, and then gradually expands into the stomach, which occupies nearly the whole interior of the animal (Pl. XVII. fig. 1, *g*). The stomach contracts rather suddenly at the thirteenth pair of legs to form a short rectum, which opens to the surface by means of a two-lipped anus at the posterior extremity of the animal. In the ordinary state of the animal the stomach is arranged in numerous small transverse corrugations. There are no lateral diverticula. It is not attached by any perivisceral septa, but appears to be free, except where the tracheæ spread over its surface.

Salivary Vessels.—These consist of two much-folded vessels (diameter ·003) on either side (Pl. XVII. fig. 1, *d*), which lie between the nerve-cord and the lateral vessels to be presently described. These vessels arise about the posterior third of the animal; they are much lobulated posteriorly, and empty themselves into a bag which expands anteriorly and, passing below the ejaculatory duct, opens in the pharynx on either side just behind the teeth. This bag is compressed laterally, and tapers backward. It is abundantly supplied with elastic fibres, which line it interiorly; and to its anterior margin is attached the adductor muscle of the teeth already described.

Ejaculatory Vessels.—These pass from the oral papillæ upward and inward over the salivary bags, to lie above the stomach (Pl. XVII. fig. 1, *a*). The anterior portion suddenly expands to form a receptacle for the viscous fluid (Pl. XVII. fig. 3), which is ejected by means of the spiral muscles already described. The narrow portion of the vessel is produced into the receptacle (fig. 3, *a*), and doubtless forms a valve which closes when the fluid is being ejected. These vessels extend backward to the posterior extremity of the body, and send off branches on either side, which penetrate almost everywhere in the perivisceral cavity. The branches are simple or rarely branched, about ·005 inch in diameter, alternate and of various lengths (Pl. XVII. fig. 4). Their terminations are closed and rounded; and they do not taper towards the end. They consist of a membranous sheath lined internally by a layer of large epithelial cells. They contain numerous granulated cells, about ·0007 inch in diameter, freely floating in a limpid fluid. The viscid fluid when ejected dries very quickly on exposure to the air, and is so tenacious that the finger is with difficulty removed if stuck to the table with it. It coagulates at once and hardens in alcohol. I have never succeeded in making them eject it under water.

Respiratory System.—Respiration is by means of tracheæ, a row of which are situated on either side of the back, alternating with the legs (Pl. XVII. fig. 1, *b*); these decrease in

cords consist of fine granular matter enclosed in a delicate membranous sheath; there is no appearance of nerve-fibres.

Reproductive System.—I have dissected more than twenty specimens of *P. novæ-zealandiæ*, and in every case found it to be hermaphrodite. The female organs consist of a single ovate ovary (Pl. XVII. fig. 8, *a*) lying above the stomach opposite the eleventh and twelfth pairs of legs, and attached superiorly to the muscular layer. From the narrow posterior end proceeds an oviduct, which soon branches into two (fig. 8, *c*), one on each side: these pass anteriorly below the ovary, and extend forward sometimes as far as the fourth pair of legs; they then bend backward, and after several foldings pass below the nerve-cords and open together into a single vulva (fig. 8, *f*), situated on the ventral aspect, in front of the anus. These oviducts are nearly twice the length of the animal, and gradually enlarge towards the extremity: in their posterior half they contain a large number of irregular, transverse, undulating spiral fibres, exactly like the spiral fibres of the tracheæ, which gradually become less and less in number anteriorly. The male organs consist of a pair of globular testes (Pl. XVII. fig. 8, *b*), from each of which two vasa deferentia pass into each oviduct a short distance from the ovary; these testes are formed of large cells. The spermatozoa are developed only in the central part of the testes. They are filiform, tapering to each end; length ·0025, breadth at middle ·00008 inch. Their movements are very slow and sluggish, and soon cease, and are probably hygroscopic. Their development was not seen; but they certainly become free in the testis. Opposite the entrance of the vasa deferentia, and for a short distance above and below them, the oviduct expands into a series of short cæca, which perform the function of vesiculæ seminales. These cæca also secrete numerous spherical cells, about ·0008 inch in diameter, full of granular matter, which fill the oviduct below them.

Development.—*Peripatus* is viviparous, and development takes place entirely in the oviducts. The number of embryos in different individuals, or in the two oviducts of the same individual, varies. In one case I counted eighteen embryos in the right oviduct, and eight in the left; in another case there were two embryos, symmetrically placed, in each oviduct. When the embryos are numerous, there is always a considerable difference in the point of development to which they have attained; but the early stages are rapidly passed through. The ova are developed on the interior of the ovary. They are at first spherical and about ·0006 inch in diameter. As they increase in size they get ovoid in shape, and the contents become granular and yellow. A germinal vesicle and spot are developed in them, and the ovum is plainly seen to be surrounded by a clear vitelline substance enclosed in a distinct vitelline membrane (Pl. XVII. fig. 9). In an ovum ·0084 inch in length the germinal vesicle was ·002 inch in diameter and the germinal spot ·0005. The vitellus now thickens and becomes dark green by transmitted light, but white by reflected light; the germinal spot disappears; and the ovum appears to be hollow, and sometimes slightly constricted in the middle (Pl. XVII. fig. 10). There is no micropyle. The ovum is next detached from the ovary; and the germinal vesicle disappears, and the ovum passes into the oviduct. On passing the vesiculæ seminales it becomes fecundated, and total segmentation ensues (Pl. XVII. fig. 11); a tough hyaline envelope, or chorion, now forms round the ovum. Owing to the toughness of this chorion and the opacity of the vitellus, the earlier stages of development are difficult to follow; but I believe that it commences by a thickening of the blastoderm at the head, which gradually extends backward, and the contents of the ovum assume a reniform shape. At a further stage, when the embryo is sufficiently firm to be removed from the chorion without injury, it is seen to be folded, with the dorsal surface outward and the posterior flexure toward the ovary. The formation of the limbs begins in front, and extends backward; they commence as hollow, slightly constricted protuberances formed of two layers of cells (Pl. XVII. fig. 13, *a*). The intestinal canal is at first slightly extended laterally towards the hollows of the legs. From the procephalic lobes bud off superiorly the antennæ (fig. 13, *b*), which become ringed before the posterior leg-buds are formed. The head is proportionally very large. The posterior extremity is divided into two lobes (fig. 12), which ultimately form the lips of the anus. At a rather later stage the opening of the gullet is formed (fig. 14, *d*), and a trilobed growth is seen on either side between the antennæ and oral papillæ (fig. 14, *c*). These, which are possibly homologous with a pair of legs, although they are developed later, subsequently grow inward and form the sides of the mouth (figs. 15 & 16, *e*). Two large oval or pyriform swellings arise from the lower surface of the cephalic lobes, just in front of the opening of the gullet (fig. 15, *f*); a longitudinal depression is formed in each of these by invagination; and in these depressions the teeth are subsequently formed. The under surface of the cephalic lobes, just in front of these swellings, now grows downward and covers them (figs. 15 & 16, *g*), and spreads backward until it unites with the trilobed growth, previously mentioned, to form the mouth. By this time the anus has been formed by the downward folding and growing together of the two posterior lobes. The lobes of the cephalic ganglion remain free until after birth. The joints and claws of the tarsi are not developed until quite late. The eyes are developed before the teeth. The young at birth are from ·3 to ·5 inch in length.

Systematic position.—The affinity of *Peripatus* to the Tracheata has been ably discussed by Mr. Moseley in his paper already mentioned. To the evidence there brought forward may now be added the salivary glands (which are much better developed than in any of the Annelida), and possibly also the moulting of the skin. But its affinities with the Annelida are much stronger, as shown in the muscular, nervous, and circulatory systems, the absence of biliary vessels, and in the dorsal position of the tracheæ. The teeth are not homologous with the mandibles of the Tracheata, but with the teeth of the Annelida, and they closely resemble those of *Eunice.* The adductor muscles of the teeth have the same attachments as those of the Annelida, and are widely different from those of insects, in which they arise from the posterior part of the head. The circulatory and nervous systems show most affinity to some of the Tubicola. I do not regard the fact of *P. novæ-zealandiæ* being hermaphrodite as of much importance in classification.

Mr. Moseley has correctly said that *Peripatus* cannot be a degraded Myriopod; but neither can it be considered a direct link between the Tracheata and the ringed worms. In all probability it is a diverging branch from the main stem through which the Tracheata were derived from the ringed worms. It may be well placed in Professor Häckel's Protracheata; but the Protracheata must be put either as an order of the Annelida, or as a distinct class of the Vermes.

EXPLANATION OF PLATE XVII.

Fig. 1. Section across anterior portion of *Peripatus*: *a*, ejaculatory ducts; *b*, tracheæ; *c*, lateral vessels; *d*, salivary glands; *e*, nerve-cords; *f*, subcutaneous muscular layer; *g*, stomach.
Fig. 2. Inner tooth.
Fig. 3. Receptacle of ejaculatory vessel.
Fig. 4. Ejaculatory gland.
Fig. 5. Branch of dorsal tracheæ.
Fig. 6. Cephalic ganglion.
Fig. 7. Portion of nerve-cord.
Fig. 8. Generative organs: *a*, ovary; *b*, testes; *c*, oviducts; *d*, nerve-cords; *e*, rectum; *f*, vulva.
Fig. 9. Ovum with germinal vesicle and spot (from ovary).

day, apart from the days of rest, representing intervals of 40–44 hours, which intervene with a certain regularity. With regard to the second point my results are equally at variance with those of M. Coste. The examination of more than 20 fresh ovaries, undertaken at times when semen ought to be found there if it ordinarily reaches the ovary, gave in most cases a negative result; only in two cases was living semen found; in three others some dead spermatozoa were observed. Only once was a living spermatozoon found outside a mature follicle, which was free from the infundibulum; of four follicles which were embraced by the infundibulum, three showed a few spermatozoa. I have never found spermatozoa inside an entire follicle. I therefore do not believe that the semen ascends to the ovary otherwise than quite exceptionally. In order to ascertain the time occupied by the semen in ascending through the oviduct to the infundibulum, several hens which had been kept by themselves for some time were paired, again isolated, and killed from 10–24 hours after. In one case, after 10 hours, a great quantity of living semen was found in the base of the infundibulum, but very little either in the other part of the duct or on the margin of the infundibulum; in a second instance the semen was found, 12 hours after pairing, in the upper part of the tube, but next to nothing in the infundibulum; in a third case, after 14 hours, much semen was found in the upper part of the tube and a little in the base of the infundibulum; in a fourth hen, after the same interval, the semen was found all over the infundibulum; in a fifth instance, after 15 hours, nearly all the semen had passed into the base of the infundibulum, but some remained in the upper part of the tube; in a sixth case, after 16 hours, semen was found all over the infundibulum, though but little occurred near the base; none was found in the tube; finally, in a hen which had been kept isolated for 24 hours after pairing, semen was found only along the margin of the infundibulum, in and above the "pitted zone" to be described hereafter. This hen had laid a sterile egg 23 hours after being paired, which consequently must have encountered the ascending semen a few hours before entering into the fourth division of the oviduct, in which the shell is formed. It cannot be doubted that some few spermatozoa remain in the duct; but it seems unquestionable that the semen ascends in bulk into the infundibulum; and my experiments show that it requires from 10–16 hours in order to reach the infundibulum, and at least 14 hours to reach the pitted zone.

I have no hesitation in saying that if M. Coste had based his experiments and arguments on the assumption of an interval of 44–46 hours between each succeeding egg, and of 14 hours as the time required for the semen to traverse the length of the oviduct, he would not have concluded from this set of experiments that the egg is fecundated in the ovary.

The most probable conclusion from the facts as above stated is that the fecundation takes place in the infundibulum; and this appears to me to gain considerable strength from the circumstance that this part of the oviduct presents a very remarkable arrangement hitherto overlooked, the pitted zone already mentioned, which seems specially well adapted for retaining and preserving the semen.

The oviduct consists of four divisions, distinguishable by their physiological functions, viz.:—one, from its shape, is aptly termed the infundibulum, in which the egg is received from the ovary; a second, in which the albumen is secreted; a third, in which the shell-membrane is formed; and a fourth, producing the shell,—which last three represent the tubiform part of the duct.

But, however different the functions of these divisions are, their boundaries are by no means easily determined anatomically; each of them merges into the following one by gradual transitions. The folds of the infundibulum are simply continuations of those of the tubiform portion; and these are gradually transformed into the lower and at last shorter folds which are characteristic of the third and fourth divisions.

It is true that in some hens a kind of circular boundary-line, caused by the less-pronounced development of the folds in this line, may be observed between the second and third portion of the oviduct; but this is by no means clearly observable in all laying hens. The same may be said of two slanting transverse folds, which generally are seen near the base of the infundibulum, and which are caused by the greater thickness of the tube in proportion to the infundibulum; these folds appear less prominent in proportion as the infundibulum is more or less swelling and as its folds are thicker; sometimes they are entirely absent. The inside of the tube is wholly covered by a mucous epithelium forming numerous folds, which are supported in their interior by corresponding expansions of fibrous tissue. In the laying hen the epithelium is strongly ciliated and the folds highly turgescent. One might be tempted to say that the whole tube by its structure is adapted for retaining and even for preserving the semen. But I have not found the semen here otherwise than in passing, nor have I found any thing here that in any way appeared *specially* constructed to serve for the preservation of the semen for a longer time. With regard to the structure of the mucous membrane of the tube and the infundibulum, I have, like many others, obtained microscopic images which in the most deceptive way simulated small sinuated or even contorted bag-shaped glands; but, by carefully comparing numbers of successive sections, I have convinced myself that there is not one single gland on the inner surface of the oviduct of the hen. I can entirely confirm the results of Grünwald in this respect (in the Handbook of Stricker, pp. 1189, 1190) as against the statements of Nasse, Meckel v. Helmsbach, Lereboullet, and Leuckart.

It is in the infundibulum that we must look for any arrangement that could serve as a receptaculum seminis; and I believe that I have discovered it there. The appearance of the infundibulum is extremely changeable. The general striking difference in the appearance of the oviduct in laying hens and in such as have not yet commenced laying, has often been pointed out. But besides this there is a great difference in this respect between hens still laying and such as are sitting or in a period of rest; and, finally, considerable individual differences may be observed between hens at the same stage.

When the young hen has moulted for the first time, or rather before the first moulting is accomplished, the oviduct increases enormously in size, the infundibulum is considerably expanded, new fusiform cells appear, older muscular fibres are extended, and the muscular layers increase in size. At the same time the cellular tissue swells considerably, becomes fibrous and covered by a ciliated epithelium. The following observations on the minute structure of the infundibulum of the laying hen are the results of the examination of more than twenty specimens:—The infundibulum is on the outside covered by the same highly vascular adventitious membrane as the tube. Inside the adventitia a fine fibrous tissue is found, in which more or less concentric bundles of indistinctly separated smooth muscular fibres are imbedded, running parallel to the margin. These bundles may be considered as constituting a direct continuation of the circular muscular stratum of the tube, just as upon the whole the infundibulum may be considered as an expanded continuation of the substance of the tube. Longitudinal muscles properly speaking are entirely absent, at any rate towards the margin of the infundibulum. There are many *apparently* longitudinal muscular fibres and bundles of such; but these appearances are caused partly by the vessels, partly by the frequent divisions and subsequent reunions of the transverse bundles, partly by the circumstance that the circular bundles near the anterior and posterior pointed extremities of the infundibulum are

depressed areas or pits lined with a strongly ciliated epithelium. In the middle portion of the margin of the infundibulum (the part nearest in front of the aperture of the tube) these meshes are smaller and more regular; towards the anterior part of the infundibulum they become longer, more irregular, and partly hidden by the folds which are here more strongly developed. The same formations are met with on the muscular band above mentioned and along its inner margin, under certain circumstances even in a peculiarly high degree of development. A series of considerably larger pits are met with on the right lobe of the infundibulum, reaching from its foremost freer lateral lobe to the ostium infundibuli, decreasing in size hindwards. By degrees, as the muscles and folds swell, the pits become deeper and their margins increase in tension so much that they almost meet, and the meshes are converted into bags with small openings. Frequently muscles, vessels, and folds swell contemporaneously around a whole set of such bags, which thus will appear on the bottom of one larger pit, and this ultimately in its turn will be converted into a bag comprising the others. This latter arrangement occurs so frequently that it cannot be considered exceptional; but the small bags occur in every laying hen after the commencement of spring. In these pits and bags the semen finds protection; and most probably they contribute to preserve it. In this pitted zone along the margin of the infundibulum the semen is found spread, but, owing to the large superficial area, not closely packed. The largest number of spermatozoa I have found in a single bag is eleven. I have not found them alive later than the twelfth day after pairing.

After a time these bags degenerate; and this process first affects those situated in the middle part of the infundibulum, where, as already stated, they are smaller in size and more numerous. Gradually the bags increase in size; the ciliated cells fall off, leaving a thin transparent basal membrane, which now forms the wall of the bag; the little opening is closed. At first sight these appearances might suggest a hydropic state; but more extended examination proves that we have a normal state of degeneration before us. In the bags a very few spermatozoa may be found, generally sticking to the wall, sometimes several in small knots together. But the bulk of the contents is formed by degenerate ciliated cells, probably several generations, not only from the wall of the bag itself, but from the general surface of the infundibulum. By examination in a warm chamber (as proposed by Professor Panum) whole streams of loose ciliated cells may be seen, however carefully one operates, passing along the folds. I have had no opportunity of instituting a comparison between these formations and the ovula Nabothi in mammalia; but their history exhibits a striking parallelism in some respects, in spite of the fundamental difference as to the place.

In the middle of the summer the tissues of the infundibulum continue to swell, so that the arrangement which, as it is seen in the spring, may be described as areolar, is now more properly described as spongeous or cavernous; parts which formerly might be examined by an immersion-lens, now defy the application of any but low powers of the microscope. The right-hand lobe of the infundibulum swells so much along the zone above described, that particularly the anterior part becomes arched inwards; whilst the fimbriæ in this part for the same reason bend towards the outer side, where by degrees they fall off and degenerate, whilst a newly-formed margin, to take the place of the incurved portion, is already formed, mostly on the external border of the zone in question; sometimes even two new lobes may be seen almost parallel to each other. This circumstance explains why in such hens the bags are most frequently found in the extreme margin of the infundibulum.

When a hen has been laying for some time, she becomes exhausted, she ceases to lay, wants to sit, and a peculiar state of dissolution may be observed in all parts of the oviduct. The ciliated epithelium falls off, and the most distended portions of folds and margin also are loosened. In the general cavity of the body a considerable quantity (I found once as much as an ounce) of a yellowish brown liquid is collected, containing some small acuform particles and a great mass of ciliated epithelium from the oviduct. The whole of the latter, together with the mesometry, seem half-dissolved, and are very fragile.. This state of things begins to show even before the laying is quite finished. In one case I found the cavity of the body full of the liquid, and the infundibulum quite ragged, in a hen which still had an egg in the lowest part of the oviduct, the largest follicle having a diameter of about 10 millims. If the hen is not allowed to sit, she begins to lay again after an interval of from six to twelve days, rarely more. This interval consequently suffices for the regeneration of the ciliated epithelium, as well as of muscular elements, in the oviduct and the mesometries. Towards the autumn, when the activity of the hen approaches its conclusion for the year, the volume of the oviduct and the infundibulum are considerably reduced during the period of rest, even if the activity is resumed to a smaller extent. When the hen sits, the oviduct is much reduced and loses its ciliated epithelium.

I have stated that the right-hand lobe of the infundibulum was generally more abundantly supplied with pits and bags than the left; and a similar difference is observed also with regard to the turgescence and luxuriant growth of the parts generally. The portion most affected is the anterior part of the right lobe, near the pointed part which stretches along the anterior mesometry towards the ovary. Here the right lobe always develops a more or less expanded, almost rectangular secondary lobe; at the same time, in the highly turgescent state, the pitted zone is arched inwards against the anterior narrower part of the infundibulum. Thus a kind of indentation is formed between the turgescent lobe and the narrow anterior part of the infundibulum. This indentation corresponds in size to the stems of the folliculi, and catches round them, collar-like, when the infundibulum has seized the follicle. The expanded right lobe then closes round the follicle in the shape of a cupola and pulls against the contractions of the mesometry, by which the ripe follicle and in part the ovary are drawn backward—a process which no doubt contributes to the bursting of the follicle. Only one case has occurred to me in which the left side of the infundibulum was more developed than the right.

I believe myself justified in concluding that this pitted zone serves to arrest the progress of the semen and to preserve it—in short, that it constitutes a true receptaculum seminis—and that the fecundation of the eggs takes place in the infundibulum, on the egg coming into contact with the semen by the bursting of the follicle. Not having met with living semen in the pitted zone later than the twelfth day after the pairing of the hen, I assume that it does not generally keep longer; and it is in good keeping with this view that fertile eggs, according to Coste's and my own experiences, are not often laid after the eleventh day, though instances have occurred of the last fertile egg being laid on the seventeenth or eighteenth day. But in these cases the hens have not been laying regularly; and though a successful pairing has been known to suffice for eight fertile eggs, its efficacy generally reaches only to five or at most seven, the subsequent eggs being sterile without renewed pairing of the hen.

the end of August in the fir-woods of Shamsi in the Alexandrovsk mountains.

C. canadensis is exactly similar to the present species in its winter dress, so much so that I mistook a specimen of *C. canadensis* in the Zoological Museum of the Academy of Sciences for the present species. This specimen was obtained by Mr. Vosnesensky at the N.W. coast of America. Not even in the coloration could any difference be discovered, except that the light-coloured spot of the Turkestan deer is a little wider at the tail than that of *C. canadensis*; but on the latter it is just as sharply marked and also surrounded by a stripe. The most important difference (except the length of tail) consists in *C. canadensis* not changing its colour during the summer. A live specimen seen by me in the Zoological Gardens at Berlin, in the month of June 1856, and another in the Moscow Gardens, in August, had both the winter dress of the Turkestan deer—the Moscow one being only a little more yellowish on the back, being, however, light with a dark belly.

C. elaphus is all over brown; different specimens, however, differ in the coloration, commencing from reddish brown and light brown, and merging even into blackish brown. The belly is lighter; the hair of the neck is longer, and is, as in the foregoing species, of a greyish-brown colour; the markings alter very little according to the different seasons of the year, except that the winter hair is rather longer and greyer than the summer dress, and at the hinder portion of the belly during the change of coat, before the rut, some blackish-brown hair appears. The light patch round the tail is not so sharply defined, and only the posterior portion of the thighs and the region round the tail are lighter than the back, being of a brownish-yellow colour.

The characters in the horns are constant, but not very conspicuous, as the very considerable differences between individuals of one species are more easily perceived than the specific characters which they have in common, the former depending upon the age and the branching of the antlers. Blasius was almost the first who fully explained these characters in the European species, and especially those of *C. elaphus* ('Säugeth. Deutschl.' p. 447). He drew attention to the deviation of the beam from its original direction at the point where each antler is given off, which also enabled him to follow the modifications of the beams and of the antlers. According to previous diagnoses, the horn of *C. elaphus* was characterized by the final division of the horn into the terminal tines, which could not be exact, for the simple reason that at that portion the points are much closer to each other than they are on the basal part of the horns.

Consequently I will make use of Blasius's description of *C. elaphus* for comparison with *C. maral*, although I have compared the horns of the two species myself.

The beam of the horns of *C. elaphus* rises perpendicularly up to the brow-antler; then it inclines outwards as far as the next branch, continuing to do so until the third antler; this outward inclination gets less vertical at every antler, so that the angles formed by the chord of this arc and the axis of the skull become gradually less, and thus the horn forms one broken line bent to the outside.

The horns soon begin to incline backwards and their extremities a little inwards, this backward inclination becoming more considerable at the root of each successive antler, so that the angles formed by the chord of this arc to the cross axis of the skull become gradually wider, and the branches, when looked at from the front, are situated in pairs, or point irregularly to the outside, forming the crown of the horns. The whole crown forms a very acute angle with the beam. The brow-antler is directed forwards parallel to the cranial axis; the next three antlers are directed outwards with a slight inclination towards the front; but those of the final curve point upwards, inclining a little to either side, the ends of all the branches rising a little, as does also the beam after its final branch.

The horns usually do not increase after having developed sixteen to eighteen points, the two basal antlers included; but sometimes horns with even as many as twenty-two points are to be found, and on old specimens a branch does occasionally grow out of the brow-point of the horns. The branches on the final curve of the horns are closer to each other than on any other part of it, and form the crown; consequently on each complete horn there is one brow-antler, two side branches, and four to seven crown-points, all together from seven to ten points.

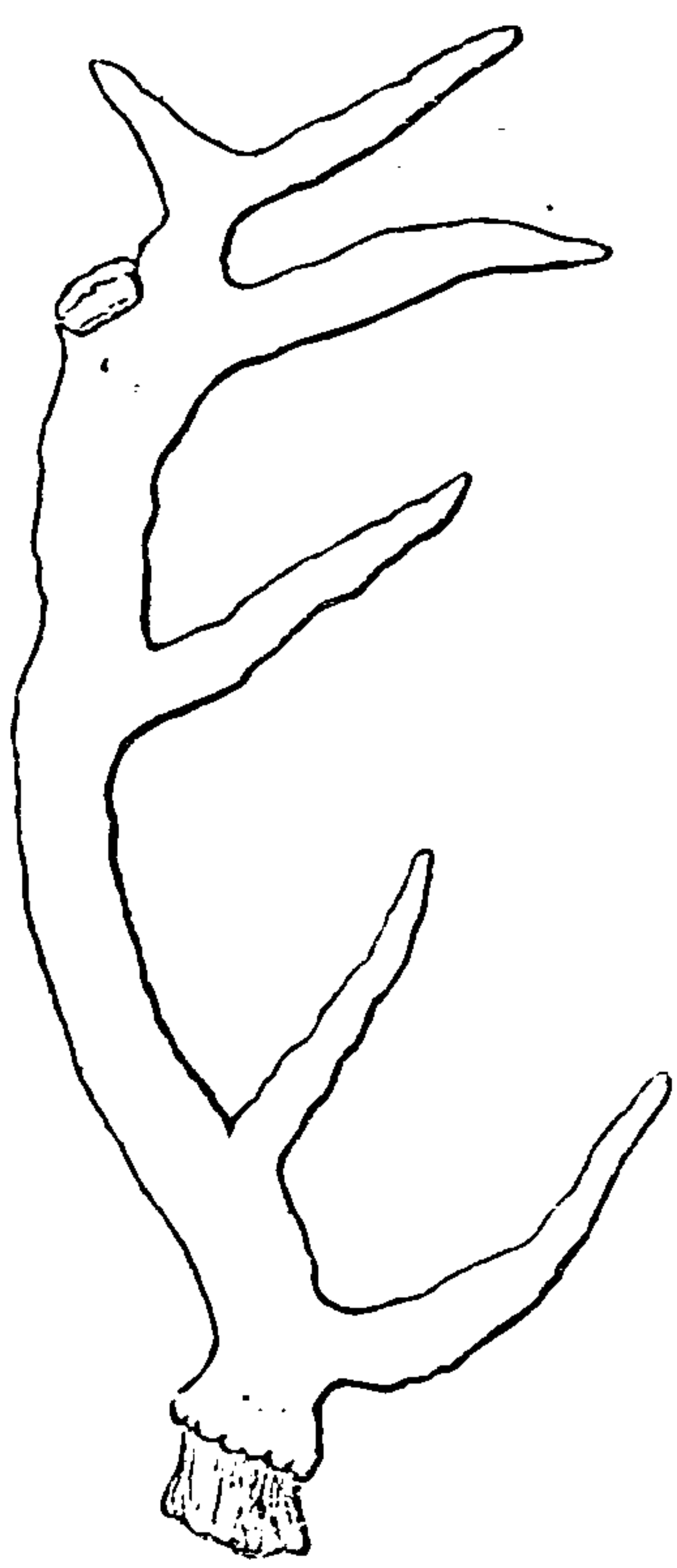
The shape of these horns is somewhat similar to that of the horns of *C. maral*, with the difference, however, that the crown of the latter does not differ so much from the other parts of the horn as it does in *C. elaphus*. The branches of the crown in the present species form a single row, being placed parallel to each other, and not branching off in different directions; sometimes they even run parallel with the lower antlers, in which latter case the anterior edge of each crown-point and that of the terminal portion of the beam are sharp, but the posterior angle very blunt, of course in different specimens to a different degree, this not being at all regular or constant. As soon as the animal becomes adult the horns begin to grow more slowly; and they finish growing earlier than in the red deer, namely after the horns get from twelve to fourteen points, or, at the most, sixteen. Consequently each complete horn possesses one brow-antler, two side branches, and from two to four crown-points. The age of *C. maral* can be estimated from the horns only up to six or eight years, whilst that of *C. elaphus* can be ascertained as late as nine or even eleven years. Both these species become adult about the same age, namely five years, with ten branches to the horns.

The horns of *C. maral* are subject to numerous and considerable variations in different specimens, particularly in the crown—which fully corresponds with the slow growing of the latter. Also the bend of the terminal portion of the beam is variable in its length and directions, as well as the branches of the crown themselves; still they are constantly further apart from each other than those of *C. elaphus*. The differences in the lengths of the points seem to me to depend upon the animal's age; they are very considerable, as the length of the crown-points differs from 5″ upwards to 20″. If the horn has long crown-points, I have noticed that it is covered all over with numerous, sharp and very prominent ridges, which in themselves give proof that the animal is old. We may therefore say that after six or eight years new points do not develop, but the former ones are reproduced of larger size, but never to the extremes of the length or thickness of the points.

These extreme limits of the development of the points do not appear without a corresponding shortening of the beam: if the branches are very long, say 21 inches, the beam does not measure above $3\frac{1}{2}$ feet; but if the latter measures $4\frac{1}{2}$ or even $4\frac{3}{4}$ feet, the antlers do not exceed 15 to 18 inches; and the short beams, if compared with the long ones belonging to animals equally old, are always thicker.

The horns of a young *C. maral* can always be distinguished from those of a young *C. elaphus* by their immense proportions. I have also observed that before the crown is developed the terminal part of the beam is longer than the last antlers, constantly forming a considerable part of the whole horn, viz. about one third, whereas this branch in the horns of *C. elaphus* does not exceed one fourth. This is the case with specimens which possess from eight to ten tines; in individuals of six years these proportions are greater, but always present the above-stated characters.

Even in captivity the difference in the colour can be noticed, which probably depends upon the climate, as the specimen of *C. canadensis* in the Berlin Zoological Gardens is greyer in summer than the specimen in the Moscow Gardens. I have also noticed the fact that *Equus hemionus*, which in summer is dun and in winter mouse-grey on the steppes, has remained mouse-grey all the year round in the menagerie of St. Petersburg. On the other hand, the difference between *C. maral* and *C. elaphus* is very ancient, and originated at a period of time when Europe and Asia were separated by the sea, which at the Pliocene period occupied the present deserts of Persia, Turcomania, the Kirgies steppe, and Barbary (in the western portion of Siberia), as far as the Arctic Ocean, thus connecting it with the Indian Ocean. These deserts and steppes prove, by their salt lakes and plains and the shells that are now and then dug out of the ground, that here there was once a sea; and at present they form the limit where *C. elaphus* and *C. maral* meet each other. This limit at different times has been different. There was a time when *C. elaphus* was distributed as far as the Ural mountains; this is proved by a horn which was dug out of the bed of the Ural river, a little below the town of Ural, and which is now in the Ural Army Museum. I give a drawing of it here.



Judging from the form of the crown of this horn, it certainly belongs to *C. elaphus*, and does not differ at all from the recent horns of that species. It is true that in the present specimen the antlers are more curved; but some specimens are also met with in which they are quite straight. The present specimen, however, is typical in the varied directions of the crown-points, which I have shown to be the best characteristic of the horns of *C. elaphus*, and which are very plainly marked in this Ural horn. This horn has seven points—one brow-antler, two lateral points, and four crown-points, which are placed in pairs and are all close to one another.

I am sorry to say that I cannot state from which strata this horn was derived, as it had been already washed by the river from its original matrix before it was dug out of the river's bed.

One of the branches is broken off; but the horn has evidently not been carried far by the stream, as its natural inequalities of surface were quite evident and not at all water-worn; it also retains its pedestal, and consequently was not a cast horn. Still, after some comparisons, the time may yet be easily fixed when *C. elaphus* inhabited the Ural, this being further east than it occurs now, towards the limit of the distribution of *C. maral.* It could not have been during the Glacial period, as at that time the whole of European Russia formed the bottom of a sea; nor could it have been much earlier, as the horn dug out of the Ural so closely resembles the recent ones. Consequently there remains the conclusion that *C. elaphus* inhabited the Ural after the glacial period: probably it may have been at the period of the deposition of the "black earth," which extends from Galicia as far as the Syrt, including the region watered by the rivers Volga and Dnjepr. The eastern frontier of the occurrence of *C. elaphus* at the present time runs between the Baltic and the Black Sea, meeting there the elk. Towards the south *C. elaphus* is distributed over the Balean peninsula, Asiatic Turkey, and the Caucasus. It is very probable that, at the time when the elk arrived in the forests between the Vistula and the Altai, it drove out *C. elaphus* from these localities and forced it to go further west; whilst *C. maral* has been driven away further to the south-east. At the time when *C. elaphus* was distributed as far as the river Ural, *C. maral* may have occurred further west than it does now, namely up to the basin of the Tobol and river Turgai and Sari-sa. It is even now met there, but only occasionally, in the forests of the Karkalinsk and Bayan-aulsk mountains. To the south from the Altai the maral, avoiding the steppes of Nor-saysan, inhabits the mountain-forests which extend over the Thian-Shan range. In Russian Siberia it has been met with on the Semiretchje and the Zailisky Alatau, in the mountains near Issik-kul and Narin, everywhere in fir-woods, and only occasionally in the greenwood districts. In summer it feeds even on the Alpine meadows, above the fir-district, and by night it always descends lower down to rest. In spring it sometimes feeds on the new leaves of bushes. It grazes usually about dusk—that is, early in the morning and late in the evening, resting and ruminating during the day. I obtained one at ten o'clock in the morning of the 20th September, when it was resting.

The horns are cast in spring; by the Thian-Shan deer about the end of April to May. During the months of June and

July the newly-grown horns are soft; and this is the time when these animals are mostly pursued by the Cossacks for the sake of their horns, which are readily bought by the Chinese people. In August the horns become hard; and in September the rut commences; the change of coat usually begins in the month of August. A young stag in my collection, shot on the 24th September at the sources of the river Merca, to the west from Vernoe, is 5′ 10″ long, and 3′ 8″ high at the shoulders. Like the old specimens, it was already in the full winter dress; but the horns were only just commencing to grow, forming two very small points on the skull. I reckoned that it was born in April, the more so as I saw in September a young hind of the same size, and also in winter dress, which had been caught alive in July when it was quite small. According to this the period of gestation would extend for about seven and a half months, namely from the beginning of September to the end of April or May.

A maral stag, if caught when young, is very easily tamed; the one seen by me in Vernoe followed its master like a dog, and was also very friendly with strangers. It used to eat out of one's hands, and sometimes even would walk into the rooms, where it smelled and looked at every thing; sometimes it ran about the town, and, in fact, knew the streets very well indeed, as it came home by itself and never lost its way. It fed on any plants it could get hold of, on hay, oats, barley, bread, boiled and raw potatoes, cabbage and all sorts of roots, and was very partial to the leaves of apple-trees.

M. W. P. Semenoff also kept a stag for about six years. It was always allowed to run about at liberty, sometimes keeping in the mountains for several days, but always coming back again. During the breeding-season it associated with the wild deer; but after this season was over it came back again to stables, which it very seldom left during the winter. It must have been ultimately killed by some sportsmen who mistook it for a wild deer.

The soft horns were every year cut off and sold to the Chinamen; and in several places stags are kept and bred for that purpose, especially in the Altai Zabaikalje.

I obtained a female specimen for my collection even further than Issik-kul, namely from the fir-woods of Semsha in the Thian-Shan mountains, on the 9th July, in a very much worn summer dress: this also proves the above-stated time of the animal's change of coat. There is very little doubt that it occurs in the fir-woods of the Alexandrovsk mountains, and still further west than Semsha, at least about the river Ala-archa.

on I was again struck with the resemblance of *C. maral* to *C. canadensis*, which I saw alive in the Zoological Gardens at Berlin; but from *C. elaphus* I always distinguished the present species correctly.

This led me to a comparative examination of the three forms, which showed me that I had hardly made a mistake in supposing *C. maral* to be *C. canadensis*. I could only distinguish the two by the labels attached to them in the gardens or museums; the differences are so trifling and indistinct; and at the time I even thought these differences were not constant.

It now seems to me that it would be unadvisable to retain the name of *C. canadensis*, var. *asiatica*; and I think it would be more correct to name it *C. maral* or *C. wapiti*, which latter name is better known to American zoologists, with three or even four local varieties, namely:—

Cervus maral (*C. wapiti*).

A. Var. *americana*.	B. Var. *asiatica*.
a. *canadensis*.	a. *sibirica*.
b. *californica*.	b. *songarica*.

Var. *songarica*.—These are the Thian-Shan stags, which are larger than the Siberian ones, and darker-coloured in winter, being brownish grey and not of a whitish colour; and, finally, the stems and branches of the horns of Thian-Shan specimens are longer and thicker.

The marking of the skin and the division of the points from the stem of the horns—in short, all the differences separating *C. maral* from *C. elaphus* are present in Siberian and the Thian-Shan specimens.

78. *Cervus capreolus pygargus*.

Is common all over the north-eastern portion, but occasionally occurs also in the neighbouring provinces; it is commonly to be met with in the mountains at an altitude of from 6000 to 10,000 feet above the level of the sea, hardly ever descending lower than 6000.

79. *Cervus* sp.?

This deer, which I could not exactly identify, was observed in the spring of 1858, by some hunters who accompanied me as far as the left shore of the Sir-Darja, near Port Peroff, in the "sacsaulnics," which extends over some wooded districts. Then again in the autumn of 1866 I saw a horn in Port Peroff belonging evidently to this deer. It was rather large, with six points but no crown; and as I quite forgot to make a drawing of it, I cannot say to which species it belongs. It is certainly a deer's horn belonging to the group of *C. elaphus* and *C. maral*. At the time I thought it belonged to *C. elaphus*. It is, however, more likely to be *C. maral*, which might have descended to the Darja from Karatau, having passed through the forests and plains, which latter extend from Susak to the west end of the Karatau mountain chain, and going round the latter, these plains reach to the Darja and even further than that.

Here the question arises, whether it is the true *C. maral* that inhabits the Karatau and Thian-Shan mountain-plains, which are not covered with fir-wood, or is it a new species altogether.

No specimens have ever been obtained from the western hills of Turkestan, and not even horns from there are known; and all the information we have is taken from the statements of the Kirgics, as I have already mentioned in describing the distribution of *C. maral*.

80. *Equus caballus.*

Is common in Turkestan at all seasons of the year. In winter it inhabits the lower places, not above 6000 feet, but in summer goes even up the highest mountains.

81. *Equus hemionus.*

Is rather rare in Turkestan, and to be found only about the Karatau mountains and near the rivers Aris, Keless, Chirchik, and the delta of the Sir-Darja, and even there only during the winter.

82. *Equus asinus.*

Is rare in the east but common in the west; it does not ascend far up in the hills, and is never to be met with above 6000 to 7000 feet.

83. *Sus scrofa aper.*

Is common all over Turkestan, except the south-western district, and inhabits the plains as well as the mountains, in which latter it also remains during the cold season.

[In the copy of the 'Fauna of Turkestan' translated by me, I find the following short list of addenda, by Dr. N. A. Severtzoff.—F. C. C.]

MAMMALIA.

1. *Felis* (*Catolynx*) *chaus* (vel *Chaus catolynx*, Pall.).

Occurs about Semiretchje, Issik-kul, about Hodgent, and in the whole Zarevshan valley, Lower-Oxus marshes. It has considerably larger feet than *F. servalina*.

2. *Canis aureus.*

On the Oxus.

3. *Vesperugo noctula.*

At Cheenaz on the Syr it was caught in March 1875; not observed before.

4. *Spermophilus xanthoprymnus*, Benn.

Erroneously noticed by me formerly as *Sp. fulvus*, Licht., which also exists in Turkestan, but only near the lower Syr. *Sp. xanthoprymnus* was found by me near Tashkent and Cheenaz, and near Samarkand by Russoff.

5. *Spermophilus Eversmanni*, Brdt.

Found, in the summer of 1874, near the mountain-lake Lairam-kul, north of Kulja.

XXXVII.—*Descriptions and Figures of Deep-Sea Sponges and their Spicules, from the Atlantic Ocean, dredged up on board H.M.S. 'Porcupine,' chiefly in* 1869 (*concluded*). By H. J. CARTER, F.R.S. &c.

[Continued from p. 324.]

Cometella pyrula, n. sp. (Pl. XIV. fig. 20, and Pl. XV. fig. 38.)

General form pear-like, twisted upon itself or towards the stem, which is attached to a small stone; head pyriform, apiculated by the projection of a conical point (Pl. XIV. fig. 20, *f*). Colour cream-yellow. Surface smooth, hard, firm, punctate, each punctum being the apex of a low conical projection formed of spicules arranged in a whorl-like manner (fig. 20, *h*). Pores not seen, probably the puncta respectively

accompanied by the stem of another, from which the head has been broken off. The label on the jar is "78," which gives the locality and depth above mentioned. It appears to belong to Schmidt's genus "*Cometella*" ('Atlantisch. Spongienf.' 1870, p. 49), and under other circumstances might grow erect and have a longer stem, as the headless one (fig. 20, *c*) seems to point out. The spicules indicate an alliance with those of the group Halichondrina, while the compactness of the tissue is like that of the Suberite *Halichondria suberea*, &c. In the jar with it are specimens of *Halichondria carnosa*, *Polymastia*, *Hymeraphia verticillata*, *Phakellia ventilabrum*, and *Tethya cranium*=*Donatia*, Gray.

Hymeraphia microcionides, n. sp. (Not illustrated.)

General aspect laminiform, extremely thin, following horizontally the form of the surface on which it may be growing. Colour now light yellow. Surface hirsute from the projection of long smooth spicules. Pores and vents indistinct. Internal structure consisting of a layer of spined spicules confusedly arranged, out of which spring vertically others which give the hirsute character just mentioned. Spicules of two kinds, viz. skeleton- and flesh-spicules. Skeleton-spicule of three forms, viz.:—1, large, long, acuate, smooth, nearly straight, attenuatingly pointed, increasing in size gradually from the large or fixed to the small or free end, 100- by 1½-1800th inch; 2, subskeleton, much smaller than the foregoing, acuate, short-spined, attenuatingly pointed, slightly curved towards the fixed end, which is a little smaller than that of the shaft that follows it, 16- by 1-1800th inch; 3, subskeleton, cylindrical, circularly curved (that is rainbow-like), spined throughout, especially at the ends, which are obtuse and round, 10- by ½-1800th inch. Flesh-spicule of one form only, viz. equianchorate, small, navicular in form, rather bent in the shaft, 6-6000ths inch long. The curved, cylindrical, spined spicule forms a dense layer in which the two acuates are fixed vertically by their large ends, the spined acuate only just appearing above the surface, while the large smooth one is 1-12th inch long, and the flesh-spicule, or anchorate, scattered irregularly throughout the lamina. Size of specimen about ¾ inch in diameter, and 1-96th inch thick, exclusive of the long spicules.

Hab. Marine, on hard objects.

Loc. Station 25, in 374 fathoms, near Cape St. Vincent, growing over a piece of *Pachastrella abyssi*.

Obs. There is nothing peculiar in this sponge beyond its resemblance to *Microciona* in its growth, form, and spicules.

In *Microciona*, however, the arrangement of the latter is for the most part scopiform, or in vertical bundles (hence Schmidt's name "*Scopalina*"); while here there is a distinct layer formed by the curved spinous spicules, out of which the acuates project separately and directly upwards like hairs on the surface of the body. The equianchorate is like that of *Microciona*; and most probably both it and *Hymeraphia* will hereafter be shown to be intimately allied.

Since this was written, Mr. T. Higgin has sent me a specimen of a like sponge, which he found on a piece of old stony coral from Grenada, in the West Indies. It is laminiform, extremely thin, and consists of a layer of spiniferous spicules, out of which project a number of smooth long acuates hirsutely. But the bedding spined spicules are *quadriradiate*, somewhat like in form to those of *Dercitus niger*; and I could detect no kind of flesh-spicule.

Subcrites massa, Sdt. (Spong. Adriat. Meeres, p. 67, Taf. vii. fig. 2).

Two fragments of this sponge were dredged up at station 65 in 345 fathoms. They consist of small round branches about 2 inches long, which are again branched irregularly and more or less coalescent. Indeed they look as if they had been torn off from some larger coalescent mass of vertical branches of the same nature. The colour is light yellow, the surface villous, the structure compact, and the spicule of one kind only, viz. pin-like, with smooth, fusiform, pointed shaft and more or less oval head.

The tendency of this sponge is evidently to coalesce, so that, in its lower or older part, it becomes massive, as seen in the specimen illustrated by Schmidt, where the tops of the branches only remain free. A similar specimen exists in the British Museum, where it is even more consolidated—and another where the branches have remained more separate and terminate in flattened digitate or serrate margins respectively, like toes on the human foot. These came from the coast of Portugal. I have also a specimen of the kind from the Mauritius, sent to me by Dr. Dickie, of a pinkish yellow colour.

Another in the British-Museum collection was dredged up by Sir J. Ross in $74\frac{1}{2}°$ south latitude, depth 206 fathoms; but it is of a leaden grey colour, and possessing a pin-like spicule, in which the head is for the most part spherical and much larger than any other part of the spicule, I have proposed for this (in MS.) the name of "*Suberites antarctica*." In its surface are nestled parasitically many small crustaceans, which have been named, described, and figured by the Rev. Thomas R. R. Stebbing, M.A. ('Annals,' 1875, vol. xv. p. 184, pl. xv. fig. 1, &c.).

POLYMASTINA.

(μαστός, nipple.)

I would propose this name for a group of sponges which provisionally might be placed before *Donatina*, in the suborder Suberitida, under the order Holorhaphidota in my classification ('Ann.' 1875, vol. xvi. p. 190), characterizing it by a smooth appendiculate (mastophorous) surface, for the most part sessile, sometimes stalked; composed internally of a radiating structure consisting of bundles of large, smooth pointed, fusiform spicules, for the most part round or inflated pin-like at the inner or larger end, sometimes acerate or sharp at both ends; faced with a smaller spicule of the like form, which, together with the larger ones, project more or less beyond the surface, so as to give it the villous character above mentioned. More or less hollow or soft internally, or intensely compact and hard throughout.

Of these, *Polymastia brevis*, *bulbosa*, *mamillaris*, *ornata*, and *robusta*, Bk. (*op. cit.* vol. iii. 1874), also *Thecophora semisuberites*, Sdt., *T. ibla*, Wy. Thomson, *Rinalda uberrima*, Sdt., with the, to me, stalked forms, viz. *Polymastia stipitata*, n. sp., *Cometella simplex*, n. sp., and *Podospongia Lovenii*, Bocage, together with the laminiform *Latrunculia cratera*, Bocage, have all, with the exception of *Cometella simplex*, which seems to have come from the "chops" of the English Channel, been dredged up at various stations respectively between the north of Scotland and the Färöe Islands, especially at station 65, in 345 fathoms.

Other species of *Polymastia* have been described and illustrated by Dr. Bowerbank (*op. cit.*), viz. *P. conifera*, *radiosa*, and *spinularia*, also by Schmidt (Atlantisch. Spongienf. 1870), viz. *Radiella spinularia*, Sol., *Eumatia sitiens* and the stalked sponge *Cometella stellata* perhaps; while Balsamo-Crivelli in 1863 (Atti della Soc. Ital. di Scienze, vol. v. tav. vi. figs. 10–17) *first of all* figured the species *Suberites appendiculatus*. It is possible that several of these species are but different forms of the same; hence further observations may considerably reduce their number.

The second kind of sponges included under Polymastina is the hard, solid, compact one, but still presenting the same kind of spicules and villous surface. One of these I described and illustrated in 1870 under the name of *Trachya pernucleata*

truncate obliquely above and horizontally below, the truncated areas being circumscribed by a prominent ridge, which above, when fully developed, rises into a circular wall that terminates the head. Stem long, slender, expanded at first where in connexion with the head, then narrow, and afterwards gradually increasing towards the lower end, where it suddenly thickens into an irregularly bulbous form, to terminate in a bunch of numerous root-like fibres more or less matted together with the sand in which the sponge has been fixed. Colour grey. Surface hirsute throughout, hirsuteness especially evident over the head and ridges formed by the pointed ends of projecting spicules, which, taking a spiral direction round the body, end in a whorl for the most part situated in the centre of the summit; stem rugose or corrugated circularly on the surface, where the rugæ are most prominent at the lower part. Pores not seen. Vents on the summit and upper part of the head respectively, consisting of a large one in the centre of the whorl, and one to five smaller ones along the projecting line formed by the upper ridge, each vent prolonged by a little conical tuft of spicules. Internal structure radiate, consisting of bundles of large spicules imbedded in sarcode and issuing in gyrate lines from a central point towards the circumference, where their points intermingle with those of a dermal layer of small spicules, which thus together produce the hirsute surface; traversed by the branches of the excretory canal-systems which terminate at the vents mentioned. Stem internally consisting of a gently spiral cord formed of large long spicules applied longitudinally to each other successively, where they are all held together by sarcode, and covered by a dense dermal layer or sheath, through which the dermal spicules project perpendicularly in the form of a minute crust. Spicules of one form only and two sizes, viz. a body- and a dermal-spicule. Body-spicule large, long, acerate, fusiform, attenuatingly pointed at both ends, one of which is *slightly* obtuse, nearly straight, 250- by 4-1800ths inch. Dermal spicule of the same form, but only a 40th part of the length, being 6–8- by $\frac{1}{3}$-1800th inch. The body-spicule chiefly belongs to the stem and bundles of the head, each of which is faced by the layer of dermal spicules, while an intermediate size filling up the interstices of the head causes the hirsute character there to be more evident than on the stem, where the dermal spicule alone exists.

Size. This, like the form, depends upon age and the degree of development. The largest I have is about $3\frac{1}{2}$ inches long, $\frac{1}{2}$ an inch of which is head and the rest stem; the head is about $\frac{5}{12}$ inch in diameter at its upper part.

Hab. Marine, growing erect in a sandy bottom, in which the root-like fibres are spread out for fixation.

Loc. Chiefly between the north of Scotland and the Färöe Islands.

Obs. The above description shows that the structure of the head is essentially like that of the sessile *Polymastiæ*, Bk.; hence its designation; while the lower end of the stem, being suddenly enlarged and terminating in a bunch of numerous rootlets, contrasts strongly with the following species, which is the reverse, although the structure of the head here too will be seen to resemble that of *Polymastia*. At first I thought *Polymastia stipitata* was Sars's *Hyalonema longissimum*, since some of the specimens of the former (which came from near Cape St. Vincent) are exactly like his figures: but there is no central inflation of the spicule in any of them; and if there were, there would be no sexradiate cross of the central canal, which is peculiarly, as Schmidt has noticed, the character of the Hexactinellida: therefore I wonder that the name of "*Hyalonema*" should have been applied to these sponges; a glass stem alone does not make a hexactinellid sponge. The same might be said of Lovén's *H. boreale* (figs. 9–11, 'Ann.' 1868, vol. ii. p. 81, pl. vi.); while Prof. Wy. Thomson ('Depths of the Sea,' p. 114) only gives a figure of the entire sponge without alluding to the form of the spicules. Still the forms represented by Lovén's, Sars's, and Thomson's figures respectively of the entire sponge are all present among those dredged up on board the 'Porcupine,' none of which have any central inflation on the spicule: or if so, it must be the exception; for after repeated examinations I have not found one.

Cometella simplex, n. sp. (Pl. XVI. fig. 53.)

General form consisting of a head and stem. Head obovate globular, passing below into a fine stalk, which, narrowing towards the lower end, divides dichotomously into a few delicate, dendriform, root-like fibres. Colour light yellow. Surface of head and stem hirsute throughout, hirsuteness especially prominent over the former, arising from the projection of the pointed ends of the spicules. Pores and vents not evident. Internal structure radiate, consisting of bundles of large spicules extending from a central point to the circumference, where they are met by a much smaller set, which together produce the hirsute appearance; head in a longitudinal section presenting a thin transparent dermal layer, then an opaque much thicker subdermal zone, followed by a layer of compressed cavities, which belong to the excretory canal-system, finally resting on the radiating structure of the centre (see section of *Cometella pyrula*, Pl. XIV. fig. 20, *d*). Stem internally consisting of large spicules applied longitudinally to each other successively as they are held together by sarcode, and finally covered by a denser dermal sheath, pierced perpendicularly by smaller spicules. Spicules of three forms, viz. acuate, sub-pinlike, and pinlike or dermal, all smooth, nearly straight, fusiform, and attenuatingly pointed. The largest or acuate has the large end rounded and a little less in diameter than the shaft, 150- by $\frac{3}{4}$-1800th inch; the smallest or dermal is pinlike, with globular terminal inflation, also a little less in diameter than the shaft, 20- by $\frac{1}{2}$-1800th inch; and the sub-pinlike of intermediate size between the two, with the terminal inflation equally variable, as the globular head appears to pass gradually into the simple, round, acuate or *un*inflated end of the large skeleton-spicule. The largest spicules are confined to the stem and the bundles in the head, both of which are faced by a layer of the pinlike dermal spicule, mixed with the intermediate sub-pinlike ones, not only in the head but throughout the stem. Size of specimen (for there is only one) $\frac{5}{12}$ inch long in totality, of which $\frac{2}{12}$ belong to the head.

Hab. Marine, growing erect, fixed in a sandy bottom by the root-like fibres above mentioned.

Loc. Probably the "chops" of the English Channel in about 500 fathoms.

Obs. Although there is no number on the jar containing this specimen, its concomitants seem to indicate the locality just mentioned. By a comparison with the foregoing species, viz. *Polymastia stipitata*, the points of difference will be obvious, although the structure of the head together with the forms and disposition of the spicules respectively closely allies it to the Polymastina. The specimen is very small; and therefore its fully developed form may be somewhat different, as in the last species. Being like Schmidt's genus *Cometella* in figure and constitution, I have given it his generic name, with the specific designation of "*simplex*," as it contains no flesh-spicule like that of *C. stellata*, Sdt.

Podospongia Lovenii and *Latrunculia cratera*, Boc.

Specimens of these two sponges, so well described and illustrated by Bocage (Journ. d. Sc. Math. Phys. et Naturelles, no. iv. Lisbonne, 1869), were dredged up between the north of Scotland and the Färöe Islands, and the former also at two or three other stations between this and the coast of Portugal. Between Scotland and the Färöe Islands, the former came

into the lobes respectively of the petrous crust. Vents in the cribriform structure at the bottom of the deep depressions of the surface. Internal structure consisting of a circumferential zone of spicules arranged parallel to each other and perpendicular to the body-substance on which their pointed ends rest, while their heads support the petrous crust of siliceous balls; composed of the "zone-spicule" *par excellence* (fig. 45, *a*), the "body-spicule" (fig. 45, *c*), and the two forms of "anchoring-spicule" (fig. 45, *d*). Body-substance composed of the "body-spicules" alone, held together by areolar sarcode charged more or less with flesh-spicules, and traversed by the branches of the excretory canal-system. Excretory canal-system most developed towards the circumference, least towards the centre of the body-substance, where the spicules are most densely aggregated and the structure most compact, whence the subnucleated appearance. Skeleton-spicules of three forms, viz.:—1, the zone-spicule, composed of a long, stout, straight shaft, smooth, round, sharp-pointed, and directed internally, supporting a head consisting of three arms, furcated, expanded horizontally, and a little recurved, supporting the petrous crust externally, shaft 170- by 8-1800ths inch, total expansion of the arms 54-1800ths inch in diameter (fig. 45, *a*); 2, body- or staple spicule, acerate, stout, more or less curved, smooth, round, attenuatingly pointed, mixed with the zone-spicules, where it often pierces the crust, and forming, with the exception of the siliceous balls in all stages of development and the body-stellates exclusively, the skeleton-spicule of the body-substance, 190- by 5-1800ths inch (fig. 45, *c*); 3, anchoring-spicule, composed of a long, delicate, straight shaft, smooth, round, sharp-pointed, and directed internally, supporting a small head with usually three delicate arms recurved like the flukes of an anchor, or extended like the prong of a fork (fig. 45, *d*), associated with the zone-spicules, but often piercing the petrous crust so as to form anchoring-spicules externally, which are for the most part broken off, shaft very long and thin, variable in length, arms about 9-1800ths inch long. Flesh-spicules of four forms, viz.:—1, the nodastrellum, globular, the rays being represented by minute round tubercles about 2-6000ths inch in diameter, hence its name, most abundant in the dermal reticulation (fig. 45, *g*, *k*): 2, dermal, acerate, slightly curved, smooth, round, attenuatingly pointed, supporting the dermal reticulation over the petrous crust, about 22- by ½-1800th inch (fig. 45, *h*): 3, siliceous ball, spheroidal or elliptical (fig. 45, *f*), slightly compressed, presenting, when fully developed, a tessellated stelliferous surface, and a hilum-like depression on the flattened sides respectively, composed of radiating, columnar structure internally, each pillar ending on the surface in a little stelliform head, which, in juxtaposition, produces the tessellated appearance mentioned; the siliceous balls at maturity form the crust, and are scattered throughout the sarcode of the outer part of the body-substance and zone, as before stated, in all stages of growth, where their gradationary development may be easily observed; largest or adult size about 7-1800ths inch in diameter: 4, body-stellate, consisting of a starlike spicule with conical pointed rays, united together in the centre *without* a nucleus or body (fig. 45, *e*, *i*), sparsely scattered through the bódy-substance, about 3-6000ths inch in diameter. Size of largest specimens, which are tuberous, 4 inches in diameter; size of smallest specimens, which are spheroidal, 4-12ths inch in diameter.

Hab. Marine, free or attached to solid bodies.

Loc. In the deep water between the north of Scotland, the north-west of Shetland, and the Färöe Islands, at stations 51, 57, 61–63, and 65 respectively; also near Cape St. Vincent.

Obs. It is difficult to find a satisfactory distinguishing character among most of the Geodina, as they are so much alike in all parts of the world. In the above instance this is chiefly to be found in the nodose form of the surface-spicule or stellate, and hence the designation "*nodastrella*;" while the furcate division of the arms of the zone-spicule appears to offer (for the specimens dredged up on board the 'Porcupine' at least) a convenient character for separation, if not also for recognizing the *embryonic form of the ovum*, as will presently be seen.

It was at the base of a specimen of one of these *Geodiæ*, about 2 inches in diameter, that I found two projecting spicules bearing respectively a globular embryonic form, which, from its size, appears to be the first stage after the elimination of the ovum of this species. These I mounted in balsam together, on the spicules bearing them respectively as I found them. One, the largest, is 14-, and the other 9-1800ths inch in diameter. They are both composed of furcate zone-spicules, which have the furcated arms of their heads incurvated over the convexity of the embryo, while their shafts are directed towards the centre; in both, too, the sarcode is sparsely charged with minute stellates, from some of which the siliceous balls might subsequently have become developed, as the latter originate in this way, while when fully developed the siliceous ball is nearly as large as the whole embryo itself. Besides these spicules, the smaller specimen possesses the acerate body-spicule, which projects a little beyond the surface; and one or two of these linear projecting shafts having been broken off leads me to infer that these might have been anchoring-spicules which had lost their heads, as the latter are not to be seen on either embryo. The whole of the embryo and its spicules are, of course, of microscopic minuteness, as they can only be seen with $\frac{1}{4}$-inch compound power, equal to nearly 400 diameters, although quite as clearly as if the spicules had been of the largest size.

I have been thus particular in describing these embryos taken from the base of a *Geodia* and corresponding in the form of their spicules with those of that *Geodia*, because the name of "ovarium" has been applied to the "siliceous balls" of the petrous crust by Dr. Bowerbank, and that of "ovisacs" by the late Dr. Gray in his "Notes on the Arrangement of Sponges" (P. Z. S. 9th May, 1867), while many others have adopted a similar terminology; so that, had not Dr. Johnston (Brit. Spong. 1842, p. 202), Schmidt, and those who have particularly examined these bodies from their earliest appearance to their full development, which every specimen of *Geodia* presents in abundance, been perfectly satisfied that they could not be considered reproductive elements of the *Geodia* under any form, these two embryos would prove that the "siliceous balls" are nothing more than sponge-spicules of this particular form; besides, they have just the appearance and general character of the embryos of *Tethya cranium*, which I described and illustrated in 1872 (Ann. & Mag. Nat. Hist. vol. ix. p. 426, pl. xxii.).

The description of *Geodia nodastrella* above given may appear prolix; but it is the first time that I have had the opportunity of giving a *typical* one; and the species are so much alike that this in its general characters may serve for all the rest.

Geodia megastrella, n. sp. (Pl. XVI. figs. 46 and 46′.)

General form hemispheroidal, elongate, flattened at the base, where it is adherent to the surface of the large fragment of *Corallistes Bowerbankii* on which it has grown, presenting a large circular aperture on the summit. Colour now grey. Surface, where not rubbed off, the same as in the foregoing species; but the stellate of the dermis (fig. 46′, *h*, *m*) furnished with minutely spined capitate rays instead of simple nodes, and the siliceous ball very large, being 13-1800ths inch in diameter (fig. 46′, *g*). Pores as in the last species (fig. 46, *c*). Vent single, on the summit, consisting of a large circular hole partly closed by a diaphragm of sarcode (fig. 46, *d*). Internal

is only 87- by 3-1800ths inch long, and the arms 29-1800ths inch long respectively. Here also there is a tendency to bifurcation in the latter; while the large stellate (megastrellum) of the interior, although of the same size as that of the foregoing species, has for the most part only six arms, and these are *smooth, not microspined* (fig. 47, *d, h*), as in the foregoing species.

Hab. Marine.

Loc. Above mentioned.

Obs. With only a fragment of the capping or petrous crust of this form, this is all that can be stated descriptively about its spicules; and the general form of the entire sponge of course is absent altogether.

The specimen, however, is very interesting in a developmental point of view; for its spicules being in many instances abnormal in form, especially the siliceous ball, shows how intimately the latter is connected with a stellate, and how, in all probability in its minutest form, it always originates in one. Thus the siliceous ball, even when of full size, often presents itself here in the form of a thick coarse stellate, with from five to seven arms, each of which may present more or less of the little stellate terminations which, in juxtaposition, make up the tessellated surface of the matured and normally developed ball, showing plainly that the latter belongs to the stellate group of spicules.

We see a similar development of the siliceous ball in Dr. Bowerbank's illustrations of *Geodia tuberosa* (Proc. Zool. Soc. 1872, pl. 46. fig. 11) and especially in the abnormal developments given by Schmidt (Spong. Küste Algier, 1868, Taf. iv. fig. 6) on the left side of the illustrations of *Stelletta intermedia*, where, as *Stelletta* has no siliceous balls, it is evidently the abnormal development of the stellate itself, which closely approaches that of the abnormally developed siliceous ball in *Geodia megastrella*, var. *lævispina*.

The fact, too, that the siliceous ball belongs to and probably originates in a stellate form, bears upon the nature of the stellates present in the embryos of *Geodia megastrella*, which altogether are respectively hardly larger than the full-sized siliceous balls of this species, and therefore can only present these balls in a rudimentary state—that is, in the stellate form.

In the three species of *Geodia* above described, the fluked anchoring-spicule somewhat differs in the form of its head, as may be seen in the illustrations; but this has not been insisted on in the descriptions, because the form often differs so much even in the same species.

Stelletta pachastrelloides, n. sp. (Pl. XV. fig. 40, &c.)

General form large, flat, thick, irregularly undulated, amorphous, composed of a confused mass of spicules; margin thick, round, and also irregularly undulous, except where it appears to have been broken off from the submarine object to which the sponge had been attached. Colour cream-yellow. Upper and under surfaces so much alike as to be almost undistinguishable, the former undulating, even, asperous from projection of the ends of the large spicules, which are more or less confusedly and horizontally imbedded in the dermal sarcode; the latter similar, but more granular, and sometimes indicated by the impressions of small pebbles on which the sponge may have rested while growing; the whole more or less enveloping small objects such as minute Foraminifera (*Globigerina*), small shells, &c., also overgrown by a variety of other sponges. Pores chiefly in the dermal sarcode, tympanizing the interstices between the projecting spicules. Vents single or in groups, more or less irregularly scattered over both surfaces, especially the lower one. Internal structure more compact, consisting also of a confused mass of spicules held together by cancellated sarcode, traversed by the branched canals of the excretory system, which chiefly run towards the lower surface, where they end in the vents mentioned. Spicules of two kinds, viz. skeleton- and flesh-spicules. Skeleton-spicules of three forms, viz.:—1, zone-spicule, comparatively small, consisting of a three-armed shaft, arms equal, equidistant, simple, smooth, sharp-pointed, expanded almost horizontally and slightly recurved; shaft about twice the length of the arm, straight, smooth, sharp-pointed, 60- by 5-1800ths inch, arm 35- by 4-1800ths inch (Pl. XV. fig. 40, *b*); 2, body-spicule, *very large* simple acerate, slightly curved, and sharp-pointed, 260- by 7-1800ths inch (fig. 40, *a*); 3, anchoring-spicule, a three-armed shaft, arms equal, equidistant, simple, smooth, sharp-pointed, at first expanded for a short distance, and then suddenly bent backward; shaft thin and very long, smooth, straight, sharp-pointed, 260- by 1½-1800th inch long, arms 12- by 1½-1800th long (fig. 40, *c*, *h*). The forked form not observed. Flesh-spicules of four forms, viz.:—1, long, simple, acerate, slightly curved and thickly microspined, 58- by 1½-6000th inch, but very variable in size (fig. 40, *d*, *i*); 2, short, simple, acerate, curved or bent in the centre, with or without central inflation, pointed or obtuse at the extremities, thickly microspined, 11- by 2-6000ths inch (fig. 40, *e*); 3, globular stellate, of 6 or 7 rays, rays unequal, microspined at the extremities, 4-6000ths inch in total diameter (fig. 40, *f*); 4, elongated stellate, axis bacilliform, twisted and spined, spines or rays linear, 3-6000ths inch long (fig. 40, *g*). Zone-spicules chiefly confined to the surface, where they are disposed together confusedly, with their arms for the most part expanded over the surface and their shafts directed inwards. Body-spicule, which is the staple form and dominant size, confusedly spread throughout the mass, and where near the surface projecting through it so as to give a horribly asperous character. Anchoring-spicule much less numerous, imbedded in the general structure, or projecting with its head outwards and the shaft in the sponge. Flesh-spicule disposed in a mass among the foregoing, so as to fill up the interstices, where No. 2 is chiefly confined to the surface, the stellates being for the most part scanty. Size of specimens averages 5 inches broad by 1 inch thick.

Hab. Marine, frequently free, not fixed.

Loc. Atlantic Ocean, in 374 fathoms, at station 25, near Cape St. Vincent.

Obs. The fragments of this sponge, in their flat, amorphous forms, respectively resemble the broken ones of a thick, coarse, uneven earthenware dish with the edges rounded. Four are dry and without number; while the fifth is in a large jar accompanied by fragments of *Corallistes Bowerbankii*, *Macandrewia azorica*, and *Azorica Pfeifferæ*, *Geodia nodastrella*, *Phakellia ventilabrum*, *Hymeraphia verticillata*, *Histoderma phlyctenodes*, *Polytherses*, D. et M. (*Hircinia* permeated by the alga *Spongiophaga communis*), and small specimens of *Thalysias*, *Microciona*, and *Isodictya* respectively.

There is a great resemblance in general form between the fragments of this sponge and those of *Corallistes Bowerbankii* and *Pachastrella abyssi*, as if they all originally came from flat expanded masses, unless they grew out *Polyporus*-like by marginal attachment to some submarine rock, or were currented about in a free state. Their confused structure of densely packed spicules, too, agrees with that of the Pachastrellina and Lithistina, together with the perpendicular direction to the flat surfaces of the short excretory canals, opening chiefly on one side; while the proportions of the zone-spicule approaching, in the length of its arms and shortness of the shaft, to that of the Pachastrellina causes this *Stelletta* very much to resemble the sponges of that group. On the other hand the large size of the body-spicule or acerate and the presence of the anchoring-spicule ally it to the Stellettina; hence the designation "*pachastrelloides*."

The anchoring-spicule when projecting externally has its head for the most part broken off, and therefore is only found

ment. It differs from *T. cranium* in the following particulars, viz.:—the anchoring-spicule of both forms (fluke and fork) are much larger and stouter; in the fluked form (fig. 48, *c*) the arms are much more expanded and not so recurved as in *T. cranium*, while those of the forked form (fig. 48, *a*) are truncated towards their extremities, which respectively terminate in a cup-shaped excavation bordered by a serrated margin, while the central canal at the bottom of the cup-shaped cavity divides into a lash of branches, each of which goes to one of the tooth-like processes on the margin of the cup (fig. 48, *b*). Neither does the specimen, although in other respects exactly like *T. cranium*, contain any flesh-spicules (bihamates).

I have given the specimen a special designation; but I am very desirous not to introduce any thing into the description of a sponge which even borders upon an abnormal or pathological development of any part of it, as its natural varieties are quite sufficient to occupy our attention at one time. If their pathological ones are to be described, this should be done separately, and in an article exclusively devoted to the subject, as mixing the two must lead to inextricable confusion.

Pachastrella amygdaloides, n. sp. (Pl. XIV. fig. 22.)

General form almond-shaped, truncated at the apex, sessile. Colour yellowish white. Surface even, rough; structure of dermal sarcode confusedly spiculous in direct continuation with the interior, not corticate, charged with small, linear flesh-spicules filling up the interstices of the larger radiate or skeleton ones. Pores in the interstices among the small linear spicules, which are confusedly heaped together around them. Vents congregated in a circular depression at the truncated end (fig. 22, *c*). Internal structure composed of spicules equally confusedly held together by the internal sarcode, traversed by the excretory canal-system, which opens at the vents mentioned. Sarcode cancellous, of the same colour as the surface. Spicules of two kinds, viz. skeleton- and flesh-spicules. Skeleton-spicule of two forms, viz.:—1, large, triradiate, in which the fourth arm or shaft is only represented by a short extension of the central canal *inside* the spicule, or subquadrate, in which this is only extended into a short round elevation or knob (fig. 22, *g g*), arms round, smooth, sharp-pointed, and somewhat curved, 50- by 4-1800ths inch; 2, long, acerate, fusiform, smooth, sharp-pointed, 117- by 1-1800th inch (fig. 22, *h*). Flesh-spicules of three forms, viz.:—1, acerate, fusiform, sharp-pointed, slightly curved, microspined, varying in size from 6- to 30-6000ths inch long (fig.

22, *i*); 2, the same but smaller, and for the most part centrally inflated (fig. 22, *k*), probably passing, when more developed, into the former; 3, stelliform, irregularly rayed, or with elongated axis and rays chiefly developed at the ends bistellate-like, rays linear (fig. 22, *l l*). The large triradiate and subquadriradiates, together with the acerate skeleton-spicules which are very long, are confusedly arranged together throughout the sponge, lying perhaps most horizontally on the surface, while the flesh-spicules, imbedded in the sarcode, make up the rest of the mass, the larger microspined flesh-spicules being chiefly confined to the interior, and the smaller ones to the surface, while the stellates are dispersed generally and very subordinate in number. Size of specimen about 1 inch long, 7-12ths inch broad, and 5-12ths inch in its vertical diameter.

Hab. Marine, on hard bodies.

Loc. Atlantic Ocean, at station 24=292 fathoms, near Cape St. Vincent.

Obs. There is only one specimen of this sponge, which is contained in a jar labelled "24, 292 fathoms," which station will be found on the chart accompanying the report of the cruise of the 'Porcupine' in 1870 (Roy. Soc. Proc. no. 125). It is accompanied by small specimens of several other sponges, viz. *Histoderma appendiculatum*, *Hymedesmia Johnstoni*, *Geodia*, *Tisiphonia*, *Tethya cranium*, *Pachastrella abyssi*, and a histodermal form of *Halichondria panicea*, together with several rolled pieces of agglomerated spicules of various sponges.

There is a great resemblance between the spicules of this sponge and those of Schmidt's *Sphinctrella horrida*, Atlant. Spongienf. p. 65, Taf. vi. figs. 6 & 7 (that is, rather, to the spicules in the slide of this sponge belonging to the British Museum), but it differs much from Schmidt's illustration fig. 7, in which there are distinct sphinctral areæ of the dermal sarcode charged with stellates, while the larger linear skeleton-spicules are obtusely pointed—which is quite opposite to the above description of *Pachastrella amygdaloides*, taken, too, from a specimen unusually perfect.

Pachastrella geodioides, n. sp. (Pl. XIV. fig. 23 &c.)

General form globular, a little wider at the base than at the summit, sessile. Colour dark grey. Surface even, uniform, slightly roughened by projecting spicules; dermal sarcode charged confusedly with the spicules of the species mixed with minute foreign organisms of various kinds, directly continuous with the internal structure that is *not* corticate. Pores in the dermal structure, more or less indistinct. Vents small, scattered singly here and there. Internal structure compact, consisting of cancellated sarcode confusedly charged with the spicules of the species, together with minute foreign objects like those of the dermal layer, traversed by the excretory canal-system, which opens at the vents mentioned. Colour of sarcode dark grey. Spicules of two kinds, viz. skeleton- and flesh-spicules. Skeleton-spicules of three forms, like those of *P. amygdaloides*, viz.:—1, large triradiate, in which the fourth arm or shaft is only represented by a short extension of the central canal inside the spicule, or subquadriradiate, in which this is extended into a short round prominence more or less prolonged, arms of equal length, smooth, round, sharp-pointed, somewhat curved, 50- by 6-1800ths inch (fig. 23, *i*, *b*); 2, similar to the foregoing, but much smaller, with the fourth ray or shaft produced or not, and the three arms bifurcated or not at the extremities (fig. 23, *k k k*); 3, linear, acerate, fusiform, smooth, sharp-pointed, and slightly curved, much smaller and more subordinate in this respect than the linear spicule of *P. amygdaloides*, 53- by $\frac{2}{3}$-1800th inch (fig. 23, *l*). Flesh-spicule of one form only, viz. globostellate, with the rays reduced to short round tubercles, mulberry- or blackberry-like (fig. 23, *m*, *o*, *p*), often presenting a distinct stellate in the centre, whose rays respectively end in the short round tubercles of the surface (fig. 23, *m*, *n*), 6-6000ths inch in diameter. Although the average largest size of the spicules respectively is easily obtained, there is a great variety in this as well as in the forms of all, and they are all confusedly massed together, mixed up with the flesh-spicules in great abundance as well as with the minute foreign objects, especially consisting in this instance of the siliceous balls of *Geodia*: perhaps the arms of the large radiates lie flatter on the surface than anywhere else, where they are partially hidden by the flesh-spicules among which they are imbedded, and thus present a tessellated surface; but there is no *cortex*, as before stated, and the dermal surface is but the limit externally of the internal or general structure and composition of the sponge. Size of specimen about 1 inch high by 1 inch in diameter at the bottom.

Hab. Marine, attached to hard objects.

Loc. Atlantic Ocean, in company with *P. amygdaloides*, near Cape St. Vincent.

Obs. There is but one specimen of this sponge; and it is contained in the jar with *P. amygdaloides*, under which the number of the station &c. is mentioned. Although much like *P. amygdaloides* as regards the presence of the large triradiate and subquadriradiate skeleton-spicules, there is abundant evidence in other respects for separation, as may be seen by the descriptions of these two species of *Pachastrella* respectively.

throughout its course a number of short blunt spines of different lengths, chiefly radiating from the ends, and more or less congregated at two points on the body of the shaft (fig. 41 *a*), 5-6000ths inch long; 2, minute, also bacillary in the shaft, which is more or less twisted, and presents a number of fine, thin, long, linear spines, chiefly congregated about the ends, so as to assume a bistellate appearance, $2\frac{1}{2}$-6000ths inch long (fig. 41, *b*).

Pachastrella parasitica, n. sp. (Pl. XVI. fig. 50 &c.)

Like the foregoing, but not belonging to the sponges dredged up on board the 'Porcupine,' is a *Pachastrella* which I have lately found on a specimen of *Polytrema utriculare* ('Annals,' 1876, vol. xvii. p. 211, pl. xiii. fig. 17, *a*, *b*), and have therefore designated "*parasitica*." Locality unknown. The linear, acerate (Pl. XVI. fig. 50, *c*), and ramular skeleton- (fig. 50, *a*), with the bacillary spinous (fig. 50, *d*) and minute stellate (fig. 50, *f*) flesh-spicules are, *mutatis mutandis*, the same. Here, however, the branches of the ramular skeleton-spicule are *thrice* divided, not "twice" only, as erroneously figured and stated in the 'Annals' (*l. c.*), where also the shaft should have been prolonged anteriorly. The large bacillary spined flesh-spicule, too, is thin, slightly undulating and thickly beset with minute spines like that of *Pachastrella abyssi*; but we have not the distinguishing character of the latter here, viz. the thick, solid, *skittle*-shaped flesh-spicule.

Had not my attention, at the time I alluded to this species in the 'Annals,' been chiefly taken up in examining the organism on which it is parasitic, I should not have made the mistakes in delineation &c. to which I have above referred; while now that it is specially called to the sponges, I have the opportunity of correcting them.

All the species of *Pachastrella*, beginning with *Dercitus niger* of our coasts, are amorphous, and are in the habit of penetrating any crevices over which they may be growing; so that they are often found in the midst of the branches of old corals and deciduous shells, in company with a boring *Cliona*, which they follow but *do not precede*. Again, they do not reject hard objects with which they may come into contact during growth, especially *P. abyssi*, which appears to incorporate every thing of the kind it meets with, in which these sponges very much resemble fungi.

With the shaft being often prolonged beyond the giving-off of the branches in *P. parasitica*, together with the twisted and divided form of the distal bifurcations, we have a ramular form which seems to lead into the still more complicate one of the Lithistina.

[To be continued.]

XXXVIII.—*Descriptions of supposed new Birds from the Khási-Nágá Hill-ranges south of the Brahmaputra River, Assam.* By Major H. H. Godwin-Austen, F.Z.S. &c.

Garrulax nuchalis, n. sp.

Above, top of head to nape dark slaty grey, succeeded by a broad rich ferruginous collar an inch in breadth, which fades into the olive-green of the back. Wings and tail of a rather darker tint of olive, the latter tipped black; the first four primaries are edged hoary grey; the shoulder of wing has a rusty tinge. A narrow frontal band; the lores, with a narrow line over and below the eye, black; this is continued in a streak of dark rusty brown over the ear-coverts; a few white feathers border the black frontal band above. Chin black, extending a short way down the middle of throat; breast pale ashy, with a slight vinous tinge. Cheeks and ear-coverts pure white. Flanks and under tail-coverts dull olive-green. Bill black. Irides purple lake. Legs fleshy grey.

Length 10 inches, wing 4·25, tail 4·6, tarsus 1·7, bill at front 0·9.

This beautiful species was among a batch of birds lately received from and collected by Mr. M. T. Ogle of the Topographical Survey, in the Lhota-Nágá hills. It is the representative there of *G. chinensis*, but differs in possessing the broad ferruginous nape, and the neutral grey of the head is of a darker hue. In other respects it is identical, save in some minor points, such as:—the black of the throat does not extend so far down on to the upper breast; the lower breast is paler than in *chinensis*, and has a vinous tinge; the under tail-coverts are pure olivaceous with no ochraceous tint; and, lastly, the white of the cheek and ear-coverts extends in this new form further down the side of the neck.

On a careful comparison, made by myself and Lord Walden, of *Suya atrogularis* of the Darjeeling hills with specimens I had hitherto supposed to be exactly the same found on the Khási hills, the differences are so well marked that they are sufficient to separate them as a distinct race, to which I give the title *Suya khasiana*.

These differences are as follows:—

Suya atrogularis, Moore (of which eight specimens were examined),

a. Is a greyer bird, with a decided tinge of olivaceous;
b. None show pure white beneath;
c. Thigh-coverts pale brown.

Suya khasiana, n. sp.
(fourteen examples compared),

a. Has a general tinge of ferruginous throughout, which is particularly strong upon the forehead and wing;
b. Generally pure white on abdomen and centre of breast;
c. Thigh-coverts pure rufous;
d. The terminal white spots on the black feathers of the lower part of the neck are larger.

XXXIX.—*Note on the Genera* Astacoides *and* Paranephrops. By EDWARD J. MIERS, Assistant in the Zoological Department, British Museum.

IN the 'Annals' for last month Professor J. Wood-Mason published a very interesting note "On the Mode in which the Young of the New-Zealand *Astacidæ* attach themselves to the Mother." He states (p. 306) that he observed this peculiar mode of attachment in the young of "a female of *Astacoides zealandicus*," which, he adds in a footnote, "=*Paranephrops setosus*, Hutton;" and, in another footnote, he cites the genus *Paranephrops* of White as synonymous with *Astacoides* of Guérin-Méneville. As it appears to me still uncertain to what species Professor Wood-Mason refers in his communication, the following observations may be of interest.

Guérin-Méneville founded the genus *Astacoides*, in April 1839*, for a species of crayfish described as occurring very frequently in the rivers of Madagascar, to which he applied the name of *A. Goudotii*, after its discoverer M. Goudot. This species was noticed almost contemporaneously by M. Milne-Edwards†, and subsequently described at greater length and well figured by him‡, under the name of *A. madagascariensis.* Of this species, unfortunately, no specimens are in the collection of the British Museum; but the published descriptions and figure suffice, I think, to show that the genus is well characterized by its robust form, powerful anterior legs, with broad hands and short palm, and the position of the antennæ, which are inserted *beneath* the antennules and are furnished with a small or rudimentary basal scale.

In the genus *Paranephrops* of White§, as exemplified in

* Revue Zoologique, ii. p. 109 (1840).
† L'Institut, p. 152 (1839).
‡ Archives du Muséum d'Histoire Naturelle, ii. p. 35, pl. iii. figs. 1–5 (1841).
§ Zoological Miscellany, ii. p. 79 (1842).

XL.—*Notes on a Group of Russian* Fusulinæ. By Henry B. Brady, F.R.S.

[Plate XVIII.]

Certain minute fossils of the Carboniferous Limestone of Miatschkovo, Toula, and elsewhere in Russia, variously treated by a succession of observers, seem scarcely yet to have found a settled or recognized position. Amongst a number of rock-specimens of Carboniferous age kindly sent to me some time ago by General G. von Helmersen of St. Petersburg, was a piece of the white limestone of Miatschkovo; and the following brief notice of its constituent organisms is intended to set at rest, as far as may be, some of the doubtful or debated points of the structure and affinities of the group to which they pertain.

The fossils referred to have been more or less described by Fischer, Rouillier and Vosinsky, Ehrenberg, D'Eichwald, and Abich, under the generic names *Fusulina*, *Nummulina*, *Borelis*, *Alveolina*, and *Orobias*, as follows:—

Fusulina cylindrica, Fischer von Waldheim, 1829, Bull. Soc. Imp. des Naturalistes de Moscou for 1829, p. 329; Oryctographie de Moscou, p. 126, pl. 13. figs. 1–5.
—— *depressa*, id. ibid. p. 127, pl. 13. figs. 6–11.
Nummulina antiquior, Rouillier and Vosinsky, 1849, Bull. Soc. Imp. des Naturalistes de Moscou, vol. xxii. p. 337, pl. K. figs. 66–70, &c.
Borelis princeps, Ehrenberg, 1854, Mikrogeologie, pl. 37. § x. C. figs. 1–4.
—— *sphæroidea*, ibid. D. fig. 1.
—— *constricta*, ibid. figs. 5, 6.
—— *labyrinthiformis*, ibid. pl. 37. § xi. fig. 3.
—— *palæolophus*, ibid. figs. 4, 5.
—— *palæophacus*, ibid. fig. 6.
—— *palæosphæra*, ibid. figs. 7, 8.
Alveolina montipara, ibid. pl. 37. § x. C. fig. 5.
—— *prisca*, ibid. § x. D. fig. 7, § xi. fig. 1.
Fusulina sphærica, Abich, 1858, Mém. de l'Acad. Imp. des Sci. de St. Pétersbourg, sér. 6, vol. vii. 1859; Mém. phys.-math. p. 528, pl. 3. fig. 13, *a*, *b*, *c*.
Orobias antiquior, D'Eichwald, 1860, Lethæa Rossica, vol. i. p. 353. Esp. 26.
—— *æqualis*, ibid. p. 353, pl. 22. fig. 16, *a–c*.

Some of these forms had been mentioned by Ehrenberg in the 'Monatsberichte' of the Berlin Academy for 1843, *i. e.* previous to the publication of the 'Mikrogeologie;' but the figures of the latter work are more eligible for reference than the mere names or verbal descriptions which alone are given with the preliminary notice.

Most of the organisms in this list have been treated, in times past, both by Messrs. Parker and Rupert Jones and myself, as varieties of the genus *Fusulina*; but I hope to be able to demonstrate that they are all members of a series in which it may not eventually be difficult to trace every gradational link from the elongate fusiform contour of the type (*F. cylindrica*) to a compressed lenticular form having the general aspect of a Nummulite.

The specimen of Carboniferous Limestone to which I have referred was a whitish-grey mass, granular and friable in some parts, more compact in others, and almost entirely composed of fossils of small size. A piece, the size of a walnut or somewhat less, was disintegrated by crushing and then washed. Many specimens were doubtless broken in the process, but no gentler treatment was of any avail. As they exist in the rock, a considerable proportion of the organic remains are already more or less in fragments, and the surfaces of most of them are waterworn; notwithstanding which a good number, perhaps from a hundred to two hundred, remained in very fair condition for examination. A few of the more characteristic of these are represented in Pl. XVIII. They have been carefully drawn by Mr. Hollick from the objects themselves, and give a fair idea of the whole. Many additional intermediate forms might have been taken from the collection, had more extended illustration been needful. When it is considered that this series of figures was drawn from a few specimens out of the many that existed in a very small fragment of material, it will be evident that the mass of the deposit, if properly examined, would furnish any number of gradational links between the two extremes of form. The only notable break in the series, as represented in the Plate, is between the normal fusiform variety (figs. 1–4) and the elliptical modification (fig. 5); but amongst the broken specimens are fragments that show that transition forms do exist, and that there is no gap that might not readily be filled by the examination of a larger quantity of material.

As a matter of convenience, many of the trivial names in the foregoing list may be employed with propriety for the salient forms of the group; but it is to be understood that such names have only varietal significance, and that no truly specific or hereditary distinctness can be claimed for the successive modifications of so compact a series. I propose to notice these salient varieties in order, commencing with the recognized type, *Fusulina cylindrica*.

Fusulina cylindrica, Fischer. Pl. XVIII. figs. 1–4.

Fusulina cylindrica, Fischer, Bull. Soc. Imp. des Nat. Moscou, *loc. cit.*
—— *depressa*, id. ibid.
Alveolina prisca, Ehrenberg, Mikrogeologie, *loc. cit.*
—— *montipara*, id. ibid.

The typical form of *Fusulina*, as delineated by Fischer, is largely represented in the Miatschkovo rock. Of our Plate, figs. 1 and 2 are from perfect specimens, figs. 3 and 4 from worn and broken ones; the latter correspond pretty accurately with one of the drawings in the 'Oryctographie.' The size of the specimens also answers to the dimensions given by Fischer. The shell-wall is somewhat thick in comparison with that of many varieties; and the chambers show more or less tendency to subdivision into chamberlets, but not to the extent to which the same character may be observed in several of the larger members of the genus.

Ehrenberg's figures of *Alveolina prisca* and *A. montipara* are sufficiently marked representations of this typical form—the one being very slightly smaller, the other a little larger, than the dimensions appended to the original description. Slight variations in size and proportional contour are of course only individual peculiarities.

Fusulina constricta (Ehrenberg).

Borelis constricta, Ehrenberg, Mikrogeologie, *loc. cit.*

Under the above name Ehrenberg figures an oddly shaped *Fusulina*, somewhat less than 4 millims. in length, and rather under 3 millims. in diameter at its broadest part, rounded at the ends, and irregularly constricted near the middle. Dr. Carpenter * associates the figure with the *F. hyperborea* of Salter †; and Messrs. Parker and Jones ‡ refer it to the same arctic species. It is quite possible that their estimate may be correct; but there is an alternative view which is worth consideration. The specimens described by Mr. Salter are very large, not less than 14 millims. in length; and the central constriction is gradual and rounded. These appear to be normal (not exceptional) characters in the *Fusulinæ* of the Carboniferous Limestone at Dépôt Point, their arctic locality. Ehrenberg's specimen is a great deal smaller: but that is not all; the thinning towards the centre is altogether irregular, and it appears much more like the effect of a weathering or wearing of the surface than as a character of the original shell. Nearly all worn specimens of *Fusulina* show the effects of attrition most near the middle, where the test is thinnest owing to the room occupied by the aperture; and it seems more probable, all things considered, that *F. constricta* constitutes an intermediate variety of the type, shorter and less fusiform than *F. cylindrica* and longer than *F. princeps*, and

* Introd. p. 305.

† In 'Belcher's Arctic Voyage,' 1855, vol. ii. p. 380, pl. xxxvi. figs. 1–3.

‡ Ann. & Mag. Nat. Hist. 1872, ser. 4, vol. x. p. 258.

number of the segments in each convolution differs very widely in the several forms; but such characters, whilst they form a legitimate basis for specific or subspecific distinction, cannot be held to possess any higher significance. However this may be, it is clear that any alteration of the trivial name of the Sumatran species, if alteration be needful, is better left until the publication of the researches of the eminent German observers to whom allusion has been made.

Fusulina sphæroidea (Ehrenberg). Pl. XVIII. figs. 7–9.

Borelis sphæroidea, Ehrenberg, Mikrogeologie, *loc. cit.*
—— *labyrinthiformis*, id. ibid.
Fusulina sphærica, Abich, Mém. de l'Acad. St. Pétersbourg, *loc. cit.*

The transition from the elliptical and prolate specimens to the oblate or drum-shaped, and even to the complanate varieties with rounded margins, is most easy and gradual, as may be seen by reference to figures 5 to 9 inclusive of Plate XVIII. The interval between the two extreme forms might be bridged by a much more numerous series had their connexion needed more copious demonstration. Ehrenberg's drawing of *Borelis sphæroidea* represents a fossil with nearly the contour of fig. 8, or between that and fig. 6, its dimensions being nearer those of the specimen from which the latter was taken. His *B. labyrinthiformis* appears to be only a section of a cast of the chambers of a somewhat similar drum-shaped form.

Dr. Hermann Abich, of Tiflis, in his paper "Vergleichende Grundzüge der Geologie des Kaukasus," *loc. cit.*, describes and figures a precisely similar oblate-spherical variety. Through the kindness of Dr. Abich, I have had the opportunity of examining specimens of this form from the Mountain Limestone of Armenia and Azerbeidjan; and they leave no doubt whatever on my mind that it is identical with Ehrenberg's species. Not only are the two alike in general external characters and contour, but the internal structure, as far as can be made out (for it is very badly preserved in both), is precisely similar. The size of average specimens from the two localities is about the same, those from the Caucasus probably attaining somewhat the larger dimensions.

Fusulina æqualis (D'Eichwald). Pl. XVIII. figs. 10–13.

Borelis palæolophus, Ehrenberg, Mikrogeologie, *loc. cit.*
—— *palæophacus*, id. ibid.
Orobias æqualis, D'Eichwald, Lethæa Rossica, *loc. cit.*

The figures in the 'Mikrogeologie' to which the names *Borelis palæolophus* and *B. palæophacus* are appended represent casts of the chambers of a symmetrical lenticular Foraminifer. Why two specific names should have been given to specimens which differ in no material particular it is difficult to say. There can, however, be no question that both pertain to small (probably young) examples of the fossil subsequently described by D'Eichwald as *Orobias æqualis*; and it is manifestly right that the specific name employed by the latter author, associated as it is with the description and figures of the external as well as the internal characters of the adult organism, should be employed for this particular form, in preference to any term founded on mere casts of the interior of what are possibly immature specimens.

My own specimens, from the Miatschkovo limestone (figs. 10–13), are of intermediate dimensions, much larger than Prof. Ehrenberg's, but generally smaller than D'Eichwald's. Fragments of larger specimens of similar contour were met with; and it is probable that the species may have considerable range in size. Many of the specimens are split (fig. 12) in Nummuline fashion; and the fractured surface scarcely differs in any appreciable degree from that of the typical fusiform shell when broken across the centre. The smooth specimens, figs. 17 and 18, represent pretty closely the external features of those figured by D'Eichwald, except that the two faces are not quite equally convex.

Fusulina antiquior (Rouillier and Vosinsky).

Nummulina antiquior, Rouillier and Vosinsky, Bull. Soc. Imp. des Nat. de Moscou, *loc. cit.*
Orobias antiquior, D'Eichwald, Lethæa Rossica, *loc. cit.*

The salient character of the species described under this name appears to be its bilateral asymmetry; one surface is greatly more convex than the other; and the margin of the test is rounded. My material has yielded no specimens precisely corresponding to the original drawings; but examples unsymmetrically built in various ways are by no means uncommon. Perhaps the nearest approach to Rouillier and Vosinsky's figures are numbers 17 and 18 of the Plate; and these specimens are in reality somewhat flatter on the underside than the drawings make them appear. But those described by the Russian authors were of far finer dimensions, and had the inequality of the two sides much more strongly marked. That they presented no true Nummuline structure was satisfactorily ascertained by D'Eichwald, who founded a new genus, *Orobias*, for their reception on this account.

Such are the general indications afforded by the study of this little group of fossils from the Miatschkovo limestone. The chief thing to be regretted is that so little can be learnt from them with respect to the minute structure of the test. They are all comparatively thick-shelled; but the finer characters are completely obscured by mineral infiltration, and even the tubulation of the walls can scarcely ever be traced. The position of the genus *Fusulina*, whether more nearly related to the Nummuline or the Rotaline types of Foraminifera, is still an occasionally debated point; and though the subject has been treated by Dr. Carpenter* with much clearness, and the value of the characters *pro* and *con* in each case has been stated by him in a way that leaves little to be desired, it is still important that evidence should be obtained as far as possible from each section of the genus.

In general terms it may be said that, in the perforation of the shelly investment, *Fusulina* occupies a place between the Rotaline and the Nummuline types, whether as to the size of the tubuli or their distance apart; and in both of these particulars it approximates more nearly to the former than to the latter group. The absence of double septal lamellæ, and consequently of supplementary skeleton and its attendant canal-system, form *primâ facie* evidence against Nummuline affinity. On the other hand, the usually perfect bilateral symmetry of form and the position of the aperture on the median plane are essentially Nummuline features. Practically, therefore, the decision on the question depends on the amount of significance to be attached to the canal-system as a basis of classification; and to form a correct estimate on this point it is needful to look beyond the genus *Nummulina* and its immediate allies.

Amongst the Rotalinæ, for example, at least three genera present quite unmistakable evidence of this higher organization: *Rotalia*, *Calcarina*, and *Tinoporus* can be shown each of them to have a characteristic system of interseptal passages. The modifications of these three types may be traced in series from their simpler to their more complex forms—that is, from minute varieties, with thin shells and single septal walls, to more massive representatives, having a supplementary skeleton developed to a greater or less degree and furnished with a system of ramifying canals.

The series comprised in the genus *Rotalia* has, to begin with, a delicate thin-shelled variety (*R. nitida*, Will.), in-

* Introd. Foram. p. 306; and Monthly Micr. Journ., April 1, 1870, p. 182.

sent case true relationship, as far as it can be traced, bears out the conclusion that had been arrived at on different grounds—namely, that *Fusulina* finds its most appropriate place in the family Nummulinida, though amongst the least highly organized members of the group.

In conclusion, these notes are brought forward as a slight contribution to the history of a single section of a large and important genus of Foraminifera; and no attempt has been made to invest them with a more general character. The material in the hands of Dr. Stache and Dr. Schwager will furnish a basis for much wider treatment of the subject; and care has been taken to avoid touching on the points that have specially occupied their attention, lest their results should in any way be forestalled.

EXPLANATION OF PLATE XVIII.

Note.—In figures 1, 13, 15, and 16 two views are given of the respective specimens. In each case, *a* represents the aspect in the line of view perpendicular to the axis, *b* the aspect from a point on the line of the central axis.

Figs. 1–4. *Fusulina cylindrica*, Fischer, typical form. Figs. 3 & 4 are worn and broken specimens. All magnified 10 diameters.

Figs. 5 & 6. *Fusulina princeps* (Ehrenberg). ×12 diam.

Figs. 7–9. *Fusulina sphæroidea* (Ehrenberg). ×12 diam.

Figs. 10–13. *Fusulina æqualis* (D'Eichwald). × 12 diam. This form is often found split on the median plane; fig. 12 represents such a specimen.

Figs. 15 & 16. Represent worn specimens, scarcely more than casts, of varieties like those embraced in *F. sphæroidea*. ×12 diam.

Figs. 17 & 18. Somewhat unsymmetrical examples—the two sides, as measured from the median plane, being unequal in size and convexity. Such specimens lead up to the "*Nummulina*" *antiquior* of Rouillier and Vosinsky, which is doubtless a *Fusulina* of this sort, though of larger dimensions and with the asymmetry more fully developed. ×12 diam.

Figs. 14, 19–21. Various worn, irregular, or otherwise unsymmetrical specimens. ×12 diam.

XLI.—*Descriptions of two new Species of* Cetoniidæ. By Charles O. Waterhouse.

Lomaptera Jamesii, sp. n.

L. statura omnino *L. Wallacei*, viridis, nitidissima; elytris fascia lata prope basin læte rufa ornatis, regione suturali ante apicem transversim strigosa.

♂. Tibiis anticis inermibus. Long. 13½ lin., lat. 6¾ lin.
♀. Tibiis anticis ante apicem bidentatis. Long. 12 lin., lat. 6 lin.

Clypeus with the sides nearly straight, a little narrowed towards the base. Thorax very broad, and rounded in front, with a few punctures scattered over the sides, the posterior lobe not quite covering the scutellum. Elytra with a broad bright red band occupying nearly all the basal half of the elytra, but not quite reaching the base; the apical half of the sides of the elytra and the pygidium are strongly laminate-strigose; the sutural region of the elytra towards (but not extending to) the apex is sparingly marked with flexuous scratches. The sides of the mesosternum are reddish.

Hab. New Guinea, Yule Island. Brit. Mus.

Closely resembles *L. Wallacei* in form; but the ground-colour is slightly tinted with olive. Besides the coloration, it is distinguished by the sides of the clypeus being more parallel, and by the sutural region of the elytra near the apex being strigose.

A single example of this beautiful species was first brought to this country by Mr. Octavius Stone. Several specimens have now reached us from Dr. James, after whom I have named the species, in accordance with a wish expressed by Mr. Higgins.

Gymnetis decemguttata, sp. n.

G. obscure picea, nitida; thorace parce fortiter punctato, marginibus striga albida notatis; elytris sat fortiter subseriatim punctatis, singulis maculis quinque albidis ornatis. Long. 10 lin., lat. 5½ lin.

Of a deep pitchy brown colour, shining. Head thickly and strongly punctured, with two white spots between the eyes. Thorax much narrowed in front, the sides marked with a white velvety stripe close to the margin. Elytra each with five white spots—three on the lateral margin, one close to the suture a little behind the middle, and the fifth a little within the apex; a spot on each side of the pygidium and two rows of spots on each side of the abdomen are also white.

Hab. Medellin (Granada). Brit. Mus.

British Museum,
October 19, 1876.

XLII.—*New and peculiar Mollusca of the* Pecten, Mytilus, *and* Arca *Families procured in the 'Valorous' Expedition.* By J. Gwyn Jeffreys, LL.D., F.R.S.

Pectinidæ.

*Pecten fragilis**, Jeffr.

Shell roundish, equilateral, much compressed or flattened, excessively thin and brittle, of a paper-like consistency, semi-transparent, rather glossy, and somewhat iridescent: *sculpture*, in the upper valve 15–20 concentric ribs or undulating folds, which do not extend to the sides, besides numerous longitudinal fine and raised striæ, which latter radiate from the beak and cover the whole surface; the sides are otherwise marked by close-set lines of growth only; the lower valve has a few slight concentric ribs, but no longitudinal striæ: *colour* silvery-white: *margins* semicircular in front, and sloping gradually towards the hinge-line, below which on each side there is a gentle curve or depression: *beaks* very small and rather prominent: *ears* small but broad, equal in size, right-angled: *hinge-line* straight: *cartilage-pit* very small, triangular: *hinge-plate* broad and smooth: *inside* pearly: *muscular scars* inconspicuous. L. 0·35. B. 0·35.

'Valorous' Expedition: Station 9, 1750 fathoms; St. 12, 1450 fathoms; St. 16, 1785 fathoms. Norwegian Expedition, 1876, 1000–1500 fms. Fragments only.

This species belongs to the section or subgenus *Pseudamussium* of Klein, along with *Pecten grœnlandicus*, *P. vitreus*, and *P. similis*.

A specimen from 1450 fathoms is permeated by the same curious branching sponge (?) or organism that infests so many shells from deep water and has been considered a Fungus by some naturalists.

Genus Amussium †, (*Amusium*) Rumphius.

Shell inequivalve, more or less circular, flattened, smooth or variously sculptured, furnished inside with slight ribs, which radiate from the hinge and are not impressions of outside markings, but are quite irrespective of them.

The institution of this genus has been attributed by every author to Klein; but Rumphius (the "Plinius Indicus") has precedence of him by nearly half a century. The type of

* Brittle.

† Something exactly and evenly planed.

Other species of *Amussium* in the European seas are:—*A. fenestratum*, Forbes (*Pecten*), the lower valve of which is his *P. concentricus*, Philippi's *P. antiquatus*, Acton's *P. Philippii*, E. von Martens's *P. Actoni*, and Tiberi's *P. inæquisculptus*; and *A. striatum*, Jeffr. MS. To this genus also belongs *Pecten cristatus* of Bronn, a fossil of the older Italian Tertiaries.

Lima ovata, S. V. Wood.

Lima ovata, S. V. Wood, Monogr. Crag Moll. (Palæont. Soc. Publ.), vol. ii. p. 48, tab. vii. fig. 5.

SHELL broadly oval, with a somewhat oblique outline, convex, rather thin, semitransparent, and glossy: *sculpture*, about 50 fine longitudinal ribs, which are of a proportionate size throughout; these are crossed by numerous and close-set concentric striæ, giving the crests of the ribs a slightly notched or prickly appearance: *colour* white, with a yellowish-brown tint in a living specimen: *margins* rounded and more or less scalloped in front, with a gentle curve at the sides: *beaks* prominent, and having a blunt or tubercular nucleus: *ears* very small and narrow, obtuse-angled: *cartilage* minute: *ligament* narrow: *hinge-line* straight: *hinge-plate* spindle-shaped, with a plain or smooth edge: *cartilage-pit* triangular and narrow: *inside* glossy, exhibiting the reverse of the ribs but no central or other furrow. L. 0·2. B. 0·125.

One living specimen and three valves, besides a few fragments, from Station 12, 1450 fathoms. One fragment is much larger than the others, and represents a size double that which is stated in the above description.

I have described anew this species, for the purpose of giving more details than are found in Mr. Wood's diagnosis of the Crag fossil and of comparing with it what I believe to be the now living or recent form. The oblique contour is observable in some of the Crag specimens. These are certainly thicker than living specimens; but such difference may be explained by the nature of the former and present habitats. The Coralline Crag, in which *L. ovata* occurs, was probably formed at a depth not exceeding 50 fathoms. I have shown in the cases of *Mactra solida* and its variety *elliptica* ('British Conchology,' vol. ii. pp. 418, 419), as well as of *Buccinum undatum* and many other Mollusca, that shells of the same species from deep water are invariably thinner than those from shallow water. The partial absence of ribs or striæ in the Crag specimens is observable also in the variety *leviuscula* of *Lima elliptica*; and even Crag specimens of *L. ovata* vary in that respect. In my specimen of *L. ovata* from Monte Mario the ribs cover the whole surface. Some allowance may also be made for "descent with modification" during the enormous lapse of time which has taken place since the Tertiary epoch, as well as for altered conditions of temperature. The same remark is applicable to *Discina fallens* and *D. Atlantica.*

In shape this species is allied to *L. Sarsii* (or *L. crassa?*): but the sculpture is very different; it is not, like that species, solid; and the hinge-plate is not crenellated or notched.

As to the specific name, I admit that there may be some doubt whether this is the *Ostrea nivea* of Brocchi, to which I once referred it; and I have therefore adopted Mr. Wood's name *ovata.* Brocchi, indeed, did not notice the furrow, which is characteristic of *Lima subauriculata* and *L. elliptica*; and his description and figure are not inappropriate to the present species. Renier never described his *Ostrea nivea*, and merely published the name, with a remark that it came nearest to *O.* (*Lima*) *inflata. Lima nivea* of Risso and Philippi is apparently *L. subauriculata*, with which Philippi himself subsequently identified it.

Lima subovata *, Jeffr.

SHELL somewhat oval, convex in the middle and compressed towards the sides, thin, semitransparent, and glossy: *sculpture*, about 50 very fine and thread-like longitudinal ribs, which radiate from the beaks and extend to the sides; two of the ribs in the middle are larger than the rest and are divided by a straight furrow; the ribs are crossed by numerous concentric lines of growth: *colour* white: *margins* sharply curved in front, and sloping on each side towards the middle, so as to give the shell the shape of a hen's egg: *beaks* proportionally large and prominent: *ears* triangular, well defined, and nearly straight, with rectangular corners: *cartilage* small: *ligament* narrow: *hinge-line* straight: *hinge-plate* narrow, plain-edged: *cartilage-pit* triangular, with a shelf or ledge on each side to separate the ears: *inside* glossy, exhibiting the reverse or underside of the ribs and central furrow. L. 0·25. B. 0·14.

Single valves from Station 12, 1450 fms. 'Porcupine' Exp., 1869, off the north-western coast of Ireland, 664–1443 fms.; between the Hebrides and Färöe Isles in 542 fms., and between the Färöes and Shetland in 125 fms. 'Challenger' Exp., off the Azores, 1000 fms. Palermo (Monterosato)!

This species has a more oval shape and is shorter than *L. subauriculata*; it is bluntly pointed in front and expanding

* Somewhat oval.

on each side; it is not so convex throughout; and the ribs are twice as many and finer. In shape it somewhat resembles *L. ovata*, but is more delicately ribbed, and especially has a central furrow.

Lima gibba *, Jeffr.

Differs from *L. subovata* in being larger and proportionally broader, and in having a somewhat oblique outline; it is remarkably gibbous, pinched up at the sides, and much more sharply pointed in front; and the ribs are much slighter, more irregularly disposed, and sometimes more or less wanting. In every state of growth the two species are distinguishable by these characters, although found together. L. 0·3. B. 0·2.

Station 9, 1750 fms.; 12, 1450 fms.; 16, 1785 fms. Single valves and fragments.

Mytilidæ.

Idas †, Jeffr.

Shell transversely oblong, thin, nacreous: *ligament* external: *cartilage* none: *hinge* toothless: *hinge-plate* crenated on both sides of the beaks.

Perhaps allied to *Myrina*, although that genus has an internal ligament or cartilage, and it wants the remarkable character afforded by the hinge-plate being crenated. *Modiolaria* and *Crenella*, as well as *Dacrydium*, have the hinge-plate crenated on the posterior side; but the sculpture in these first named two genera is very different from that of *Idas*, and *Dacrydium* has an internal cartilage. *Idas* resembles *Arca* in shape.

Idas argenteus ‡, Jeffr.

Shell having the shape of an irregular parallelogram, of a delicate texture, rather opaque, iridescent: *sculpture*, very fine and close-set transverse striæ and microscopic longitudinal striæ; the latter radiate from the beaks and cover the whole surface of the shell: *colour* silvery white, except the beaks which are reddish brown: *margins* straight at the back and in front, rounded on the anterior and smaller side, and sloping from the back with a curved outline on the posterior side: *beaks* circular and incurved, placed near the anterior side: *ligament* not observable, in consequence of the specimens being imperfect and consisting of single valves only; but it is

* Gibbous or hunched.
† One of the Argonauts, the "valorous" (see Morris's 'Life and Death of Jason').
‡ Silvery.

line sharply angular: *hinge-plate* broad: *teeth* strong but short, 8 on the posterior and 6 on the anterior side: *inside* highly nacreous and glossy, smooth; inner margin closely and finely notched: *muscular scars* roundish. L. 0·15. B. 0·175.

An imperfect specimen and a small valve from Station 7, 1100 fms. 'Porcupine' Exp. 1869, off the north-western coast of Ireland, 420–1470 fms. 'Challenger' Exp., off Newfoundland, 1000 fms.

Allied to *N. tumidula*, Malm,=*pumila* (Lovén, MS.), Asbjörnsen, but differs in its smaller size, being more globular and having consequently a less triangular outline, its thinner texture, more prominent and nearly central beaks, and in its finely decussated sculpture.

Leda pusio, Philippi.

Nucula pusio, Phil. Moll. Sic. ii. p. 47, tab. xv. fig. 5.

Var. *latior*. Rather larger than the fossil type, but not so solid, more oval than triangular in consequence of the posterior side being extended into a beak or point; agreeing in all other respects with the type.

Station 9, 1750 fms.; 12, 1450 fms. 'Porcupine' Exp., 1869, off the north-western coast of Ireland, 1180–1215 fms.; 1870, Bay of Biscay, 257–994 fms.

Fossil in Calabria (Seguenza). Type from Calabria also (Philippi); Messina (Seguenza).

Leda pustulosa *, Jeffr.

Shell forming a short oval, equilateral as regards the position of the beaks, but not as regards the proportions of each side, convex, thin, opaque, glossy, and nacreous: *sculpture* consisting of slight wrinkled striæ, which radiate from the beaks to the front, and of fine close-set but irregular concentric striæ, besides the lines of growth; there is also a sharp ridge with a corresponding furrow on the posterior side, causing that last to appear pinched up: *colour* white, under a pale yellowish-brown *epidermis*, which has a peculiar blistered appearance: *margins* nearly straight at the back, rounded at the anterior side, sloping at the posterior side to a point something like that of a bill-hook, below which it is indented by the furrow, and curved in front: *beaks* central, prominent, and incurved: *lunule* inconspicuous: *ligament* wanting: *cartilage* and pit minute and narrow: *hinge-line* gently curved: *hinge-plate* broad, but not thick: *teeth* small, thorn-like, 12 on each

* Full of blisters.

side, including 3 or 4 minute tubercles close to the cartilage; a space is left on the outer sides of the hinge-plate between the margins and the teeth: *inside* smooth and polished: *scars* triangular and large. L. 0·15. B. 0·225.

Station 12, 1450 fms.; a single but large specimen. 'Porcupine' Exp., 1869, 420–1470 fms.; 1870, Bay of Biscay, 202–740 fms. Fossil in the Zanclean formation at Messina (Seguenza)!

Its nearest ally is *L. frigida*; but that species wants the peculiar sculpture and epidermis, as well as the drooping of the posterior side and indentation below the angle of *L. pustulosa*: its teeth are very much smaller, and they do not extend so far on the hinge-line. From *L. acuminata* (or *Messanensis*) it also differs in being more shortly oval, and having the posterior angle obtuse instead of acute.

Leda expansa *, Jeffr.

SHELL transversely oval, nearly equilateral, compressed, thin, semitransparent, and glossy: *sculpture*, numerous slight but regular concentric striæ, which are observable only by means of a lens and disappear towards the beaks; there are also faint traces of microscopic lines radiating from the beaks to the front: *colour* pale yellowish-white: *margins* nearly straight at the back except for the projection of the beaks, spread out and equally rounded at each side, and semicircular in front: *beaks* central, prominent, and calyciform: *lunule* forming a sharp ridge: *ligament* inconspicuous or wanting: *cartilage* and pit very minute, the latter sunken: *hinge-line* very gently curved: *hinge-plate* rather broad: *teeth* small, recurved, 7 or 8 on each side of the beak: *inside* polished, showing faint traces of the longitudinal striæ; margin plain: *scars* indistinct. L. 0·1. B. 0·175.

Station 9, 1750 fms.; 12, 1450 fms.; 13, 690 fms.: one living and a few more or less perfect specimens. 'Porcupine' Exp., 1869, off the north-western coast of Ireland, 1180–1380 fms.

Differs from *L. lucida* in being much smaller and more compressed; and the posterior side is rounded instead of pointed and angular.

Leda lata †, Jeffr.

SHELL forming a short oval, with an oblique contour, rather convex and solid, transparent, and highly glossy: *sculpture*, none except slight irregular lines of growth: *colour*

* Spread out. † Broad.

pearl-white under the *epidermis*, which is pale yellowish: *margins* sloping on the back towards each side, which is equally rounded (the posterior side being upturned and occasionally more or less angular towards the point), semicircular in front: *beaks* placed about two-fifths nearer the anterior side, very small and incurved: *lunule* lance-shaped, narrow, and defined by a sharp ridge in the middle: *ligament* extremely slight: *cartilage* and pit very small: *hinge-line* obtusely angular, occupying the greater part of the dorsal area: *hinge-plate* narrow: *teeth* recurved, placed on the inside of the hinge-plate, 7 to 10 on each side: *inside* glossy; margin plain: *scars* slight and inconspicuous. L. 0·175. B. 0·2.

Station 9, 1750 fms.; 12, 1450 fms.; 13, 690 fms.; 16, 1785 fms. One living specimen and some valves. 'Porcupine' Exp., 1869, off the north-western coast of Ireland, 165–1443 fms.; 1870, off the coast of Portugal, 740–1095 fms. 'Challenger' Exp., lat. 37° 26′ N., long. 25° 14′ W., 1000 fms.

This has a peculiarly oblique outline, in consequence of the posterior side being upturned; and the true length (measured from the beak to the front margin) is proportionally greater than in the allied species. The position of the beak is excentric compared with that in *L. expansa*.

*Leda sericea**, Jeffr.

SHELL transversely oval, somewhat inequilateral, convex, rather solid, opaque, and of a dullish hue: *sculpture*, numerous fine, regular, and close-set concentric striæ, besides a few occasional lines of growth: *colour* white under the *epidermis*, which is pale yellowish: *margins* sloping from the beak to each side, which is equally rounded, gently curved in front: *beaks* placed nearer the anterior side, blunt or depressed: *lunule* long, inconspicuous: *ligament* slight: *cartilage* and pit small, the former horn-colour: *hinge-line* obtuse-angled: *hinge-plate* rather broad: *teeth* recurved towards the beak, 7 to 10 on the anterior and 10 to 15 on the posterior side; those close to the beak are minute and crowded, the others becoming much larger as they diverge outwards: *inside* smooth; margin plain: *muscular scars* pear-shaped: *pallial scar* distinct, placed within the margin. L. 0·1. B. 0·15.

Var. *ovata*. Longer in proportion to the breadth.

Station 12, 1450 fms. 'Porcupine' Exp., 1869, off the north-western coast of Ireland, 1366–1380 fms.; 1870, off the coast of Portugal, 740–1095 fms.

* Silky.

neath the beaks: *hinge-line* straight: *hinge-plate* narrow, occupying about one-fifth of the circumference of the shell: *teeth* rather slight, slanting inwards, 4 or 5 on each side of the beak: *inside* porcellaneous, with a bevelled and smooth or plain but narrow edge: *scars* inconspicuous. L. 0·35. B. 0·3.

Station 12, 1450 fms.

Smaller and thinner than *L. aurita*, and more delicately sculptured; the epidermis is not pilous as in that species, but arranged in distinct rows; the hinge-line is straighter, the hinge-plate is narrower, and the teeth are much slighter and set obliquely on both sides of the beak. In *L. aurita* the teeth are erect on the anterior side, and slant inwards on the posterior side.

Limopsis cristata *, Jeffr.

SHELL rounded, but inclined to become oblique in aged specimens (as in *Pectunculus glycymeris*), convex, rather solid, opaque, rather glossy: *sculpture*, numerous fine riblets or raised lines, which radiate from the beak, and equally fine concentric lines, causing by their intersection a slight cancellation; the concentric lines are not granulated or beaded: *colour* white: *epidermis* light yellowish-brown, arranged in regular spinous rows, except towards the front, where it is somewhat matted and projects beyond the edge of the shell: *margins* nearly straight at the back, and rounded at the sides and in front: *beaks* small, rather prominent, blunt, and incurved: *hinge-area* long, reddish brown, smooth: *cartilage* horn-colour, placed in a triangular cavity under the beaks: *hinge-line* gently curved: *hinge-plate* broad, occupying about one-fourth of the circumference of the shell: *teeth* small but strong, straightish, varying in number from 5 to 8 on each side: *inside* glossy, indistinctly striated lengthwise, furnished with a close-set row of small tubercles a little within the edge of the shell; these tubercles are nearly equal in size: *scars* conspicuous. L. 0·25. B. 0·25.

Station 13, 690 fms. 'Porcupine' Exp., 1869, off the north-western coast of Ireland, 420–808 fms.; Bay of Biscay, 517 fms.; North Sea, 542 fms.: 1870, Bay of Biscay, 292–1095 fms.

It is distinguishable from *L. minuta* (*borealis*, Woodward) by its shape and sculpture, its coarser epidermis (which in *L. minuta* is much finer and greater in quantity), its teeth being upright on both sides, instead of being oblique on the posterior side, and by the marginal tubercles being equal in size throughout and not larger on that side. Having, since

* Crested.

the publication of my last volume on British Conchology, had the opportunity of comparing a great many living specimens of all ages and sizes of *L. borealis*, Woodward, from various parts and depths of the North Atlantic and Mediterranean, with an equally extensive series of the fossil *L. minuta*, Philippi, I am now quite satisfied that they are one and the same species. The differential characters noticed by me are very variable. The name *minuta* must therefore be substituted for *borealis*. My *L. pygmæa*, from Corsica, is the young of this species, as well as *L. tenuis* of Seguenza, from the Straits of Messina.

Malletia excisa, Philippi.

Nucula excisa, Phil. Moll. Sic. ii. p. 46, tab. xv. f. 4.

Station 9, 1750 fms.; 12, 1450 fms. One living specimen and some valves. 'Porcupine' Exp., 1869, off the north-western coast of Ireland, 1443 fms. Fossil in Calabria (Philippi); Zanclean formation at Messina (Seguenza)!

A remarkable and beautiful species. The transverse striæ are rather more numerous and close-set in the recent than in fossil specimens. The ligament in this, as well as in other species of the genus *Malletia* of Desmoulins (= *Solenella*, Sowerby, = *Ctenoconcha*, Gray), is wholly external; in *M. excisa* it extends on both sides of the beaks.

The present species belongs to a section or group which Messrs. Adams have designated under the generic name *Neilo*. Desmoulins and Sowerby published their two genera in the same year, 1832; but the Number of the 'Actes' of the Linnean Society of Bordeaux in which the former described and figured *Malletia* bears date the 15th of February, while the Number of the 'Proceedings' of the Zoological Society of London in which the latter described *Solenella* is dated December 11. Sowerby considered his genus to belong to the *Solen* family. No one seems to have noticed the cartilage and its corresponding pit or depression in the hinge.

Malletia cuneata *, Jeffr.

SHELL obliquely oblong, inequilateral, compressed, thin, semitransparent, glossy and somewhat nacreous: *sculpture* none, except slight and irregular lines of growth: *colour* whitish, under a thin and pale yellowish-brown *epidermis*: *margins* sloping gradually on the back towards each end, rounded on the anterior side, bluntly angular and wedge-shaped on the posterior side, and gently curved in front: *beaks* situate

* Wedge-shaped.

near the anterior side at about two-fifths the length of the back; they are small, slightly prominent, and calyciform: *lunule* indistinct: *ligament* narrow, yellowish brown, altogether external and placed between the "nymphæ," or pouting edges of the shell, on the posterior side: *cartilage* minute, oblong, contained in a narrow depression immediately underneath the beaks: *hinge-line* obtuse-angled: *hinge-plate* rather narrow: *teeth* small, erect, and pointed, 12 on the anterior side and 20 on the posterior side, the middle of the hinge-plate forming the cartilage-pit: *inside* polished; edge plain: *muscular* and *pallial scars* large and conspicuous. L. 0·2. B. 0·35.

Station 9, at the entrance of Davis Strait, 1750 fms.; Station 12, in the North Atlantic, 1450 fms. 'Porcupine' Exp., 1869, off the north-western coast of Ireland, 1215–1443 fms.; 1870, Bay of Biscay, 718–1095 fms., and Mediterranean, 1415 fms. Norwegian Exp., 1876, 1800 fms.

May be easily known from *M. obtusa*, Sars, by its very different shape.

XLIII.—*Description of a new Species of* Macrotus. By G. E. Dobson, M.A., M.B., F.L.S., &c.

Macrotus bocourtianus, n. sp.

Ears as long as the head: front margin of the nose-leaf scarcely defined, continuous with the upper lip; terminal leaf narrow and subacutely pointed: last caudal vertebra and half the antepenultimate vertebra free; the free portion of the tail nearly equal to the thumb in length.

Teeth as in *M. waterhousii*. Fur dark brown above, paler beneath.

Length (of a specimen not quite full-grown)—head and body 2·15 inches; tail 1·35, tail free from membrane 0·4; head 1·0; ear 1·0; tragus 0·4; nose-leaf 0·3; forearm 2·05; thumb 0·5; second finger—metacarp. 1·5, first phalanx 0·68, second phalanx 0·7, third phalanx 0·6; third finger—metacarp. 1·4, first phalanx 0·65, second phalanx 0·55; fourth finger—metacarp. 1·6, first phalanx 0·6, second phalanx 0·45; tibia 0·85; calcaneum 0·35; foot and claws 0·45.

The above description has been taken from the largest of four specimens preserved in the Paris Museum, obtained by M. Bocourt in Vera Paz, Guatemala, which, through the kindness of M. Alph. Milne-Edwards, I have been enabled to examine and describe. All the specimens agree in the remarkable length of the projecting portion of the tail, and in other characters described above.

(salivary ?) glands, which open always into the mouth and never into the forcipules, and of the Malpighian tubes, and, finally, a large number of histological observations which it is impossible for me to summarize.

The physiological part comprises special researches on alimentation, on the manner in which the *Lithobii* kill their prey, and, lastly, on digestion properly so called. In *Cryptops* the aliments accumulate in the spacious buccal intestine of which I have spoken above, are retained there by the valvular apparatus, and are there transformed by the digestive liquid secreted by the middle intestine situated further on.

In the other Myriopods the principal digestive phenomena take place in the true middle intestine. The liquid secreted is neutral, sometimes slightly alkaline, in *Lithobius*, *Cryptops*, *Himantarium*, *Geophilus*, and *Glomeris*; in *Iulus* alone it is slightly acid. This liquid forms an emulsion of the fats, and evidently dissolves the albuminoid substances.

I have been unable completely to elucidate the function of the anterior glands. The arrangement of their excretory canals and other characters prove that in the carnivorous Myriopods these are not venomous glands *: but their secretion, at least in *Lithobius* and *Himantarium*, does not possess the characteristic property of the true saliva of the vertebrates and of insects; it does not transform starch into glucose.

As far as we can judge, the Malpighian tubes of the Myriopoda act precisely in the same manner as those of insects; they produce uric acid, urates (*e. g.* urate of sodium), and oxalate of calcium. They are therefore depuratory urinary organs.—*Mém. de l'Acad. des Sci. de Belgique*, tome xlii. 1876.

On the Femoral Brushes of the Mantidæ *and their Function.* By J. Wood-Mason, Esq.

The author states that, while recently examining a specimen of a species of *Hierodula* from the Nicobars, his attention was arrested by two brightish oblong spots, situated one near the distal end of each of the fore femora and nearer to the lower dentate than to the upper entire edge of the joint—and that, on examining these spots more closely by the aid of a lens, he had found that they were brushes of stiff hairs, all of which were directed away from the upper edge of the femur, some of which (namely, those forming the upper half of the brushes) were closely appressed to the surface and threw back the light strongly, while the rest projected almost straight out from it and were the stiffest of all. He had been unable to find any account of these structures in any entomological work to which he had access; and neither M. de Saussure, who had recently published an admirable account of the external anatomy and habits of the whole family, nor Dr. Fischer, the author of the learned Latin work on the Orthoptera of Europe, had made

* The true venomous glands, which I have succeeded in isolating in some species, will form the subject of a future memoir.

any mention of them. These brushes occurred in numerous species belonging to the following genera:—*Metalleutica, Chæradodis, Humbertiella, Micromantis, Pseudomantis, Archimantis, Mesopteryx, Chasmatomantis, Euchomena, Gonypeta, Hierodula, Mantis, Tenodera, Iris, Phespis, Fischeria, Schizocephala, Hymenopus, Creobrota, Paroxypilus, Popa, Deroplatys, Oxypilus, Phyllocrania, Ceratomantis, Hestias, Gongylus, Empusa, Blepharis,* &c., and probably universally throughout the whole group, although he had examined none of the American species, which, however, were hardly likely to prove an exception to the rule.—*Proceedings of the Asiatic Society of Bengal,* June 1876.

On the Geographical Distribution of Schizocephala, *a Genus of* Mantidæ. By J. Wood-Mason, Esq.

The author states that, so far from being a peculiarly African form, as it is considered to be by M. de Saussure in his recent monograph of the family, the remarkable genus *Schizocephala* is one of the most widely distributed, not only of Mantidæ but of insects, in India—and, in support of his statement, gives a long list of localities from which he has received either perfect or immature examples of the (?) single species *S. bicornis,* viz. the Karakpur hills in Behar, Devapur and Chánda in the Central Provinces, Kaladgi in the Bombay presidency, Kachh, Ceylon, Murshidabad and Calcutta in Bengal, Pegu, &c., and quotes the old entomologist Stoll, who describes and figures examples from Tranquebar and China, and Professor Westwood's 'Arcana Entomologica,' in which it is referred to as an Asiatic form. Finally, he concludes either that the locality given by M. de Saussure is erroneous, or that that author's specimens, if really from South Africa, represent a second species of the genus.—*Proceedings of the Asiatic Society of Bengal,* June 1876.

On the Capture of Rattlesnakes, and on the Association of these Serpents with a small Owl and a little Marmot. By M. A. Trécul.

During my journey in North America, I traversed in 1848 a region situated to the west of Arkansas, where rattlesnakes are very common. I took several of them, which I sent to the museum; the following year I also sent some from Texas. Having remarked that, after making themselves heard, they had little disposition to fly at persons a little way from them, I conceived the idea of taking them in the following manner. I attached a thread to the end of the ramrod of my gun, and made a slip-knot at its free extremity: I then went to the snake, which I had heard or which had been pointed out to me by the Osages with whom I travelled; I excited it; and when it raised itself up, threatening and hissing, I passed my running knot round its neck and pulled it up. The snake did not then make any movement or any effort to disengage itself, but remained straight as a stick. It was easy to kill it. Those which I sent to the Natural-History Museum at Paris were taken in this way, which other travellers may find useful.

As I am speaking about rattlesnakes, I ask the permission of the Academy to refer to a supposed society that travellers in the prairies have sometimes mentioned. It is said to be composed of three very dissimilar animals—a sort of small marmot (*Arctomys* or *Cynomys ludoviciana*), an owlet (*Athene cunicularia*), and a rattlesnake (*Crotalus confluentus*, Say).

I had the opportunity of visiting the seat of this supposed association. I met with it in the neighbourhood of the Salt River, which is one of the affluents on the right bank of the Arkansas. Not far from the *Grande Saline*, as the Indians call it, I saw two villages of the prairie-dogs. They give this name to the places inhabited by these little marmots, on account of the cry that they make when they come out of their burrows. As they live in numerous families, their villages are sometimes of considerable extent. One of those which I visited was about half a kilometre in diameter: the other was much smaller; it was barely fifty or sixty metres broad. There are some, I was told, a mile in diameter. The aspect of the two villages which I saw was as different as the nature of the soil. The narrower one, established in a level fertile spot covered with tall herbage, presented a surface entirely denuded by the work of these little animals, without a single blade of grass, but here and there with little mounds from two to three decimetres in height, each one surrounding an opening of the burrows, which communicate with one another. From the summits of these eminences the marmots observe the environs to ascertain that no danger menaces them. At first they do not venture to put out any thing but their heads; but they utter that little sharp bark which has procured them their name; and as they become reassured they gradually come further out. They do not, however, quit their hole and the mound until after long observation of the neighbourhood; and they reenter with astonishing rapidity at the smallest appearance of danger.

The larger village, established on dry, stony, and uneven ground, had not so clean a surface as the first; a thin herbage grew there. It did not seem, as in the other village, that a vigilant edileship took care of this less-favoured spot. It was in this latter village that I found the three animals above mentioned together. I saw the little owl come out of a burrow; and I was fortunate enough to procure it. The hole from which it issued was evidently frequented also by the little marmots; the freshly moved earth showed that it was often traversed. This was not the case in another burrow, in which I discovered the rattlesnake: the earth had not been scratched for a long time. This opening was certainly abandoned by the other animals, and it was clear that no intimacy existed between these latter and the *Crotalus*. An Osage having killed the little marmot before my eyes, I wished much to have the rattlesnake. I had much trouble in making it come out of its retreat; to force it to do so I was obliged to irritate it for a long time with the ramrod of my gun. Finally it came slowly out of the opening, and I was able to pass my running knot round its neck.

The three animals were sent to the museum.—*Comptes Rendus*, Sept. 18, 1876, p. 603.

high, that the vertex is hardly so elevated, and that the eyes are more produced laterally and are armed with a conspicuous bluntish spine; vertex divided by four slight impressions into three lobes, the two median ones of which impressions pass down on to the front round the elevation that carries the ocelli to the bases of the antennæ; "chaperon" scarcely twice as broad as long, transversely carinate, with its sides slightly convergent below, and with its upper and lower margins almost straight, divided off from the upper part of the face by a well-marked groove; the facial shield, or the part of the face intervening between the "chaperon" on the one hand and the ocelli and the bases of the antennæ on the other, is marked with two shallow pits placed symmetrically one on each side of the middle line, is deeply emarginate at its upper angles for the insertion of the capillary antennæ, and has its lower angles produced downwards, so that its inferior margin is concave.

Prothorax shaped just as in *Heterochæta tenuipes*, long and slender, fully as wide at its hinder extremity as it is at the setting-on of the fore legs, with its lateral margins very minutely denticulate, especially in front, with scattered minute granules and a sharp, fine, longitudinal raised line on its disk; its supracoxal dilatation feeble, rounded at the sides.

Organs of flight tolerably well developed, extending a little beyond the third abdominal segment. Tegmina narrow, of uniform width, narrowly rounded at the extremity, pale luteous, semiopaque; basal half of the anterior margin gently arcuate. Wings tricolorous, being coloured red, yellow, and brown with amethystine reflections; subhyaline, their anterior margin pale luteous; the discoidal nervure simple, the membranous spaces on either side of it each with a longitudinal row of minute brown blotches on a pure sulphur-yellow ground; posterior area pale rose-red at the base, then brown, and finally barred with concentric alternate bands of bright sulphur-yellow and brown, the yellow bands being by far the broader, and all becoming gradually narrower and less distinct towards the posterior margin, and all being everywhere broken up into blotches occupying only the membranous interspaces between the nervures.

First pair of legs tolerably long and slender; the coxæ unarmed, their three strong crests being only a little scabrous, about half the length of the prothorax, uniform in width, straight; femora rather longer, shaped like those of *H. tenuipes*; tibiæ straight, armed on the inner edge with fourteen spines, with nine on the outer edge, the base of which is unarmed, exclusive in both cases of the relatively enormous and very strongly curved terminal claw.

There is nothing remarkable about the rest of the legs, except that they are slightly scabrous.

Abdomen slender, filiform, wider than the prothorax; the supraanal plate short, transverse, fully twice as broad as long, truncate-rounded at the free end; terminal cleft portion of the infragenital plate strongly and suddenly compressed, and projecting wholly beyond the abdomen, but hardly reaching the extremities of the *cerci*; these are oval, broadly foliaceous, scarcely thrice as long as broad, indistinctly articulated at the base, where they are formed of a number of very short joints all ankylosed together, but showing three tolerably distinct large apical joints, the terminal one of which is obliquely truncate, so that the upper margin of the appendage appears strongly convex, while the lower is almost straight.

Colour of the living insect, with the wings closed, pale luteous grey; the tegmina slightly yellower than the body.

Male unknown.

Total length 50 millims.; length of prothorax $14\frac{1}{2}$, of which the neck is $4\frac{1}{2}$, width of prothorax at supracoxal dilatation 2; length of abdomen 26, width of abdomen $2\frac{2}{3}$; length of tegmina $23\frac{1}{2}$, width of tegmina 5; length of wings $22\frac{1}{2}$, of fore coxa $7\frac{1}{2}$, of fore femur 9.

Hab. A single specimen of this beautiful little insect was captured by my wife on a dinner-table in Calcutta. It flew in at the window, attracted by the bright lights. Westwood's *H. tenuipes* is said to have come from Senegal.

XLV.—*On some new and little-known Amphipodous Crustacea.* By the Rev. T. R. R. Stebbing, M.A.

[Plates XIX. & XX.]

Amphilochus concinna, n. sp. Pl. XIX. figs. 1, 1*a*, 1*b*.

Amphilochus concinna was dredged in or near Torbay in April 1876.

The antennæ are subequal in length; the superior the more robust, with the first joint longer than the other two and the flagellum as long as the peduncle; several articulations of the flagellum are furnished with long hairs. In the lower antennæ the penultimate joint is the longest; the flagellum has only three articulations, together equalling in length the last joint of the peduncle. The head has a depressed rostrum; each side also is produced into a sharp point between the upper and lower antennæ. The segments of the pereion are not so short compared with those of the pleon as in *Amphilochus manudens*. The coxæ increase in depth and breadth from the first to the fourth, which is very large; the lower edges of these are finely serrated. The first and second gnathopods are similar in form, the second being twice as large as the first. The thighs are elongate. The hands are more or less triangular, with the palms rounded and finely denticulate; the front margin of the hand is produced beyond the hinge-joint of the finger into a sharp tooth. In the second gnathopods the long sharp finger curves right round the palm and meets the wrist, which is produced all along the hinder margin of the hand, and terminates in three or more cilia. In the first gnathopods the finger is scarcely so long as the palm, and the process of the wrist is shorter than the margin of the hand. In the second gnathopods the distal extremity of the knee is obtusely pointed, and terminates in a short seta; while the distal extremity of the metacarpus is truncate, with a small cavity occupying the hinder half of the truncated line, and containing in the centre of this cavity a short stiff seta. This minute feature may perhaps be present also in the first pair of gnathopods; but the point could not be determined in the specimen examined. The five pairs of pereiopoda are subequal, long and slender—the first two having the thighs elongate and the metacarpus a little produced anteriorly, the last three having the thighs larger than the coxæ, broad, and with serrated edges, and the metacarpus posteriorly produced.

The telson and the last pair of pleopoda were wanting in the specimen here described; but the excavations in the pleon-segment from which they had been detached seemed to suggest that the caudal plate would have been lanceolate, as in *Amphilochus manudens*, and that the last pleopoda would have been of considerable size, though in this respect they would differ from those of the species just named. The two other pairs of pleopoda are biramous, the antepenultimate pair having the peduncle much longer than that of the penultimate, and the branches extending further.

The specimen described is a female; its length one eighth of an inch.

Danaïa dubia, Spence Bate. Pl. XIX. figs. 2, 2 *a*–2 *c*.

Danaïa dubia received its specific name from Mr. Spence Bate, its discoverer, in allusion to doubts which he felt on certain points of its structure, his one specimen having disappeared before the examination of it was completed. Specimens since

appearance it comes near to all the three genera *Probolium*, *Danaïa*, and *Amphilochus*, it seems necessary to assign it in solitary grandeur to a genus by itself. Its length is little more than an eighth of an inch.

The antennæ are subequal. Of the upper, the basal joint is the longest and stoutest, though shorter than the head in the lower, the penultimate and antepenultimate joints are slender, and the ultimate inconspicuous. The flagella of both pairs of antennæ consist of few and small articulations. There is no secondary appendage. The head has a small, slightly depressed rostrum; the lateral margin is produced into a sharp point below the upper antennæ. The eyes are round.

The coxæ of the first segment are almost concealed, only the upper margin appearing above the coxæ of the second segment. The first gnathopods are simple or almost simple. The hand is short, with sides nearly parallel, and some hairs in the neighbourhood of the palm. The finger is shorter than the hand, only slightly curved, and set a little way from the antero-distal extremity of the hand, from which point there springs a long hair. The wrist is longer than the hand; near its distal hinder extremity there projects what seems to be a rather pronounced spine, unless I have been deceived by the convergence of two hairs—a source of error which has more than once led observers astray, and which cannot be easily obviated when specimens are too rare to permit of their being freely handled.

The second gnathopods resemble those of *Amphilochus*. The hand is triangular, with the same antero-distal tooth as in *Amphilochus*; the palm is denticulate. The wrist is produced, though not so far as to reach the palm; from its extremity, and from the inner side of the produced portion, spring some long hairs. The finger is remarkable: it curves over and beyond the palm and wrist, ending in a long, straight needle-like portion, not opposable, it would seem, to any portion of the limb.

The pereiopoda are subequal, all moderately long and slender. The coxæ of the second pair are large, similar in shape to those of *Danaïa dubia*, but very slightly denticulate round the margin; while the lower margins of the preceding pairs of coxæ are very sharply but unevenly denticulate. The last three pairs of pereiopoda are remarkable for their large membranaceous thighs, the antepenultimate pair being oblong-ovate and having on the lower margin an irregular denticulation like the coxæ above mentioned. The last two pairs are more rounded and denticulated evenly. The telson is lanceolate, excavated above. The pleopoda are all biramous. The branches of the penultimate pair, which are much shorter than either of the other pairs, are unequal. The ultimate and antepenultimate pairs have the peduncle longer than the branches; the branches subequal. While the pereion is stout, the pleon is narrow and elongated. The colour is tawny, with some red spots chiefly on the large coxæ.

The generic name refers to the beauty of the denticulate membranaceous thighs; the specific name to the peculiarity of the finger of the second gnathopods.

Exunguia stilipes, Norman, and *Cratippus tenuipes*, Spence Bate.

The genus *Cratippus* and the species *Cratippus tenuipes* were founded by Mr. Spence Bate on a single specimen, and that apparently an abnormal or imperfect one. The type specimen, such as it was, has been unfortunately mislaid or lost. It thus becomes impossible absolutely to decide whether the genus *Exunguia* (Norman) is or is not identical with *Cratippus*, unless fresh specimens of the latter should happen to be found agreeing with the original description. *Exunguia stilipes* was described in this Journal (ser. 4, vol. iii. p. 359) by the Rev. A. M. Norman, with that writer's usual clearness and accuracy. Specimens minutely agreeing with his description may be obtained at Meadfoot and at Austis' Cove, Torquay, by a careful examination of the sponge *Halichondria panicea*, which in many places coats the rocks beneath overhanging seaweeds. The sponge should be broken into small pieces, when now and then a little white glistening line, about an eighth of an inch long, will reward the searcher with the desired object. A person of sharp sight may notice that the white line is ornamented by a pair of red eyes.

Accompanying Mr. Norman's description above referred to are figures of certain portions of the animal—one especially deserving of attention, which shows the microscopic serrulation of the branches of the uropoda. It does not appear, however, that any figure of the whole animal has hitherto been published. In regard to the lower antennæ, I may notice that the underside is flattened and that the outer edges are minutely serrulate. The flagella of both pairs of antennæ have some rather long fine hairs projecting from them. The eyes are round; the faceting over the red pigment is white. Under the rostrum of the head there is a projecting triangular plate, beneath which are packed the maxillipeds. The metacarpus of the first gnathopods is stouter than the wrist and hand. The antepenultimate uropods are folded under the pleon, and do not extend so far as the penultimate pair. The ivory whiteness of the body is not in any part stained with colour; but under the microscope pale markings may be observed, especially on the dorsal surface, such as are delineated in the accompanying figure (Pl. XX. fig. 4).

In establishing the genus *Exunguia*, Mr. Norman considered that his specimen was distinguished from *Cratippus* by the remarkable character of the first gnathopods, which have no finger, its place being supplied by a fasciculus of little spines projecting directly forwards. The generic account of *Cratippus*, on the contrary, had described the first two pairs of hands as subchelate. Nevertheless, both in detail and in general facies, both by figure and description, *Cratippus tenuipes* and *Exunguia stilipes* so closely resemble one another that it would be a decidedly singular case of mimicry or coincidence of form if they really belonged to distinct genera. But it will be noticed that in the specific description of *Cratippus tenuipes* the generic account which makes the gnathopoda subchelate is modified by the explanation that the first gnathopoda are scarcely subchelate. Further, these limbs are omitted from the figure of the creature—a fact which is noted but not explained. But any one dealing with a single specimen of *Exunguia stilipes*, which he wishes to describe but not to mutilate, will understand the reluctance with which slender organs such as those under discussion sometimes lend themselves to the manipulation requisite for faithful figuring or accurate description. Packed away as they often are between the coxæ, and perhaps more than half hidden by other projecting limbs, one must in such case be content with observing "pas ce qu'on veut, mais ce qu'on peut." Now the fasciculus of little spines which does duty in place of a finger in the first gnathopods of *Exungia stilipes* can only with great difficulty be distinguished from a finger when the animal is dry; and even when it is in liquid, the convergence of the hairs or spines often produces a finger-like appearance, especially as the anterior spine or hair is the longest and often takes a slight curve such as is common in the finger of an Amphipod. In the first specimen I myself examined, not only was this appearance decidedly set up, but, by a curious coincidence, two hairs on the palm of one of the second gnathopods produced the appearance of just such a tooth as Mr. Spence Bate figures and describes in that position on one of the second gnathopods of *Cratippus tenuipes*.

While, however, the remarkable antennæ, the shallow coxæ, the relative sizes of gnathopods and pereiopoda, the general appearance of the segments both of pereion and pleon, the telson

grey: two small pale spots near the middle of the costal margin, and several black spots before the middle.

Exp. $1\frac{7}{10}$ inch.

Hab. Angola (*Rogers*).

Unlike any other species.

Hesperia Ligora.

Alis supra fuscis: anticis punctis octo hyalinis: posticis fascia flava macula tripartita hyalina notata: his infra albis macula atra, fasciaque lata submarginali, fuscis.

Upperside black. Anterior wing with eight transparent spots—two in the cell, three below these placed longitudinally, and three in the usual position near the apex. Posterior wing with a transverse pale yellow band (part of which is transparent) before the middle; the fringe at the anal angle fulvous.

Underside. Anterior wing as above, except that there is a bifid white spot near the outer margin. Posterior wing white, with the costal margin, a quadrate spot towards the inner margin, and a broad transverse band from the inner margin near the anal angle to beyond the middle of the wing, all dark brown.

Exp. $1\frac{8}{10}$ inch.

Hab. Angola (*Rogers*).

Unlike any other species.

Hesperia Cyrina.

Alis utrinque fuscis: anticis punctis septem hyalinis, uno in cellula bipartito: posticis punctis quinque hyalinis, fimbria aurantiaca.

Upperside dark brown. Antennæ ringed with white near the point. Anterior wing with seven transparent spots—one in the cell bifid, three placed longitudinally below this, and three near the apex. Posterior wing with five transparent spots forming a circle: the fringe, except at the apex, orange.

Underside as above, except that the anterior wing has the outer margin near the anal angle yellow, and that the posterior wing has the outer margin between the branches of the median nervures, as well as the fringe, yellow and indented inwardly.

Exp. $1\frac{8}{10}$ inch.

Hab. Darjeeling.

Unlike any described species.

Hesperia Maracanda.

Alis utrinque fuscis: anticis macula magna tripartita centrali flava, punctis duobus sub apicem albis: posticis infra punctis quinque albis.

Upperside dark brown. Antennæ ringed with yellow near the point. Anterior wing crossed at the middle by a pale yellow, trifid, transparent band; two minute white spots near the apex.

Underside as above, except that there is a bifid pale spot at the middle of the costal margin of the anterior wing, and a third spot near the apex, and that the posterior wing is marked by five minute white spots—two before the middle, and three after triangularly placed.

Exp. $2\frac{3}{10}$ iuches.

Hab. Angola (*Rogers*). Most nearly allied to *H. Thrax.*

Hesperia Sybirita.

Alis supra rufo-fuscis: anticis maculis sex hyalinis: anticis infra macula subapicali lilacina: posticis ad basin lilacinis, maculis atris notatis.

Upperside dark brown. Anterior wing with three separate central large spots and three at the apex transparent; the fringe narrow, rufous.

Underside rufous-brown. Anterior wing as above, except that there is a large subapical lilac spot. Posterior wing tinted with lilac near the base, and marked by two dark brown spots, followed at the middle by a transverse series of brown spots.

Exp. $2\frac{5}{10}$ inches.

Hab. Singapore (*Wallace*).

Like *H. Thrax* on the upperside.

Hesperia Dacela.

Alis utrinque fuscis: anticis punctis sex hyalinis, uno in cellula bipartito: alis anticis infra macula subapicali lilacina: posticis margine postico sub apicem lilacino.

Upperside dark brown. Anterior wing with three separate spots in the middle (one in the cell bifid) and three at the apex all transparent: a linear mark indicating the male.

Underside as above, except that the anterior wing has the inner margin rufous and a subapical lilac spot, and that the posterior wing is lilac on the outer margin near the apex.

Exp. $1\frac{8}{10}$ inch.

Hab. Fernando Po (*Rogers*).

Hesperia Dasia.

Alis supra fuscis ad basim cæruleo tinctis: anticis fascia bipartita punctoque hyalinis: posticis infra punctis quatuor pallidis.

Upperside dark brown: the base of both wings slightly blue. Anterior wing with a bifid band at the middle and a small spot a little beyond it transparent.

Underside as above, but paler. Posterior wing with four pale undefined spots—one in the cell and three beyond it.

Exp. $2\frac{2}{10}$ inches.

Hesperia Schædia.

Alis supra fuscis: anticis punctis tribus hyalinis punctoque flavo: posticis infra apice flavo.

Upperside dark brown. Anterior wing with three separate transparent spots at the middle (one in the cell bifid) and a small spot near the inner margin.

Underside as above, except that there is a small pale yellow spot on the middle of the costal margin of the anterior wing, that the small spot near the inner margin joins those above it, and that the posterior wing has the apex pale yellow.

Exp. $1\frac{8}{10}$ inch.

Hab. Sumatra (*Wallace*).

Hesperia Cratæa.

Alis utrinque fuscis: anticis maculis tribus centralibus, punctisque tribus sub apicem minutissimis hyalinis.

Upperside dark rufous-brown. Anterior wing with three separate transparent, triangularly placed spots in the middle, and three very minute spots near the apex also transparent: an indistinct pale spot near the inner margin.

Underside as above, except that it is tinted with purple.

Exp. $1\frac{19}{20}$ inch.

Hab. Bahia.

Hesperia Decinea.

Alis utrinque fuscis: anticis punctis sex hyalinis punctoque ochraceo: posticis punctis duobus hyalinis.

Upperside dark brown. Anterior wing with six transparent spots and one opaque ochraceous spot—one in the cell sinuated on both sides, two between the branches of the median nervure, and three near the apex. Posterior wing with two central transparent spots.

Underside as above, except that there is an ochreous line near the costal margin of the anterior wing, and that the small ochreous spot described above is much enlarged.

Exp. $1\frac{13}{20}$ inch.

Hab. Brazil.

Hesperia Sicania.

Alis supra rufo-fuscis: anticis macula centrali tripartita punctoque sub apicem minuto hyalinis, apice albo: posticis puncto hyalino: alis infra rufis.

Upperside dark brown. Anterior wing with a large central trifid spot and a minute spot towards the apex transparent: the apex white. Posterior wing with one nearly central transparent spot.

Underside as above, except that the costal margin and apex of the anterior wing are rufous, and the posterior wing rufous paler at the base.

Exp. $1\frac{15}{20}$ inch.

Hab. Brazil.

Hesperia Cydia.

Alis utrinque fuscis: anticis punctis septem hyalinis: posticis infra rufo-fuscis, fascia centrali maculaque lineari sub angulum analem albis.

Upperside dark brown. Anterior wing with seven transparent spots—one in the cell bifid, three below it placed longitudinally, and three near the apex.

Underside as above, except that it is rufous brown, that there is an ochreous spot on the middle of the costal margin of the anterior wing, and that the posterior wing is crossed at the middle, from the costal margin to near the anal angle, by a band of white, and has an oblong spot of the same colour at the anal angle.

Exp. $1\frac{15}{20}$ inch.

Hab. Brazil.

Nearly allied to *H. Fusina*, but not, I think, a variety of that variable species.

Hesperia Corduba.

Alis utrinque fuscis: anticis punctis octo minutis hyalinis.

Upperside dark brown. Anterior wing with eight small transparent spots—one in the cell bifid, four in a longitudinal band, and three near the apex.

Underside as above, except that the inner margin of the anterior wing is rufous.

Exp. $1\frac{7}{10}$ inch.

Hab. Gaboon (*Rogers*).

Hesperia Dimassa.

Alis utrinque fuscis: posticis infra punctis quatuor niveis.

Upperside dark brown.

Underside as above, except that there are two very indistinct minute white spots below the middle of the anterior wing, and that the posterior wing has four distinct pure white spots below the middle.

Exp. $1\frac{2}{10}$ inch.

Hab. Brazil.

Unlike any other species.

Hesperia Corissa.

Alis supra rufo-fuscis: anticis punctis quinque hyalinis punctoque flavo: posticis macula flava: alis infra rufis, anticis in medio atris.

Upperside rufous-brown. Anterior wing with five transparent spots—two in the cell (one very small), three below these in a longitudinal band, and one near the apex, bifid: a triangular yellow spot near the inner margin. Posterior wing with a rather large bifid ochreous spot below the middle of the costal margin.

Underside rufous. Anterior wing dark brown from the base to beyond the transparent spots. Posterior wing without the ochreous spot.

Exp. $1\frac{6}{10}$ inch.

Hab. Borneo.

Hesperia Mammœa.

Alis utrinque fuscis: anticis punctis quinque hyalinis, duobus sub apicem minutissimis: posticis punctis quatuor hyalinis: his infra punctis septem ochraceis.

Upperside dark brown. Anterior wing with four transparent spots, and one opaque yellow spot near the inner margin: two spots between the branches of the median nervure, one (very minute) outside of these, and one towards the apex. Posterior wing with a transverse series of four small spots, two of which are transparent.

Underside rufous-brown, except the base of the anterior wing, which is dark brown. Anterior wing with the spots as above, except that there is a small spot in the cell, and that the spot near the inner margin is much larger and of a bright yellow. Posterior wing with a minute spot in the cell and below it a transverse irregular series of six minute yellow spots.

Exp. $1\frac{8}{10}$ inch.

Hab. Brazil.

Hesperia Papœa.

Alis utrinque fuscis: anticis punctis octo hyalinis, quatuor in medio (uno minutissimo), quatuor sub apicem positis: posticis puncto minuto: his infra punctis tribus albis.

Upperside dark brown. Anterior wing dark brown, with eight transparent white spots: four (one very minute) in a longitudinal band at the middle, and four near the apex, the fourth very minute. Posterior wing with one small transparent spot below the middle.

Underside as above, except that it is castaneous, that the inner margin of the anterior wing is broadly grey, and that there is a minute white spot on each side of the spot described above on the posterior wing.

Exp. $1\frac{13}{20}$ inch.

Hab. Espiritu Santo.

Hesperia Lamponia.

Alis supra fuscis: anticis punctis quinque hyalinis: posticis infra rufis, punctis sex albis minutis.

Upperside dark brown, paler towards the base. Anterior wing with five transparent white spots—two between the branches of the median nervure (the spot between the first and second branches large and square) and three near the apex.

Underside rufous, except from the base to the middle of the anterior wing, which is dark brown. Posterior wing with six minute white spots—one in the cell and five in a curved band below it.

Exp. $1\frac{6}{10}$ inch.

Hab. Brazil.

Near to *H. elegantula* of Herrich-Schäffer.

Hesperia Locutia.

Alis supra fuscis: anticis punctis sex hyalinis (tribus apicalibus minutissimis): posticis puncto uno hyalino: his infra dimidio postico rufo, punctis tribus atris notato.

Upperside dark brown. Anterior wing with six transparent white spots—three forming a central longitudinal band, and three minute and apart at the apex. Posterior wing with one minute transparent spot below the middle.

Underside as above, except that the anterior wing has the costal and outer margins and a spot near the apex rufous, and that the outer half of the posterior wing is rufous marked by a transverse series of three black spots.

Exp. $1\frac{13}{20}$ inch.

Hab. Brazil.

Near to *H. subcordata* of Herrich-Schäffer.

Hesperia Cynea.

Alis utrinque fuscis: anticis punctis quinque hyalinis (duobus minutissimis).

XLVII.—*Descriptions and Figures of Deep-Sea Sponges and their Spicules, from the Atlantic Ocean, dredged up on board H.M.S. 'Porcupine,' chiefly in* 1869 (*concluded*). By H. J. CARTER, F.R.S. &c.

[Concluded from p. 410.]

Ophiraphidites tortuosus, n. sp.

Groups of large, tortuous acerates, more or less uniform in size, congregated in deep depressions on the surface of *Discodermia polydiscus* and *Stelletta pachastrelloides*, without definite arrangement, naked, void of sarcodic structure, and unaccompanied by any other spicules but a few large trifids from *Pachastrella abyssi*; adherent by one end to the surface on which they may be situated, and retained in position chiefly by their intertwining with each other. Form of spicules chiefly acerate, sometimes nearly straight or only slightly curved, bow-like; sometimes acuate, and occasionally obtusely pointed or round at the ends, also occasionally with one extremity bifid, 200- by 5-1800ths inch long when nearly straight.

Hab. Marine, growing in the depressions above mentioned.

Loc. Probably near Cape St. Vincent, as the dried specimens on which they are situated appear to be identical with those in the jar numbered "25, 75, 374 fathoms."

Obs. As the spicules of these groups are very remarkable from their snake-like shape, together with the circumstances above mentioned, it is necessary to describe them as far as possible, from their occurring in the dredgings of the 'Porcupine.' I cannot state with certainty whether they represent a distinct sponge or are the transformed spicules of another sponge; but incline to the latter opinion, and to think that they belong to *Pachastrella abyssi*:—first, because the only other spicules that I have found among them are the large trifids of this sponge; secondly, because the arms of this large trifid, as it *occurs on the surface*, are also occasionally tortuous; and, thirdly, because the arms of these large trifids are frequently bifid at the extremities. On the other hand, the spicules of *Ophiraphidites* chiefly consist of large acerates which, when without the tortuous curving, are precisely like those of *Stelletta pachastrelloides* (Pl. XV. fig. 40, *a*), where the large acerates in size as far surpass any other of the spicules as the large bifids in *Pachastrella abyssi* surpass in size its acerates; so that, if we adopt the transformation of the latter, it must be from a trifid into a tortuous acerate—if of the former, of a large, normally curved acerate into a tortuous one. Hence the uncertainty in my mind as to which they belong to if they do not represent a distinct sponge. I might also add that in no sponge have I ever seen these tortuous acerates grouped together as above described below the surface, except in *Hymeraphia vermiculata*, Bk., and its variety *erecta* (Pl. XV. fig. 26, *b*), where their great inferiority in size and their forming part of a distinct structure, from the midst of which projects large acuates, shows at once that they are not *Ophiraphidites tortuosus*. At the same time, as the laminiform species, viz. *Hymeraphia vermiculata*, Bk., grows on the surface of hard objects, such as pebbles, and other sponges, indiscriminately, and there are tortuous acuates mixed up with the tortuous acerates in *Ophiraphidites*, it may still be a question whether this may not be after all a transformation of the spicules of *H. vermiculata* with which a few of the trifids of *Pachastrella abyssi* have become accidentally mixed.

Be this, however, as it may, after having described *Ophiraphidites tortuosus* as part of the dredgings of the 'Porcupine,' the great point of interest that attaches to them is that such spicules are found fossilized in the Upper Greensand of Haldon Hill, near Exeter, in the Mid-Miocene or Bruxellien "étage" about Brussels, and in the Cretaceous strata of Westphalia, in Germany, respectively. In my illustrations of the fossil sponge-spicules of the Upper Greensand of Haldon Hill, near Exeter, I have figured one ('Annals,' 1871, vol. vii. p. 131, pl. x. fig. 79) under the name of "*Esperites giganteus*," conceiving it then to be, from its sigmoid shape, a gigantic S-shaped bihamate (fibula) of an *Esperia*, whereas now I see that it is a spicule like those of *Ophiraphidites tortuosus*; hence the term "*Esperites giganteus*" should be erased, and that of *Ophiraphidites tortuosus* substituted for it. The specific name "*giganteus*" cannot be retained, because its size corresponds with that of the spicules of the existing *Ophiraphidites*. I next observed it in M. A. Rutot's illustrations of fossil sponge-spicules "de l'étage Bruxellien" about Brussels (Ann. de la Soc. Malacologique de Belgique, t. ix. 1874, pl. 3. figs. 5 & 29), confirmed by its presence in some of the spiculiferous sand itself (kindly sent to me by M. E. Vanden Broeck), wherein it is plentifully present; lastly, in Prof. K. A. Zittel's illustrations of sponge-spicules found about a specimen of *Cœloptychium agaricoides* from the Quadersandstein of Westphalia (Abhandlungen der k. bayer. Akad. der W. ii. Cl. xii. Bd. iii. Abth. Taf. 4. figs. 25 & 26, 1876). Schmidt has also figured them (Grundz. Spongienf. d. atlant. Gebietes, 1870, p. 24, Taf. iii. fig. 3, *c*), in connexion with *Corallistes Bowerbankii* (*C. typus*, Sdt.), as they certainly are no part of this sponge. To M. Rutot and Prof. Zittel I am greatly indebted for a copy of their memoirs respectively, which no one engaged in the study of sponges, either recent or fossil, should be without.

LITHISTINA, Carter.

There were four species of Lithistina dredged up on board the 'Porcupine' during the cruise of 1870, probably all from the neighbourhood of Cape St. Vincent, viz. *Corallistes Bowerbankii*, *Discodermia polydiscus*, *Macandrewia azorica*, and *Azorica Pfeifferæ*—the two former in dead fragments, and the two latter in a living state. I am unable to say with certainty that *Discodermia polydiscus* came from the same locality as the rest, because the specimens, which are dry, are without number; but presumptive evidence is in favour of it.

Corallistes Bowerbankii, Carter, 1876, = *Dactylocalyx Bowerbankii*, Johnson, 1863, = *Corallistes typus*, Schmidt, 1870.

The type specimen of this sponge is in the British Museum, and in general form might be likened to a large, shallow, patulous cup with undulating sides and round edges, supported on a thick short stem. It is 12 inches in diameter, and ½ an inch thick in the wall; and its structure internally, which consists of the filigreed form of spicule common to the Lithistina, is faced by a dermal layer of three-armed shafts, the arms of which are furcated, intercross with each other and in all parts, are round, smooth, and pointed, *not* filigreed; these, again, are imbedded in the dermal sarcode, which is charged with a single form of flesh-spicule, consisting of a short, thick, subspiral shaft, tuberculo-spined throughout, and not two forms, as erroneously stated in my paper on the Hexactinellidæ and Lithistidæ ('Annals,' 1873, vol. xii. pp. 437 & 441), which mistake was occasioned by my having described from a slide into which the acerate flesh-spicules of *Macandrewia azorica* had got by accident. Colour cream-yellow in the dried state.

I have changed the name of "*Dactylocalyx Bowerbankii*" to that of *Corallistes Bowerbankii* for two reasons, viz.:—first, because *Dactylocalyx* was given by Stutchbury to a Hexactinellid sponge, viz. *D. pumiceus*, so far back as 1841 (half of which is in the British Museum), and therefore is typically connected with this order of sponges; and secondly, because Schmidt has given the name of "*Corallistes*" to many of his Lithistid sponges, which belong to a totally different order—thus avoiding the confusion which must arise by mixing up in name the Hexactinellid with the Lithistid sponges. So far, too, all the Lithistina are sessile or thick, short, stipitate sponges,

the possibility of its being confounded with any other of the kind either in the Geodina, Stellettina, or Pachastrellina. Thus the existence of *Corallistes Bowerbankii* near Cape St. Vincent is established.

From the position of the large furcate spicules being *in* rather than on the surface of the specimens, it might be inferred that these, in particular, were on their way to that transformation which the surface layer of all growing sponges must undergo if it passes into and becomes incorporated with the tissue of the interior, while the characteristic layer of these dermal spicules imbedded in the sarcode charged with the flesh-spicule in the living sponge would then altogether disappear. Thus a little further in than the surface no trace of the furcate spicule would be seen; for by this time they would all have become transformed into the staple form of the interior structure—unless the old dermal layer is absorbed, the internal structure pushed forward, and a new dermal layer formed, or the old dermal layer is expanded and its deficiences made up by the addition of new dermal layer—neither of which appears to be so likely as the first assumption. Be this as it may, the characteristic dermal spicule of *Corallistes Bowerbankii* is present here.

On crushing some portions of these specimens taken from parts which had been washed clean of mud &c., the fragments of the larger filigreed spicules, under the microscope, forcibly recalled to mind those which I had found in the Upper Greensand of Haldon Hill near Exeter ('Annals,' 1871, "On Fossil Sponge-spicules, &c." vol. vii. pl. viii.).

For good illustrations of the dermal and flesh-spicules of this species, see Dr. Bowerbank's figures (Proc. Zool. Soc. 1869, pl. vi. figs. 5–8, "Monograph on the Siliceo-Fibrous Sponges").

Discodermia polydiscus, Bocage, 1869, = *Dactylocalyx polydiscus*, Bowerbank, 1869.

The type specimen of this species is in the British Museum; and its general form is shallow, cup-like, with comparatively thick walls and an equally short, stout, stipitate base. It is an inch in diameter, and $\frac{3}{4}$ of an inch high; and its structure internally consists of the filigreed spicule common to the Lithistina (but of a peculiar form, which will be mentioned directly), faced by a dermal layer of thin, smooth, subcircular disks with more or less curvilinear or toothed margin, furnished respectively with a short, round, pointed shaft, which projects internally, and imbedded in a dermal sarcode densely charged with a minute, curved, acerate, microspined flesh-spicule.

The peculiarity of the staple spicule of the interior is that it presents four smooth, round arms, which, radiating irregularly from a central point, soon divide into two branches respectively that terminate botryoidally or in the form of a bunch of grapes, which unites or interlocks with that of the neighbouring branch; and thus the internal structure is formed, except at the surface, where the branches immediately under the dermal layer of disks &c. terminate respectively in flat filigreed or dendriform expansions which do *not* intermingle with those of opposite branches. In the dermal disks there is a circular space opposite the end of the shaft with a *trifid* line, which represents the trifid central canal; and this in the body of the spicule of the interior is often seen in its *quadruple form*, from the addition of the shaft, which makes the fourth arm. Colour yellowish grey or white. Here, again, I prefer the term "*Discodermia*" of Bocage to that of "*Dactylocalyx*," Bowerbank, for the reasons above mentioned.

Several fragments of this sponge were dredged up on board the 'Porcupine,' probably near Cape St. Vincent; but they are all dry and without number. Unlike the foregoing, they are all more or less rounded and elliptical, varying in size, under 1 inch long by $\frac{3}{4}$ of an inch in their short diameter. One fragment is a little longer and somewhat lobed; but they give no idea whatever of what the general form of the entire sponge might have been. Like the fragments of the foregoing species, too, they are sarcodeless, and partly filled with deep-sea mud and its accompanying minute organisms, but not overgrown with other sponges, perhaps from their having been less stationary and more exposed to friction than the fragments of *Corallistes Bowerbankii*, except in one instance, where the rolled fragment presents a depression in which there is a good specimen of *Ophiraphidites tortuosus*.

The peculiar form of their internal structure, and the presence of the peculiar dermal disks amongst it in considerable numbers, although no trace of the flesh-spicule remains, are quite sufficient to establish the species.

For good illustrations of the dermal and flesh-spicules, together with that of the staple spicule of the interior, see Dr. Bowerbank's figures (Proc. Zool. Soc. 1869, pl. vi. figs. 9–14) and Bocage's "Éponges siliceuses nouvelles de Portugal et de l'ile St. Iago, Archipel de Cap-Vert" (Journal des Sci. Mathémat., Phys. et Naturelles, no. iv. Lisbonne, 1869).

It may seem strange that only dead fragments of this and the foregoing *Corallistes* were dredged up on board the 'Porcupine;' but when it is remembered that these sponges grow on hard objects such as rocks &c., it can easily be understood how living specimens, as in the following instances, are only obtained by mere accident. (*Euplectella cucumer* was accidentally brought up by a hook and line at the Seychelles by a fisherman there.)

Schmidt's *Corallistes polydiscus* (Atlant. Spongienf. p. 24, Taf. iii. figs. 8 & 9) appears to me, from the form of its surface-spicule, to be a different species, according in this respect with a large vase-like specimen from the Philippine Islands that I have lately been examining, in which, however, there is, in addition to the acerate flesh-spicule, a small solid one of an elliptical form like that characterizing *Pachastrella abyssi*, while the acerate flesh-spicule in all is almost identical with that of *Macandrewia azorica*.

Macandrewia azorica, Gray, 1859, = *Dactylocalyx McAndrewii*, Bowerbank, 1869, = *Corallistes clavatella*, Schmidt, 1870.

The type specimen of this sponge is in the British Museum, and in general form might be likened to a deep vase with contracted stipitate base and thick wall, becoming deeply undulated as it expands upwards, and terminating in an equally thick round margin, which not only follows the undulating form of the wall itself, but is more or less indented irregularly and curvilinearly throughout. It is 5 inches high by 4 inches in diameter in the widest part of the brim. The inner surface presents a number of circular vents regularly arranged, which, while the dermal sarcode remains on, are single and form the centres respectively of so many sets of superficial, radiating, branched canals converted into gutters by the dermal sarcode, which, when rubbed off or raised, appear in the form of groups of 5–7 or more small holes, that are very characteristic of the species; while the outer side is covered with minute puncta that represent the pores. The internal structure is composed of the filigreed spicule common to the Lithistina, faced by a dermal layer of three-armed shafts, each arm of which is flattened, spread out horizontally, more or less divided and bordered by a curvilinear toothed edge on each side, while the shaft which projects into the interior is smooth, rather short, round, and pointed. These spicules are imbedded in dermal sarcode charged with a minute acerate, smooth (not microspined as in *Discodermia*), curved, fusiform, flesh-spicule in great abundance, which, where the curvilinear edges of opposite arms of the great dermal spicule form between them a circular area, are arranged in the sarcode in a radiating manner, extending from the centre to the circumference, so as to leave in the centre a pore, which can be

Azorica Pfeifferæ, Carter, 1873, ? = *Leiodermatium Lynceus*, Schmidt, 1870.

The type specimen of this sponge is in the British Museum; and its general form is that of an expanded vase whose walls, rising from a thick short stem, soon spread out in an undulating manner into a head 14 inches in diameter, which has the appearance of a large "double flower," on account of the sinuous infoliations of the wall, which are so abundant as to fill up the whole of the vasal cavity, with the sides and bottom of which they are of course continuous. It is 11 inches in vertical diameter, and the wall seldom more than $\frac{1}{6}$ of an inch thick, slightly thinning towards the margin, which is round and irregularly fissured or curvilinear. The surface is even, especially on the *outer* side of the wall, where the *pores* are situated in the form of puncta closely approximated, and only interrupted on the *inner* side of the wall, where the *vents* are situated, by the latter, which in the form of single circular holes, each with an elevated margin, are irregularly scattered over this surface at some distance from each other.

The structure internally consists of that filigreed kind of spicule common, as before stated, to the Lithistina generally, faced by a dermal layer of siliceous network in which the branching, although larger in some respects than in others, is so irregular that it is impossible to divide it into distinct heads indicative of its being composed of so many distinct dermal spicules like those of the other Lithistina; neither are the supports or shafts of these supposed heads a bit more distinguishable on the inner side of the dermal layer, on account of their irregularly branching there also; so that this layer cannot be designated an irregular network. But on the branches of both outer and inner aspects there are short, thick, oval tubercles of a peculiar form, inasmuch as the summit of each respectively presents a short thick branch, which soon divides once or twice into crooked attenuated extremities, while the ends of many of the branches terminate in the same manner; but *the branched oval tubercle appears to me the characteristic feature of the structure*, as I do not observe it to be so marked in any other species, although that of *Farrea densa* ('Annals,' 1873, vol. xii. pl. 17. fig. 6) is something like it. Besides this, the sarcode is charged with an abundance of long, delicate, fusiform acerate spicules, the largest of which are about 1-14th inch in length by 1-3000th in thickness; but these are *only* found towards the *margin* of the frond-like wall, where, coming from opposite sides, they meet, and drying in their sarcode together, there form a more or less sharp, fringed edge. These spicules rapidly diminish in size with their distance from the margin of the wall; so that very soon they altogether disappear; whether by incorporation with the older and general structure or by absorption I am not able to state. Where they are not present, the margin of the wall presents a *rounded* form. Occasionally the larger ones on the edge are inflated or spined at one or both extremities; but this appears to be an abnormal state, their staple form being acerate. Colour whitish yellow. The "oval" appearance of the summit of the tubercle when seen from above is an optical delusion which is corrected by the lateral view.

There are a few fragments of this sponge in the same jar as the foregoing species (viz. that bearing the numbers "25, 75, 374 fathoms"); and they average 2 inches in diameter by $\frac{1}{6}$ of an inch in thickness. These, which consist chiefly of *living* portions or portions which were taken *alive* and afterwards preserved in spirit and water, bear all the characters above mentioned, including the presence of the acerate spicules, which are very abundant where the living border of a new layer can be traced growing over the surface of a previously dead or denuded surface of the frond. The fragments appear to have been broken off by the dredge from the head of a living specimen, as the fractured parts are not worn by attrition.

I have given a short account of a very large specimen of this species, viz. *Azorica Pfeifferæ* ('Annals,' 1873, vol. xii. p. 442), which, together with a slightly smaller one of the same kind, was presented to the British Museum by Madame Ida Pfeiffer.

It appears from Schmidt's figures (Atlant. Spongienf. pl. iii. fig. 2 &c.) to be very like his *Leiodermatium Lynceus*; but here the oscules were on the *outer* side, which is the reverse of what they are in *Azorica Pfeifferæ*, and the reverse of what generally obtains in sponges, where the concave or tubular portion receives the vents. Schmidt's diagnosis of *Leiodermatium* (smooth-skin), too, is:—"In der Oberflächenschicht liegen keine isolirten Kieselkörper" (*op. cit.* p. 21). So the presence of the isolated acerate spicules above mentioned, although confined to the sarcode towards the growing margin of *Azorica Pfeifferæ*, is also opposed to this. Hence it becomes doubtful whether Schmidt's *Leiodermatium Lynceus* is *Azorica Pfeifferæ*; but there is no doubt that the latter does not agree with his diagnosis, although the "isolated acerates" are only partially present—that is, about the growing portion. Then, in the Lithistina, where there *are* "isolirte Kieselkörper" on the surface, they all disappear from it as the latter becomes incorporated with the internal or older structure, and thus transformed into this structure *pari passu* with the growth or increase in bulk of the sponge.

The reason for my designating this sponge "*Pfeifferæ*" is evident from what I have above stated; and we may now extend its distribution from Madeira to the coast of Portugal.

CALCAREA.

Grantia ciliata, Fleming, ? var. *spinispiculum*. (Pl. XII. figs. 6, 7, & 8.)

The specimen of this calcareous sponge dredged up on board the 'Porcupine' on the North-Sea side of Shetland in 64–75 fathoms has grown on one of the cones of *Dictyocylindrus virgultosus*, Bk., together with a young specimen of *Tethya cranium* (Pl. XII. fig. 6). It is $\frac{11}{12}$ inch long by $\frac{3}{12}$ inch broad. The body is fusiform; and the beard, which is $\frac{1}{12}$ inch wide, is composed of an erect row of large, acerate, linear spicules arranged parallel to each other, intermixed with small triradiates, and ending in a defined free edge, which is neither patulous nor fringed, but even; while the body itself is composed of the usual mass of triradiates, among which are plentifully scattered long, fusiform, stout acerates, which are grouped together in projecting tufts all over the surface, thus presenting a grannlated aspect, in which tufts, especially towards the lower part of the sponge, are fine acerate spicules recurvedly barbed or spined in a serrated manner, chiefly on *one* side of the outer third of the free end (fig. 7). This form of spicule, which averages, in its largest size, 124- by 1-6000th inch long, and of which about a third is barbed, is a peculiarity that has necessitated my giving a short description of the whole sponge, not only because such a form of spicule is present *here*, but because I have met with a similar form before, in connexion with a specimen of *Grantia ciliata* obtained from a piece of sea-weed thrown up on the beach of this place (Budleigh-Salterton, south coast of Devon).

In July 1870, while looking at some spicules of *Grantia ciliata* which had been mounted about two years previously, I observed that there were two or three linear ones with one end inflated and spined on one side, something like the end of the spined anchoring-spicules of *Euplectella aspergillum*, together with other recurved spines like barbs, extended more or less in the same line for a certain distance up the shaft; while, knowing that calcareous spicules mounted in balsam sooner or later pass into dissolution, leaving behind them only a few aqueous-looking globules, I immediately measured and

it than that it was about the size of that above mentioned, but had *no beard*, and an *un*tufted even surface without any trace of barbed spicules, but with the usual triradiates and the large acerates above mentioned, which, when entire, must have given it somewhat of the character of *Ute capillosa*, Sdt. (Spongienf. Adriat. 1862, Taf. 1. fig. 6).

Since the above was written and illustrated, I have seen Franz Eilhard Schulze's paper on the structure and development of *Sycandra raphanus*, Häckel (Zeitschrift f. wissensch. Zoologie, xxv. Bd., 3. Supp., Dec. 1875), in which four figures are given like the spined spicules above mentioned in the Budleigh-Salterton specimens commonly called "*Grantia ciliata*" (Taf. xix. fig. 1, *a–d*), also said to be "rare" and occurring in the tufts at "the distal ends of the radiating tubes."

Addendum.

Having made a Table of all the sponges dredged up on board H.M.S. 'Porcupine' in 1869–70 that were handed over to me, with the stations and depths respectively from which they had been obtained, I have been able to draw up the following summary so far as the information accompanying them permits, viz.* :—

1st. *In the Deep Sea between the North of Scotland, the Orkneys, the Shetland and the Färöe Islands.*

Aplysina nævus, n. sp.
Spongia officinalis *auctt.*
Dysidea fragilis, *Johnst.*
Spongelia pallescens, *Sdt.*
Dictyocylindrus virgultosus, *Bk.*
—— abyssorum, n. sp.
Plumohalichondria microcionides, n. sp.
Microciona jecusculum, *Bk.*
—— longispiculum, n. sp.
Phakellia ventilabrum, *Bk.*
—— infundibuliformis, *C.*,= Halichondria infundibuliformis, *Johnst.*
Hymeraphia vermiculata, *Bk.*
—— erecta, n. sp. (? variety).
Cornulum textile, n. gen.
Dictyocylindrus simplex, n. sp.
—— anchoratus, n. sp. (Ann. & Mag. Nat. Hist. 1874, vol. xiv. p. 251, pl. xv. fig. 43, *a*, *b*, c.)
Halichondria foliata, *Bk.*
—— panicea, *Johnst.*
—— cancellata, var. nov.
Isodictya varians, *Bk.*
Thalysias, *Duchas. de Fonb. et Michelotti.*
Reniera crassa, n. sp.
—— fibulata, *Sdt.*
Halichondria incrustans, *Johnst.* (var.).
—— forcipis, *Bk.* (*Op. et loc. cit.* p. 246, pl. xiv. figs. 29–32 &c.)

* As these sponges are arranged consecutively in accordance with my classification, as far as is at present possible, no notice is to be taken of the same name being repeated here and there, as this refers to the author' appellation, and not to the location of the sponge in my Classification.

Halichondria abyssi, n. sp. (*L.* c. p. 245, pl. xiv. figs. 26–28 &c.)
Melonanchora elliptica, n. gen. (*L.* c. p. 212, pl. xiii. figs. 6–12, &c.)*
Cribrella hospitalis, *Sdt.*
Esperia cupressiformis, n. gen. (*L.* c. p. 215, pl. xiv. figs. 16–19, &c.)†
Chondrocladia virgata, *Wy. Th.* (*L.* c. p. 217, pl. xiv. figs. 20 & 21 &c.)
Cladorhiza abyssicola, *Sars.* (*L.* c. p. 219, pl. xiv. fig. 22.)
—— ——, var. corticocancellata, nov.
Esperia placoides, n. sp.
—— villosa, n. sp. (*L. c.* p. 213, pl. xiii. figs. 13–15 &c.)
Halichondria Hyndmani, *Bk.*
—— carnosa, *Johnst.*
Hymedesmia Johnsoni, *Bk.*
Hymeraphia verticillata, *Bk.*
Suberites massa, *Sdt.*
Cometella pyrula, n. sp.
Podospongia Lovenii, *Boc.*
Latrunculia cratera, *Boc.*
Desmacella pumilio, *Sdt.* (*L.* c. p. 250, pl. xv. fig. 42, *a*, *b*, c.)
Donatia lyncurium, *Gray*, = Tethya lyncurium, *Lam.*
Trichostemma hemisphæricum, *Sars*
Thecophora semisuberites, *Sdt.*
—— ibla, *Wy. Th.*
Rinalda uberrima, *Sdt.*
Polymastia ornata, *Bk.*
—— brevis, *Bk.*
—— robusta, *Bk.*
—— mamillaris, *Bk.*
—— stipitata, n. gen.
Geodia nodastrella, n. sp.
Wyville-Thomsonia Wallichii, *Wright*, = Tisiphonia agariciformis, *Wy. Th.*
Stelletta pachastrelloides, n. sp.
Tethya cranium, *Lam.*
—— zetlandica, *Cart.*, ? var.
—— abyssorum, ? var.
—— infrequens, ? var.
Pachastrella abyssi, *Sdt.*
—— geodioides, n. gen.
Rossella velata, *Wy. Th.* (Annals, 1875, vol. xv. p. 120.)
Holtenia Carpenteri, *Wy. Th.* ‡
Grantia ciliata, ? var.

2nd. *Deep Sea in the "Chops" of the English Channel.*

Corticium abyssi, n. sp. (Annals, 1873, vol. xii. p. 18, pl. i. figs. 1–9 & 15.)
—— parasiticum, n. sp.
Isodictya varians, *Bk.*
Reniera fibulata, *Sdt.* (*Op. cit.* 1874, vol. xiv. p. 250, pl. xv. fig. 44, *a*, *b*.)
Esperia cupressiformis, n. g. (*L.* c.)
—— ——, var. hamatifera, nov.
Hymedesmia Johnsoni, *Bk.*
Cliona abyssorum, n. gen. (*L. c.* p. 249, pl. xiv. fig. 33 &c.)
Desmacella pumilio, *Sdt.* (*L.* c.)
Tisiphonia agariciformis, *Wy. Th.*
Aphrocallistes Bocagei, *Wright.* (*Op. cit.* 1873, vol. xii. p. 446.)
Farrea occa, *Bk.* (*L.* c. p. 445.)
Holtenia Carpenteri, *Wy. Th.*
Corallistes, spicules of a.

* Stray, fully developed anchorates of this sponge (that is, with the three arms united like a four-ribbed ellipse) are very common in the Atlantic sea-bed. Dr. Wallich sent me a drawing of one dredged up on board the 'Bulldog' in 1860.

† For "No. 27, &c.," p. 216 ('Annals,' 1874, vol. xiv.), sixth line from bottom, read "42=862 fathoms, Chops of English Channel."

‡ *Holtenia Carpenteri* has been described and illustrated by Sir Wy. Thomson in the 'Philosophical Transactions' for 1869 (vol. 159, pt. ii. p. 701 &c.), who before leaving in the 'Challenger' had had similar illustrations lithographed of *Hyalonema lusitanicum* and *Tisiphonia agariciformis*; so no description of either of these sponges will be found in my report.

3rd. *A "few miles north of Cape St. Vincent,"* 1870.

Halisarca cruenta, n. sp.
Hircinia (Polytherses, *Duch. de Fonb. et Michelotti*).
Microciona jecusculum, *Bk.*
—— planum, n. sp.
Phakellia ventilabrum, *Bk.*
—— infundibuliformis, = Hal. infundibuliformis, *Johnst.*
Halichondria panicea, *Johnst.*
Isodictya spinispiculum, n. sp.
Thalysias tricurvatifera, n. sp.
Thalysias (*Duch. de Fonb. et Michelotti*).
Reniera fibulata, *Sdt.* (*L.* c.)
Histoderma appendiculatum, n. gen. ? = Cœlosphæra tubifex, *Wy. Th.* (*Op. cit.* 1874, vol. xiv. p. 220, pl. xv. fig. 39, *a*, *b*.)*
Halichondria forcipis, *Bk.*, var. bulbosa, nov.
—— phlyctenoides, n. sp.
—— carnosa, *Johnst.*
Polymastia stipitata, n. gen.
Geodia megastrella, n. sp.
—— ——, var. lævispina.
Tisiphonia agariciformis, *Wy. Th.*
Tethya cranium, *Lam.*
—— ——, var. zetlandica, *Cart.*
Pachastrella abyssi, *Sdt.*
—— amygdaloides, n. sp.
—— geodioides, n. gen.
—— intexta, n. sp.
Corallistes Bowerbankii, = Dactylocalyx Bowerbankii, *Johnson.*
Discodermia polydiscus, *Boc.* = Dactylocalyx polydiscus, *Bk.*
Macandrewia azorica, *Gray.*
Azorica Pfeifferæ, *Cart.*
Askonema setubalense, *Kent.*
Rossella velata, *Wy. Th.* ('Depths of the Sea,' p. 419).
Polytrema miniaceum, *De Blainville.*

Jars with no Number.

Corticium parasiticum, n. sp.
Halichondria panicea, *Johnst.*
—— incrustans, *Johnst.*, var. nov.
Esperia cupressiformis, n. sp. (*Op.* et *loc. cit.*)
—— ——, var. hamatifera, nov.
Chondrocladia virgata, *Wy. Th.* (*Op.* et *loc. cit.*)
Guitarra fimbriata, n. gen. (*Op. cit.* 1874, vol. xiv. p. 210, pl. xiii. figs. 2–5 &c.)†
Podospongia Lovenii, *Boc.*
Desmacella pumilio, *Sdt.* (*L. c.*)
Donatia lyncurium, *Gray.*
Cometella simplex, n. sp.
Polymastia ornata, *Bk.*
Geodia nodastrella, n. sp.
Tisiphonia agariciformis, *Wy. Th.*
Aphrocallistes Bocagei, *Wright.* (*L. c.*)
Farrea occa, *Bk.* (*L. c.*)
Askonema setubalense, *Kent.*
Holtenia Carpenteri, *Wy. Th.*
Hyalonema lusitanicum, *Boc.* Probably from station 46, about 55 miles N.W. of the Butt of Lewis.

Dried Specimens of Sponges.

Among the dried specimens without number are *Hyalonema lusitanicum*, *Holtenia Carpenteri*, and *Rossella velata*, with a fragment of the base of *Euplectella aspergillum directly* attached to a piece of old coral detritus, and fragments of *Aphro-*

* For "2 and 24, &c.," p. 221 ('Annals,' 1874, vol. xiv.), eleventh line from top, read "24 & 24 = 292 fathoms, near Cape St. Vincent;" and for "2," in thirteenth line from top, read "24 and 2 in pencil."

† In a sponge from the neighbourhood of the Falkland Islands, sent me by Mr. T. Higgin, of Huyton, Liverpool, the anchorate of *Guitarra* is present in plurality as a foreign object.

favour of the *Xanthidia* being the petrified orbicular statoblasts of the Polyzoa than the petrified sporangia of Desmidieæ."

Xanthidium bicirratum, n. sp. (Pl. XV. fig. 44.)

General form a spheroidal or slightly elliptical cell, provided with two opposite erect cirri, each of which, after a short distance, divides into two longer filaments that, recurving in opposite directions apparently in the same plane, finally cross those of the opposite side. Cell empty or filled with a few yellowish fragments of soft material. Composition chitinous. Size of cell about 2-6000ths inch in diameter; length of cirrus before dividing about 1-6000th inch, length of filaments after dividing 5-6000ths inch.

Hab. Marine.

Loc. Common between the north of Scotland and the Färöe Islands.

Obs. Although, in this instance, the cell is not more than a fifth of the size of that of *X. abyssorum*, its general appearance, together with its contents, inclines me to view it as a *Xanthidium*—that is, the shell, at least, of the egg of a Polyzoon. Nitric acid applied on the slide does not cause any appreciable alteration in the shape, nor does drying or mounting in balsam, probably on account of the chitinous wall being thicker than in *X. abyssorum*.

Coccoliths and Rhabdoliths.

The oval and cyclical *Coccoliths* with their respective *Coccospheres* have also been generally present in great abundance; also *Rhabdoliths*, but no *Rhabdospheres*. The oval *Coccolith* appears to abound between the north of Scotland and the Färöe Islands; the cyclical one southwards, and the *Rhabdoliths* from the "chops of the English Channel" to Cape St. Vincent, where all three forms are found together—at least, judging from what I have observed about the sponges from these three different localities.

I might here add that, in the sand about the sponges in the British Museum, dredged up by Sir J. Ross in 300 fathoms, $74\frac{1}{2}°$, and in 206 fathoms, $77\frac{1}{2}°$ south latitude, respectively, I found no *Coccoliths* and very few *Globigerinæ*, but many Radiolaria.

BLACK GRAINS.

Among the *Globigeriniferous* sand may often be observed "black grains," frequently shapeless and more or less angular, but often representing casts, with their peculiar markings, of the chambers of *Globigerina* and other minute Foraminifera. If a little of this sand be carefully washed, dried, and placed under the microscope, it will be easily seen that they have all the same origin; for, beginning of a yellowish colour, passing into brown, and finally black, they may respectively be observed within the chambers of *Globigerina*, half in and half out, as they approach that state in which, being altogether without even a fragment of the white calcareous test, and in the form of casts, they either retain this recognizable form or lose it altogether and become more or less angular.

EXPLANATION OF THE PLATES.

Plate XII.

Fig. 1. Pebble on which there is a Terebratule and six kinds of sponges. *a a*, pebble; *b*, Terebratule,—the Terebratule bearing c, *Aplysina nævus*, *d*, *Spongia officinalis*, *e*, *Dysidia fragilis*; the pebble bearing:—*f f f*, fronds of two specimens of *Phakellia ventilabrum*, Bk.; *g g*, *Spongia Lovenii*, Boc.; *h*, *Microciona longispiculum*. All natural size.

Fig. 2. *Aplysina nævus*, grown over a branch of coral, natural size. *a*, fragment, magnified, to show:—*b*, dermal incrustation covered with pore-depressions or puncta; and c, basal end of filaments expanded into layer of attachment.

Fig. 3. *Dictyocylindrus abyssorum*, natural size. *a*, portion of branch, magnified, to show hirsute character; *b*, small acuate, spined; c, anchorate; *d*, tricurvate (bow): *b*. c, *d* on scale of 1-24th to 1-1800th of an inch. *e*, end of tricurvate, more magnified, to show that it is spined; *f*, anchorate, more magnified. For skeleton-spicules see Pl. XV. fig. 25, *a*, *b*.

Fig. 4. *Hymeraphia vermiculata*, Bk., var. *erecta*, natural size. *a*, fixed end of large skeleton-spicule; and *b*, tortuous subskeleton-spicules with which it is surrounded: scale 1-24th to 1-1800th inch. *c*, *H. vermiculata*, Bk., covering a small pebble: natural size. For skeleton- and subskeleton-spicules, see Pl. XV. fig. 26, *a*, *b*.

Fig. 5. *Dictyocylindrus virgultosus*, Bk., bearing a young *Tethya cranium* and a variety of *Grantia ciliata*. *a*, *Tethya*; *b*, *Grantia ciliata*; *c*, small acuate spined spicule of *D. virgultosus*; *d*, acerate subskeleton-spicule, smooth: scale of c, *d*, 1-24th to 1-1800th inch.

Fig. 6. *Grantia ciliata*, Flem., var. *spinispiculum*, C., on *Dictyocylindrus virgultosus*, natural size.

Fig. 7. The same, barbed spicule among the acerates towards the base: *a*, fixed end; *b*, free or barbed end. Scale 1-24th to 1-6000th inch.

Fig. 8. *Grantia ciliata*, Flem., variety (from Budleigh-Salterton, south coast of Devonshire). Two barbed spicules with inflated extremities, respectively; one spined like the anchoring-spicule of *Euplectella aspergillum*. Scale 1-12th to 1-6000th inch.

Fig. 9. *Cornulum textile*, natural size. *a*, textile sheath; *b*, fibrous structure of the interior, projecting and frayed out; *c*, anchorate; *d*, tricurvate: c, *d*, on the scale of 1-24th to 1-6000th inch. *e*, anchorate, more magnified. For the skeleton-spicule see Pl. XV. fig. 28.

Fig. 10. *Halichondria foliata*, Bk., fragment, natural size. *a*, anchorate; *b*, tricurvate: scale 1-24th to 1-6000th inch. For the skeleton-spicules see Pl. XV. fig. 29, *a*, *b*.

Fig. 11. *Plumohalichondria microcionides* (rolled fragment), natural size. *a*, clavate acuate, spined, 1-48th to 1-6000th inch; *b*, anchorate, more magnified: scale 1-24th to 1-6000th inch. For skeleton-spicules see Pl. XV. fig. 30, *a*, *b*.

Plate XIII.

Fig. 12. *Esperia placoides*, natural size. *a a a*, scales; *b b*, grooves between the scales; c c, vents; *d*, stem; *e*, diagram of two scales, viewed laterally, to show their structure and the groove between them; *f*, free surface, hirsute; *g*, base, rooted to the interior by bundles of skeleton-spicules; *h*, vertical portion; *i*, groove: scale 1-24th to 1-48th inch. *k*, diagram of a portion of the surface of a "groove," magnified, to show *l*, the pore-areæ occupying the interstices of the reticulated smooth rugæ, *l' l' l'*; *m*, vent, magnified, to show form; *n*, anchorate; *o*, bihamate or fibula; *p*, bundle of tricurvates; *q*, single tricurvate: *m–q* on same scale, viz. 1-24th to 1-6000th inch. For the skeleton-spicule see Pl. XV. fig. 32.

Fig. 13. *Esperia borassus*, on a fragment of *Pachastrella abyssi*, Sdt., natural size. *a a a*, pachastrella and spicules; *b*, *E. borassus*; *c*, anchorate; *d*, bihamate: on the same scale, viz. 1-24th to 1-6000 inch. For the skeleton-spicule see Pl. XV. fig. 33.

Fig. 14. *Esperia cupressiformis*, var. *hamatifera*, free extremity, natural size. *a*, large anchorate; *b*, small anchorate; *c*, bihamate: on the same scale, viz. 1-24th to 1-6000th inch. For the skeleton-spicule see Pl. XV. fig. 34.

Fig. 15. *Cladorhiza abyssicola*, Sars, branch of, natural size. *a*, characteristic bihamate.

Fig. 16. *Cladorhiza abyssicola*, var. *corticocancellata*, end of branch of, natural size. *a*, characteristic bihamate.

Fig. 17. *Halichondria phlyctenodes*, on a fragment of *Corallistes Bowerbankii*, natural size. *a a a*, *Corallistes*; *b*, *H. phlyctenodes*; *c c*, appendiculate tubular vents; *d*, end of one that has been cut off; *e*, tubular vent, magnified two diameters; *f*, anchorate; *g*, bihamate: on the same scale, viz. 1-24th to 1-6000th inch. For the skeleton-spicule see Pl. XV. fig. 35.

Fig. 18. *Cribrella hospitalis*, Sdt., natural size. *a*, sponge; *b*, pore-areæ, circular and cribriform; *c*, stem; *d*, anchorate: on the scale of 1-24th to 1-6000th inch. For the skeleton-spicules see Pl. XV. fig. 36, *a*, *b*.

Fig. 19. *Halichondria forcipis*, Bk., var. *bulbosa*, a fragment in a fragment of a bivalve shell, natural size. *a*, shell; *b*, sponge; c, anchorate; *d*, bihamate; *e*, tricurvate, in the form of a pair of open compasses: on the same scale, viz. 1-24th 1-6000th inch. *f*, one arm of the tricurvate, more magnified to show the bulb at the extremity. For the skeleton-spicules see Pl. XV. fig. 37, *a*, *b*.

both the last species, only one figure has been given; but it should be remembered that while it varies in length in both species, especially in the latter, it is generally three times the length in *P. amygdaloides* that it is in *P. geodioides*.

Fig. 24. *Halichondria abyssi* ('Annals,' 1874, vol. xiv. p. 245, pl. xiv. fig. 2, c), "embryonic form" of flesh-spicule (anchorate), magnified, to show that it is birotulate: *a*, lateral view; *b*, end view.

Plate XV.

Fig. 25. *Dictyocylindrus abyssorum*, skeleton-spicules: *a*, large; *b*, small. Scale 1-24th to 1-1800th inch.

Fig. 26. *Hymeraphia erecta*, skeleton-spicules: *a*, large; *b*, small. Scale 1-24th to 1-1800th inch.

Fig. 27. *Dictyocylindrus virgultosus*, Bk., skeleton-spicule. Scale 1-24th to 1-1800th inch.

Fig. 28. *Cornulum textile*, skeleton-spicules: *a*, large; *b*, small. Scale 1-24th to 1-6000th inch.

Fig. 29. *Halichondria foliata*, Bk., skeleton-spicules: *a*, large; *b*, small. Scale 1-24th to 1-6000th inch.

Fig. 30. *Plumohalichondria microcionides*, skeleton-spicules: *a*, large; *b*, small. Scale 1-48th to 1-6000th inch.

Fig. 31. *Microciona longispiculum*, skeleton- and flesh-spicules: *a*, large; *b*, small; c, flesh or echinating spicule. Scale 1-24th to 1-1800th inch.

Fig. 32. *Esperia placoides*, skeleton-spicule. Scale 1-48th to 1-6000th inch.

Fig. 33. *Esperia borassus*, skeleton-spicule. Scale 1-48th to 1-6000th inch.

Fig. 34. *Esperia cupressiformis*, var. *bihamatifera*, skeleton-spicule: *a*, body form; *b*, surface form. Scale 1-12th to 1-1800th inch.

Fig. 35. *Halichondria phlyctenodes*, skeleton-spicule. Scale 1-48th to 1-6000th inch.

Fig. 36. *Cribrella hospitalis*, Sdt., skeleton-spicules: *a*, large; *b*, small. Scale 1-24th to 1-6000th inch.

Fig. 37. *Halichondria forcipis*, Bk., var. *bulbosa*, skeleton-spicules: *a*, large; *b*, small. Scale 1-24th to 1-6000th inch.

Fig. 38. *Cometella pyrula*, skeleton-spicule. Scale 1-48th to 1-6000th inch.

Fig. 39. *Hymeraphia verticillata*, Bk., var. *erecta*, skeleton-spicules: *a*, large; *b*, small or centrally inflated. Scale 1-24th to 1-1800th inch.

Fig. 40. *Stelletta pachastrelloides*. *a*, large acerate skeleton- or "body-spicule;" *b*, three-armed "zone-spicule;" *c*, anchoring-spicule;" *d*, microspined subskeleton-spicule: all on the same scale, viz. 1-48th to 1-1800th inch. *e*, microspined flesh-spicule, more magnified; *f*, large stellate spicule with conical rays spiniferous; *g*, minute bistellate spicule with linear rays: scale of *f* & *g*, 1-12th to 1-6000th inch. *h*, head of anchoring-spicule, more magnified; *i*, microspined subskeleton acerate spicule, more magnified.

Fig. 41. *Pachastrella intexta*, quinqueradiate skeleton-spicule, scale 1-24th to 1-6000th inch. *a*, bacilliform blunt-spined flesh-spicule; *b*, bistellate minute flesh-spicule with linear rays: scale 1-12th to 1-6000th inch.

Fig. 42. *Isodictya spinispiculum*, spicule of. Scale 1-24th to 1-6000th inch.

Fig. 43. *Microciona intexta*: *a*, skeleton-spicule; *b*, bihamate; c, bihamates in the mass. Scale 1-24th to 1-6000th inch.

Fig. 44. *Xanthidium bicirratum*. Scale 1-12th to 1-6000th inch.

PLATE XVI.

Fig. 45. *Geodia nodastrella*. *a*, "zone-spicule," viewed laterally; *b*, end view of head; c, "body" or large skeleton acerate spicule; *d*, "anchoring-spicule" fluked and forked; *e*, body-stellate; *f*, siliceous balls of crust, globular and elliptical forms; *g*, nodostellate of dermis and crust; *h*, dermal acerate: all on the same scale, viz. 1-48th to 1-1800th inch. *i*, body-stellate, more magnified; *k*, nodostellate of dermis and crust, more magnified.

Fig. 46. *Geodia megastrella* on a fragment of *Corallistes*: *a*, sponge; *b*, aperture or common vent; *c*, pore-areæ; *d*, fragment of *Corallistes Bowerbankii*.

Fig. 46′. The same, spicules of. *a*, zone-spicule; *b*, less frequent form of head of zone-spicule; c, "body" or large skeleton acerate spicule; *d*, anchoring-spicules, fluked and forked; *e*, megastrella, arms microspined; *f*, body-stellate; *g*, siliceous balls of crust, globular and elliptical forms; *h*, dermal stellate; *i*, dermal acerate: all on the same scale, viz. 1-48th to 1-1800th inch. *k*, megastrella, more magnified; *l*, body-stellate, more magnified; *m*, dermal stellate, more magnified.

Fig. 47. *Geodia megastrella*, var. *lævispina*. *a*, zone-spicule; *b*, body or large skeleton acerate spicule; c, anchoring-spicules, fluked and forked respectively; *d*, megastrella; *e*, siliceous balls of crust; *f*, stellate of dermis and crust; *g*, dermal acerate: all on the same scale, viz. 1-48th to 1-1800th inch. *h*, megastrella, more magnified; *i*, spines broken off; *k*, dermal stellate, more magnified.

Fig. 48. *Tethya cranium*, var. *infrequens*. *a*, projecting forked anchoring-spicule, with arms truncated and terminating in little cup-shaped excavations with serrated margins respectively; c, projecting fluked or anchor-like anchoring-spicule: scale 1-48th to 1-6000th inch. *b*, extremity of arm of forked form (*a*), more magnified.

Fig. 49. *Tethya cranium*, var. *abyssorum*: *a*, two bihamates, magnified to show that they are spinous. Scale 1-6th to 1-6000th inch.

Fig. 50. *Pachastrella parasitica*. *a*, radiate skeleton-spicule, showing that its arms are thrice forked; *b*, shaft, prolonged above as well as below; *c*, acerate skeleton-spicule; *d*, spinous bacillary flesh-spicule; *f*, minute stellate: all on the same scale, viz. 1-24th to 1-6000th inch. *e*, spinous bacillary flesh-spicule, more magnified.

Fig. 51. *Microciona minutula*: *a*, large skeleton-spicule; *b*, different forms of its head; c, slender acuate; *d*, bihamates. Scale 1-24th to 1-6000th inch.

Fig. 52. *Corticium parasiticum*, spicules of. Scale 1-24th to 1-6000th inch.

Fig. 53. *Cometella simplex*, natural size.

XLVIII.—*On a Collection of Lepidoptera recently received from Abyssinia.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

I HAVE recently had the pleasure of examining a large collection of insects (chiefly Lepidoptera) from Atbara (Abyssinia), and have been interested to see how many of the species are identical with those of Natal.

There seems to be no *Papilio* at Atbara; but the two species of *Charaxes*, *C. epijasius* and *C. jocaste*, appear to be extremely common.

The following are among the butterflies which have been examined.

Nymphalidæ.

DANAINÆ, Bates.

Danais dorippus, Klug.

There were several examples of this interesting species and of its mimic, *Diadema misippus*, in the collection.

SATYRINÆ, Bates.

Melanitis ismene, Cramer.

This species occurs in three gradational varieties, but all of them with the same coloration above.

Mycalesis desolata, n. sp.

Wings above olive-brown, with a narrow pale margin intersected by a black line; two blind blackish spots on the disk, the lower one largest and situated on the first median interspace. Wings below greyish, tinted with pink; external half slightly paler; two central slightly irregular dark brown transverse lines, the inner one arcuate, the outer one with a narrow whitish external border; outer border lilacine greyish; two submarginal sinuated dark brown lines; two dark brown lines close to the margin; fringe dark brown: primaries with three dark brown abbreviated lines across the cell; with five inconspicuous ocelli upon a dusky nebula, the second and fifth largest, black, with testaceous irides, white pupils, and broad lilacine grey zones: secondaries with seven inconspicuous ocelli, the first and fifth largest, the first separated from the series, all black, with white pupils, testaceous irides, and broad lilacine grey zones: body below grey. Expanse of wings 2 inches 1–3 lines.

Junonia chorimene, Guér.

Common.

Junonia micromera, n. sp.

Wings above dark brown, clouded with ferruginous, crossed by a broad discal tawny band intersected by a series of black spots, and bifurcate towards costa of primaries; outer border black, with a double series of ill-defined submarginal white lunules; primaries with two tawny spots in the cell; disco-cellulars and a spot below the cell reddish tawny: wings below much paler, the spots better-defined; the discal band not bifurcate; the basal area not clouded with ferruginous, but dark brown, spotted with large and small testaceous and pale tawny spots; submarginal lunules well-defined; palpi, coxæ, tibiæ, and tarsi whitish. Expanse of wings 1 inch 9 lines.

Not uncommon.

Allied to *J. octavia* and *J. ceryne*.

Hypanis ilythia, var *goetzius*, Herbst.

Not uncommon.

Neptis marpessa, Hopffer.

The figure of this species seems to define the white lines too clearly on the upper surface.

Acræinæ, Bates.

Acræa cæcilia, Fabr.

Not common.

Acræa Rougetii, Guér.

This seems to be simply *A. eponina*.

Lycænidæ.

Lycæninæ, Butler.

Lycæna knysna, var.?, Trimen.

Lampides jobates, Hopffer.

Rare.

Lampides sybaris, Hopffer.

There is a male of this species no larger than *L. Barberæ* of Trimen.

Lampides amarah, Guér.

Lampides sigillata, n. sp.

♂. Allied to *L. pulchra*, smaller: wings above lilac, with a broad brown outer border; fringe of secondaries white: primaries below silvery pale grey, a basi-subcostal brown streak; a spot in the cell, a second below it, a discocellular lunule, a subapical oblique series of five contiguous spots, an oblique litura on first median interspace, an interrupted submarginal line, and a series of seven submarginal dots black, bordered with white: secondaries white; an oblique basal dash, a spot on abdominal margin, two close to costa, a small one subcostal, a large one in the cell, three forming a triangle below the first median branch, one on first median interspace, three beyond the cell, the discocellulars, a submarginal interrupted irregular line, and seven or eight small submarginal spots black; spots at anal angle crossed by a metallic blue line. Expanse of wings 1 inch.

♀. Pale brown above, shot with lilac at the base; primaries with a white spot crossed by a brown discocellular spot; secondaries with two subanal blackish spots. Expanse of wings 1 inch 1 line.

This species also occurs at the White Nile.

Lampides pulchra, Murray.

This agrees with Natal examples.

Lampides cyclopteris, n. sp.

♂. Wings above dull shining lilac, with a rather broad dentated brown outer border; primaries with the discocellulars blackish; secondaries with the costal area brown; fringe pale brown, a brown marginal line; five submarginal spots, the fourth black, edged outwardly with white and inwardly with ochraceous, the others brown, edged with white: wings below pale whity brown; markings almost as in *L. osiris*, pale brown, edged with white; secondaries crossed near the base by an oblique line of white-edged black dots; a white-edged subcostal black spot opposite to the end of the cell; only one large black submarginal spot with metallic blue edge and broad orange lunule behind it, all the other submarginal spots pale brown edged with white. Expanse of wings 1 inch 3 lines.

Nearest to *L. osiris*, but the wings much more rounded, broadly brown-bordered, with only one blue-edged spot below.

Lycænesthes princeps, n. sp.

♂. Wings above shining lilacine brown, basal area shot with pale cupreous brown, base and interno-basal area of secondaries deep dull purple; a marginal black line; fringe whitish; secondaries with two white scale-tufts; two or three black subanal dots near outer margin; abdominal area brown: wings below much as in *L. bubastus*, pale brown, the external half of primaries and the external two thirds of secondaries traversed by white-bordered pale brown bands; secondaries with two blackish subcostal spots; two anal submarginal black spots dotted with metallic blue, and broadly bordered behind with orange, the one at anal angle bifid, base blackish: body below white. Expanse of wings 1 inch 2 lines.

♀. Above bright purple, with the costal half and external area of primaries and a clavate subcostal streak on secondaries dark brown: primaries with three increasing submarginal pearly whitish spots near external angle; secondaries with a discal angulated series of opaline lunules, five submarginal spots, the fourth largest, rounded behind, almost entirely orange, with a black centre, the others conical, white, with brown centres: wings below much as in the male, but the markings more strongly defined. Expanse of wings 1 inch 5 lines.

Castalius resplendens, n. sp.

Wings above snow-white, basal area dusky, the basal and internal areas brilliantly shot with silvery lilacine blue; veins dark brown; a submarginal dark brown line; costa of all the wings dark brown; primaries with a spot of black-brown at the end of the cell; a broad and very irregular black-brown discal band from the costa to just below the first median branch; outer border dark brown, coalescing with the submarginal line towards apex; secondaries with a submarginal series of black spots and a black marginal line: wings below white, spotted and streaked with black; primaries almost exactly as in *C. rosimon*; secondaries somewhat as in *C. rosimon*, but the spots on the basal area smaller, fewer, and more irregular, the disk also crossed by a zigzag series of seven large spots, the inner submarginal series not double, small and lunular; marginal or outer submarginal series smaller. Expanse of wings 1 inch 3 lines.

This beautiful little species of the section '*Castalius*' is more nearly allied to *C. rosimon* than to any other *Lycæna*. In the general pattern and coloration of the upper surface it reminds one of *Iolaus Bowkeri*.

subapical dull golden streak; no other markings. Expanse of wings 1 inch 10 lines.

A very distinct species.

Terias regularis, n. sp.

Allied to *T. Desjardinsii*. Bright golden yellow; outer border and costa of primaries rather broadly black-brown; the outer border regularly sinuated between the nervures, nearly twice as wide on the primaries as on the secondaries: wings below slightly paler, nervures terminating in black dots; borders only visible through the wings; primaries with costal edge blackish, a black dot on upper discocellulars; secondaries with costal area irrorated with dark brown, two purplish brown subcostal dots (one near the base), a third at origin of subcostal branches, a fourth on lower discocellulars ill-defined, a fifth below the median nervure, and a few scattered scales of the same colour on the disk. Expanse of wings 1 inch 1–7 lines.

Terias candace, Felder, = *T. zoë*, var., Hopffer.

Teracolus abyssinicus, n. sp.

♀. Allied to *T. eris*, but much more heavily marked. Primaries above with the spots on the outer border smaller; the dark brown internal border three times as wide; spot on discocellulars strongly marked, sinuation of outer border rather less pronounced: secondaries with large conical marginal brown spots; base brown; an angular discal series of brown spots: below, the apical area of primaries and the whole of the secondaries pale sordid ochraceous. Expanse of wing 2 inches 2 lines.

There can be no doubt that this is a well marked species: the female always has a yellow tint and the black and brown markings greatly developed. Unfortunately, although I have three females before me, I have not a single male. Both sexes are common.

Teracolus gaudens, n. sp.

Allied to *T. chrysonome*, but twice the size. The primaries above bright orange with the base snowy white, the markings black; secondaries sordid sandy orange, base bluish; veins and margin black: primaries below cadmium-yellow; apical area bright sulphur-yellow, base of costa the same colour; transverse irregular discal band and veins on apical area deep orange; secondaries bright sulphur-yellow, base streaked with orange; costa, two central transverse series of spots (the outer series angulated), and a series of large hastate spots at the terminal extremities of the nervures dark orange. Expanse of wings 1 inch 10 lines.

One example.

This beautiful insect, though on the upperside it looks like a gigantic specimen of *T. chrysonome*, is at once distinguished by the brilliant coloration of the underside.

Teracolus amelia, Lucas.

Quite common.

The female of this species differs from the male (sex doubtful in the description by Lucas) in not possessing the diffused orange coloration beyond the black border of primaries.

Teracolus calais, Cramer.

Rare.

Teracolus arne, Klug.

This form will have to be kept distinct from *T. phisadia* on account of its much greater size and brighter colouring.

Teracolus antigone ♀, Boisd.

Somewhat like *T. eione* ♀.

Teracolus helle, Butler.

This species was confounded with the following by M. Lucas.

Teracolus isaura, Lucas.

The female of this species is much deeper in colour than that sex of *T. helle*, and has a much broader black band across the orange apical area; in fact all the black or blackish markings are heavier.

Teracolus zera, Lucas.

I have only seen the male. It was formerly confounded with *T. antevippe*.

Teracolus epigone, Felder.

Teracolus microcale, n. sp.

♂. Wings above snow-white, basal area irrorated with grey; apical area orange, bordered on all sides with black-brown; veins on outer half of orange area black; secondaries with a marginal row of black-brown conical spots: wings below snow-white; primaries with a black dot at end of cell; the orange apical area visible through the wing; secondaries with a black dot attached to a golden-orange spot at end of cell. Expanse of wings 1 inch 6 lines.

♀. With the orange apical area narrower and touching the white ground-colour from below the third median nervure; primaries below pale sulphur-yellow at base; secondaries feebly reticulated with olive-brown, a streak of the same colour across the median branches; orange spot at end of cell bright: otherwise as in the male. Expanse of wings 1 inch 3 lines.

Teracolus anteupompe, Felder.

♂. Like *T. eupompe*, but without a discocellular dot in primaries, the basal area above less dusky, the borders of the carmine apical patch narrower, the marginal spots of secondaries smaller; discocellular spot of secondaries below small and vermilion. Expanse of wings 1 inch 10 lines.

♀. Much like *T. eupompe* above, but at once distinguished by the sulphur-yellow colour of the secondaries and the apex of primaries on the underside. Expanse of wings 1 inch 11 lines.

Dr. Felder only describes the female.

Teracolus phœnius, n. sp.

♂. Like *T. pseudacaste* ♂, but more heavily marked with black. Expanse of wings 2 inches.

♀. Like *T. pseudacaste* ♀, but the basal area tinted with lilacine, its margin strongly excavated on secondaries: primaries with the inner portion of the apical area distinctly reddish, the pale yellow hastate markings between the nervures better-defined and broader; the black spot near anal angle smaller; the brown border of secondaries divided into large pyriform spots; the discocellular black spot obsolete: secondaries below and apex of primaries pale sulphur-yellow, the discal spots almost wholly red; primaries with a red subapical streak, the veins not blackened, no transverse black band near the base; secondaries with the discocellular spot red. Expanse of wings 1 inch 11 lines.

Teracolus dedecora, Felder.

Teracolus citreus, Butler.

The female of this species has the same general character as the female of *T. eucharis*.

Druce tells me that it has already received a name; but I can find no published description of it, although I have gone carefully through the Records.

Herpænia tritogenia, Klug.

This and the preceding species are evidently not rare in Abyssinia. *H. eriphia*, which I have examined from Angola, is a larger and more creamy-coloured species than *H. tritogenia* (with which it has been united). I think the two forms will prove to be perfectly distinct: the markings are not quite the same on the hind wings.

Hesperiidæ.

Pamphila inconspicua, Bertoloni.

Pyrgus (close to *P. galba*).

Thanaos (two species near *T. Motozi*, Wllgr.).

Tagiades (very near to *T. flesus*, Fabr.).

The Hesperiidæ require figures to distinguish them readily from species already described, to which they are nearly allied.

XLIX.—*New and peculiar Mollusca of the* Kellia, Lucina, Cyprina, *and* Corbula *Families procured in the 'Valorous' Expedition.* By J. Gwyn Jeffreys, LL.D., F.R.S.

Kelliidæ.

Montacuta Dawsoni, Jeffr.

Montacuta Dawsoni, British Conchology, vol. ii. p. 216; vol. v. p. 178, pl. xxi. f. 27.

Godhavn, Disco, 5–25 fms.; Station 4, 20 fms.; St. 5, 57 fms.; Holsteinborg, 3–35 fms.; St. 9, 1750 fms.; Greenland (coll. Möller, in Mus. Reg., Copenhagen): Dröbak (J. G. J.): Florö, Norway, 300 fms. (Friele): 'Porcupine' Expedition, 1870, off Cape Sagres, in the Bay of Biscay; a valve only: Palermo (Monterosato).

Body whitish and gelatinous: *mantle* plain-edged, although at first I thought the edges were ciliated, in consequence of the posterior side of the shell being fringed by the polyparies of a minute Hydrozoon; the incurrent opening is wide and not tubular.

This is probably the unnamed bivalve No. 8 in Möller's Index, p. 24.

My description and figure were taken from dead specimens which the late Mr. Robert Dawson of Cruden dredged in the Moray Firth; but these may be semifossil or relics of the glacial epoch, like *Pecten islandicus*, *Astarte depressa* (*A. cribrecostata*, Forbes, = *A. Richardsoni*, Reeve), *Tellina calcaria*, and several other arctic shells which have been dredged on the coasts of Scotland. In St.-Magnus Bay, Shetland, I dredged *Leda pernula*, *L. abyssicola*, and *L. frigida* (= *Yoldia nana*, Sars) in a fresh state; and I also dredged *L. arctica* (= *Nucula truncata*, Brown, = *N. portlandica*, Hitchcock, = *N. siliqua* and *N. sulcifera*, Reeve) among the Hebrides. It is very difficult to say whether some of the above do not at present inhabit our northern seas.

Kellia symmetros *, Jeffr.

SHELL triangularly oval, equilateral, compressed but not flat, transparent, and glossy: *sculpture*, none except microscopic and slight lines of growth: *colour* glassy or clear white: *margins* sloping equally from the beaks, rounded on each side, gently curved in front: *beaks* circular or calyciform, prominent, incurved but straight: *cartilage* small, triangular, placed between the hinge-line and lateral tooth on the posterior side: *hinge-line* obtuse-angled: *hinge-plate* narrow but strong: *teeth*, in the right valve two short laminar laterals; in the left valve a strong oblique and projecting cardinal and two laterals; one of the laterals in each valve is slight: *inside* pit-marked: *scars* indistinct. L. 0·04. B. 0·05.

Station 9, 1750 fms.; a single living specimen.

The very young of *K. suborbicularis* of the same size as this is more globular; its beaks are not prominent; and the teeth are different.

Axinus cycladius, S. V. Wood.

Kellia cycladia, Mon. Crag Moll. p. 122, tab. xi. f. 4 *a, b*.
Poromya subtrigona, Jeffr. Ann. & Mag. Nat. Hist. 3rd ser. Jan. 1858, p. 42, pl. ii. f. 1.
Kellia? cycladia, British Conchology, vol. i. p. 228; vol. v. p. 179, pl. xxxii. f. 3.

Station 9, 1750 fms.; one living specimen. Shetland, 60–90 fms. (J. G. J.). 'Porcupine' Expedition, 1869, off the north-western coast of Ireland, 1366 fms.; 1870, Bay of Biscay, 386 fms. Mediterranean, 30–120 fms. (Spratt, Acton, Nares, Carpenter, and Monterosato)!

* Symmetrical.

Fossil in the Coralline Crag of Suffolk.

The 'Valorous' specimen differs somewhat from others. It is more gibbous, its contour is not so oblique, and the hinge-line is nearly straight instead of curved: the cartilage is oblong and placed obliquely. The hinge shows that this shell belongs to *Axinus* and not to *Kellia.*

Axinus eumyarius, M. Sars.

Axinus eumyarius, M. Sars, Christianiafjordens Fauna, ii. 1870 (posthumous), p. 87, tab. xii. f. 7–10.

Station 7, 1100 fms.; one live specimen. Norway, 200–450 fms. (Sars). 'Porcupine' Expedition, 1870, Bay of Biscay, 227–795 fms.; Mediterranean, 1456 fms. Palermo (Monterosato).

This species is remarkable for the length and thickness of the adductor muscles, the scars of which are visible through the shell. It somewhat resembles in shape *A. croulinensis*, but is longer and not oblique, and the beaks are pointed and project much more, so that there is a sloping droop on each side. In some of the 'Porcupine' specimens the muscular scars are less distinct, although the other characters are the same.

*Axinus incrassatus**, Jeffr.

SHELL more or less obliquely triangular, moderately convex, rather solid, and nearly opaque: *sculpture*, minute concentric striæ or lines of growth, which become fewer and regular in front: *colour* whitish: *epidermis* filmy: *margins* sloping and curved on the anterior side, rounded in front, and truncate on the posterior side: *lunule* and *corselet* indistinct: *ligament* narrow and yellowish, visible outside: *hinge-line* obtuse-angled: *hinge-plate* remarkably thick on both sides of the beak, so as to resemble laminar lateral teeth: *inside* glossy, smooth-edged: *scars* inconspicuous. L. 0·05. B. 0·075.

Station 9, 1750 fms.; 12, 1450 fms.; 16, 1785 fms. 'Porcupine' Expedition, off the north-west of Ireland, 1180 fms.

A variety which I would name *succisa* was dredged by me in the 'Porcupine' Expeditions of 1869 and 1870 in the North Atlantic and Mediterranean, at depths of 92–1366 fathoms, and by Dr. Carpenter in the 'Shearwater' Expedition of 1871, off the coast of Tunis, at depths of 40–120 fathoms. In this variety the posterior side is more abruptly truncate in the middle, and the hinge-plate is reflected or folded back on that side instead of being excessively thick. Specimens from moderate depths are larger than the type.

* Thickened.

sizes, from half a line to an inch in diameter, which I dredged in the 'Porcupine' Expedition, off the north-west of Ireland, at depths of 1230 and 1630 fathoms. A very young living specimen of *Cyprina Islandica* I got in the same locality in 808 fathoms.

The fry of *I. cor* was described by Professor Edward Forbes as *Kellia abyssicola*, by Dr. Philippi as *Venus? miliaris*, and by Professor M. Sars as *Kelliella abyssicola*.

Corbulidæ.

*Poromya rotundata**, Jeffr.

SHELL convex, not very thin, nearly circular except at the upper part of the posterior side, where there is a blunt angle, formed by the junction of the dorsal side with that part, white, covered with numerous minute and close-set tubercles, which are arranged in longitudinal rows. The hinge is wanting. Inside glossy.

Station 12, 1450 fms.; an imperfect valve.

Pecchiolia abyssicola, M. Sars.

Lyonsiella abyssicola, M. Sars, Vid.-Selsk. Forh. 1868, p. 257.
Pecchiolia abyssicola, G. O. Sars, 'On some remarkable Forms of Animal Life from the great deeps of the Norwegian coast,' i. p. 25, pl. iii. f. 21–43.

Station 12, 1450 fms.; a fragment only. Loffoden Isles, 200–300 fms. (G. O. Sars). Bergen (Koren). Greenland (Mus. Copenhagen). Davis Strait, 200 fms. (Lindahl). 'Porcupine' Expedition, 1870, chops of the English Channel, 567 fms.; coast of Portugal, 740–1095 fms.

Pecchiolia gibbosa†, Jeffr.

SHELL rather solid, obliquely raised and truncated on the posterior side, of a dark brownish colour, covered with numerous minute and close-set tubercles, which are irregularly disposed; inner layer and surface of the inside nacreous.

Station 12, 1450 fms.; a fragment only.

Pecchiolia tornata‡, Jeffr.

SHELL, although represented by several fragments, must have been rounded, and larger than any known living species except *P. acuticostata*. The present species, however, has no ribs, but merely minute and irregularly scattered tubercles. It is

* Rounded. † Irregularly hunchbacked.
‡ Rounded off.

of a thin texture, and covered with a cream-coloured epidermis, which is marked by occasional lines of growth. The beak is comparatively small and convoluted, turning towards the anterior side. The tooth in the right valve is short and strong, and placed obliquely. Inside silvery and resplendent.

Station 16, 1785 fms.; fragments.

*Neæra striata**, Jeffr.

SHELL forming a short oblong, moderately convex but not globose, thin, opaque, rather glossy: *sculpture,* from 30 to 40 longitudinal ribs or striæ, which radiate from the beak in each valve, besides a few intermediate and finer striæ; otherwise they are all nearly equal in size; in some specimens the space between the beak-like end of the posterior side and the main part of the shell is wrinkled transversely; the surface is also marked with numerous and close-set minute concentric lines in the interstices of the ribs or striæ: *colour* white: *margins* obliquely curved in front, rounded on the anterior side, nearly straight behind, and produced or extended on the posterior side into a rather long rostral or beak-like projection (rounded at the extremity), below which is a more or less distinct indentation: *beaks* small, incurved; umbones prominent, and projecting beyond the dorsal margin : *cartilage* contained in a small oval cavity underneath the beaks : *hinge-line* straight, or slightly upturned on the posterior side: *hinge-plate* narrow and slight: *teeth,* only a long triangular and erect lateral on the posterior side of the right valve, being a continuation or prolongation of the cartilage-pit to which it is united: *inside* glossy: *muscular scars* inconspicuous. L. 0·3. B. 0·5.

Station 12, 1450 fms.; 13, 690 fms.: altogether three single valves and several fragments. 'Challenger' Expedition, off Bermuda, 435 fms.

This differs from *N. costellata* in being much larger, having more numerous and regular ribs or striæ, which sometimes alternate in size, but are not stronger on the posterior side, and in the dorsal margin being nearly straight; from an undescribed species dredged in the 'Porcupine' and 'Josephine' Expeditions (which I propose to name *curta*) in not being globose, in having a longer rostral point, and also in the dorsal margin being nearly straight instead of excavated and lying below the hinge-line on the posterior side. In the last-mentioned species, as well as in *N. costellata,* the ribs are markedly stronger on that side, and are throughout unequal in size, and variable according to the specimens. The present

* Striated.

is quite distinct from any of the allied species described and figured by Mr. Hinds in the 'Zoology of the Voyage of the 'Sulphur,'' and from those described by him in the 'Proceedings of the Zoological Society' for 1843.

Some of the 'Valorous' fragments indicate a size of half an inch in length by three quarters of an inch in breadth.

A fragment of another species of *Neæra* occurred at Station 13, in 690 fathoms. It represents a specimen apparently nearly an inch broad and more than half an inch long. It has a rather compressed shape, is strongly wrinkled concentrically, and the rostral extremity is defined by two keels. The indentation below the rostrum is well marked. It probably belongs to a species which I dredged in the 'Porcupine' Expedition of 1870, off the coast of Portugal, at depths of from 740 to 1095 fathoms, and which I propose to name *bicarinata*.

I have also an undetermined fragment (part of the hinge of a right valve) of another smooth species from Station 12, 1450 fathoms, which shows a large cartilage-pit and an elongated triangular lateral tooth.

*Neæra exigua**, Jeffr.

SHELL oval, globose, thin, semitransparent, and glossy: *sculpture*, none except in front, where are some slight and close-set concentric striæ: *colour* whitish: *margins* gently curved in front, rounded on the anterior side, incurved behind on the posterior side, with a short and abrupt beak-like extremity on that side, which has scarcely any indentation below: *beaks* very small and mamillar, incurved towards the anterior side; umbones prominent, and projecting behind: *cartilage* and pit small, triangular: *hinge-line* slightly rounded on the anterior, and incurved on the posterior side: *hinge-plate* slight, folded back on the anterior side: *teeth*, a rather short triangular lateral on the posterior side of the right valve: *inside* glossy and stippled, showing under the microscope traces of longitudinal striæ: *scars* inconspicuous. L. 0·125. B. 0·2.

Station 12, 1450 fms.; a few valves and fragments.

This species differs from the young of *N. obesa*, Lovén, in being more convex and proportionally shorter, the front margin is more rounded, the rostral point is more abrupt, the ventral sinus (or indentation on the lower side of the rostrum) is scarcely perceptible, and the dorsal slope is more curved. *N. subtorta*, G. O. Sars, MS., from Norway and Spitzbergen, is shorter and twisted.

* Small.

from the inside) slightly incurved on the posterior side: *hinge-plate* thin, broader on the anterior side: *teeth* consisting of a single lateral on the posterior side in the right valve; this is rather long, triangular, and erect: *inside* glossy: *muscular scar* on the posterior side below the hinge-line triangular and strongly marked, the other scars inconspicuous. L. 0·5. B. 0·75.

Station 12, 1450 fms.; a valve and fragments. 'Porcupine' Expedition, 1870, off the coast of Portugal, 994 fms.; a small valve.

This differs from *N. notabilis* in shape and sculpture, as well as in having only a single lateral tooth. An imperfect valve represents a specimen an inch broad. The perfect valve and portion of a larger one have been drilled by apparently some small Siphonobranchiate mollusk.

Neæra papyria *, Jeffr.

SHELL oval, convex, exceedingly thin and fragile, semi-transparent, rather glossy: *sculpture*, none on the umbones; from 15 to 20 concentric lamellar ridges on the body of the shell, besides numerous and close-set but irregular minute hair-like striæ in the interstices of the ridges; the rostral part on the posterior side is closely striated across, and marked lengthwise with three or four slight rib-like striæ: *colour* white: *margins* rounded on the anterior side and in front, sloping towards the rostrum, which is snout-like and rounded at its extremity, incurved and somewhat upturned behind: *beaks* as in other species; umbones prominent: *cartilage* and pit or receptacle oblong, placed obliquely under the hinge-plate on the posterior side of the beaks: *hinge-line* nearly straight, but upturned on the posterior side: *hinge-plate* narrow and slight: *teeth*, none in the left valve; the right valve is imperfect: *inside* glossy: *scars* inconspicuous. L. 0·2. B. 0·4.

Station 12, 1450 fms.; two imperfect valves and a fragment.

Its delicate texture, the fewer number of ridges, and the intermediate striæ will serve to distinguish this from any known species.

Neæra angularis †, Jeffr.

SHELL inequivalve, obliquely oval, convex, thin, semi-transparent, and glossy: *sculpture* 25–30 concentric lamellar ridges on the body of the shell, besides numerous and close-set but irregular microscopic hair-like intermediate striæ; the

* Paper-like. † Having an angle.

ridges extend to the beaks and for a short distance across the rostral part, where they disappear and are replaced by slight transverse wrinkles; the rostrum is short and separated from the body by a strong flexuous keel or longitudinal rib, which proceeds from the beak and ends below in a sharp point; there is also in some specimens another more or less distinct keel between the rostral keel and the posterior side: *colour* whitish: *margins* gently sloping downwards from the beaks, rounded on the lower part of the anterior side, curved in front, and scalloped or indented between the keels or between the rostral keel and the posterior side; the point of the rostrum is rounded: *beaks* small, incurved, but scarcely recurved: *cartilage* small, oblong, and yellow: *lunule* large, diamond-shaped: *hinge-line* obtuse-angled: *hinge-plate* slight, thicker on the anterior side near the beaks: *teeth*, none in either valve: *inside* glossy, impressed by the ridges and rostral keels: *scars* inconspicuous. L. 0·25. B. 0·35.

Station 16, 1785 fms.: fragments only. 'Porcupine' Expedition, 1870, off the coast of Portugal, 994 fms. Gulf of Mexico, "off Rebecca," 290 fms. (Pourtales)!

The above description has been taken from a living specimen which I dredged in the 'Porcupine' Expedition. The short rostrum, angulated and separated by a longitudinal keel, distinguishes this remarkable species from any of those which are also concentrically ribbed.

L.—*List of Mollusca collected by the Rev. A. E. Eaton at Spitsbergen during the third Voyage of B. Leigh Smith, Eq. Stel. Pol., in the Greenland Sea.* Determined by J. Gwyn Jeffreys, F.R.S.

Class Pteropoda.

1. *Clione papilionacea*, Pallas. Syn. *Cl. limacina*, Phipps, &c. *Hab.* Kings Bay, &c.
2. *Limacina helicina*, Phipps. *Hab.* Common from North-Cape Island southwards, especially near the shore in bays.

Class Gastropoda.

3. *Eolis*, sp.? *Hab.* On *Alaria esculenta*, at Fair Haven, in 4–5 fathoms.
4. *Bulla striata*, Brown. *Hab.* Near the Seven Islands.
5. *Buccinum tenerum*, Gray. *Hab.* Green Harbour.
6. *B. glaciale*, Linn. *Hab.* Magdalena Bay and Green Harbour.
7. *Admete viridula*, Muller.

8. *Velutina lævigata*, Pennant. *Hab.* Hope Island.
9. *Natica*, sp.? *Hab.* Lomme Bay (*fide* A. E. E.).
10. *Trochus umbilicalis*, Broderip and Sowerby. *Hab.* Hinlopen Straits.
11. *T. helicinus*, Fabricius. *Hab.* Fair Haven, Wide Bay, Hinlopen Straits, and near Walden Island. Common.
12. *Puncturella noachina*, L. *Hab.* Near Foster's Island, Hinlopen Straits.
13. *Chiton marmoreus*, Fab. *Hab.* Wide Bay and Hinlopen Straits.
14. *C. albus*, L. *Hab.* Hinlopen Straits.

Class Conchifera.

15. *Saxicava rugosa*, L. *Hab.* From Green Harbour to Hinlopen Straits. Common.
16. *Mya truncata*, L. *Hab.* The fiords and bays of the western coast.
17. *Astarte crenata*, Gray. *Hab.* Hinlopen Straits.
18. *A. pulchella*, Jonas? (I have not Jonas or Reeves's 'Belcher' to refer to.—J. G. J.) *Hab.* Hinlopen Straits.
19. *A. sulcata*, Da Costa. *Hab.* Hinlopen Straits.
20. *Cardium grœnlandicum*, Ch. *Hab.* Lomme Bay.
21. *Leda pernula*, Mull. *Hab.* Treurenberg Bay.
22. *Modiolaria nigra*, Gray. *Hab.* Treurenberg Bay.
23. *M. discors*, Linn. *Hab.* Fair Haven.
24. *Pecten islandicus*, Ch. *Hab.* Wide Bay, Treurenberg Bay, and Hinlopen Straits.

Class Brachiopoda.

25. *Rhynchonella psittacea*, Chemnitz. *Hab.* Lomme Bay and near Carl Island.

LI.—*Description of a new Species of* Vesperugo *from Zanzibar.* By G. E. Dobson, M.A., M.B., F.L.S., &c.

Vesperugo (*Vesperus*) *grandidieri*, n. sp.

Head, ears, and tragus very similar to those of *Vesperugo abramus*, Temm. Ears short, rounded off above; outer margin of the ear-conch straight or faintly concave in upper two thirds, emarginate opposite the base of the tragus, terminating in a small rounded lobe midway between the base of the tragus and the angle of the mouth: crown of the head scarcely elevated above the face-line; nasal apertures separated widely, opening forwards, their margins not projecting.

Wing-membrane from the base of the toes; postcalcaneal lobe very shallow; half the last caudal vertebra free.

now not unfrequently taken by enterprising travellers, and gives an interesting account of the post-road between that city and the Chinese capital. Here Colonel Prejevalsky's expedition really began, his plans being, by travelling south-west from Pekin, to strike the great bend of the Hoang-ho at its most northern point, and, penetrating through the country of Ordos, to reach if possible the great inland lake Koko-nor. This route, we may remind our readers, has seldom, if ever, been taken by recent travellers. Messrs. Huc and Gabet, who traversed nearly the same district on their celebrated journey from Pekin to Lhassa in 1845–46, are almost the only exceptions. But their well-known narrative appears to have been drawn up chiefly from recollection, and has so little of the scientific element in it that it is almost useless except as an amusing story-book. Colonel Prejevalsky, therefore, may be said to have selected almost virgin ground for his explorations.

Several months having been consumed in Pekin by preliminary arrangements, it was not until the beginning of March that a start was made; and even then, the party not being quite completely organized, a preliminary tour was taken into Northern Mongolia, where the remote lake of Dalai-nor was visited and its birds studied before the grand expedition was commenced.

Having returned to Kalgan on the Kiakhta route about two months later, and made his further arrangements, Col. Prejevalsky effected a final start on the 15th of May, and travelled westwards over the high plateau of Mongolia. Three ranges of mountains (the Sharahada, the Sumahada, and the Inshan systems) were crossed before they arrived on the northern bank of the Hoang-ho. Interesting notes are given of the animals met with in both the plains and the mountain-districts, the most noticeable being the great Argali sheep (*Ovis argali*) and the mountain-antelope (*Antilope caudata*), recently described by M. Milne-Edwards from specimens obtained by Père David. Full particulars are also given respecting the botany and the ethnology of the country passed through. The Hoang-ho was crossed at the ferry of *Lang-hwaisa*, near the important town of Bautu; and the very different country of Ordos was then entered. "Ordos is the country lying within the northern bend of the Yellow River, and bounded on the south by one of the 'Great Walls,'" thus lying outside of China proper. It is a level steppe bordered by low hills; and its barren soil, except in the valley of the Hoang-ho, is ill-adapted for agriculture. Colonel Prejevalsky and his companions turned to the right after passing the ferry, and marched along the south bank of the river 290 miles until they recrossed it at Ding-hu. The whole of this country, formerly filled with an industrious population, had been devastated by the Mahommedan insurrection. "Even the footpaths are so overgrown with grass that not a trace of the former inhabitants remains. You may occasionally see a ruined village, or the skeleton of a Mongol half devoured by wolves." But some interesting plants were met with, amongst which were a species of liquorice (*Glycyrrhiza uralensis*), of which the roots are collected in large quantities by the Chinese, and examples of "the remarkable cross-shaped *Pugionium cornutum*, originally described by Gmelin in the last century, but quite unknown to modern botanists."

From Ding-hu, where much trouble was experienced from the Chinese officials, the party proceeded into Ala-shan—"a wild and barren desert, inhabited by Olub Mongols, which forms the southern part of the high plateau of the Gobi." Here, at Din-yuang-ing, a hospitable reception was met with from the ruling Prince, a tributary of the Chinese Empire. After a fortnight's stay in the Ala-shan mountains, and exploration of their fauna and flora, it was decided to return to Pekin in order to obtain fresh supplies of money and necessaries for a new journey.

In his second volume Colonel Prejevalsky gives us an account of his second expedition from Pekin, in 1872. On this occasion he left Kalgan on March 17th, and returned by the same route to Alashan, where the prince of Alashan and his sons received him with open arms, and were in fact very unwilling to let him go again. After some delay, however, he succeeded in being allowed to join a caravan of Tangutans and Mongols returning from Pekin to the temple of Chobsen, situated in the province of Kan-su, only five days' journey from Lake Koko-nor, and arrived there early in July. After spending several months in making zoological and botanical observations in the hitherto unexplored mountains of Kan-su, another start was made, and the much-desired lake reached on the 25th of October. "The dream of my life," says our author, "was thus accomplished, and the object of the expedition gained."

We need not follow our adventurous traveller in his further wanderings. Suffice to say that in a winter journey from Koko-nor he finally penetrated to the banks of the Upper Yang-tse-kiang, only about 27 days' journey (or 500 miles) from Lhassa, where want of funds was the sole obstacle that stopped his further progress. But we strongly recommend every naturalist to read Colonel Prejevalsky's narrative for himself; for a more interesting journal has never come under our perusal. Zoological, botanical, and ethnological notes respecting these unknown regions are interspersed throughout the volumes, and render them especially attractive to those engaged in the study of these sciences.

Colonel Prejevalsky's third volume, which in the original Russian gives a complete account of his biological discoveries, does not form a part of the present edition. But we believe this also is being translated by a person fully competent to the task, and will shortly be given to the English public in another form. P. L. S.

The School Manual of Geology. By the late J. B. Jukes, F.R.S. &c. Third Edition, revised and enlarged, by A. J. Jukes-Browne, F.G.S. &c. Small 8vo, with numerous illustrations. A. & C. Black: Edinburgh, 1876.

This is one of the best of the smaller geological manuals; and the editor keeps it up to the level of advancing knowledge, as far as an elementary work of this kind requires. Natural operations now affecting the earth's surface, and their results,—the rocks and strata formerly produced and subsequently altered, or worn away and reproduced, by similar agencies,—the meaning of fossils,—the successive groups of strata, or "formations," and their chief characters,—and, altogether, the history of the earth, deduced from the facts observable in it, as interpreted by the processes now in operation—these are the divisions of the subject-matter of this well written and conscientiously edited little book. Some of the latest information bearing on minerals, lithology, the Cambrian and Cretaceous systems, and the Glacial period have been concisely and carefully incorporated in this edition.

MISCELLANEOUS.

Anatomical and Morphological Researches on the Nervous System of Hymenopterous Insects. By M. Ed. Brandt.

The nervous system of the adult Hymenopterous insects is little known, still less that of their larvæ. There does not exist any investigation of the metamorphoses which the ganglionic chain undergoes in the passage from the larval state to that of the adult insect.

The nervous system of only eight species of Hymenoptera is known; these are *Bombus muscorum*, *Apis mellifica*, *Vespa crabro*, *Scolia hortorum*, *Formica ligniperda*, *Ichneumon atropos*, *Athalia centifoliæ*, and *Sirex gigas*.

Comparative and morphological researches are wanting. I have undertaken with this view a study of the nervous system of the Hymenoptera, by dissecting a number of species of the same group. I have thus determined the morphological character of the nervous system of each family. Having terminated my researches on the Hymenoptera, I have the honour of submitting to the Academy their principal results.

I have studied the nervous system of the adults in seventy-eight species belonging to all the families of Hymenoptera and to most of the genera, that of the larvæ in twenty-two species, and the metamorphoses of the chain of ganglia in fifteen species.

I. *The Nervous System of the Adult Hymenoptera.*—There are two cephalic ganglia (a supraœsophageal and a subœsophageal ganglion), two or three thoracic and from three to seven abdominal ganglia. The Apides and the Wasps (*Vespa*, *Odynerus*, *Eumenes*), as well as the *Crabrones* (*Ectennius* and *Thyreopus*) and *Chrysis* have two thoracic ganglia, while *Cerceris*, *Ammophila*, *Pompilus*, *Formica*, *Mutilla*, *Myrmosa*, the Entomospheces and the Phytospheces (*Cimbex*, *Tenthredo*, *Sirex*) have three thoracic ganglia. In the Hymenopterous insects with two thoracic ganglia the second always presents, in its middle, a more or less distinct emargination, an indication of the fusion of two ganglia. Sometimes the indentation is very marked and the ganglion becomes double (*Odynerus*).

Another very remarkable fact, which has not previously been observed, is a difference *in the number of ganglia in the same species according to the sex.* The workers and the females of *Bombus* have six abdominal ganglia, while the male has only five; the working bees have five abdominal ganglia, while the queen and the males have but four; the male *Megachile* has four abdominal ganglia, while the female has five; the working wasps have five ganglia, the females and the males six.

The stomato-gastric system is composed of a frontal ganglion, two angeian ganglia, two trachean ganglia, and a ventricular ganglion.

II. *Nervous System of the Larvæ.*—The nervous system of the larvæ is very uniform. The larvæ have thirteen ganglia, while the caterpillar of the Lepidoptera has only twelve. The larvæ of the Hymenoptera have eight abdominal ganglia, which are all simple; in very young larvæ, however, the subœsophageal and the last abdominal ganglia show traces of the fusion of three embryonic ganglia.

III. *Nervous System of the Embryo.*—The researches of O. Rietschli and of A. Kowalewski on the development of the bee have proved that the embryos possess seventeen ganglia—that is to say, one *supra-œsophageal ganglion*, three small *subœsophageal ganglia* (which unite to form a single subœsophageal ganglion in the larva), three *thoracic* and ten *abdominal ganglia* (of which the last three form afterwards the last abdominal ganglion of the larva).

IV. *Metamorphoses of the Nervous System.*—The changes which the nervous system undergoes during the metamorphoses of the larva are produced by the fusion of several ganglia. The first thoracic ganglion of the larva remains isolated in the adult insect; the second and third thoracic ganglia of the larva approach one another more or less, and in some they blend into one medullary mass. The first abdominal ganglion always joins with the last thoracic, so that the adult insect has never more than seven abdominal ganglia; but in most cases the second abdominal ganglion also unites with the last thoracic ganglion. If the number of abdominal ganglia diminishes yet more in the adult insect (5, 4, 3 ganglia), this is effected by the fusion of some ganglia with the last abdominal ganglion.—*Comptes Rendus*, Sept. 18, 1876, p. 613.

On some remarkable Species of Mantidæ. By Prof. J. Wood-Mason.

These insects belong to that division of the family in which either the legs or some parts of the body are provided with appendages, and to that section of it in which in males as well as in females the antennæ are simple and setaceous and not pectinated; and I invite attention to some sexual differences presented by them which, I believe, have never before been noticed.

In *Hestias Brunneriana* the head of the female is prolonged vertically in the form of a cone bilobed at its extremity, while in the opposite sex this great cone is represented by a mere tubercle as in both sexes of the species belonging to the genus *Creobrota* ; the fore femora, which are wanting in the specimen from which the species was described by Saussure, are equally conspicuous in both sexes, being very broadly oval, with their upper margins very strongly crested.

In the next specimen to which I would draw attention, a small (22 millims. long) female insect brought from Pegu by Mr. Kurz, and apparently allied to *Hestias* and *Oxypilus bicingulata*, De Haan, the upper edges of the fore femora are sharply crested, but not so greatly expanded; the cephalic cone is bicuspid at the extremity, and armed with two pointed cusps on each side; the occiput presents behind each eye a pointed tubercle directed backwards: the face is carinate, the keel of the "facial shield" terminating above in a stout conical tooth; the two upper ocelli are surmounted by a pair of long and slender conical spines; the organs of flight do not nearly reach to the extremity of the abdomen; and the disk of the prothorax is armed with four sharp, erect, spiniform tubercles. From the analogy of *Hestias*, I confidently expect that the male will prove to have its head similarly armed with a tubercle. I have named this curious insect *Ceratomantis Saussurii*.

I also exhibit the two sexes of an insect captured, the female by Mr. Peal in the Naga hills, and the male by Dr. Cameron in the Bhutan Doars. In the former the head is provided with a long and slightly tapering foliaceous frontal horn, truncated at the apex, longitudinally obtusely carinate in front, and sharply crested behind, and nearly three times as long as the head is high; in the latter this great foliaceous horn is reduced to little more than a tubercle only about half as long as the head is high. I have named this insect *Phyllocrania Westwoodi*, notwithstanding that the prothorax has no foliaceous expansions.

Similar sexual differences may be looked for in *Phyllocrania*, *Parablepharis*, and *Sibylla*, the males of which are still unknown.

In the Phasmidæ we meet with apparently similar sexual differences; but in these insects the great reduction in size and thickness of body that has taken place in the males may well have effaced the horns and foliaceous lobes, which after all are generally relatively not very greatly developed in the females. We see the truth of this in the case of the genus *Phyllium*, wherein the foliaceous lobes of the abdomen and legs of the female are relatively very large, and those of the male are consequently by no means inappreciable, and in the case of *Lonchodes insignis*, in which in males more than ordinarily stout the cephalic horns reappear in rudiment though they have disappeared in slenderer individuals.

Prof. Wood-Mason also announced that he had ascertained by actual observation of living specimens belonging to several species that the femoral brushes are used by the Mantidæ to keep their eyes and ocelli in a functional condition, and that they are present in the young when these quit the egg.—*Proceedings of the Asiatic Society of Bengal*, August 1876.

On Rhabditis stercoralis. By M. Bavay.

The Nematode discovered by Dr. Normand in the fæces of patients affected with Cochin-China diarrhœa, and provisionally named by me *Anguillula stercoralis*, may justly retain that designation; but it closely approaches *Rhabditis terricola*, Dujardin, belonging to the genus *Leptodera* of Schneider, and the differences which separate it therefrom do not appear to me to be of generic value. The species only is new, and may be characterized as follows:—

Length of the adult ♀ 1 millim., width about 0·04 millim. Body cylindrical, slightly narrowed in front, much more tapered behind. Surface of the body smooth; transverse furrows become visible when the animal, emptied of its viscera, retracts itself strongly.

The mouth is formed by three, not very distinct lips, the unpaired one trilobate. The triquetral, muscular œsophagus occupies about one fifth of the body; it is divided into three portions—an elongated anterior part, narrower in front, and suddenly constricted behind into a sort of strait, which forms the median portion, which is elongated and precedes a posterior part dilated into an ovoid gizzard. Towards the middle of the latter a *y*-shaped spot may be distinguished; it indicates a cartilaginous valve or stomachal armature.

The intestine, inflated anteriorly into a stomach (*ventricule*), follows the œsophageal apparatus and terminates at a lateral anus near the base of the tail. Its walls are not very distinctly visible; but a pair of brownish yellow glands bound it on each side throughout its whole length. These glands are usually arranged in symmetrical masses. The whole of these organs are always more or less displaced in the female by the mass of ova.

The vulva is situated on the right side of the body a little above the middle. It leads into a uterus which is extended before and behind, and at maturity contains from twenty to thirty ova, more or less heaped together. These ova are at first of a horny brown colour, but afterwards become yellow and show the embryo. They are sometimes hatched in the uterus.

The female presents neither wings, folds, nor tubercles along the body.

The male, which is about one fifth less than the female, has a testis surrounding the mass of the intestine and the annexed glands, and terminating at an apparatus situated to the right at the origin of the tail, quite close to the anus. This penial apparatus is composed of two small horny spicules, which are recurved, inflated at their base, attenuated at the apex, and inserted upon the same transverse plane of the animal. A very delicate horny piece, situated a *little further back*, shorter and *broader* than the spicules, is recurved in the form of an umbilicus round their base. The tail is shorter than in the female, and is always turned to the right, like the spicules.

In copulation the male twists the posterior portion of his body round the vulvar portion of that of the female. The copulation appeared to me to be of short duration; the males are moreover much less numerous than the females.

This description applies only to the adult age of both sexes. At its escape from the ovum the digestive organs of the young worm are scarcely apparent, the intestine is not so long in proportion to the œsophagus, and the uterus is not visible.

It is when about half-grown that these worms are most frequently

plasm of the filaments, while the extranuclear filaments, drowned in protoplasm, must be very difficult to distinguish. And it may be observed, in fact, in such cases as that of the Geryonidæ, in which the vitellus is almost entirely composed of a protolecyth which possesses a power of refraction very different from that of the protoplasm, that the extranuclear filaments are almost as distinct as the intranuclear filaments. The difference between these filaments is only apparent, and depends on the properties of the substance that surrounds the rays of sarcode.

The small granules or bacilli which, according to M. Bütschli, appear in the middle of each of the intranuclear fibres are in my opinion only inflations or varicosities of those filaments. I have never seen them united into a lamella, as described by MM. Strasburger and Van Beneden. M. Butschli has shown that these inflations divide, and go to unite with the centres of attraction which are now represented by aggregations of protoplasm the bulk of which increases rapidly; if these varicosities only showed themselves upon the intranuclear filaments, they would constitute a remarkable difference between the two kinds of filaments. But this is not the case. In the ova of the Geryonidæ, which are not very compact, and even in the much denser ova of the Echini, we can distinguish upon the extranuclear filaments varicosities which have hitherto escaped the notice of all observers. These inflations are more elongated and less regular than those of the interior of the nucleus; but nevertheless they are indubitable varicosities, which move like the others and pass slowly to amalgamate with the central aggregation of protoplasm.

This aggregation, therefore, is not exclusively a derivative of the substance of the old nucleus, either by its mode of formation or by its mode of growth; it is a result of the fusion of a portion of that substance with a part of the protoplasm of the vitellus. M. E. van Beneden considers the new nuclei to be composed of two pronuclei—one derived from the old nucleus, the other from the surrounding vitellus. In the cases observed by me there are no distinct pronuclei, but a direct fusion between these substances of diverse origin.

The reagent which best shows all these filaments is, in my opinion, picric acid followed by glycerine. Osmic acid, employed by M. O. Hartwig, causes the extranuclear filaments almost to disappear; hence the much too exclusive importance ascribed by him to one of the systems of filaments. What this naturalist describes as *the nuclear fibre* is an artificial product, resulting from the action of an ammoniacal liquid.

As regards the relations of the central aggregations with the new nuclei, I have often observed that these aggregations, after having absorbed the greater part of the radial filaments and their varicosities, present clearer and probably more liquid spots than the rest of the mass; this is why I previously described them under the name of *vacuoles*. The new nucleus is the result of the fusion of these vacuoles; and what remains of the central aggregation constitutes the envelope of the nucleus. Frequently, but not always, we see a vacuole originate, not in the central aggregation, but in an excentrical position, on the side of the spot where the old nucleus was. This shows that the liquid of the nucleus has the same double origin as the aggregations themselves.

We must therefore regard these phenomena of cell-division as occasioned by a fusion between the protoplasm and the nucleus of the cell, a fusion which commences at the opposite poles of the nucleus. The nucleus only occupies the centre of the cell during periods of repose; as soon as the activity of reproduction is manifested, the nucleus ceases to be the centre of the system, and the points of fusion become the places of convergence for the currents of sarcode which travel from all sides towards these new aggregations. The new nuclei result from a partial liquefaction of these aggregations; they are therefore composed of a mixture, in very different proportions in different cases, of the substance of the old nucleus and the protoplasm of the cell.—*Comptes Rendus*, October 2, 1876, p. 667.

On a Species of Iapyx. By Prof. J. Wood-Mason.

Prof. Wood-Mason exhibited specimens of a species of *Iapyx* which he had recently found amongst the decaying leaves and fungi at the foot of a bamboo-clump in his own garden at Calcutta, and said:—

"This remarkable form of Arthropoda, which has not hitherto been met with in India or, indeed, in any part of Asia, is of the greatest interest, as belonging to a group the members of which are considered by Sir John Lubbock to be the living representatives of a primæval form from which the great orders of insects have all originated. Discovered many years ago in Algeria by M. Lucas, the eminent French entomologist, *Iapyx solifugus*, the type of the group, was only made known to science in 1864, when Mr. Haliday described and figured it in the 'Transactions of the Linnean Society of London.' In the following year it was submitted to a more careful examination by Meinert, who detected a pair of rudimentary appendages on each of the seven anterior segments of the abdomen, just as in its allies *Campodea* and *Nicoletia*, in which latter, however, all the abdominal segments appear to be thus furnished. Four species of the genus have already been described, viz.:—*Iapyx solifugus*, Haliday, from Algeria, Switzerland, and various parts of Italy; *I. Saussurii*, Humbert, from Mexico; *I. gigas*, Brauer, from Cyprus; and *I. Wollastoni*, Westwood, from Madeira and an adjacent island. A fifth has now been discovered thousands of miles from the nearest of these localities, in association with a large bright crimson-coloured species of *Anoura*, two species of Springtails, two or three Pselaphidæ, and five or six Myriopods, amongst which a *Polyxenus* (differing from the European *P. lagurus* in having one instead of two pencils of silvery hairs at the end of the body) and a species of the very remarkable genus *Scolopendrella* especially merit attention."—*Proceedings of the Asiatic Society of Bengal*, August 1876.

"On the Fecundation of the Egg in the Common Fowl."

In the 'Annals' for November, p. 369, an unfortunate erratum has occurred—the name of the author of the paper under the above title being printed P. Tascher; it should be P. Tauber.

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END OF THE EIGHTEENTH VOLUME.

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