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INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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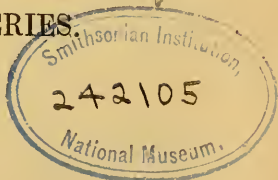
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VOL. XII.—FOURTH SERIES.  
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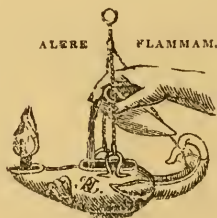
1873.

“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 elueet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exulta; malè doctis et barbaris semper inimica fuit.”—LINNÆUS.

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

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

J. TAYLOR, *Norwich*. 1818.



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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

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

N. Parthenii Giannettasii Ecl. 1.

No. 67. JULY 1873.

I.—*On some Characters of Lingula anatina, illustrating the Study of Fossil Palliobranchs.* By WILLIAM KING, Sc.D., Professor of Mineralogy and Geology in the Queen's University, Ireland, and Queen's College, Galway.

[Plate II.]

THE investigations which have led to the preparation of the present paper were begun with in order to ascertain the relationship between *Lingula* and *Trimerella*—a point which Mr. Davidson and myself considered necessary to be determined before completing the memoir we have in hand on the family typified by the last-named genus*.

* *Vide* Annals & Mag. Nat. Hist. 1872, x. p. 248.

I much regret that, owing to the distance by which we are separated, it was impossible for my friend and colleague, Mr. T. Davidson, F.R.S., to join with me in the investigations detailed in this paper. He has, however, aided me to such an extent that had it been otherwise the paper certainly would never have appeared. After much correspondence and trouble, he at last succeeded in procuring a number of specimens of *Lingula anatina* preserved in spirits. Some were supplied by Dr. L. de Koninck, Professor in the University of Liège; and others by Dr. C. Semper, Professor in the University of Würzburg, Bavaria, and Dr. G. Lindström, of Wisby, Gothland. To these gentlemen we join in recording our sincere thanks for their kind favours. We also feel it necessary to acknowledge our obligations to Prof. A. E. Verrill, of Yale College, for his valuable present of a bottle containing several fine specimens of *Discina lamellosa* and *Terebratulina septentrionalis*. These specimens have greatly assisted me in my researches on *Lingula*.

Ann. & Mag. N. Hist. Ser. 4. Vol. xii.

1

Notwithstanding that several highly valuable papers have appeared on the shell and animal of *Lingula anatina**, my investigations have not been unsuccessful in bringing to light certain characters that have apparently escaped the notice of previous observers, or have been insufficiently understood by them. These and other characters are of so much importance in elucidating the shells of some imperfectly known fossils as to induce me to make them known to palæontologists.

Few, if any, shells exceed in interest those belonging to the genus *Lingula*. Occurring in rocks that were formed in what may be regarded in the present stage of geology as the oldest life-period of our planet, and being represented in every rock-system, as well as in existing seas, while most of its con-

* Mr. Davidson has kindly furnished me with most of the items of the following list of authors who have contributed to elucidate the anatomy of *Lingula*. I have made a few additions to the list, principally of authors who have described either fossil or recent species of the genus.

- BRUGUIÈRE. This author established the genus *Lingula* in the Encyclop. Méthodique, 1789.
- CUVIER. "Mémoire sur les Lingules," Mém. du Muséum, vol. i., 1802.
- LAMARCK. Animaux sans Vertèbres, tome vi., 1819.
- OWEN. Transactions of the Zoological Society, vol. i., 1825.
- VOGT. "Anatomie der *Lingula anatina*," Neue Denkschriften der allgemeinen Schweizerischen Gesellschaft für die gesammte Wissenschaften, Bd. vii., 1843.
- SOWERBY, G. B. Thesaurus Conchyliorum, 1846: recent *Lingulas*.
- OWEN. In Davidson's 'Introduction to the British Fossil Brachiopoda;' Monograph of the Palæontographical Society, 1853.
- HUXLEY. Proceedings of the Royal Society, vol. viii., 1854.
- WOODWARD. Manual of Mollusca, 1854.
- OWEN. Lectures on the Invertebrate Animals, 2nd edition, 1855.
- HANCOCK. Transactions of the Royal Society, vol. cxlviii. 2nd part, 1855.
- GRATIOLET (P.). "Études anatomiques sur la Lingule anatine;" Journal de Conchyliologie, 1860.
- REEVE. Conchologia Iconica, 1861: recent *Lingulas*.
- SEMPER. Zeitschrift für wissenschaftliche Zoologie, vols. xi. and xiv., 1860, 1864.
- ADAMS. Annals and Mag. Nat. Hist., vol. xi., 1863: Japanese *Lingulas*.
- DAVIDSON. Palæontographical Soc. Monographs; British Fossil Brachiopoda: *Lingulas*.
- MORSE. American Journal of Science, vol. i., 1870.
- DALL. American Journal of Conchology, vol. vi. part ii., 1870.
- DAVIDSON. Proceedings of the Zoological Society of London, 1871: Japanese *Lingulas*.
- HALL. Notes on some new or imperfectly known Forms among the Brachiopoda, &c., 1872: Lower Palæozoic *Lingulas*.

Other authors, as De Blainville, Deshayes, Captain King, Stimpson, Hinds, Broderip, and Salter, have more or less contributed information on *Lingula*. Bonin and Vivier are cited by Semper; but I have not been able to ascertain any thing respecting their work, except that it is anatomical.

temporary allies have become extinct, the genus may be looked upon as the longest-lived one of its class that is known. Still the remarkable fact is, that its various species do not offer, as in many other cognate genera, any striking variations of form; indeed it has been stated, though incorrectly, that certain existing species are undistinguishable from, or identical with, others characterizing different geological periods down to the Cambrians*.

Another subject of interest attached to the study of *Lingula* is, that throughout its entire existence the shell-substance of its various species has remained constantly and essentially corneous, the mineral, but more subordinate, constituents of this substance being principally phosphate of lime. In another corneous genus, *Discina*, there are the same paucity of striking test-features, and a rôle of equal duration. How different with the calcareous genera—for the most part short-lived, and marked with great diversity of specific forms!

The great pallial interspace, answering to the general cavity of the shell, is divided into three different compartments, each characterized by special features.

1. The most important compartment occupies a considerable portion of the posterior half of the shell-cavity, is bounded by a highly muscular wall or parietal band (figs. 1 & 2, *b*), and contains all the viscera, including the muscles. I propose to name this division the splanchnocœle †, or visceral chamber. With the exception of its frontal portion, which is prolonged in the dorsal valve (fig. 2; and fig 3, A), the anterior half of the present compartment is the widest, approaching to nearly the lateral shell-margins. Its posterior half is much reduced in width by a considerable incurvation of the corresponding portions of the wall: and its frontal prolongation causes the anterior outline to differ in the two valves—it being long and tapering in the dorsal, and obtusely rounded, with a slight median point, in the pedicle- or ventral one (fig. 1; and fig. 3, B). The differences in the outline of the chamber suggest the propriety of dividing its parietal band into four portions—posterior, post-lateral, ante-lateral, and anterior.

2. The anterior half of the pallial interspace is open all round (sides and front) except at its back, which is formed by the anterior parietal. It encloses the arms or brachial appendages

* Mr. Davidson, who has been erroneously credited with this statement, has not gone beyond expressing that "many fossil forms resemble in contour such shells as the large *L. tumida*, *L. ovalis*, and *L. anatina*." See Brit. Silurian Brachiopoda, p. 34.

† From *splanchna*, internal parts, and *cœlia*, cavity.

(fig. 2, *r*), and may therefore be called the brachioœcle* or brachial chamber. Its upper and under surfaces (dorsal and ventral lobes of the pallium or mantle) are highly vascular.

3. The sides of the splanchnocœle in its posterior half, as just stated, are rather strongly incurved, giving rise to two lateral spaces (fig. 1; & fig. 2, *m*), each bounded at the back or inner side by a post-latero-parietal, but open in front or the side corresponding with the adjacent margin of the shell. Possessing no special feature, I propose to give the name pleurocœles† to these spaces, simply from their position as side chambers. The two lobes of the mantle forming their upper and under surfaces are highly vascular.

The organs contained in the different chambers of most importance in the present paper are those that lie next to, or are inserted in, the valves—namely, the parietal band, shell-muscles, liver, genitalia, and some others; in addition to which the setal band and pedicle require to be described.

Parietal band (b).—The anterior portion, as already remarked, passes much further forward in the dorsal than in the ventral valve: it slopes backward from the former to the latter. Elsewhere the band passes directly or vertically between the valves. The incurvation of the post-lateral portions is somewhat the deepest in the dorsal valve: these portions are thicker and more muscular than the others.

In the dorsal valve there are two curving laminar muscular processes (fig. 2, *t*), each running somewhat vertically from the inner face of the ante-latero-parietals to the medio-longitudinal line of the shell. Huxley has named their homologues in *Terebratula* the gastro-parietal bands.

Liver (c).—This occupies the anterior portion of the splanchnocœle. Its surface-area is smallest in the pedicle-valve, and centrally situated. In the dorsal valve the corresponding area is more expanded, reaching nearly to the ante-latero-parietals: it is divided rather deeply, and in the transverse direction, by the gastro-parietal bands; while the resulting anterior division in its middle line is slightly grooved by the posterior portion of a medio-longitudinal shelly plate (fig. 2, *s*), which belongs to the interior of the valve.

Genitalia (d).—These, which occupy the remaining portion of the splanchnocœle, are distinguished from the liver by a larger pattern of granulation. Their largest surface-area is in the ventral valve.

As made known by previous observers, the mouth is situated in the prolongation of the anterior parietal at a little

* From *brachion*, arm.

† From *pleura*, side.

distance from the dorsal valve. The œsophagus, which passes between two muscles that attach themselves to the median shell-plate, is imbedded in the anterior division of the liver. The stomach, also similarly imbedded, is in connexion with the gastro-parietal band. The intestinal canal runs directly backward through the liver and genitalia: arrived at the posterior part of the splanchnocœle, and after making a few flexures, vertical and horizontal, it emerges at the ventral surface of the genitalia: next, running forward alongside the right post-latero-parietal*, it reaches the hind part of the adjacent ante-latero-parietal, penetrating this wall as a vent (fig. 1, *f*).

Shell-muscles.—There are five pairs, and an odd one. Three pairs (*j*, *k*, *l*) are *lateral*, having their members limited to the sides of the shell. One pair is *transmedian* (*i*), each member passing across the middle to reverse sides of the shell. One pair (*h*) has its members confined to nearly the *central* region. The odd muscle (*g*) occupies the umbonal cavity.

Lateral muscles.—In the dorsal valve one pair (*j*), which may be termed the *anterior*, is attached to the median plate, a member passing from each of its sides to the corresponding one in the opposite valve, where the splanchnocœle is widest. The second or *outside* pair (*l*) in the ventral valve has each member passing from the outer side of the central muscles to the same side in the dorsal valve, close to the posterior half of the ante-latero-parietal, and in the widest part of the splanchnocœle. The third or *middle* pair (*k*) springs from the ventral valve between the central muscles, each member passing to its corresponding side in the opposite valve, increasing much in size in the passage, and becoming inserted in front of, and inwardly to, the attachments of the muscles belonging to the last pair.

Transmedian muscles (*i*).—In the dorsal valve both members of this pair are implanted in the widest part of the splanchnocœle, one on the inner side of, and immediately adjacent to, the termination of the laterals *k* and *l*. Passing backward, each member crosses diagonally to the *reverse* side of the ventral valve; but while one preserves its unity, and terminates by inserting itself near the middle of the left post-latero-parietal, the other is divided in its passage, a division becoming

* In explanation of the terms *right* and *left side*, it is necessary to state that in placing either of the valves with its interior upward, and its beak nearest to the observer, the latter part is to be considered the posterior end, and the opposite margin the anterior end: this makes the side corresponding with the right hand the right one, and its opposite the left one.

inserted near the posterior, and another near the anterior, end of the opposite and corresponding parietal. The divided member embraces the undivided one.

The *umbonal* (figs. 1, 2, 3, 4, & 5, *g*) and *central* (*h*) muscles do not require any further description.

Lingula differs widely in its muscular system from most other Palliobranchs. The *umbonal*, if, as suggested by some, it really be two muscles that have become united, may be homologous with the posterior adductors in *Discina*. There is some probability that the *centrals* correspond to the only pair of adductors or valvulars occurring in the Terebratulids and Rhynchonellids. The *laterals* appear to have little in common, except their distinctive position, with either the pedicle or the cardinal muscles in the last-named families. As to the *transmedians*, they are essentially distinct from every muscle of other genera, even the allied *Discina**—none in the latter ever connecting the two valves by their reverse or opposite sides.

It may be assumed that the central and umbonal muscles (*g*, *h*) effect the direct closing and opening of the shell, and that the laterals (*j*, *k*, *l*) enable the valves to move forward or backward on each other: but with respect to the transmedians (*i*), it is difficult to conceive otherwise than that they allow the similar extremities (the rostral) of the valves to turn from each other to the right, or the left, on an axis subcentrally situated—that is, between the anterior attachments of these muscles a little behind the medio-transverse line of the dorsal valve †. Still there are two important points, seemingly opposed to this view, that require to be considered.

Thus the position of the umbonal muscle appears to be capable of preventing any lateral displacement of the valves at

* I may on a future occasion describe the myology, and some other characters, of this interesting shell, as there is much to be added to, or amended in, the description given of it in papers already published. At present I may merely mention that the two small muscles inserted in the convex valve of *Discina*, between the adductors, appear to be the homologues of the *cardinals*, discovered by Quenstedt in *Rhynchonella* (pub. 1835), and by myself, without knowing the latter fact, in *Waldheimia* (pub. 1848). It would thus appear that *Discina* is closer in this respect to the Terebratulids and Rhynchonellids than to *Lingula*, in which these muscles are absent.

† Cuvier, in the 'Mémoires du Muséum,' vol. i. p. 69, 1802, was the first to notice the peculiar muscular character of *Lingula*. The muscles acting separately, he states, would be able to slide the valves in all directions; but he does not mention the precise mode of action of the transmedian muscles. The "sliding" motion of the valves has been strongly contested of late years; nevertheless, as will shortly be seen, the Cuvierian view is undoubtedly the true one.

the posterior end of the shell; but the objection seems to be met by the fact that this muscle is to some extent relaxable, as I have had no difficulty in turning aside the beak of either valve. Further, it might with some reason be assumed that the rostral extremity of the non-pedicle- or *unattached* valve possesses the greatest freedom of lateral motion; but the assumption requires the posterior terminations of the transmedian muscles to be inserted in the corresponding region of the valve: the contrary, however, is the fact. It is highly probable that careful observations on the habits of the animal of *Lingula* will remove these two objections: but whatever value attaches to them, or to the mode in which it has been attempted to diminish their force as a counter argument, I do not hesitate to regard the valvular movements, just contended for, to be quite in unison with the following facts:—

The umbonal muscle (*g*) is in no way fettered by the pedicle, or any other part. The shell is not only edentulous, but its hinge-margins are widely and totally separated from each other. The beaks have their margins persistently apart, even when the umbonal muscle is most rigid. The post-latero-parietals are highly muscular, necessarily permitting an unusual play of motion between the valves at their posterior extremity. The ordinary muscles (*h, j, k, l*), principally, are limited to the middle third of the valves—not, as in most Palliobranchs, to their posterior half. All these structural peculiarities are reciprocally related, and they are strictly consistent with the office herein ascribed to the transmedian muscles*.

* It will be seen by a reference to the ‘American Journal of Science,’ vol. i. pp. 103, 1870, that I am in complete accordance with the observations of Mr. Morse, who has observed living specimens of *Lingula pyramidata*, Stimpson, with the valves divaricated laterally at both ends, the axis of motion being evidently located near the centre of the shell. The idea with me was first suggested by Mr. Morse’s observations.

Since the above was written I have been favoured by Mr. Davidson with an English translation of extracts from the “Reisebericht” of Professor C. Semper, published in the ‘Zeitschrift für wissenschaftliche Zoologie,’ vol. xi. 1860, and vol. xiv. 1864. Semper, who had favourable opportunities while residing at Zamhuanga, in South America, for studying living specimens of *Lingula anatina*, I find has anticipated the above observations by Morse. In the last of the volumes cited he mentions that it is “the habit of the animal of this species to displace the valves sideways when it is about to open them. This is never done suddenly or by jerks. The valves are at first always several times pushed to one side and back again on each other, at the same time opening gradually till at last they rest opposite to each other and widely apart.” Some sketches sent by Dr. Semper to Mr. Davidson show the two valves crossing each other with a slight obliquity, as in Mr. Morse’s figures. Neither of these observers, however, enters into any explanation as to how the lateral displacements are effected.

The various muscles, including the parietals, produce scars, often well seen in the valves of recent *Lingulas*. The scars are occasionally liable to become raised at their margin, giving them the appearance of individualized muscular fulcra or myophores. A specimen before me has the scar of one of the post-latero-parietals with its inner margin completely raised in the form of a plate. Such cases are evidently of abnormal formation; but they explain the origin of what may be assumed as normal cases—for example, *Lingula albida**, in which there are two of the same kind of plates. The attachments of the gastro-parietal bands produce in the dorsal valve two transverse impressions (corresponding to *t*), each of which passes behind one of the central muscle-scars, with a slight undulation, to nearly the middle line of the shell. In *Leptana analoga* the myophore of the dorsal valve has a transverse laminar division, interrupted in the middle, which might be taken for the fulcrum of the gastro-parietal bands †; but this view could only be correct if the muscle-scars in the fossil referred to were, as in *Lingula*, situated in front of the laminar division, which is not the case.

As the shell-muscles of *Lingula* differ so widely from those characterizing most Palliobranchs, it cannot be expected that many fossils of the kind should exhibit scars indicating their possession of a similar myology. The remains of extinct species of *Lingula* occasionally show the characteristic scars, as may be seen by referring to Mr. Davidson's figure of *Lingula Lewisii* ‡. In this species, however, the central muscles appear to be situated much further back than in *L. anatina*. So far my researches have failed in detecting in fossil Palliobranchs any scars that have been produced by muscles homologous with the transmedians of *Lingula*.

In comparison with the splanchnocoele of the Terebratulids and other shells allied to them, that of *Lingula* is not only more voluminous, but it has much thicker walls. In the former the parietals, being membranous and extremely thin §, leave little

* *Glottidia albida* of Dall (see 'American Journal of Conchology,' vol. vi. p. 157, pl. viii. fig. 2).

† King, 'Monograph of Permian Fossils,' pl. xx. fig. 7.

‡ British Silurian Brachiopoda, pl. iii. figs. 5 & 6.

§ The membranous parietals in the Terebratulids are occasionally strengthened by calcareous plates, so much so in *Terebratulina caput-serpentis* that they are crowded and beautifully tessellated with radial forms of the latter, as is also the case in the exposed or outer layer of the mantle where it covers the ovaries. It would therefore not surprise me to find that in some fossil species the visceral organs had been more or less protected by completely calcified parietes. My colleague and self, it is probable, may succeed in showing that the curious internal structures occurring in the typical Trimerellas served as receptacles for certain viscera.

or no impressions; and it is the same in a number of extinct families; from which it may be concluded that the relation of the latter to the Lingulids must be remote.

One reason why the splanchnocœle of *Lingula* is much larger than usual is that it contains the genitalia. These organs, or perhaps more correctly the ovaries, in the Terebratulids &c. are for the most part located in the brachioœle, leaving impressions occasionally beautifully displayed in fossils; as may be seen in Davidson's figures of *Orthis Baillyana*, *O. rustica*, *O. calligramma**, and several others, also in some recent species. The ovaries are generally located on each side of the splanchnocœle; it might therefore be inferred that the spaces similarly situated in certain fossils, as the Trimerellids, were the seat of these organs. Judging, however, from what is seen in *Lingula*, the spaces referred to may with more reason be taken to represent the pleurocœles.

Brachioœle or brachial chamber.—The anterior prolongation of the dorsal surface of the splanchnocœle causes this chamber to be much smaller in the dorsal than in the ventral valve. Its most prominent contents are the brachial appendages (fig. 2, *r*), which are spiral, and originate in the anterior parietal, nearer to the dorsal than the ventral valve. The point or apex of the spiral is turned or directed toward the ventral valve, as in other recent Palliobranchs. The arms are too much removed from the inner surface of either valve to produce any impression, as is the case in certain fossils, notably *Davidsonia Verneuili*†, *Productus giganteus*‡, and *Strophomena Jukesii*§. If similar impressions occurred in *Lingula* they would of course show that the arms had been turned towards the ventral valve: it is remarkable, however, that in the fossils referred to these organs appear to have been turned towards the opposite or dorsal valve.

The mantle-lobes forming the dorsal (upper) and ventral (under) surfaces of the chamber are well characterized by the vascular system. Both lobes are traversed by a pair of primary vessels (*p*) that run forward from the anterior parietal, a member from each of its sides: gradually approximating in their progress, without becoming united, they terminate, the dorsal pair at about a quarter of an inch, and the ventral pair at about twice this distance, from the margins of the chamber.

* British Silurian Brachiopods, pl. xxix. fig. 20, pl. xxxiv. fig. 16, pl. xxxv. fig. 12.

† Davidson, 'Introduction to Fossil Brachiopoda,' pl. viii. figs. 187 & 188.

‡ King, 'Monograph of Permian Fossils,' pl. xix. fig. 2.

§ Davidson, 'Monograph of British Silurian Brachiopoda,' pl. xxxvii. figs. 25 & 26.

From their inner side numerous secondary vessels (*q*) strike inwardly, with a backward curve, and meet in the middle line of the valves: others, larger than the latter (*q*), run off from the outer side of the primaries in an oblique forward direction, and parallel to one another; but they become suddenly and simultaneously constricted, and next somewhat rapidly attenuated, before reaching the shell-margins. Both the primaries and secondaries are slightly branched in the middle of the anterior part of the brachiocele. The constriction of the outgoing secondaries forms a line (*v*) which runs round the margins from one side to the other of the anterior parietal: here the line is about an eighth of an inch from the margins, which distance is gradually increased to a quarter of an inch at the front. Both sets of secondary vessels give the interior of the pallial lobes a strongly plicated or ribbed character.

At its departure from the anterior parietal, each of the primary vessels sends off direct to the margin one or more branches, which, instead of stopping suddenly, like the outgoing secondaries, are abruptly turned backward, passing along the narrow space on the outside of the ante-latero-parietals, and entering the pleuroceles. These branches will be noticed again shortly.

The vessels of the brachiocele, though prominent, do not produce such strong impressions on the inner surface of the valves as might be expected. Corresponding impressions are often more marked in recent Terebratulids, &c.; and they are frequently beautifully displayed in various species of extinct genera. The specimen of *Orthis striatula** originally belonging to Dr. de Koninck, and now in the British Museum, and several other fossils that have been figured by Davidson, show them very distinctly; also *Leptæna analoga* †, and *Camarophoria multiplicata* ‡. In the last fossil the vascular impressions even show a median line, which seems to correspond with the mid rib inside the vessels in *Lingula* §.

Pleuroceles or side chambers.—Reverting to the main

* Introduction to Fossil Brachiopoda, pl. vii. fig. 133.

† Monograph of Permian Fossils, pl. xx. figs. 6 & 7.

‡ Ibid. pl. viii. figs. 6 & 7.

§ The mid rib is the *septum* of Semper, who has discovered that on one side of it the blood flows forward, and on the other side backward. Failing to detect any contractile organs, or the so-called "hearts," and from certain evidences, he is of opinion that the circulation of the blood is effected by the action of cilia lining the inside of the vessels. Each of the primary vessels appears to be divided at its origin. Assuming this interpretation to be correct, and adopting Semper's opinion, one division may serve for the outflowing, and the other for the inflowing current.

branches of the primary vessels that pass backward external to the ante-latero-parietals,—on entering the present compartments they separate a little, and pass on, anastomosing here and there, to the posterior part of the valves. Both on their inner and outer sides spring a number of offshoots: the outer pass direct to the pallial margins; and the inner (*n*), some curving backward, and others forward, pass to the post-latero-parietals. The main branches define, as it were, the outer boundary of each pleurocœle; while the inner offshoots are often sufficiently prominent to give an irregularly puckered character to its upper and under (pallial) surfaces.

The next structure to be described may be not inappropriately introduced under the present head, though it belongs equally to the brachiocœle.

Both pallial lobes have a slightly raised flattened band (*u*) from an eighth to a quarter of an inch in width, the widest part being in front: it runs round the pallial margins, from which its outer edge (*w*) is distant about one sixteenth of an inch. The attachment of the band is strongest at its inner edge (which nearly corresponds with the line of vascular constriction, *v*): the outer edge, somewhat thickened or corded, is so slightly attached that there is no difficulty, by inserting a fine blade underneath, in separating it from the mantle; while further inward the attachment is even slighter, permitting the band to be raised in its entire width except along its inner edge. Numerous long setæ are well known to characterize the pallial margins of the Palliobranchs. In *Lingula* these parts (*x*) have their basal portion, about one third of their length, imbedded in the band: they pass nearly to its inner edge, and lie so close to each other, side by side, as to form a divisional plane or an upper layer in it. On raising the upper layer, the cause of its slight attachment is at once perceived; for the setæ are tied down to the mantle only along the base of the corded margin of the band.

Although the *setal band*, as it may be termed, runs along the pallial margins in their entire extent, the course of the setæ in the ventral valve is interrupted in one part—that is, in the region of the pedicle (figs. 1 & 4): there is no interruption in the opposite part of the dorsal valve*. The band in both valves gradually thickens on approaching the hinge; at which part it is puckered, and somewhat reduced in width (fig. 4, *u*), the incrassation giving it a prominent appearance. In the ventral valve, where the setæ are interrupted, the attachment of the outer edge is discontinued (fig. 3, *u*), the band being

* In *Discina lamellosa* the setæ are not interrupted in either valve.

simply attached by its inner edge, now widened, to the narrow space between the root of the pedicle and the postparietal.

In the pleurocœles the inner edge of the setal band corresponds to some extent with the line formed by the main posterior branches of the vascular system; consequently both structures contribute to form the outer boundary of these chambers. In the brachiocœle the same edge (*v*) is in immediate connexion with the line formed by the constriction of the outgoing secondary vessels (*v*); and it becomes thicker and more prominent, appearing as if irregularly frilled, in passing to the front of the valves. The rapidly attenuated vessels, previously noticed, cross obliquely, with a slight forward curve, the setal band, giving it, especially its inner edge, a somewhat plicated character. The band is also crossed by what appear to be incised lines, or striæ, directed less obliquely than the latter vessels, and which become subdivided near its outer edge.

In none of the specimens of *Lingula anatina* that have passed under my observation is there any well-marked impression of the setal band. Aged individuals with thick valves very probably show something of the kind; and it can readily be imagined that in such the muscular attachment of the inner edge of the band will produce a submarginal scar running round both valves. Usually the posterior half of the valves is the thickest: and it is on the outside of the spaces that represent the pleurocœles (belonging to this half) that impressions may occasionally be observed, consisting of an obscurely defined line that runs backward from each side of the splanchnocœle, where it is widest, to the hinge. Traces are seen of irregular impressions (which answer to the offshoots) striking from both sides of the above line, especially on the above spaces. Often, however, these spaces are plain, each being bounded inwardly by the scar, generally strong, produced by the post-latero-parietal, and outwardly by the obscurely defined line already mentioned. The two spaces in both valves are occasionally connected at their posterior end by a faint linear scar passing behind the umbonal muscle, and which is evidently due to the attachment of the setal band. Taken together, the posterior part of the band and the two pleurocœles are represented by a large arch-shaped impression, the crown of which is linear and the sides are dilated.

In fossil Palliobranchs a posterior arch-shaped impression is uncommon. Mr. Davidson and myself are prepared to show that it occurs in the Trimerellids. Doubtless it is present in extinct species of *Lingula*. Recently Mr. James Hall, who has

kindly favoured me with gutta-percha impressions of it, has made known a singular fossil (a small one), to which he has given the generic name of *Lingulops*, on the idea that it is a Lingulid. The posterior half is furnished with a broad semi-circular impression of nearly uniform width, with a singularly scalloped inner edge, reminding one of a Moorish arch. I suspect this style of edging was produced by the symmetrical form and arrangement of the vascular offshoots that traversed the pleurocoelæ. The same vessels in *Lingula* possess a certain degree of symmetry that favours this suspicion. *Discina* shows in each valve what might be taken for an arch-shaped scar; but this is produced by the posterior adductor muscles. *Obolus* is characterized by some remarkable scars in the cardinal region, particularly a pair having a member curving outwardly from each side of the hinge. Until recently I suspected the latter to be the homologue of the arched impressions of *Lingula*; but I now feel convinced that it was due, as in *Discina*, to the posterior adductors.

Attention must be directed in the next place to the pedicle (fig. 4, *y*), its attachments and accessories (figs. 3, 4, & 5).

Beginning with the latter, the most important is the deltidium (fig. 5, *a*); which, when properly developed (not usually so), is a shallow triangular depression, having a flattened space (*c*) on each side. The lateral spaces, which form the hinge-area as usually known, are marked transversely by epidermal lines of growth*. The deltidium is marked both longitudinally and transversely by numerous fine lines, the latter being the strongest. Immediately bordering each of its sides there is a ridge (*b*) slightly raised above the level of the areal spaces, and marked with arched epidermal lines. The anterior end of the deltidial ridges is, as it were, pushed up, thereby producing a small rude callosity (*b'*): in front of the latter there is a roundish depressed scar (*c*). The ridge-callosities are no doubt insignificant; nevertheless they may be the rudiments of important structures. Apparently they have become so far developed in *Lingula Lesueuri* as to serve to articulate the valves. If I am correct in putting this interpretation on the "two depressions or pits in the cast seen close to the extremity of the beak," and represented in Mr. Davidson's figure of it †, this species cannot belong to the genus in which it has been placed; as teeth seem to render a pair of transmedian muscles (essentials in *Lingula*) unnecessary.

* There is an area in the non-pedicle-valve marked with transverse epidermal lines; but it is not broken by a deltidium, merely by a faint longitudinal groove.

† Monograph of British Silurian *Lingula*, p. 43, pl. i. figs. 2 & 3.

On the anterior edge, which slopes forward, a finely marked lineated impression (d') is seen passing from one deltidial ridge-scar to the other. The lines of this impression run parallel with, and somewhat resemble, those which cross the deltidium, so that the difference between the two is difficult to make out: indeed both might be readily confounded.

The deltidium is a variable structure in Palliobranchs generally; and its modifications are far from being properly understood. As regards the deltidium in the genus under consideration, one circumstance is remarkable: it has been in a great measure overlooked; at least I can find little, or rather no, notice of it in the writings of previous observers. It is this oversight which led the late J. W. Salter to institute his genus *Lingulella*, which he typified with the Cambrian *Lingula Davisii*, under the belief that its "pedicle-groove" and "hinge-area" do not characterize any species of the old Bruguièrian genus. *Obolus* and some apparently related genera*, also the Trimerellids, are the only shells I am acquainted with that have a structure resembling the deltidium of *Lingula*. In the latter family it is a conspicuous object, having attained a maximum development, which is equally the case with the deltidial ridges.

The pedicle (fig. 4, y), which is cylindrical, consists of two concentric layers, the innermost of which (fig. 3, h) is muscular, and the other (g) corneous. Near the proximal extremity it becomes suddenly reduced in diameter, and at the same time compressed into the form of an oval, the long axis of which corresponds to the width of the shell. At the reduced part it is attached by one of the flattened faces of the corneous layer to the deltidium (fig. 3, g, a), the transverse and longitudinal lines of which are marks of its attachment. The anterior edge or extremity (fig. 3, d) of the same face is inserted immediately in front of the deltidium—that is, along the border of the hinge-slope, the faint lineated impression previously noticed being produced by its insertion. The sides or angles of the *anterior edge* are converted into tendinous lobes, which are individually attached to each of the ridge-scars (e): the pressure of the lobes against the end of the deltidial ridges evidently gives rise to the ridge-callosities. The corneous layer is not present on the opposite face of the pedicle, but makes its appearance a little within the opening of the beaks of the shell.

The muscular layer (h), passing in advance of the corneous one under the form of a much compressed cylinder, is rooted in the narrow space between the hinge-slope and the attach-

* *Discina* may be included, as its deltidium, although remarkably modified, appears to agree with that of *Lingula*.

ment of the setal band; as may be seen by effecting the outer margin (here not attached) of the latter organ, and cutting the pedicle across at the root (fig. 5, h).

It is scarcely to be expected that any well-defined scar could result from the attachment of the muscular layer, considering the immediate proximity of such scar to those produced by other organs (setal band and corneous layer, see fig. 3), and the liability of all the scars to become confluent through the incremental creeping backward or forward, as the case may be, of the organs respectively producing them. Were it otherwise, the attachment of the setal band and the corneous layer ought to give rise to two subparallel lineated scars, more apart in the middle than at the ends; while between them there ought to be an ellipsoid, produced by the muscular portion of the pedicle (see fig. 5, h, i). For the reasons stated, the last kind of scar cannot be expected to occur: traces may; which leads me to imagine that certain lines occasionally to be seen running along the hinge-slope may represent it. An elliptical scar, similarly situated, has been detected by Mr. Davidson and myself in testiferous specimens of certain Trimerellids: it is due, we suspect, to the inner muscular layer of the pedicle.

Conclusion.—My researches connected with *Lingula* strongly enforce on me the belief that it represents a group of Palliobranchs differing in several very important points from most others of its class. From being furnished with spiral arms, it has been placed by Dr. Gray in his "subclass Helictopoda," along with *Rhynchonella*, *Spirifer*, *Productus*, and some other related genera; but as all these belong, from certain evidences which I could adduce, to the great *non-aniferous* section, whereas *Lingula* possesses an anal vent, it is clear that Gray's "subclass" would be made a more natural one by removing this genus from it.

As regards the great sections to which allusion has been made, they appear to me to constitute the two primary and most comprehensive ones into which the Palliobranchs may be divided. I would therefore propose that one section should comprise all the *non-aniferous* families belonging to Gray's subclasses Ancylopoda and Helictopoda, with the name *Clistenterata**; and that the other should include the *aniferous* families *Lingulidæ* and *Discinidæ*, and be designated *Tretenterata*†.

Confining myself to the last section, I shall briefly notice the features which distinguish it from the first one:—

* From *cleistos*, shut, and *entera*, intestine.

† From *tretos*, perforated.

Aniferous.

Splanchnocœle large, and lying *within* the pallial margins. Setal band passing continuously round the pallial margins. Genitalia principally enclosed within the splanchnocœle.

Muscular peculiarities.

Pedicle not serving as a base of attachment for any muscles*.

Judging from what Semper and Morse have already made known respecting *Lingula anatina* and *L. pyramidata*, it seems highly probable that the section is also distinguished to some extent by its respiratory apparatus.

The Tretenterates appear to admit of being grouped under two divisions, respectively represented by *Lingula* and *Discina*, as the latter genus is strikingly differentiated by its muscular system, pedicle-characters, pallial vessels, and setal band.

EXPLANATION OF PLATE II.

All the figures are diagrammatic, particularly figs. 3 & 5.

- Fig. 1.* Ventral or pedicle-valve. Splanchnocœle: this chamber in both valves is bounded by the parietal band, *b*, which I have made to consist of four portions—*posterior* (behind the part marked *g*), *post-laterals* (at the incurvations), *ante-laterals* (at the ecurvations), *anterior* (extensions in front): *c*, liver; *d*, genitalia; *e*, intestine; *f*, termination of intestine; *g*, umbonal muscle; *h*, central muscles; *i*, transmedian muscles; lateral muscles (*j*, anteriors; *k*, middles; *l*, outsiders): *m*, pleurocœles; *n*, vessels of pleurocœles (exaggerated): brachiocele—all the anterior half of the valves outside the anterior parietal; *p*, primary vessels of brachiocele; *q*, secondary vessels of brachiocele (those passing from the inner side of the primaries may be called *in-goers*, and those on the outer side *out-goers*); *u*, setal band (the pedicle is not represented, in order to show the continuation of this band in the rostral region); *v*, inner edge of setal band—answering also to the line of vascular constriction; *w*, outer edge of setal band; *x*, setæ.
- Fig. 2.* Dorsal valve. *r*, arms or brachial appendages (relative position and direction of spirals merely shown); *s*, medio-longitudinal shell-plate; *t*, gastro-parietal bands (attached to slightly raised shell-ridges in the valve, and which are represented under *t*). All the other parts are lettered as in fig. 1.
- Fig. 3.* Medio-longitudinal section of cardinal region of both valves. A, dorsal valve; B, ventral or pedicle-valve: *a*, deltidium; *d*, cardinal or hinge-slope: *g*, corneous or external layer of pedicle—the lower division (or, rather, under face of the pedicle) is attached to *a* and *d'*; *h*, muscular or inner layer of pedicle; *i*, central hollow of pedicle: *b*, posterior parietal of splanchnocœle; *g*, umbonal muscle; *u*, setal band; *x*, setæ.
- Fig. 4.* Cardinal region of pedicle-valve. *y*, pedicle (its attached end is covered by the setal band, *u*); *b*, posterior parietal (a horizontal

* In *Discina*, contrary to what has been stated, the pedicle, which is an external organ, has no proper muscular connexion with the interior of the shell; the connexion is chiefly vascular and neural.

section); *g*, umbonal muscle (a horizontal section); *u*, setal band; *w*, outer edge of setal band; *x*, setæ.

Fig. 5. Cardinal region of pedicle-valve. *a*, deltidium; *b*, deltidial ridges; *b'*, deltidial callosities, slightly developed; *c*, areal spaces; *d'*, lineated impression, produced by anterior end of corneous layer of pedicle (see fig. 3, *d*); *e*, lobe-scars produced by tendinous lobes of corneous layer of pedicle; *h*, cross section of muscular or inner layer at root of pedicle; *i*, central hollow of pedicle: *b*, posterior parietal; *g*, umbonal muscle; *u*, setal band, which has its outer edge (*w*) everted to show the parts *d*, *h*, *i* (the corneous layer is removed to show the lineated impression made by the anterior end of its lower division—see fig. 3, *d*, *g*).

II.—On two new Species of Gummineæ, with Special and General Observations. By H. J. CARTER, F.R.S. &c.

[Plate I.]

IN a glass jar bearing the inscription "H.M.S. 'Porcupine,' No. 3a, lat. 48° 31' N., and long. 10° 03' W., depth 500 faths., and muddy bottom," which must have been just outside the so-called "chops" of the English Channel, is an oblong specimen about $2\frac{1}{2} \times 1\frac{1}{4} \times \frac{3}{4}$ inch, consisting of a mass of dead *Lophohelia prolifera*, over which has grown a *Farrea*, which, having shared the same fate, had become partially infested, both inside and out, with three other sponges bearing spicules which indicate that they belong respectively to *Dictyocylindrus*, Bk., *Desmacella*, Sdt., and *Reniera*, Sdt., together with a *Cliona* whose habitat was inside the stems of the *Lophohelia* and its fenestral openings on the surface of the latter, all of which have finally become enveloped in a *Gummina*, whose fleshy substance now forms the greater part of the mass (Pl. I. figs. 1 & 2).

With the exception of the *Lophohelia* and *Farrea*, all appear to be new species.

As the three infesting sponges are merely parasitic growths of small dimensions and without definite form, I shall only be able to characterize them by their complements of spicules respectively. The *Cliona*, too, having lived in the interior of the *Lophohelia*, necessitates a similar description, while the *Gummina*, which, as before stated, forms the greater part of the mass, claims our first and chief consideration.

It is with great pleasure that I embrace this opportunity of calling attention to a class of sponges which has been very little studied, especially in England; and having found in the British Museum, through the aid of Dr. Gray, another species, which came from Port Jackson in New South Wales, I shall thus be able to give the results of my examination of this as well as the

deep-sea one, together with observations on the Gummineæ generally.

For the deep-sea specimen I would propose the name of "*Corticium abyssii*," and for the one from Port Jackson "*Chondrilla australiensis*," giving my reasons for adopting these names hereafter.

Corticium abyssii, n. sp. (Pl. I. figs. 1-9 & 15.)

Repent, amorphous, assuming more or less the form of the object or cavity in which it may be growing. Smooth, slippery, of a light greyish-yellow colour; semielastic, subcartilaginous, solid. Tearing when wet like hard-boiled white of egg, but much tougher; brittle when dry, and breaking like glass. Spiculiferous, but not fibrous in the sense of spongologists—that is, without fibrous skeleton. Aspect homogeneous, massive, puckered here and there on the surface towards fixed points as if from contraction or forcible extension. Vents numerous, small, of different sizes, congregated here and there irregularly (figs. 1 & 2, *c*). Pores microscopic, linear, more or less uniformly spread over the surface (fig. 9, *b*). Internal structure fleshy, solid, composed of an opaque mass or body of ovoid cells, surrounded by a thin, translucent cortical rind; permeated throughout by branched systems of excretory canals, respectively terminating in the vents mentioned, and charged with siliceous spicules most numerous at the circumference. *Microscopic structure*: Surface consisting of a thin, tough, transparent cuticula, composed of parallel fibres, supported on the points of spicules, in the intervals between which are the pores; covering the cortical substance beneath, which consists of a layer of spicules imbedded in a kind of trama composed of fine fibres and minute graniferous cells. Trama of the cortex soon rendered opaque by the presence of the body of ovoid cells, to which it affords respectively separate cavities of a similar shape throughout the mass. Ovoid cell about 5-6000ths inch long, filled with granules, in which there appears sometimes to be a faint trace of a nuclear body; maintaining its form when out of its cavity, but presenting no appearance of cell-wall (fig. 8, *a*). Surface of the excretory canals covered with an epithelium of small conical cells, whose free ends, projecting above the level of the canal, form, in juxtaposition, a remarkably rough granular pavement, which appears to be not less common to the mouths of the pores and their canals than to the excretory system generally (figs. 15 & 9, *b*). Mode of termination inwards of the pore-canals and commencement of the excretory ones not observed. Spicules of two kinds, viz. bi-

ternate and birotulate; the former moderately large, and the latter extremely minute. The biternate spicule consists of a straight shaft and three arms given off at the union of the two upper fourths of the former (fig. 3); shaft obtusely pointed above (fig. 4, *a*), and finely pointed below (fig. 4, *c*); inflated in the centre, and covered throughout with short, conical, vertical spines, except between the inflation and the arms, where it is smooth like the first part of the latter (fig. 4, *b*). Arms three in number, parting from the shaft at equal distances from each other, and dividing respectively into three secondary arms, all of which are on the same plane and nearly perpendicular to the shaft; secondary arms obtusely pointed and covered throughout with short, vertical, conical spines (fig. 5, *a, b*). Central canal evident in every part (fig. 4, *d*), showing that the original design of the spicule was biternate, which is confirmed by the smaller or younger forms being of the same kind, but without spines, and the central inflation consequently more evident (fig. 6, *a*). Birotulate spicules extremely minute, consisting of a straight shaft and four recurved arms at each end (figs. 7 & 8, *b*). *Distribution*: The biternate spicule, besides being plentifully scattered throughout the mass, is particularly congregated towards the surface, where it forms a layer with the arms horizontal, and the obtuse ends of the shafts, as before stated, supporting the cuticula. The birotulate spicule, on the other hand, although equally scattered through the mass, appears to be congregated most about the surface of the excretory canals, whose course can be thus traced by this accumulation in specimens which have been dried under compression and afterwards mounted in Canada balsam. *Measurement*: Shaft of the biternate spicule 14-6000ths inch long; diameter of the head or arms 13-6000ths. Shaft of birotulate spicule 1-5000th inch long; other parts too minute for measurement. Size of specimen, that of the mass of dead *Lophohelia* over which the *Corticium* has grown.

Hab. Marine, growing over various objects, imbedded or not in deep-sea mud, as the case may be.

Loc. Western entrance of the English Channel, about 48° 31' N. lat., and 10° 03' W. long., in 500 fathoms.

Obs. As the spicules of this *Gummina* come nearest to those of *Corticium candelabrum*, Sdt. (Die Spong. adriat. Meeres, p. 42, Taf. iii. f. 25) and *C. plicatum* (Die Spong. Küste Algier, p. 2, Taf. iii. f. 11), I have given it this generic name, with a deep-sea designation. It occurs in the specimen mentioned, and on a large piece of *Pachastrella abyssi*, Sdt. (also dredged up by the 'Porcupine'), over part of which it has dragged itself, enveloping every thing in its course like an *Æthaliium*. While

fresh or in spirit it has much the appearance of wet chamois-leather; and although not more than half as tough (for it can be easily torn), it is so soft and resilient that it will receive the impression of the nail, and efface the same of its own accord. After it has been dried, however, it becomes hard like glue, and breaks with a similar fracture; while, wet or dry, its aspect is so homogeneous, that at first sight one would hardly conceive it to possess all the structures above mentioned.

The pores, the vents, and branched systems of excretory canals, together with the siliceous spicules, all point to its intimate connexion with the sponges; while the entire absence of the so-called sponge-fibre-structure, and the presence of the ovoid cell (fig. 8, *a*), which makes up the greater part of the body-mass, together with the remarkably granulated form of the epithelial layer of cellules on the surface of the excretory canals (fig. 15, *a*), are equally characteristic of the Gummineæ.

By the so-called "sponge-fibre-structure" I mean the skeleton of sponges, *par excellence*, which is horny in many, and composed of spicules united together into a fibrous structure by amorphous sarcode in others. "Fibre" is a bad name for this structure; for, besides being inappropriate, there is *real* fibre (that is, minute linear filament) to be seen in many soft parts of sponges, which has nothing to do with the skeleton whatever. Thus, although in the Gummineæ, there is no "sponge-skeleton-fibre" so to speak, the cuticula and a great part of the body is made up of fine, intercrossing filaments, which are so soft that, on drying, they all sink their form into a common homogeneous mass, like hard glue.

Nothing can be more unlike sponges in general than the slippery, resilient, amorphous, rounded, sublobed, flat, incrusting, homogeneous-looking mass presented by the Gummineæ; while, perhaps, a piece of wet dough resembles them most.

Although the vents appear to retain their circular form, the pores are more like crevices—that is, linear, and sometimes triangular like the form of a leech-bite (fig. 13), not circular, as they are in the true sponges. This may be owing to the structural lining of the pore, which, together with that of the excretory canals, as before stated, in the Gummineæ consists of a rough, granulated layer, each granule of which is a separate cellule (fig. 9, *b*) (probably flagellate in the living state); while in the true sponges the pore is circular and smooth, as if always surrounded by a homogeneous layer of sarcode. If there be similar cells in the latter during life, they subside into the form of a homogeneous sarcode after death, and thus become indistinguishable; while in the Gummineæ they remain, indicative of a higher state of development—that is, a state in which the his-

tological element maintains its living form instead of relapsing after death into a common homogeneous mass. In the true sponges the softer histological elements, such as fibre-filament, cells, &c., hardly do more than *loom*, as it were, in the scale of development, vanishing with death into homogeneity; while in the higher developments they become permanent—*e. g.*, the histological elements in the human subject. Homogeneity of appearance, as in the intercellular sarcode of sponges, is no proof whatever of the absence of histological structure. There is structure in glass, as I have often said before; but this cannot be demonstrated.

It is possible that the pores may be continuous, through tubular prolongations, with the excretory canals, as in the following species; but although invisible here (probably on account of the thick surface-layer of spicules in the cortex), there can be little doubt that the increasing size of the branches of the latter, as they join one another to form a common trunk, indicates, as in the true sponges, a current *inwards* through the pores, and *outward* through the oscula.

The ovoid cells (fig. 8, *a*), which are only half the size of those in the following species, have been called "embryos" by Schmidt (Spong. adriat. Meeres, p. 42); and Kölliker has used the same name after him, although evidently not satisfied of their true import (Icones Histologicae, "Feinere Bau der Protozoen," p. 68, with excellent illustrations, Taf. viii. f. 18, and Taf. ix. f. 10 & 11); but if they be the "embryos," where are we to look for the *adult* forms?—since, throughout every part of *Corticium abyssii*, as well as in the following species, viz. *Chondrilla australiensis*, respectively, they are all alike.

It is also possible that ova may be present, and that I have overlooked them, as they have been seen in *Corticium candellabrum* by Kölliker, and figured (*op. cit.* Taf. viii. fig. 3); but no one could confound the "ovoid cell" with an ovum, inasmuch as the globular form of the latter, with evident nucleus and nucleolus, must contrast strongly with the conoid form of the ovoid cell filled with granules, in which a nucleus is only now and then faintly visible. I must, then, for the present, look upon these ovoid cells of the Gummineæ as analogous to the spheroidal groups of flagellated cells in the fibrous sponges, reserving all further description of them in this respect until I shall have observed and experimented on them in the living state, as I have heretofore done on the true sponges. To show that the cells which line the surface of the excretory or water-canal (*Wimper-Apparat* of Lieberkühn), or those of the ampullaceous sac (*Wimperkorb* of Schmidt), are flagellated is not

sufficient: we want to know if they take in crude material for food, like those of the other sponges. This is what I claim to have shown in 1857 in *Spongilla* (Annals, vol. xx.), and repeated in 1871 in *Grantia compressa* (*ib.* vol. viii.).

The birotulate of *Corticium abyssi* is the smallest spicule that I have met with. Even under 1-40th-inch focus, which Mr. Powell, junior, kindly put upon it for me, I could hardly distinguish its form, and then not so distinctly as with one of his $\frac{1}{8}$ immersion object-glasses. (So much for the definition of the higher powers!) To see this spicule, even tolerably satisfactorily too, with a $\frac{1}{8}$, it is necessary to boil a piece of the *Corticium* in nitric acid, and, after a convenient amount of dilution with water, to place a little of the fluid containing the spicules under a glass cover, when, by the vibration of the spicule causing it to turn over and over, the arms may now and then be distinguished, and the shaft appear to be microspined about the centre. This must be done at once, as the accumulation of organic matter about the spicules, after a few hours' interval, entirely defeats the object.

One of the most interesting points elucidated by the examination of this deep-sea specimen is the fact that the *Corticium* has enveloped the remains of a *Farrea*, and that the *Corticium* possesses similar "biternate" spicules to those figured by Dr. Bowerbank as the "retentive spicules" of his *Farrea occa* (Proc. Zool. Soc. Lond., May 1869, pl. xxiv. figs. 2-6).

Were it not evident that a "biternate" spicule can never form part of a Hexactinellid sponge, the fact of such spicules having not only been figured in connexion with *Farrea occa*, but also with *Dactylocalyx pumiceus* and *Iphiteon panicea* (Proceed. Zool. Soc., Jan. 1869, pl. iii. fig. 16, and May *ib.* pl. xxii. fig. 11), would cast a doubt over their real parentage.

Taken, however, in connexion with the fact that Dr. Bowerbank's specimens of *Farrea occa* were obtained from the detrital mass supporting *Euplectella cucumer*, Owen (Trans. Linn. Soc. vol. xxii. pl. xxi.), it seems not unlikely that they were there also accompanied by a *Gummina*, as in our deep-sea specimen, but of a form, as may be seen by the spicules figured by Dr. Bowerbank, still more nearly approaching those of Schmidt's *Corticium candelabrum* (*op. cit.* Taf. iii. fig. 25, a, g) than those of *Corticium abyssi*.

The fragments of *Farrea* enveloped by *Corticium abyssi* in the deep-sea specimen (fig. 2, *dd*) will form the subject of my next communication, in which I shall endeavour to show what the loose spicules that belong to *Farrea* really are, and what relation *Farrea* itself bears to *Aphrocallistes*.

Chondrilla australiensis, n. sp. (Pl. I. figs. 10-14 & 16.)

Incrusting, or self-supporting and spreading horizontally; flat, cake-shaped, lobed, of a dirty yellow or buff colour. Surface smooth, slippery, glistening. Consistence semielastic, subcartilaginous, slowly resilient in effacing impressions of the nail, tolerably tough. Vents numerous, small, of different sizes, congregated into groups here and there, or larger and single at the end of a mammiform lobe (figs. 10, *c*, & 12, *g*). Pores microscopic, linear, each in the centre of a graniferous area having the appearance of a lobule, forming altogether a continuous uniform layer presented by the surface generally (fig. 13, *a, b*). Internal structure consisting of an opaque fleshy mass or body of ovoid cells, surrounded by a translucent cortical rind (fig. 12, *b, a*). Body-mass (fig. 12, *b*) permeated by branched systems of excretory canals (fig. 12, *b*), which respectively terminate on the surface in the vents mentioned; scantily charged with siliceous globular stellates of two kinds, most numerous towards the circumference (fig. 12, *h*). *Microscopic structure*: Surface consisting of a thin, fibrous cuticular layer, pierced by the pores in the manner above mentioned. Cortical layer translucent, consisting of a *trama* formed of fine fibres and minute graniferous cells traversed by the pore-tubes (fig. 12, *d*). Trama (fig. 14, *a*), extending inwards, soon arrives at the opaque body of ovoid cells (figs. 12, *b*, & 14, *b*), throughout which it is continued, forming for them separate but similarly shaped cavities in close approximation (fig. 14, *b*). Ovoid cell 12 to 15-6000ths of an inch in length, filled or lined with minute cellules (fig. 14, *b*). Surface of the excretory canals, when fresh, apparently provided with the epithelial granular layer so characteristic of the Gummineæ (fig. 15)—but *here* absent, probably from defective preservation. Pore-tubes frequently increasing in size and branching before they have traversed the translucent cortical layer, to become lost in the opaque body-substance, where they appear to join the excretory canals (fig. 12, *ee*). Commencement of the excretory canals not observed. Spicules globular, siliceous, of two kinds, viz. sphæro-stellate and radio-stellate:—the former, which is the largest, consisting of a clear spheroid covered uniformly with short, sharp, smooth, conical spines arranged perpendicularly to the surface (fig. 16, *a*); and the latter consisting of several long, conical, spiniferous rays, bifid and sometimes trifid at the extremities (fig. 16, *b*). *Distribution*: Scattered indiscriminately throughout the mass (fig. 12, *h*), being most thickly congregated, as above stated, towards the surface. *Measurement*: Sphæro-stellate 6-6000ths inch in diameter; radio-

stellate 5-6000ths. Size of largest specimen about 3 inches long, 1 inch broad, and $\frac{1}{4}$ inch thick, covering a tunicated ascidian; the other specimen about $2\frac{1}{2}$ long by $2\frac{1}{4}$ broad, and the same thickness, enclosing the valves of an oyster.

Hab. Marine, growing over various objects and upon other sponges. Incrusting for the most part, but sometimes self-supporting, in the form of caudal or mammilliform prolongations.

Loc. Australia, Port Jackson.

Obs. The sphæro-stellate spicule (fig. 16, *a*) being identical in form with that of *Chondrilla nucula*, Sdt., I have called this species "*C. australiensis*." In consistence, *C. nucula* (judging from Schmidt's specimens in the British Museum) appears to have been a little firmer, of a darker colour on the surface, and far more spiculiferous; but then it only possesses one, the sphæro-stellate form of spicule, while the Australian species has two. In other respects there is a great resemblance between the two species, although, probably from defective preservation, the characteristic epithelial layer of the excretory canals of the Gummineæ generally has here, for the most part, passed into dissolution.

There are two specimens in the British Museum, both from Port Jackson—one, as above stated, surrounding the deciduous valves of an oyster, and the other all but covering a large tunicated ascidian fixed to the detrital mass supporting a rough, muricated, brown specimen of *Hircinia*, which contrasts strongly in appearance with the smooth, doughy, fleshy-looking *Gummina*.

The ovoid cells in this species are fully double the size of those in *Corticium abyssi*, and filled or lined, as above stated, with minute cellulæ, whereby we may infer that the so-called granules filling the ovoid cells of *Corticium abyssi* (fig. 14, *b*) would also turn out to be cellulæ, if more highly magnified. There is no visible cell-wall on these cells; but its existence may be inferred from the group of cellulæ retaining the same ovoid form after they have been pressed out of the cavities in the trama, unless they cohere together in this form by their sarcode individually.

General Observations.

The group of sponges called by Schmidt "*Halisarcinæ Gummineæ*" (Atlantisch. Spongienfaun. p. 78), to which the two foregoing species belong, has been very little studied—partly, perhaps on account of the species having been overlóoked among the Compound Tunicata, which are much in the same condition, and partly because they are so totally unlike the form and appearance of sponges generally.

If we were to see a tough, wet, shining lump of dough lying on a piece of sponge in our bath-room, there would be no hesitation in distinguishing the two objects; but if we were to observe something like this attached to a sponge growing on a rock in its natural habitat, the probability is that it would be a *Gummina*. Such may give some idea of the typical form of the Gummineæ.

As yet only one species has been noticed on the British coasts; and that has been designated by Johnston "*Halisarca Dujardinii*," after the illustrious naturalist who first described and gave it the name of "*Halisarca*" (*ἅλιος*, marine, and *σάρξ*, flesh). Johnston found it in Berwick Bay, and has given the following description of it in his 'British Sponges,' published in 1842 (p. 192), together with a figure (pl. xvi. f. 8):—

“HALISARCA, Dujardin.

“CHARACTER. *Substance fleshy or rather gelatinous, semi-transparent, unorganized, forming an irregular crust on the objects to which it adheres.*

“1. *H. Dujardinii* (plate xvi. fig. 8).

“*Halisarca*, Dujardin, in Ann. des Sc. Nat. n. s. x. p. 7, pl. 1. fig. 5.

“*Hab.* On the underside of stones between tide-marks, and on the stalk and roots of *Laminaria digitata*, common. Berwick Bay; Holy Island (G. J.).

“Sponge in the form of a gelatinous crust, spreading irregularly, about a line in thickness; the surface even and smooth, of a straw or ochre-yellow colour, mottled with little pale circular spots or pores, produced apparently by a deficiency of colouring-matter in their places. A few of these transparent spots are larger than the others; and if the former have any relation to the pores of the true sponges, the latter may be the analogues of the fæcal orifices.

“This production is liable to be mistaken for one of the crustaceous Compound Tunicata, or, rather, for the gelatinous spawn of the naked mollusca; but a careful inspection easily detects the difference. This exhibits no trace of any oviform bodies or cellular tissue, and contains neither crystals nor spicula, but is no other thing than a mass of irregular and granulous globules, of great minuteness, that lie imbedded in a clear jelly, covered over with a more consistent and coloured skin. Dujardin has ascertained that, when broken up, the separated masses shoot out from their sides delicate prolongations or filaments of various lengths, and slowly change their figure, in the same manner as do the detached sarcoid pieces of the freshwater sponges (see woodcut no. 9, p. 61).”

Thus commenced our knowledge of this family.

In 1859 (Archiv f. Anat.) Lieberkühn seems to have published (for I have not the means of referring to his papers here) observations on *Halisarca Dujardinii* made in Heligoland; and to him we are indebted, according to Schmidt, for having more accurately identified this organism with the true sponges (Die Spong. adriat. Meeres, p. 79, 1862).

Finally, Schmidt, in a former part of the same publication (p. 36 *et seq.*), established a family for this and similar species by the name of "GUMMINEÆ," under which are included the following four genera and six species, viz. :—1. Gummina: *G. gliricauda*, *G. ecaudata*. 2. Chondrilla: *C. nucula*, *C. embolophora*. 3. Cellulophana: *C. pileata*. 4. Corticium: *C. candelabrum*. And further on, at p. 79, under HALISARCA, Dujardin, *H. lobularis*. In his first "Supplement" to this publication (p. 41, 1864) was added another species of the latter, viz. :—*Halisarca guttula*. Then follow new species which he received among other sponges from the coast of Algiers (Die Spong. der Küste von Algier. p. 1, 1868), viz. :—*Chondrosia*, Nardo: *C. reniformis*, Nardo; and *C. plebeja*, Sdt. Finally those mentioned in his 'Atlantisch. Spongienfauna,' p. 25, 1870, viz. *Cellulophana collectrix*, Columnitis, n. gen., *C. squamata*, and *Chondrilla phylodes*,—making altogether 7 genera and 13 species, to which adding *Halisarca Dujardinii*, a species described and figured by Dr. Emil Selenka under the name of "*Lacinia*" (Zeitsch. f. wissenschaft. Zool. B. vi. S. 568, Taf. xxxv. figs. 8-10), and the two species above described gives a total of 17 species.

Although Selenka claims for his species (which is from Bass's Straits in Australia, cake-shaped, and about 2 inches long by 1 thick) a new genus, on account of the sphæro-stellate spicule with which it is charged being *calcareous* and not *siliceous*, it seems to me to require further elucidation; for, in the first place, the sphæro-stellates, in material and form, appear to be almost identical with those which abound in many species of Compound Tunicata not unlike *Lacinia* in general form, and, in the second place, the anatomical details do not satisfactorily show that the species is similarly composed to the class of sponges under consideration. The genus is called "*Lacinia*," and the species *L. stellifica*.

While Schmidt gives excellent figures of the general form and spicules of his species, Kölliker, in his 'Feinere Bau der Protozoen,' gives the best illustrations of the softer parts.

I have not been able to get beyond what Kölliker has here figured and stated, simply because, like Kölliker, my observations have been confined to specimens preserved in spirit; nor

have I become aware until just now that I had such an important group of sponges to study; while, as I cannot help thinking that there must be more species than *Halisarca Dujardini* to be found on our coasts, so I hope to meet with not only this but other species of the family here in a living state, through which I may, by experiment, be able to add something more satisfactory to our knowledge of their intimate structure than we at present possess.

Aided by Schmidt's figures and descriptions of the last species, which he has published (*Atlantisch. Spongienfaun. l. c.*), I now plainly see, from mounted specimens, that the incrusting cartilaginous sponge which I found associated with the specimens of *Polytrema* on a crab-claw kindly given to me by Dr. Carpenter, and noticed in the *Annals* (vol. v. p. 392, 1870), charged with minute stellates and long, pin-like spicules, bearing a "close alliance to *Tethya lyncurium*," is as closely allied to the incrusting species of *Gummina* called by Schmidt *Columnitis squamata*, described and figured in the *Atlantisch. Spongienfaun. &c.* (p. 25, Taf. v. figs. 3 & 4); while the figured section of this *Gummina*, in spicules and structure, is almost identical with a vertical section of the circumference of *Tethya (Donatia) lyncurium*. In short, both species are but repent forms of *Donatia*, which, although for the most part (but not always) assuming a globular form, is, in the structure of its cartilaginous circumference and spicules, more nearly allied to the species of Gummineæ just noticed than to any other form of sponges yet described. Then, too, we cannot help seeing the intimate relation which subsists between these sponges and the Suberites, *e. g.* *Cliona celata*, var., *Raphyrus Griffithsii*, Bk., &c.; and thus the value of Schmidt's grouping *Donatia (Tethya) lyncurium* and the latter sponges &c. under the heading "Suberitidinæ" (*Atlant. Spongienfaun. &c.* p. 79) becomes apparent.

In this category will also have to come several specimens in the British Museum when I have time to illustrate and describe them, the species (indicated by their spicules) which appear in Dr. Bowerbank's illustrations of the Hexactinellid sponges mentioned, and no doubt many others which will sooner or later come to notice—all showing that this will one day form a very large and important group among the Spongiadæ.

With reference to my statement (*Annals*, 1872, vol. x. p. 47) that Schmidt's *Halisarca guttula* appeared to me to be a compound tunicate animal and "no sponge at all," I would add that later examination of the Gummineæ shows me that such an assertion has yet to be proved. Undoubtedly, when the calcareous sphæro-stellates are dissolved out of some incrusting species of Compound Tunicata, the embryos of the latter have

very much the appearance of what is seen in *Halisarca guttula*, and if arrested in this stage of development would be almost identical; but when the cell-mass of the embryo is "told off" into the organs which they are to assume in the fully developed Ascidian, then, of course, the difference at once becomes obvious.

Still there may be lower forms of the Compound Tunicata which permanently remain in the embryo state of the higher ones; and this I propose to myself to determine when time and opportunity enable me to hunt for them among the rocks of the sea-shore in this locality.

All are liable to shortcomings, and Schmidt among the rest, although he is certainly, at present, much beyond all others in actual knowledge of this family; still I could have wished that he had not compared the fibrillæ of the Gummineæ (Die Spong. adriat. Meeres, p. 37, 1862) to the fibrillæ of Lieberkühn's Filifera, since the said fibrillæ upon which this family of sponges has been built are nothing but a parasite, which I have not only found in different sponges from all quarters of the globe, but especially pervading a species of *Reniera* like Schmidt's *R. fibulata* (Die Spong. des adriat. Meeres, p. 73, pl. vii. f. 9), viz. bearing smooth, fusiform, slightly curved acerates and small bihamates, which is equally cosmopolite.

In my arrangement of the sponges in the British Museum I have had to expunge the family of "Filifera" in name (*Polytherses*, Duchas. et Michelot.) altogether, and for the algal parasite itself on which the family was erroneously founded by Lieberkühn have proposed the name of "*Spongiophaga communis*" (Annals, 1871, vol. viii. p. 330).

If called upon for a practical definition of the Gummineæ, I should say that they are like a piece of yellowish dough in appearance. Incrusting, lobed. Tough, semielastic, subcartilaginous. Slippery, smooth. Consisting of a cortical and medullary or body portion: the former translucent and narrow; the latter opaque, bulky, and massive. The former covered by a thin fibrous cuticle, uniformly pierced by pores and presenting here and there oscula singly or in groups. Composed of a kind of *trama* formed of fine fibres and minute graniferous cells, which trama extends throughout the body-mass and affords cavities for the ovoid cells respectively of which the body is composed. The cortex traversed perpendicularly by the pore-tubes continued from the pores inwards to unite with the branches of the excretory canals, which, in their turn, traverse the body-mass in tree-like forms to terminate respectively in the oscula mentioned. Abundance of siliceous

spicules (in Selenka's species calcareous), of different forms according with the species, or none at all as in the Halisarcinæ; but in no instance a fibrous skeleton, like that of sponges in general; indeed no skeleton at all, which is the chief distinguishing point between the Gummineæ and true sponges.

About the specimen dredged up on board the 'Porcupine' are:—besides the well-known *Coccoliths*, a great number of that species first described and figured by Schmidt as "*Rhabdolithes*" (Annals, 1872, vol. x. p. 359, pl. xvii.), for which I would propose the name of *R. Schmidtii*, after its well-known discoverer (Pl. I. fig. 17); also a number of calcareous spherical cells lined with minute cellulæ, for which I would propose provisionally the name of *Sphaolithes abyssi* (fig. 18), as they may perhaps hereafter, be found to be embryos of the *Globigerine* or some other deep-sea foraminifer. They are, however, very numerous and of all sizes below the largest, which is that figured.

The fragments and spicules of the other sponges about this specimen, viz. *Dictyocylindrus abyssi*, n. sp. (Pl. I. fig. 2, e), *Desmacella annexa*, Sdt. (Florida) (fig. 2, e), *Reniera fibulata*, Sdt. (fig. 1, e), and *Cliona abyssi*, n. sp. (fig. 1, d), will be described and figured on a future occasion.

EXPLANATION OF PLATE I.

- Fig. 1.* Portion of *Lophohelia prolifera*, imbedded in *Corticium abyssi*, n. sp., dredged up on board H.M.S. 'Porcupine' in the "chops" of the English Channel; depth 500 fathoms, muddy bottom. Natural size. *a*, *Lophohelia*; *b*, *Corticium abyssi*; *c*, vents of the same; *d*, fenestral openings of *Cliona abyssi*, n. sp., in *Lophohelia*; *e*, portion of *Reniera fibulata*, Sdt.; *f*, fragments of large spicules imbedded in the *Corticium*.
- Fig. 2.* The same, opposite side, nat. size: *a*, *Lophohelia prolifera*; *b*, *Corticium abyssi*; *c*, vents of the same; *d*, portions of a *Farrea* which grew on the *Lophohelia* before the whole became imbedded in the *Corticium*; *e*, portions of *Dictyocylindrus* (Bk.) *abyssi*, Cart., n. sp., and *Desmacella annexa*, Sdt., filling and surrounding the tube net of *Farrea*; *f*, portion of *Corticium* filling tube net of *Farrea*; *g*, fragment of large spicule imbedded in *Corticium*; *h*, fragment of *Reniera fibulata*, Sdt.
- Fig. 3.* *Corticium abyssi*, biternate spicule of, lateral view.
- Fig. 4.* The same, average largest size of biternate spicule: *a*, portion of shaft supporting the cuticula; *b*, arms broken off; *c*, inner portion of shaft; *d*, central canal. Scale 1-12th to 1-6000th of an inch.
- Fig. 5.* The same, vertical view of head of biternate spicule: *a*, main arms, not spined; *b*, secondary arms, spined. Same scale.
- Fig. 6.* The same, young form of biternate spicule, spineless: *a*, central inflation.
- Fig. 7.* The same, birotulate with four recurved arms, about 1-5000th of an inch long. Scale 1-12th to 1-6000th of an inch.
- Fig. 8.* The same, portion of body-substance: *a*, ovoid cells, and *b*, biro-

ulates, relatively magnified. Scale 1-48th to 1-6000th of an inch.

Fig. 9. The same, pore surrounded by ovoid cells, seen through the cuticula: *a*, ovoid cells; *b*, epithelial cells lining the pore. Scale 1-24th to 1-6000th of an inch.

Fig. 10. *Chondrilla australiensis*, n. sp., small specimen attached to a piece of oyster-shell: *a*, *Chondrilla*; *b*, oyster-shell; *c*, vent: magnified 2 diameters.

Fig. 11. The same, vertical section, nat. size.

Fig. 12. The same, vertical section (No. 11) magnified 8 diameters: *a*, cortical translucent rind; *b*, body-substance, opaque; *c*, oyster-shell; *d*, pore-tubes passing down vertically through rind; *e*, pore-tubes, enlarged, branching and apparently opening direct into excretory canal-system; *f*, excretory canal-system, segmented in the section; *g*, vent, or single termination of the same; *h*, sphæro-stellate and radio-stellate spicules imbedded in the cortex.

The spicules, though really existing throughout the mass, are generally not inserted, for the sake of perspicuity, any more than the ovoid cells and opaque structure of the body-mass.

Fig. 13. The same, portion of the surface, showing pore-openings, vertical view: *a*, pore; *b*, surrounding granules. Scale 1-48th to 1-6000th of an inch.

Fig. 14. The same, portion of the body-substance, showing:—*a*, trama, consisting of fine fibrillæ or filaments and minute granuliferous cellulæ; *b'* ovoid cells lined with cellulæ, situated in ovoid cavities of the trama; *c*, sphæro-stellate spicules. All relatively magnified; scale 1-48th to 1-6000th of an inch. (Compare with fig. 8, on the same scale, to show that the cells of *Corticium* are only half the size of those of *Chondrilla*.)

Fig. 15. *Corticium abyssi*, diagram of fragment of excretory canal-system, to show characteristic epithelial-cell lining: *a*, vent; *b*, "fragment." (In *Chondrilla australiensis* this cell lining is not present, probably from defective preservation.)

Fig. 16. *Chondrilla australiensis*, spicules of: *a*, sphæro-stellate; *b*, radio-stellate. Scale 1-12th to 1-6000th of an inch.

Fig. 17. *Rhabdolithes Schmidti*, Cart. Scale 1-12th to 1-6000th of an inch. (See Schmidt's figures and description, 'Annals,' 1872, vol. x. p. 359, pl. xvii.)

Fig. 18. *Sphærolithes abyssi*, n. sp., Cart., average largest size. Same scale. (The double line is a deception here; it should merely signify the outer boundary of the layer of cellulæ, in fact the capsule which is perfectly spherical.)

III.—A Catalogue of the Neuropterous Insects of New Zealand; with Notes, and Descriptions of new Forms. By ROBERT M'LACHLAN, F.L.S.

It has been represented to me that the entomologists of New Zealand are greatly in need of classified lists of the insects of that colony, and that any contribution in this way would be welcome. Acting upon this suggestion, I have drawn up a catalogue of the New-Zealand Neuroptera (in the Linnean

sense). The task has not been difficult ; for, including three new species here described, the total number of insects of the order at present known to inhabit the colony barely exceeds forty-five species ; and some of these are yet doubtful, pending further information. Nearly half of them are Trichoptera, which division appears to be the best-represented ; or it may be that they are best known only because a friend, knowing my *penchant* for these insects, has collected them more assiduously.

Owing to the proximity of New Zealand to the Australian continent, and to the fact that some few species are common to both, it may not be uninteresting to give a brief comparative sketch of the various Neuropterous families as regards their numerical strength in the two districts, so far as present knowledge will permit. The physical conditions of Australia and New Zealand are so different that a considerable discrepancy might naturally be expected ; but, owing to its ramified water-system and comparative freedom from drought, the advantage ought to be on the side of the latter. Let us see, then, how this idea is affected by the apparent facts. I will commence with the Odonata (Dragonflies). In Australia all the tribes (excepting Calopterygina) are tolerably abundant. From New Zealand I know of only eight species ; the great tribe Libellulina is wholly absent ; the Corduliina are represented by three species of Australian facies ; the *Æschnina* by one Australian species ; the Gomphina by one (*Uropetala*), a magnificent insect of an Australian group ; the Calopterygina are absent, but are almost so in Australia ; of the Agrionina there are only three species. Of other Pseudo-Neuroptera the Termitidæ, Ephemeridæ, and Perlidæ have a few representatives in both ; the Psocidæ are not known from New Zealand, and but few have been noticed in Australia ; but this is probably owing to their minute size. Among the Planipennia, New Zealand and Australia have each a species of Sialidæ (*Chauliodes*) ; the former has only one ant-lion (Myrmeleontidæ), though they are common in the latter ; Ascalaphidæ appear to be wanting in the former and tolerably well represented in the latter ; and the same remark will apply to Chrysopidæ and Mantispidæ. Australia has one species of Nemopteridæ and a few Panorpidæ, neither of which are known from New Zealand ; while Hemerobiidæ and Osmylidæ are feebly represented in both ; the Nymphidæ, an almost peculiarly Australian family, are unknown in New Zealand. In Trichoptera alone does New Zealand appear to have the advantage over Australia.

The paucity of species of Dragonflies is very remarkable ; and one is tempted to believe that in New Zealand there must

be a scarcity of aquatic insects both as larvæ and otherwise, and of those aerial insects upon which the perfect Dragonflies prey. Another point strikes me; and that is the small number of aphidivorous Planipennia, the chief of which (the Chrysopidæ) are unrepresented. Can it be that indigenous Aphides are happily almost unknown there? It may be that the ideas here thrown out are based upon erroneous premises; and if so it behoves the entomologists of New Zealand to set me right by producing a fair sample of the insect fauna of their colony.

The list of Trichoptera here given is scarcely more than a reprint of that already published by me in the 'Journal of the Linnean Society' (Zoology), vol. x. Much of the material from which the entire list is compiled has been received from my friend Mr. R. W. Fereday of Christchurch, and from Mr. H. Edwards, who was for some time at Auckland; nor must the collections formed by Dr. Sinclair, Mr. Colenso, Dr. Hooker, Col. Bolton, the naturalists of the 'Novara,' &c. be forgotten. No special localities are given, because many of the insects are noted simply as from New Zealand without further indication.

In the references I have indicated by an asterisk where the best description of each species may be found; and if this sign occurs so frequently in connexion with my own descriptions, the reader must please consider that I do not claim for them any special excellence, and that it is owing to the fact that in most cases no others exist.

PSEUDO-NEUROPTERA.

Termitidæ.

Genus CALOTERMES, Hagen.

1. *Calotermes insularis*, White.

Termes insularis, White, Zool. of Voyage of 'Erebus' and 'Terror' †; Walk. Brit. Mus. Cat. Neuropt. pt. iii. p. 522. *Calotermes insularis*, Hagen, Linnæa Entomologica, Band xii. p. 42 *; *id.* Brit. Mus. Cat. Neuropt. (Termit.), p. 2.

Also found in New Holland.

2. *Calotermes improbus*, Hagen.

Calotermes improbus, Hagen, Linnæa Entomologica, Band xii. p. 44 *; *id.* Brit. Mus. Cat. Neuropt. (Termit.), p. 6; Brauer, Reise der 'Novara,' Neuropt. p. 45.

Hagen described a wingless example from Van Diemen's Land. Brauer described the winged form of what he considers to be the same species from New Zealand.

† I have not been able to verify this reference.

Genus STOLOTERMES, Hagen.

3. *Stolotermes ruficeps*, Brauer.

Stolotermes ruficeps, Brauer, Reise der 'Novara,' Neurop. p. 46.*

Perlidæ.

Genus STENOPERLA, M'Lachlan.

4. *Stenoperla prasina*, Newman.

Chloroperla prasina, Newman, Zoologist, 1845, p. 853.* *Hermes prasinus*, Walk. Brit. Mus. Cat. Neuropt. pt. ii. p. 206. *Stenoperla prasina*, M'Lachl. Trans. Ent. Soc. ser. 3, vol. v. p. 354.*

Genus PERLA, Geoffroy.

5. *Perla* (?) *Cyrene*, Newman.

Chloroperla Cyrene, Newman, Zoologist, 1845, p. 853.* *Perla* (?) *Cyrene*, Walk. Brit. Mus. Cat. Neuropt. pt. i. p. 168.

This insect is certainly not a *Chloroperla*, nor is it a *Perla* as restricted. The wings are densely reticulate with cross veinlets. I have seen no examples in good condition.

Genus LEPTOPERLA, Newman.

6. *Leptoperla opposita*, Walker (?).

Perla opposita, Walk. Brit. Mus. Cat. Neuropt. pt. i. p. 171.

Walker mentions two examples from Van Diemen's Land and one from New Zealand; but I much doubt if this latter is specifically identical with those from Tasmania.

I have seen two or three more species of Perlidæ from New Zealand, but await additional information before describing them. One is an insect with the *facies* of *Nemoura* or *Teniopteryx*, but with short caudal setæ.

Ephemeridæ.

Genus LEPTOPHLEBIA, Westwood;
Eaton, Trans. Ent. Soc. Lond. 1871, p. 77.7. *Leptophlebia dentata*, Eaton.

Leptophlebia dentata, Eaton, Trans. Ent. Soc. Lond. 1871, p. 80, pl. iv. figs. 18 & 18 a-d (details).*

8. *Leptophlebia nodularis*, Eaton.

Leptophlebia nodularis, Eaton, Trans. Ent. Soc. Lond. 1871, p. 81, pl. iv. figs. 20 & 20 a-c (details).*

Genus COLOBURUS, Eaton, Trans. Ent. Soc. Lond.
1871, p. 132.

9. *Coloburus humeralis*, Walker.

Palingenia humeralis, Walk. Brit. Mus. Cat. Neuropt. pt. iii. p. 552 (♀ subimago). *Baetis remota*, Walk. *op. cit.* p. 564 (imago). *Coloburus humeralis*, Eaton, Trans. Ent. Soc. 1871, p. 132, pl. iii. fig. 3 (wing), pl. vi. figs. 6 & 6 a, b (details).*

I possess yet two species of Ephemeriidæ from New Zealand, one of which may be the Australian *Leptophlebia costalis*, Burmeister.

Odonata.

Tribus CORDULIINA.

Genus CORDULIA, Leach, Selys.

10. *Cordulia Smithii*, White.

Cordulia Smithii, White, Zoology of Voyage of 'Erebus' and 'Terror,' pt. xi. pl. vi. fig. 2 (♀); Selys, Syn. Cordulines, p. 27. *C. novæ-zealandiæ*, Brauer, Verh. zool.-bot. Ges. Wien, 1865, p. 501; *id.* Reise der 'Novara,' Neuropt. p. 78, t. ii. figs. 3-3 b.*

Genus EPITHECA, Charpentier.

11. *Epitheca Grayi*, Selys.

Epitheca (Somatochlora) Grayi, Selys, Syn. Cordulines, p. 49.*

12. *Epitheca Braueri*, Selys.

Epitheca (Somatochlora) Braueri, Selys, Syn. Cordulines, p. 50.*

Tribus GOMPHINA.

Genus UROPETALA, Selys.

13. *Uropetala Carovei*, White.

Petalura Carovei, White, Zoology of Voyage of 'Erebus' and 'Terror,' pt. xi. pl. vi. fig. 1 (♂); *id.* in Dieffenbach's Travels in New Zealand, vol. ii. p. 281; Selys, Syn. Gomphines, p. 92. *Uropetala Carovei*, Selys, Mon. Gomphines, p. 370, pl. xix. fig. 2 (details)*; *id.* Secondes Addit. Syn. Gomphines, p. 42.

Tribus ÆSCHNINA.

Genus ÆSCHNA, Fabricius.

14. *Æschna brevistyla*, Rambur.

Æschna brevistyla, Ramb. Hist. Névropt. (Suites à Buffon), p. 205.*

I received three examples of this Australian species from Mr. Henry Edwards, labelled "New Zealand;" and although

that gentleman also collected in the neighbourhood of Melbourne, there is no reason to suspect any confusion of locality. The *Æschnina* are insects of notoriously wide distribution and great power of wing.

Tribus *AGRIONINA*.

Genus *LESTES*, Leach.

15. *Lestes Colenisonis*, White.

Agrion Colenisonis, White, Zoology of Voyage of 'Erebus' and 'Terror,' pt. xi. pl. vi. fig. 3 (♂). *Lestes Colenisonis*, Selys, Syn. Agrion. (*Lestes*), p. 44.*

Genus *TELEBASIS*, Selys †.

16. *Telebasis zealandica* ‡, n. sp.

♂. Caput supra nigrum, longe brunneo-pilosum, antice et postice cum nasi margine labroque (macula mediana nigra excepta) sanguineum; ore flavido. Pronotum nigrum, marginibus maculisque tribus sanguineis; margine postico fere semicirculari. Thorax supra niger, inter alas sanguineus, lineis duabus sanguineis; ad latera rubescens, lineis duabus brevibus ad alarum bases nigris. Pedes sanguinei, nigro-spinosi, tarsorum apicibus nigro-terminatis. Abdomen sanguineum, ad apicem obscurius; macula quadrata ad basin segmenti basalis, juncturis lineaque utrinque apicem versus nigris; segmento ultimo supra in medio exciso; appendicibus superioribus parvis, sanguineis, intus tuberculo nigro instructis; inferioribus elongatis, subforcipatis, sanguineis, nigro terminatis. Alæ vitreæ; pterostigmate rufo-brunneo vel flavido.

♀. Caput thoraxque fere ut in ♂, sed colore sanguineo in flavum mutato; labro postice evidenter nigro-marginato. Pedes pallidiores; femoribus supra infuscatis. Abdomen supra nigrum, juncturis (ad apicem exceptis) flavis; infra flavum.

♂. Long. corp. 14–15^{'''}, long. abdom. 11–12^{'''}; exp. alar. 16–17^{'''}, long. alæ postic. 8–8½^{'''}. ♀. Long. corp. 15^{'''}, long. abdom. 11½^{'''}; exp. alar. 19^{'''}, long. alæ postic. 9^{'''}.

Male. Head and thorax above black, with long brownish hairs. Hinder and anterior margins of the head, the front margin of the nasus, and the labrum wholly (excepting a black spot in the middle) red; under lip yellowish; second joint of the antennæ red, black at the apex. Pronotum with the margins and three discal spots red; posterior margin nearly

† The characters of *Telebasis* are briefly indicated in a note appended to the introduction to his 'Synopsis des Agrionines,' 5^{me} légion, p. 4. The chief character is that the wings are petiolated up to the first basal postcostal nervule.

‡ De Selys, MS.

semicircular, very slightly produced in the middle. Two bright red lines on the thorax above; the sides reddish, with two short black streaks, one under the base of each wing; there is also an appearance of two lines paler than the ground-colour. Legs bright red, with black spines; the tips of the tarsal joints black. Abdomen bright blood-red; a quadrate black spot above at the base of the first segment; the sutures of all the segments with a black ring; on the sides a black subapical line, commencing at the apex of segment 6, continuous on segment 7, and nearly so on segment 8, but not there reaching the margins; segment 10 excised in the middle above; superior appendages short, only slightly exerted, subtriangular, red, with a black tubercle internally; inferior appendages somewhat forcipate, long, red, with the tips black and pointed. Wings hyaline, narrow; veins black, slightly reddish at the base; pterostigma reddish brown (yellowish in immature examples), in the form of an irregular lozenge, the upper edge much longer than the lower, surmounting one cellule; in the anterior wings the upperside of the quadrilateral is more than one half shorter than the lower, in the posterior wings about one third shorter; thirteen to fourteen post-cubital nervules in the anterior wings; three cellules between the quadrilateral and the nodus.

Female. All the markings of the head and thorax that are red in the male are here yellow; the base of the labrum has a distinct black line; on the prothorax there are only two spots instead of three. Legs yellowish, the femora fuscous above. Abdomen bronzy black above, pale yellowish beneath; segments 1-6 above with a yellow half-ring at the base of each; appendages short, conical, blackish; vulvar valves yellow, the terminal appendages black.

I have examined several males and females of this species.

17. *Telebasis sobrina*, n. sp.

♂. *T. zealandicæ* valde affinis, sed major; appendices superiores multo longiores, inferioribus dimidio tantum breviores. Long. corp. 18''', long. abdom. 15''' ; exp. alar. 22''' , long. alæ postic. 10½''' .

Very closely allied to *T. zealandica*, but considerably larger; on the abdomen the basal spot at the base of segment 1 is divided; the superior appendages are much exerted, scarcely one half shorter than the inferior, subtriangular, the lower edge concave, hence the tips are much curved downward (the black tubercle is present as in *T. zealandica*). There are four cellules between the quadrilateral and the nodus in all the

wings, and the pterostigma is larger and surmounts fully two cellules; fifteen postcubital nervules in the anterior wings.

Notwithstanding the great similarity I must, for the present, consider this insect specifically distinct from *T. zealandica*. Only one male has been examined, and that rather immature, the red markings on the head and thorax not being fully developed and more or less yellowish, and the pterostigma dusky yellow.

PLANIPENNIA.

Sialidæ.

Genus CHAULIODES, Latreille.

18. *Chauliodes diversus*, Walker.

Hermes diversus, Walk. Brit. Mus. Cat. Neuropt. pt. ii. p. 205. *H. dubitatus*, Walk. *op. cit.* p. 204 * (cf. M'Lachlan, Ann. & Mag. Nat. Hist. July 1869, pp. 37 & 39).

This insect varies much in size. Of five individuals in my collection the smallest (male) has an expanse of wings of only 25", the largest (female) expands to 41". The structure of the antennæ is the same in both sexes.

Myrmeleontidæ.

Genus MYRMELEON, Linné, Hagen.

19. *Myrmeleon acutus*, Walker.

Myrmeleon acutus, Walk. Brit. Mus. Cat. Neuropt. pt. ii. p. 377.*

Appears to be the sole representative in New Zealand of this extensive family. The hind wings of the male possess a "pelote" or knob at the extreme base of the inner margin, as in many other species.

Osmylidæ.

Genus STENOSMYLUS, M'Lachlan.

The New-Zealand species might be transferred to a new genus on account of the subfalcate wings and excised apical margin; but the Australian *S. pallidus* is in some respects intermediate between them and the typical species; hence their retention in this genus will answer every purpose, at any rate for the present.

20. *Stenosmylus incisus*, M'Lachlan.

Osmylus incisus, M'Lachl. Journ. of Entom. vol. ii. p. 112, pl. vi. fig. 1 * (cf. M'Lachl. Entom. Monthly Mag. vol. vi. p. 195).

21. *Stenosmylus citrinus*, n. sp.

S. forma S. incisi. Citrinus. Frons obscurior, supra nigricans. Thorax utrinque niger. Tibiæ anticæ et intermediæ (femoraque postica) ad apices et in medio fusco semicinctæ. Alæ anticæ punctis nigris conspersæ; macula discali subapicali, nonnullisque parvis ad marginem apicalem et internum albidis, nigro marginatis: posticæ pallidiores, punctis nigris subobsoletis solum ad costam, maculis albidis nullis. Abdomen infuscatum. Long. corp. 7^{'''}; exp. alar. 27^{'''}.

The whole insect is of a delicate citron colour, excepting the abdomen, which is infuscate; but the colour of this part is probably changed in dry examples. On the face the colour becomes obscured, and below the base of the antennæ it is blackish. On the pronotum anteriorly there is a trace of a black median longitudinal line, and the sides are broadly black, with black hairs; the meso- and metanota have the sides broadly infuscate, bordered by a black line. The anterior and intermediate tibiæ have a black spot at each end and in the middle; the posterior femora are somewhat infuscate, darker at each end, and with a trace of a black spot in the middle; all the legs are clothed with citron-coloured hairs. The anterior wings have many small black dots, those below the radius, and two discal ones, larger than the others; at the end of the first branch of the sector and the upper cubital vein, before the apex, is a conspicuous irregular whitish spot margined with black, and along the excised apical margin and on the inner margin are smaller whitish spots, margined with blackish internally, or with a blackish dot on each side; the sector has sixteen principal branches; the inner series of gradate nervules is rudimentary. The posterior wings are paler than the anterior, without whitish spots; and the black dots are only faintly indicated on the costal margin.

A very beautiful insect, of the same form as *S. incisus*.

Hemerobiidæ.

Genus DREPANOPTERYX †, Leach.

22. *Drepanopteryx instabilis*, M'Lachlan.

Drepanopteryx instabilis, M'Lachl. Journ. of Entom. vol. ii. p. 115, t. vi. fig. 4.*

Found also in Australia without apparent specific difference. Most of the New-Zealand examples (but not all) pertain to the

† According to the characters of the genera *Drepanopteryx* and *Megalomus* as laid down by Brauer (cf. 'Verhandl. zool.-bot. Gesellschaft in Wien,' 1866, p. 987), the two New-Zealand species and the Australian *D. binoculus* ought perhaps to be placed in the last-named genus.

variety indicated at fig. 4*, with a large whitish costal spot in the fore wings; but at present I see nothing to indicate that these form a distinct species.

23. *Drepanopteryx humilis*, M'Lachlan.

Drepanopteryx humilis, M'Lachl. Journ. of Entom. vol. ii. p. 116, pl. vi. fig. 5.*

Found also at Moreton Bay. The smaller size seems to indicate that this is not a form of *D. instabilis*.

Genus MICROMUS, Rambur.

24. *Micromus tasmanicæ*, Walker.

Hemerobius tasmanicæ, Walk. Trans. Ent. Soc. Lond. ser. 2, vol. v. p. 186.*

I have two examples which scarcely appear to differ specifically from others from Australia; but it is desirable that long series of both Australian and New-Zealand specimens should be compared. The insect has the costal area of the fore wings narrowed at the base, and without a recurrent nervule, and hence is a *Micromus* and not a *Hemerobius* as restricted.

TRICHOPTERA.

Sericostomatidæ.

Genus ECONESUS, M'Lachlan.

25. *Econesus maori*, M'Lachlan.

Econesus maori, M'Lachl. Trans. Ent. Soc. Lond. ser. 3, vol. i. p. 303 *; *id.* Journ. Linn. Soc., Zool. vol. x. p. 211, pl. ii. fig. 1 (neuriation), ♂.

I now possess the female of this insect; it differs from the male in its larger size; the neuriation of the anterior wings is regular; and in the posterior wings there are two additional apical forks. The maxillary palpi are 5-jointed, the basal joint very short, the second slightly longer, the third to fifth still longer and nearly equal *inter se*.

Genus OLINX, M'Lachlan.

26. *Olinx Feredayi*, M'Lachlan.

Olinx Feredayi, M'Lachl. Journ. Linn. Soc., Zool. vol. x. p. 198, pl. ii. figs. 2-2 d (details).*

Genus PYCNOCENTRIA, M'Lachlan.

27. *Pycnocentria funerea*, M'Lachlan.

Pycnocentria funerea, M'Lachl. Trans. Ent. Soc. Lond. ser. 3, vol. v. p. 252, pl. xviii. fig. 1 (details).*

28. *Pycnocentria evecata*, M'Lachlan.

Pycnocentria evecata, M'Lachl. Journ. Linn. Soc., Zool. vol. x. p. 199
pl. ii. fig. 3 (details).*

29. *Pycnocentria aureola*, M'Lachlan.

Pycnocentria aureola, M'Lachl. Journ. Linn. Soc., Zool. vol. x. p. 200,
pl. ii. figs. 4 & 4 a (details).*

HELICOPSYCHE.

This term was applied to certain cases of the larvæ of Trichoptera found in Europe, which depart from the usual forms and assume a spiral condition, thus resembling small Helices, formed of sand grains neatly cemented together; and this resemblance has often deceived conchologists, who have described them as shells. They have since been found in streams almost all over the world, and their real nature has long been known. Recently in North America the perfect insect of one species has been bred. Three forms occur in New Zealand (*cf.* M'Lachlan, Journ. Linn. Soc., Zool. vol. x. p. 200). There is yet much mystery about the species that form them; and it is possible that they are the work of more than one genus of Sericostomatidæ. The European forms have not been referred to any particular insects; and in Europe no insect has been discovered that absolutely agrees generically with that bred in America. The same remark applies to those from New Zealand; and I have a suspicion that they may be the work of species of *Pycnocentria*. It is much to be desired that colonial entomologists will investigate this matter; the cases are probably found attached to stones in streams.

Leptoceridæ.

Genus TETRACENTRON, Brauer.

30. *Tetracentron sarothropus*, Brauer.

Tetracentron sarothropus, Brauer, Verh. zool.-bot. Ges. in Wien, 1865,
p. 418; *id.* Reise der 'Novara,' Neurop. p. 12, t. i. fig. 5 (details).*
Pseudonema obsoleta, M'Lachl. Trans. Ent. Soc. Lond. ser. 3, vol. i.
p. 305 (*cf.* M'Lachl. Journ. Linn. Soc., Zool. vol. xi. p. 128).

31. *Tetracentron amabile*, M'Lachlan.

Tetracentron amabile, M'Lachl. Journ. Linn. Soc., Zool. vol. x. p. 201,
pl. ii. figs. 5-5 d (details).*

Genus NOTANATOLICA, M'Lachlan.

32. *Notanatolica cognata*, M'Lachlan.

Leptocerus cognatus, M'Lachl. Trans. Ent. Soc. Lond. ser. 3, vol. i.
p. 306.* *Notanatolica cognata*, M'Lachl. *loc. cit.* vol. v. p. 258.

33. *Notanatotica cephalotes*, Walker.

Leptocerus cephalotes, Walk. Brit. Mus. Cat. Neuropt. pt. i. p. 73 (cf. M'Lachl. Journ. Linn. Soc., Zool. vol. x. p. 213).

A doubtful species.

Genus LEPTOCERUS, Leach, Hagen.

34. *Leptocerus* (?) *alienus*, M'Lachlan.

Leptocerus (?) *alienus*, M'Lachl. Journ. Linn. Soc., Zool. vol. x. p. 202.*

This insect is not a true *Leptocerus* as restricted.

Genus SETODES, Rambur.

35. *Setodes unicolor*, M'Lachlan.

Setodes unicolor, M'Lachl. Journ. Linn. Soc., Zool. vol. x. p. 203, pl. ii. fig. 7 (details).*

Hydropsychidæ.

Genus HYDROPSYCHE, Pictet, Hagen.

36. *Hydropsyche fimbriata*, M'Lachlan.

Hydropsyche fimbriata, M'Lachl. Trans. Ent. Soc. Lond. ser. 3, vol. i. p. 309.*

37. *Hydropsyche colonica*, M'Lachlan.

Hydropsyche colonica, M'Lachl. Journ. Linn. Soc., Zool. vol. xi. p. 131, t. iv. fig. 16 (details).*

Genus POLYCENTROPUS, Curtis.

38. *Polycentropus puerilis*, M'Lachlan.

Polycentropus puerilis, M'Lachl. Journ. Linn. Soc., Zool. vol. x. p. 204, t. ii. figs. 8-8 b (details).*

Genus HYDROBIOSIS, M'Lachlan.

39. *Hydrobiosis frater*, M'Lachlan.

Hydrobiosis frater, M'Lachl. Journ. Linn. Soc., Zool. vol. x. p. 207, t. ii. figs. 9-9 b (details).*

40. *Hydrobiosis umbripennis*, M'Lachlan.

Hydrobiosis umbripennis, M'Lachl. Journ. Linn. Soc., Zool. vol. x. p. 208, t. ii. figs. 9 c, d (details).*

Genus PSILOCHOREMA, M'Lachlan.

41. *Psilochorema mimicum*, M'Lachlan.

Psilochorema mimicum, M'Lachl. Trans. Ent. Soc. Lond. ser. 3, vol. v. p. 274, pl. xviii. fig. 4 (details).*

42. *Psilochorema confusum*, M'Lachlan.

Psilochorema confusum, M'Lachl. Journ. Linn. Soc., Zool. vol. x. p. 210, t. ii. figs. 10-10 b (details).*

Rhyacophilidæ.

Genus PHILANISUS, Walker.

43. *Philanisus plebejus*, Walker.

Philanisus plebejus, Walk. Brit. Mus. Cat. Neuropt. pt. i. p. 116. *Anomalostoma alloneura*, Brauer, Verh. zool.-bot. Ges. in Wien, 1865, p. 422; *id.* Reise der 'Novara,' Neurop. p. 16, t. i. fig. 6 (details).*

Hydroptilidæ.

Genus OXYETHIRA, Eaton.

44. *Oxyethira albiceps*, M'Lachlan.

Hydroptila albiceps, M'Lachl. Trans. Ent. Soc. Lond. ser. 3, vol. i. p. 304. *Oxyethira albiceps*, Eaton, *loc. cit.* 1873, p. 145.*

This species was accidentally omitted in my list in 'Journ. Linn. Soc.,' Zool. vol. x.

IV.—*Description of two new Species of Bush-buck (Cephalophus) from Western Africa.* By Dr. J. E. GRAY, F.R.S. &c.

IN the 'Proceedings of the Zoological Society' for 1871, p. 588, I published some notes on the *Cephalophi*, and described two new species which had been sent home from Africa by M. du Chaillu as materials for stuffing out the skin of the bongo (*Eurycerus eurycerus*). I now add the descriptions of two others from the inside of the same skin, which I did not notice at the time because I hoped to have additional specimens in confirmation of their distinctness; but second consideration has induced me to believe that they are the evidence of the existence of two other species in that country, though M. du Chaillu said that there were no antelopes in Western Africa, and confirmatory of the idea that he obtained the chief of his collections from native collectors and he really did not know what he had brought home.

1. *Cephalophus aureus*.

Fur on the sides of the body rather elongate and soft, of the head and neck shorter and more rigid, pale bay. The crown of the head and long hairs between the horns black; spot over the eye deep bay; front part of the body and front part of the fore legs darker brown, varied with blackish hairs, which are

more abundant and form the indistinct streak down the back of the neck and front part of the back; but in the latter part they are more or less spread over the shoulders so as not to form any regular dorsal band; the black hairs are abundant on the front part of the fore legs; fore legs from the knees to the hoofs and the hind feet blackish; underside of the head rather paler; chest blackish, hinder part of the belly and inner side of the thighs white; tail dark brown, white on the underside. Hoofs elongate.

Hab. West Africa, Gaboon (*Du Chaillu*).

Differs from *C. dorsalis* in the softness of the fur, in the underside of the head being bay and not whitish, in the hind legs being brown, and in the hocks and feet to the upper hinder hoofs only being black. In many respects it is like *C. nigrifrons*; but the fur is softer and longer and much paler.

2. *Cephalophus leucogaster*.

Fur bay, darker in the middle, with a broad black undefined dorsal streak, which is broader in the middle and narrower and more defined on the rump; crown darker blackish brown, paler-grizzled; underside of the head, middle line of the throat, the chest, belly, and inner side of the limbs white. Tail rather bushy, with intermixed black and white long hairs.

Hab. West Africa, Gaboon (*Du Chaillu*).

In *Cephalophus badius* the underside of the body is rather paler bay; the chest is black, which extends some way down the belly in a narrow line; the underside of the head is paler whitish, the hinder part of the belly and inner side of the thighs whitish.

The *Cephalophi*, with conical, short, more or less recumbent horns and separate nasals, may be divided into groups according to the bones of their skulls.

I. *Nasal bones elongate.*

* *The lachrymal cavity deep, large.*

† *The lachrymal pit high up from the tooth-line.* Sylvicultrix.

C. sylvicultrix, P. Z. S. 1871, p. 595, f. 4.

†† *Lachrymal cavity near the upper edge of the grinders, separated from it by a ridge.* Cephalophus.

C. natalensis, Gray, Cat. Ungulata, t. 10. f. 1.

C. nigrifrons, Gray, P. Z. S. 1871, p. 598, f. 6.

** *Lachrymal cavity large, shallow, broad behind down to the base of the teeth, flattened in front of the sides of the nose.*

C. Maxwellii, Gray, P. Z. S. 1871, p. 600, f. 8.

*** *The lachrymal pit shallow, deepest in the middle and front of the lachrymal bone, which is very large and produced in front.*

C. Ogilbyi.

II. *Nasal bones short, broad behind.*

C. coronatus, Gray, P. Z. S. 1871, p. 599, f. 7. Lachrymal pit deep and broad.

C. rufilatus, Gray, P. Z. S. 1871, p. 597, f. 5. Lachrymal pit shallow and more elongate.

C. badius. Lachrymal pit small, triangular.

V.—*Herpetological Notes*. By A. W. E. O'SHAUGHNESSY, Assistant in the Natural-History Department, British Museum.

EUPREPES NOVARÆ (Fitz. *in literis*), described as a new species from Tahiti by Dr. Steindachner (Rept. in Voyage of the 'Novara,' p. 47), is the *Scincus noctua* ("Scinque phalène") described and figured by Lesson (Voyage of the 'Coquille,' Zoologie, tom. ii. p. 48, pl. iii. fig. 4, *gr. nat.*), which seems to have been overlooked by subsequent writers, with the exception of Girard, who describes it in vol. xx. of Wilkes's United-States Exploring Expedition, p. 249, and in 'Proc. Acad. Nat. Sc. Philad.' 1857. It is one of the common species, according to Girard occurring in the habitations of the natives, and having almost as wide a range as *Mabouya cyanura*. Lesson procured it in a field of sugar-canes in Ovalau.

The new subgenus and species, *Chalcides (Hapalolepis) Abendrothii*, described by Dr. Peters in the 'Monatsber. der Königl. Akad. Berlin,' August 1871, p. 399, is the genus and species *Ophiognomon trisanale* described at length by Mr. E. D. Cope in the 'Proc. Acad. Nat. Sc. Philad.' 1868, p. 100. Both authors make the same remark as to its apparent resemblance to the Amphisbænians. It is probably through an oversight that Mr. Cope states that his genus differs from *Chalcis* in the position of the nostril; the position of the nostril is the same in both, as Dr. Peters rightly indicates, the obvious difference being the absence of an internasal plate. This plate is present in *Chalcis*. The "nasorostrales" of Duméril and Bibron = the

nasals; their "internasorostrale" = the internasal; and consequently their "fronto-internasorostrales" = the frontalia anteriora.

List of Species of the Genus Gerrhonotus.

Group I. *Head depressed; occipital and temporal plates more or less swollen. Scales of back and sides weakly keeled or smooth.*
Abronia.

Gerrhonotus Deppii, Wieg. *Herpet. Mexicana*, 1834, p. 31, pl. ix. fig. 3.

Mexico. Type in Berlin Museum.

G. taeniatus, Wieg. *l. c.* pl. ix. figs. 1, 2.

Mexico. Type in Berlin Museum.

G. gramineus, Cope, *Proc. Acad. Nat. Sc. Philad.* 1864, p. 179.

Mexico. Smithsonian Museum.

Apparently closely allied to *G. Deppii*.

G. auritus, Cope, *l. c.* 1868, p. 306.

Vera Paz. Smithsonian Museum.

G. Vasconcellosii, Bocourt, *Nouv. Archives du Muséum*, 1872, p. 107.

Guatemala.

Group II. *Head not depressed; occipital shields not prominent. Scales of back keeled, the keels forming longitudinal ridges.*
Gerrhonotus.

A. *Head more or less tapering; body slender; tail very long and tapering.*

* *A small plate interposed between the first supranasals.*

G. tessellatus, Wieg. *l. c.* p. 32. (See Cope, *l. c.* 1866, p. 321, and Bocourt, *l. c.* p. 102.)

? *Pterogasterus ventralis*, Peale & Green.

Mexico. Types in Berlin Museum and several specimens in British Museum.

G. lemniscatus, Bocourt, *l. c.* p. 105.

Mexico, Vera Paz.

The British Museum possesses three specimens which I

recognize as belonging to this species—a still longer and slenderer one than *G. tessellatus*, and having the tail of excessive length, but agreeing with the latter in the arrangement of the supranasals.

G. ophiurus, Cope, *l. c.* 1866, p. 321.

Oriza, Mexico.

G. infernalis, Baird, Emory's U. S. B. Exped., Rept. p. 11 ;
Proc. Acad. Nat. Sc. Philad. 1858, p. 255 ; Cope, *l. c.*
p. 322.

Texas.

G. viridiflavus, Bocourt, Ann. des Sc. Nat. xvii., Déc. 1872.
Mexico.

** *No small accessory plate between the first supranasals.*

G. Webbii, Baird, *l. c.* pl. xxiv. figs. 1–10 ; Proc. Ac. Nat.
Sc. Philad. 1858, p. 255.

California.

The young specimen figured by Baird seems to have only one pair of narrow oblique supranasals.

G. nobilis, Baird & Gir. Proc. Acad. Nat. Sc. Philad. 1852,
p. 129 ; Emory's U. S. B. Exped., Rept. pl. xv.
figs. 1–8.

New Mexico.

G. (Elgaria) Kingii, Gray, Ann. Nat. Hist. 1838, i. p. 390.

G. multifasciatus, Dum. & Bibr. ; Bocourt, *l. c.* p. 106, note.

The type of this species in the British Museum is in a rather bad state. It agrees with the lengthened description of *G. multifasciatus* in the 'Erpétologie Générale.' Two pairs of narrow supranasals, without accessory plate between. Tail more than twice the length of body and head together ; fifty transverse series of scales from occiput to commencement of tail.

B. *Head and body stouter ; tail of moderate length.*

G. Wiegmanni, Gray, Catal. of Lizards, 1845, p. 54.

Type in the British Museum. I do not find any allusion to this species by succeeding writers. The arrangement of the plates of the head is the same as that in the figures of *Elgaria*

grandis, the description of which it agrees with in other respects, having, however, forty-eight instead of fifty transverse series of scales between occiput and commencement of tail. Head broad posteriorly; supranasals two pairs, oblique, unsymmetrical; internasal wide, transverse; fronto-nasals large and broadly in contact along the median line. Scales of back keeled, moderate, in forty-eight transverse series from occiput to tail, thirty-two between axil and groin; in fourteen longitudinal series; ventral plates in twelve longitudinal series. Limbs short, not meeting. Tail once and a half the length of head and body.

G. (Elgaria) grandis, Baird & Gir. Proc. Acad. Nat. Sc. Philad. 1852, p. 176; Wilkes's Expl. Exped. xx. p. 212, pl. xxii. figs. 1-9.

Oregon.

Fifty transverse series of scales between occiput and commencement of tail; fourteen longitudinal dorsal series.

G. (Elgaria) scincicauda, Skilton; Baird & Gir., Stansbury's Exped. p. 348, pl. iv. figs. 1-3; Wilkes's Expl. Exped. xx. p. 210, pl. xxiii. figs. 1-9.

Closely allied to the preceding.

Scales in fifty-two transverse, fourteen longitudinal series.

G. (Elgaria) formosa, Baird & Gir. Proc. Acad. Nat. Sc. Philad. 1852, p. 175; Wilkes's Expl. Exped. xx. p. 206, pl. xxiii. figs. 10-17.

Upper California.

Closely allied to the last two.

Scales in forty-eight transverse, sixteen longitudinal series.

?*G. multicarinatus*, De Blainv. Nouv. Ann. du Mus. iv. p. 289, pl. xxv. fig. 2; Dum. & Bibr. Erpét. Génér. v. p. 404; Hallowell, Pacific Railr. Exped., Rept. p. 9, pl. ix. fig. 1.

California.

G. Burnnettii, Gray, Catal. of Lizards, p. 54.

South America. Type in British Museum.

Head rather short; supranasals two pairs, large, one behind the other, followed by a subcircular internasal; fronto-nasals well developed and broadly in contact, coming obliquely forwards to meet the supranasals, and thus enclosing the inter-

nasal. Dorsal scales in forty-eight transverse series from occiput to tail, and sixteen longitudinal; ventral plates in twelve longitudinal series. Limbs short, not meeting. Tail short, only equal to length of head and body.

G. caeruleus, Wieg. Isis, 1828, p. 379.

Brazil.

G. (Elgaria) principis, Baird & Gir. Proc. Acad. Nat. Sc. Philad. 1852, p. 175; Wilkes's Explor. Exped. xx. p. 214, pl. xxii. figs. 1-16.

Oregon.

Dorsal scales in forty-eight transverse, fourteen longitudinal series.

G. Moreletii, Bocourt, Nouv. Arch. du Mus. 1872, p. 102.

Guatemala.

Founded by M. Bocourt upon the specimen given in Duméril's Catalogue (1851) as the unique example of *G. tessellatus*. The British Museum now possesses four specimens of this well-marked species: two of these seem referable to *G. fulvus* of M. Bocourt, but appear scarcely specifically distinct. This is the lizard which Mr. Salvin obtained at Lanquin, and which he mentions in 'Proc. Zool. Soc.' 1860, p. 455, under the name *G. Wiegmanni*, as follows:—"A single specimen was the only one that came under my notice; this I caught on the convent wall. It was shown me by the priest, who said that he had noticed it on the same spot several nights in succession."

G. fulvus, Bocourt, l. c. p. 104.

Elgaria marginata, Hallowell, Proc. Acad. Nat. Sc. Philad. 1852, p. 179 (unrecognizable); Sitgreave's Exped. Zuni and Colorado, p. 114, pl. iii. (bad).

Probably *G. tessellatus*.

G. olivaceus, Baird, Emory's U. S. B. Exped., Rept. p. 11; Proc. Acad. Nat. Sc. Philad. 1858, p. 255 (description insufficient).

"No single frontal."

California.

VI.—Descriptions of new Species of Fossorial Hymenoptera in the Collection of the British Museum. By FREDERICK SMITH, Assistant in the Zoological Department, British Museum.

[Continued from vol. xi. p. 451.]

Genus NOTOCYPHUS, Smith.

Notocyphus maculifrons.

Female. Length $7\frac{1}{2}$ lines. Head, thorax, and base of the abdomen black, the following segments ferruginous; wings fusco-hyaline, with the apex of the anterior pair dark fuscous. Head as wide as the thorax; a narrow abbreviated line at the inner orbits of the eyes, above the insertion of the antennæ; a small yellow angulated spot on each side of the clypeus; an obscure fulvous line on the seven apical joints of the antennæ beneath; the palpi rufo-testaceous. Thorax: the prothorax shorter, and the metathorax a little longer than the mesothorax; the latter truncate; the claws of all the tarsi and the spurs of the anterior tibiæ ferruginous. Abdomen: the posterior margin only of the first segment ferruginous; the two following segments have on each side a pale ferruginous curved line, those on the third segment uniting at the base of the segment; the two following segments have, at their base, a dark fuscous transverse spot; beneath, each segment has a large black macula on each side, which occupies the greater part of the segment.

Hab. Para.

This species resembles the type of the genus, *N. scvissimus*, also found at Para; but it has a broader head, its prothorax is proportionally shorter, as is also the metathorax; it differs also in having ferruginous claws and in the coloration of the wings, and in having the clypeus maculated.

Genus PEPSIS, Fabr.

Pepsis eximius.

Male. Length $7\frac{1}{2}$ lines. Brilliant green, with golden tints. Head: the sides of the clypeus and of the face covered with bright golden pubescence, the cheeks are also adorned with the same; antennæ orange-yellow, with the scape and first joint of the flagellum black. The sides of the thorax and the coxæ beneath covered with bright golden pile; the sides of the scutellum, the postscutellum, and entire margins of the metathorax above with golden pile; legs black, with tints of bright green in certain lights; wings fulvo-hyaline, with a

dark fuscous cloud at their apex, which covers the marginal and third submarginal cells, and extends to the apex of the wings. Abdomen subpetiolate, and of a vivid golden green.

Hab. Santarem.

Pepsis tinctipennis.

Female. Length $15\frac{1}{2}$ lines. Black, with blue and green shades in different lights; wings dark brown, glossy, but not prismatic, with the apex of the anterior wings yellow from the base of the third submarginal cell. Head: the scape of the antennæ of a blue tint; the seven following joints opaque black; the five apical joints orange-yellow. Thorax: the disk has a bright green tint in certain lights; the metathorax obscurely tinted with shades of blue or green, and irregularly, strongly, transversely striated; the legs dark blue; the tibiæ and tarsi thickly set with short spines. Abdomen shining, and reflecting shades of purple, blue, and green.

Hab. Para.

Pepsis fuscipennis.

Female. Length 9– $11\frac{1}{2}$ lines. Head and thorax obscurely blue; abdomen black, exhibiting a blue lustre in certain lights. Head: antennæ pale yellowish white, with the scape and three, or sometimes four, of the basal joints black; the third and the fourth joints also occasionally more or less pale at the apex. Thorax: the metathorax more or less covered with pale golden pile, and transversely striated; wings fuscous, not darkly so, with the apex of the anterior pair milky white; legs obscure blue; the tibiæ and tarsi thickly set with short spines. Abdomen elliptical; the second and three following segments with two very obscure, divergent ferruginous lines in the middle.

Hab. Ega; Para.

This may possibly be the *P. elongata* of St. Fargeau in very fine condition, having golden pile on the metathorax; it has the wings paler, and it also differs in having the tips of the anterior wings pale; still I have a suspicion of its being a local variety. *P. elongata* is from Surinam.

Pepsis optimatis.

Female. Length 12 lines. Head and thorax clothed with golden pubescence; abdomen black, with a beautiful changeable opaline lustre. Head: the antennæ orange-red; the scape black, and with a golden pile. Thorax bright golden; wings dark rufo-fuscous, with a pale spot in the second dis-

coidal cell; legs black; the tibiæ and tarsi very strongly spinose; the coxæ with golden pile. Abdomen black, with a sericeous pile that changes in tint in different lights, to green, gold, blue, or opaline lustre.

Hab. Para.

Pepsis purpureus.

Female. Length 7 lines. Purple, with blue and green tints in certain lights. The four apical joints of the antennæ, and the apex of the fifth, bright orange-yellow. The posterior margin of the prothorax incrassate; the metathorax transversely and irregularly striated, and having a longitudinal central impressed line, extending to the apex; the wings dark fuscous, with a minute hyaline spot at the base of the second discoidal cell; the intermediate and posterior tibiæ and tarsi strongly spinose. Abdomen smooth and shining, partaking of splendid tints of purple, blue, and green in different lights; the apical segment covered with erect black hairs.

Hab. Tapajos; Para.

A specimen of what I can only regard as a variety of this species, from Para, differs in having an additional pale joint at the apex of the antennæ, and also in having the impressed line on the metathorax very faintly traced.

Genus CEROPALES, Latr.

Ceropales crassicornis.

Male. Length 6 lines. Black, and variegated with spots and fasciæ of a pale ochraceous colour, tinged with ferruginous. Head rather wider than the thorax, the antennæ fulvous beneath; the clypeus and inner orbits of the eyes as high as the anterior stemma, and a narrow line behind the eyes ochraceous; the labrum sulphur-yellow. Thorax: the posterior margin of the prothorax, the tegulæ, and a line over them, an oblong spot on the mesothorax, the scutellum, the sides of the metathorax, and a line in its centre, not reaching its apex, ochraceous; two ovate black spots at the base of the scutellum; all the coxæ ochraceous, and more or less striped with black; wings flavo-hyaline, with a dark fuscous cloud at the apex of the anterior pair, which extends nearly to the base of the marginal cell; the posterior pair faintly clouded at their apex; the nervures ferruginous, the costal ones black. Abdomen: the basal margin of the first, second, and third segments with an ochraceous fascia; beneath, the three basal segments have their lateral margins broadly ochraceous.

Hab. Para.

Ceropales lugubris.

Male. Length $3\frac{1}{2}$ lines. Black, thinly covered with hoary pile; wings subhyaline and iridescent, faintly clouded at their apex, with their nervures fuscous. Head: the clypeus covered with silvery pubescence, and, as well as the palpi and a minute spot on the cheeks, close to the base of the mandibles, white; a yellowish-white spot on the scape of the antennæ. Thorax: the posterior margin of the prothorax, a minute spot on the scutellum, another on the mesothorax between the wings, white; a pale spot at the apex of the anterior tibiæ; the anterior tarsi rufo-testaceous; the posterior legs nearly twice as long as the body. The apical segment of the abdomen white.

Hab. Santarem.

Ceropales pedestris.

Male. Length 3 lines. Black, the wings hyaline and beautifully iridescent; posterior legs more than twice the length of the body, and the abdomen maculated with white. Head rather wider than the thorax; the clypeus, labrum, palpi, scape in front, first joint of the flagellum in front, and the inner orbits of the eyes, as high as their sinus, white. Thorax: the postscutellum, coxæ beneath, anterior trochanters beneath, and the tibiæ and tarsi entirely white; the tibiæ have a narrow black line above; the nervures of the wings black; the scutellum elevated into a pointed tubercle; the metathorax with a changeable silvery pile. Abdomen: each segment with a lateral oblong macula; the fifth with two central ovate spots, the sixth with a large quadrate one, and the seventh segment entirely white.

Hab. Para.

Ceropales irregularis.

Male. Length $4\frac{1}{2}$ lines. Head and thorax black and shining; abdomen and legs red; the posterior legs twice the length of the body. Head: the labrum, clypeus, face, as high as the insertion of the antennæ, a line at the inner orbits of the eyes, which widens and terminates in their sinus, and a narrow line behind the eyes white; the scape and first joint of the antennæ white beneath. Thorax: the posterior margin of the prothorax, the postscutellum, and anterior coxæ beneath white; the metathorax with a deep central longitudinal incision, and with its posterior lateral angles white and covered with silvery pubescence; wings hyaline, their nervures black, with the apical margin of the anterior pair slightly fuscous; the posterior tarsi black.

Hab. Para.

Genus APORUS, Spin.

Aporus quadrimaculatus.

Female. Length $5\frac{3}{4}$ lines. Black, with a large ovate white macula on each side of the second and third segments. Head: the tips of the mandibles, the scape beneath, as well as the four basal joints of the flagellum of the antennæ beneath, fulvous. Thorax: the posterior margin of the scutellum, the postscutellum, and the metathorax covered with a glittering silvery pile that changes in different lights to shades of greater or less brilliancy; the coxæ and femora also covered with glittering pile; the calcaria at the apex of the intermediate and posterior tibiæ white; the anterior wings dark fuscous, with a hyaline fascia crossing them at the apex of the first submarginal cell; the externo-median cell is also hyaline, and the extreme apex of the wings pale; the posterior wings are hyaline and iridescent, with a faint cloud at their apex. The apical segment of the abdomen white, or yellowish white.

Hab. Para; Santarem.

Aporus canescens.

Female. Length $3\frac{1}{4}$ -5 lines. Black, and covered with hoary pile, most thinly so on the vertex, disk of the thorax, and base of the abdomen. Tips of the mandibles ferruginous; wings dark fuscous, and having a coppery refulgence; the hoary pile is most dense at the base of the segments of the abdomen.

Hab. Para; Ega.

The male only differs in being smaller and less pilose; the wings are dark fuscous; the metathorax concavely truncate.

Aporus minutus.

Male. Length 2 lines. Black, and thinly covered with a fine hoary pile; smooth and shining; the wings fuscohyaline; the spines and calcaria on the intermediate and posterior tibiæ and tarsi elongate; the apex of the metathorax rounded; the abdomen narrow, and pointed at its apex.

Hab. Para.

This insect is very like the male of *A. canescens*, but, I think, is a distinct species; the metathorax is not distinctly truncated.

Family Sphegidæ.

Genus TRIGONOPSIS, Perty.

Trigonopsis cyclocephalus.

Male. Length 8 lines. Head and thorax black; abdomen ferruginous, with the petiole black; anterior wings with two light-brown fasciæ. Head slightly narrowed behind, smooth, shining, and impunctate; the sides of the face and the clypeus covered with golden pubescence; the latter produced into two teeth at its anterior margin, which, as well as the mandibles, are ferruginous; the latter black at their tips; the scape of the antennæ pale ferruginous, and the two following joints of the flagellum obscurely ferruginous beneath; the prothorax smooth, shining, and narrowed anteriorly into a short neck; its posterior margin fringed with silvery hairs, and in the middle it is elevated into a slight tubercle; the anterior and intermediate tibiæ and tarsi ferruginous; the anterior femora, and the other femora more or less, ferruginous at their apex.

Hab. Ega.

This species is very distinct from all those that have a similar coloration—namely, the typical one (*T. rufiventris*), *T. affinis*, and *T. intermedius*, described by Saussure in ‘Reise der Novara.’ It is distinguished from the type by its shorter and rounder head, by the pale tibiæ and tarsi, its shorter neck and metathorax, the latter being covered with transverse striae. From the male of *T. affinis* it is at once distinguished by the ferruginous scape of the antennæ, and by its having the teeth and anterior margin of the clypeus also ferruginous; it has the second submarginal cell square and larger, and its legs are differently coloured. From *T. intermedius* it will probably prove to differ; but the male of that species is not known.

Trigonopsis plesiosaurus.

Female. Length 7 lines. Elongate and attenuated; head and thorax shining black; abdomen red. Head narrowed behind, the sides nearly parallel, or only slightly widest anteriorly; the clypeus and face with a golden pile; the anterior margin of the clypeus with four teeth, the outer pair stoutest and longest; the mandibles arcuate, and, as well as the scape of the antennæ in front, ferruginous, as are also its extreme base and apex. Thorax smooth, shining, and forming a long neck with a deep central abbreviated channel at its base; the mesothorax with scattered large deep punctures;

the metathorax strongly punctured, and with a triangular patch of silvery pubescence at its base; the wings with similar fasciæ as in *T. cyclocephalus*; the tegulæ obscurely testaceous; the anterior and intermediate femora, tibiæ, and tarsi ferruginous; the intermediate femora more or less fuscous above; the posterior pair ferruginous at their extreme base and apex; the petiole and swollen part of the segment, except its apical margin, black.

This is perfectly distinct from all the species with which I am acquainted; its long attenuated form alone would distinguish it; but its punctured metathorax, without striation, at once separates it.

Hab. Ega.

Genus AMPULEX, Jurine.

Ampulex trigonopsis.

Female. Length $7\frac{2}{3}$ lines. Black: head and thorax with an olive-green pile; wings maculated. Head: clypeus covered with silvery pile, sharply carinated, and produced in front into an acute tooth; covered with somewhat oblong punctures; those on the pro- and mesothorax are similar; the metathorax with a central and on each side four longitudinal carinæ, three of which converge inwards; between the carinæ it is transversely striated; the posterior lateral angles dentate; wings hyaline; the nervures black; the anterior margin of the superior wings fuscous; a fuscous cloud covers the marginal, two submarginal cells, and the apex of the third discoidal cell; the legs have an olive silky pile. Abdomen very smooth and shining, with a pale silvery pile over the apical margin of the second segment, and also the rest of the abdomen; the apical segment rufo-testaceous.

Hab. Ega.

Family Larridæ.

Genus LARRADA, Smith.

Larrada fasciata.

Female. Length $4\frac{1}{2}$ lines. Black; pilose. The face and clypeus silvery, only observable in certain lights; the tips of the mandibles ferruginous. Thorax: the mesothorax with pale golden pile, on the rest of the thorax it is silvery, and on the metathorax brightest; that on its truncation very dense and bright; wings hyaline; the anterior pair with a pale fuscous fascia crossing them from the stigma, its width being

equal to the length of the third discoidal cell; the nervures fuscous; the stigma and costal veins blackish; the tegulæ obscurely testaceous. The abdomen narrowed at its base and subpetiolate; the three basal segments with silver fasciæ on their apical margins; the three apical segments with a covering of pale golden pile, only observable in certain lights.

Hab. St. Paulo (Amazons).

Larrada facilis.

Female. Length $5\frac{1}{4}$ lines. Black, and brilliantly adorned with bright silvery pile. The face and clypeus silvery. Thorax slightly shining; the metathorax opaque, and more or less covered with bright silvery pile; wings subhyaline, the nervures fuscous; costa and stigma black; the outer margin of the tegulæ testaceous. The apical margins of the three basal segments of the abdomen with bright silvery fasciæ; the two apical segments entirely silvery.

Hab. Ega.

Larrada tenebrosa.

Female. Length $4\frac{1}{2}$ lines. Shining black; the head and mesothorax highly polished and impunctate. The clypeus with silvery pile. Thorax: the sides, and also beneath, thinly covered with a short changeable hoary pubescence; the metathorax finely transversely striated, and having a central longitudinal depression; the truncation with a central impressed line, and with the lateral margins roughened; wings fuscous, with their apex pale. Abdomen smooth, shining, impunctate, and destitute of marginal fasciæ.

Hab. Ega.

Larrada pruinosa.

Female. Length $5\frac{1}{4}$ lines. Black, and covered with a thin hoary pile, most densely so beneath; on the sides of the thorax and legs, in certain lights having a silvery lustre. The face and clypeus with bright silvery pile, also the metathorax on the sides and posteriorly; the wings hyaline, faintly tinted with yellow; the nervures pale testaceous, with the costa and stigma black. Abdomen with silvery fasciæ on the posterior margins of the three basal segments; the apical segment with a changeable short fuscous pubescence.

Hab. Ega.

Larrada æthiops.

Female. Length $8\frac{2}{3}$ lines. Black; head and abdomen

shining; thorax opaque. Head: mandibles ferruginous, with their base black; the anterior margin of the clypeus rounded; the head behind covered with silvery pile, a patch of the same on each side of the clypeus. The thorax covered with a changeable silvery pile, most sparingly so on the mesothorax; the legs pilose; the scutellum shining; a patch of bright silvery hair on the metathorax close to the insertion of the posterior coxæ; wings dark brown, and having a coppery and violet iridescence in certain lights; the base of the posterior pair subhyaline. Abdomen smooth, shining, and impunctate.

Hab. Ega; St. Paulo.

Larrada limpidipennis.

Female. Length $5\frac{1}{4}$ lines. Black, with pale flavo-hyaline wings; their tegulæ and all the nervures towards the base of the wings bright yellow, but towards their apex becoming slightly darker; a faint cloud at the apex of the superior pair. Head: the clypeus densely covered with bright silvery pile, the cheeks also pilose; the mandibles, and the antennæ beneath, ferruginous. The metathorax, the coxæ, and femora beneath, covered with bright, changeable, silvery pile; the apical joints of the tarsi ferruginous. The apical margins of the three basal segments of the abdomen with fasciæ of bright silvery pile.

Hab. Para.

Genus TACHYTES, Panz.

Tachytes iridipennis.

Female. Length $3-3\frac{3}{4}$ lines. Black; wings hyaline, and exhibiting beautiful iridescent colours in different lights. Head: the lower part of the face and the clypeus covered with bright silvery pubescence. The mesothorax shining and finely punctured; the metathorax above with longitudinal, fine, divergent striæ; the wings with the neuration black and the tegulæ pale testaceous; the apical joints of the tarsi ferruginous; the sides of the thorax beneath, and also the legs, with a thin, changeable, cinereous pilosity. Abdomen conical, very thinly pilose, shining, and with changeable silvery fasciæ on the apical margins of the segments; beneath smooth and shining.

Hab. Ega.

Tachytes fervens.

Male. Length $4\frac{1}{2}$ lines. Black; the legs ferruginous; adorned with golden pubescence. Head: the face and clypeus covered with bright golden pubescence; the mandibles fer-

ruginous. Thorax: the pubescence thin on the disk of the mesothorax, but dense and bright at its margins, and also on the prothorax and postscutellum; the metathorax covered with a thin, erect, pale pubescence; wings flavo-hyaline, their nervures ferruginous; the tegulæ pale testaceous; legs ferruginous, with the coxæ and base of the femora above blackish. Abdomen: the posterior margins of the segments broadly ferruginous, and covered with a thin golden pile; beneath ferruginous, with the base of the first and second segments more or less black.

Hab. Ega.

Tachytes simulans.

Female. Length $5\frac{1}{2}$ lines. Black; the abdomen with pale golden fasciæ. The face and clypeus covered with silvery pubescence; the mandibles ferruginous. Thorax: the sides and beneath, covered thinly with a changeable hoary pile; the prothorax, margins of the mesothorax, and of the scutellum with very pale golden pile; the tibiæ and tarsi have a pale golden pile, their spines ferruginous; wings flavo-hyaline, with the nervures pale ferruginous; the tegulæ pale testaceous. Abdomen thinly covered with a fine, changeable, golden pile; the posterior margins of the segments with fasciæ of bright pale golden pubescence; the apical segment entirely golden.

Hab. Ega.

Tachytes frontalis.

Female. Length 7 lines. Black; the face densely clothed with bright golden pubescence, that on the cheeks pale golden, inclining to silver; the mandibles ferruginous, with some silvery pubescence at their base. Thorax semiopaque, and on the sides and beneath thinly covered with cinereous pubescence; the margins of the mesothorax and postscutellum silvery; the legs pilose, more or less silvery in certain lights; the spines on the tibiæ and tarsi ferruginous; wings hyaline, the nervures pale ferruginous, the costal ones fuscous; a narrow fuscous stain runs along the anterior margins of the front wings from the base of the first submarginal cell to the apex of the wing; the sides of the metathorax with long hoary pubescence. Abdomen: a bright silvery fascia on the posterior margins of the first and three following segments; the apical segment covered with pale golden pubescence.

Hab. St. Paulo (Brazil).

Tachytes auro-vestitus.

Female. Length 9 lines. Black; the head and thorax

densely clothed with bright golden pubescence. The mandibles ferruginous at their tips; their base covered with golden pubescence; the palpi pale ferruginous. The wings subhyaline, the nervures pale ferruginous, the costal nervures dark fuscous; a narrow fuscous stain runs along the anterior margin of the front pair, from the base of the first submarginal cell to the apex of the wings; the tegulæ rufo-testaceous; the tibiæ with golden pubescence outside; the tarsi are pale golden, inclining to silver; the spines on the tibiæ and tarsi pale ferruginous. Abdomen: the basal segment with a thin, pale golden pile; the apical margins of the four basal segments with silvery fasciæ.

Hab. Ega.

[To be continued.]

VII.—On *Nephropsis Stewarti*, a new Genus and Species of *Macrurous Crustaceans*, dredged in deep water off the Eastern Coast of the Andaman Islands. By JAMES WOOD-MASON*.

IN April of last year I was deputed by the Trustees of the Indian Museum, with the sanction of the Government of India, to proceed to the Andaman Islands for the purpose of making a collection illustrative of the marine fauna of that part of the sea of Bengal in which those islands are situated. I reached Port Blair about the 6th of April, and immediately put myself in communication with the Chief Commissioner, who at once placed at my disposal a well-manned boat and a small steam-launch, with which I dredged for nearly two months, with much success, from low-water line down to near 50 fathoms. Towards the end of my stay, General Stewart, knowing my intense desire to try my fortune in deeper water, placed at my disposal for one day the S.S. 'Undaunted,' which had been recently armed and put into commission for service as a guard-ship. The time allowed was short, but sufficiently long to enable me to bring away samples of the life supported by the sea-bed at and beyond the 100 fathoms' line, and to ascertain that the sea-bed was uniformly covered with a thick deposit of fine olive-coloured mud, derived from the waste of the coral-reefs and of the sandstone and serpentine rocks of the islands †.

* From the Journal of the Asiatic Society of Bengal, vol. xlii. part 2, 1873. A plate accompanies the original.

† The following rough analysis by Mr. Tween, the chemist of the Geological Survey of India, will show the proportion of insoluble matter:—

Soluble in HCl, mostly Ca O CO ₂	42·8
Insoluble clay and sand	57·2

100·0

This mud was not very productive, yielding only a few Annelids, but was crowded with dead shells of Pteropods and *Dentalium* and with fragments of a large Brachiopod.

It was in the last cast of the dredge that I had the good fortune to capture the interesting addition to the crustacean fauna of these seas described in the following pages. It is closely allied to *Nephrops norvegicus* of northern European seas—indeed, so closely allied that, were it not for the absence of the squamiform appendage of the antennæ, I should be under the necessity of placing it in the same genus as a second species. The absence of this appendage, however, leaves me no choice but to establish a new genus for its reception.

The discovery in these warm seas of a very near, of the nearest ally, in fact, of so characteristic a cold-water species, remarkable though it is, will not appear so surprising when I mention that my crustacean lived and burrowed in the mud of the sea-bed at a depth of nearly 300 fathoms, in a temperature certainly not exceeding 50° Fahr.

One of the chief points of interest attaching to this new form lies in the loss of its organs of vision by disuse, as in *Calocaris Macandrea*, Bell, in *Cambarus pellucidus* (a member of the same family as that to which *Nephropsis* belongs), and in the other crustaceans and animals inhabiting the caves of Carniola and Kentucky. I not only agree with Mr. Darwin* in attributing the loss of the eyes to disuse, but I also regard the great length and delicacy of the antennæ and the great development of the auditory organs as modifications effected by natural selection in compensation for blindness†.

NEPHROPSIS, gen. nov.

DIAGN. Antennal scale absent.

Nephropsis Stewarti, sp. nov.

Body covered with fine rounded tubercles and with a short

* Origin of Species, 5th edit. pp. 171-173.

† Since these remarks appeared in the abstract of my paper (Proc. As. Soc. Beng. 1872, viii. p. 151), Dr. Hagen's Monograph of N.-American *Astacida* has reached Calcutta; and from it I give the following extract, on account of its obvious applicability to the species here described, merely remarking that the perusal of it led me to note also the stoutness of the rostrum and the great development of the cephalostegal spines in *Nephropsis* as compared with the slenderness of the one and the minuteness of the others in *Nephrops*:—"But it seems to be a somewhat well-recognized law in Nature (Rathke, Metamorph. Retrogr. p. 135), that if any part is atrophied, or stopped in development, the nearest parts show an abnormal increase of development. This is apparently the case in *C. pellucidus*: the eyes are atrophied; and the rostrum, the fore border of the cephalothorax, the antennal lamina, the basal joint of the inner antennæ, and the epistoma are altered or largely developed."—*Op. cit.* p. 34.

but dense pubescence. The carapace is subovoid, armed on each side, just externally to the base of the rostrum, and behind the anterior margin, with an acute, forwardly directed spine; a similar spine springs from each side of the anterior margin itself at about the level of the upper surface of the antennal peduncle; the basis of each of these two spines is confluent, with a conspicuous convexity to be seen just behind it; immediately in front of each of these convexities lies a smooth, slightly excavated surface, bounded in front by a curvilinear row of tubercles. The cervical suture, dividing the carapace into an anterior or cephalostegal, and into a posterior or omostegal portion, is broad and deeply impressed mesially and laterally, until it reaches the level of the anterior margin of the epistoma, where it bends boldly upwards and backwards upon itself, passing into the well-defined semicircular depression that bounds the lateral convexities described above. The cardiac region is broader than long, very convex transversely, and bounded on each side by a densely tuberculated elevation, which running backwards, downwards, and forwards along the line of the granulated rim of the branchiostegite, and finally bending upwards almost opposite the origin of the second pair of abdominal appendages, passes again into the swollen anterior boundary of the omostegite; the ovoidal area thus limited off is more sparsely beset with tubercles, and presents a marked depression on its anterior half.

The rostrum carries on each side a most acute spine, directed upwards and forwards and curved slightly inwards, and above presents two roughly granulated ridges, coalescent towards the tip, but divergent at the base; beyond the spines it is canaliculate on each side, above and below; and each lateral ridge is fringed with long hairs; below it is carinated and coarsely granulated at the base. A faint linear impression, continuous with the groove between the ridges on the rostrum, passes along the middle line of the carapace almost to its posterior border; situated in this line, and marking the anterior limit of the convex gastric region, lies an almost erect spiniform tubercle.

Antennae and antennules.—The peduncles of these appendages lie, as in *Nephrops norvegicus*, in the same horizontal line; and their inner margins are ciliate. The basal joint, or coxocerate, of the former is extremely short, and wants the apical spine in *Nephrops*, but the perforated conical process on its inferior surface is remarkably salient; the second is devoid both of the prominent spine into which, in *Nephrops*, its distal and external angle is produced, and of the squamiform appendage or scale seen in all the other recognized genera of

*Astacide**, and developed to such an extraordinary degree in Carideous Crustacea, one or two small folds or impressions between or upon the second and fourth joints being all that remains of the antennal scale and of the rudimentary joint that in *Nephrops* corresponds to the movable spine of *Astacus*†.

The flagella of the antennæ are remarkably long and of excessive fineness at their extremities.

The basal joint of the antennules has its upper surface greatly inflated, owing to the remarkable development of the auditory organ to which, in most Podophthalmatous Crustacea at any rate‡, this joint gives lodgment; and the almost globular appearance of the joint as seen from the side contrasts strongly with the flatness of its upper surface in *Nephrops* or *Astacus*. Of the two remaining joints of the antennular peduncle, the first is short and cylindrical, being less than half the length of the last, which in *Nephrops* is short and equal to that which precedes it. The peduncle terminates, in the usual manner, in a double flagellum, the outer branch of which is conspicuously stouter than its filamentous and cylindrical fellow, perceptibly compressed, and thickly fringed below with short hairs along its distal third.

The *epistoma* is much the same as in *Nephrops*, save that its posterior edge is straight and presents two small tubercles, which give it the appearance of being slightly roundly emarginate in the middle.

The *external maxillipeds* and the parts of the mouth in front of them are identical in structure with those of *Nephrops*.

The *eyes* are completely rudimentary, neither pigment nor corneal membrane being developed: the peduncles, indeed, are present; but even these are short, subcylindrical, mere aborted structures, concealed entirely from view by the stout base of the overhanging rostrum; in spirit they have become perfectly

* The antennal scale in *Astacoides* escaped the notice of Guérin, who founded his genus on its supposed absence.

† There appears to be no doubt that the antennal scale is the representative of the outer of the two appendages borne upon the protopodite at an early stage of embryonic life; and if the movable spine in *Astacus* and its undoubted homologue in the antennæ of *Nephrops* represent the inner of these appendages, then must the three distal joints of the peduncle with the flagellum be looked upon, as Dr. Fritz Müller looks upon them, as a new formation (Neubildung) and no longer as being in serial homology with the five distal joints of the other appendages, *e. g.* of an ambulatory leg, which represent the endopodite, the exopodite being completely aborted or represented at most, as Rolleston remarks, by the annular constriction on the ischiopodite. For the facts relating to the transformation of the embryonic exopodite into the antennal scale of the prawn, *pari passu* with the budding-out of the flagellum and the abortion of the endopodite, *vide* Fritz Müller's admirable essay on the development of the Crustacea, entitled 'Für Darwin,' p. 41, fig. 31.

‡ The caudal ear of *Mysis* forms an exception to this.

blanched like the rest of the appendages; but in life the delicate rose-pink coloration of the animal extended itself to their very tips. The peduncles are far less conspicuous from the side view than represented in the plate.

The first pair of *abdominal appendages*, those which bear the great *chela*, are unfortunately absent, the specimen having lost its claws a considerable period previously to its capture, as the presence of uncalcified reproduced rudiments of these appendages indicates; the other legs are smooth and slender: the second and third pairs are didactyle; of these the former has both its upper and lower margins, from the base of the carpopodite to the extremity of the claws, fringed with long hairs; the latter, much the slenderer as well as the longer of the two, has its propodite greatly elongated, and its claws are ciliated: the fourth pair, the longest of all and ciliated only on the outer face of the dactylopodite, and the fifth, about as long as the second pair, are monodactyle.

The last abdominal somite is immovably united to that which precedes it, as in *Nephrops* and the common lobster*; and the sternum is linear, as in the *Astacidae* generally.

Postabdomen.—The postabdomen is gradually attenuated to the extremity of the telson. The appendages of its first somite are as completely rudimentary as they are in the female of *Nephrops norvegicus*†; those which follow are long and slender, their foliaceous branches being very narrow, produced to a sharp point, and fringed with excessively long cilia. All the terga are covered with minute rounded tubercles, and present at their anterior ends, just behind the tergal facets, a broad smooth transverse groove, with its hinder margin convex backwards.

The pleuron of the first somite is precisely similar to that of *Nephrops norvegicus*; but those of the remaining somites are even more acutely triangular than in that species, and have their margins denticulate and furnished with a fringe of long cilia. In all the somites, with the single exception of the first,

* On characters furnished by the claws alone Dana artificially divides the recognized genera of *Astacidae* into two groups, typified respectively by *Astacus* and *Nephrops*; the first of these is further subdivided according to the number of the branchiæ and the mobility or immobility of the last abdominal somite; but no mention is made of the fact that this is firmly fixed in *Nephrops* too. If *Paranephrops*, a genus including only fresh-water forms, should turn out to have a mobile last abdominal somite, then we shall have this curious fact presented to us—viz., that all those members of the family *Astacidae* which live in fresh water or are terrestrial (*Engæus*) have this somite movably united by membrane only to that which precedes, while those of them that are marine have it fixedly united to the rest of the sternum.

† The ventral plates of the 2nd, 3rd, and 4th postabdominal somites in the males of *Nephrops norvegicus* have an erect spine in the middle line; but the females exhibit no trace of such.

the tergal and pleural regions are most sharply defined as such, the former not curving continuously with the latter, but terminating abruptly at the level of the ventral chords in a line convex outwards; so that if a somite were detached, deprived of its ventral chord, and flattened out on the table with its dorsal surface uppermost, the imaginary continuation from pleuron to pleuron of the plane in which these pleura lay would pass below that of the surface of the tergum.

The "*swimmeret*," constituted as in all other *Macrurous Crustacea* by the highly modified and backwardly placed appendages of the last postabdominal somite and by the "*telson*," differs in no particular of more than specific value from that of *Nephrops*; the mesial element, or *telson*, is longer in proportion to its breadth, its greatest breadth being a transverse line separating its anterior from its middle third, and not at the base as in *Nephrops*, is slightly more truncate posteriorly; and the oblique rounded elevations, that gradually narrow as they pass backwards into the spines at its postero-lateral angles, are stronger than in *Nephrops*. The outer plate of the lateral elements of the swimmeret is movably articulated at its posterior third, as in the rest of the *Astacidae*; but the sutural line is curved, and the posterior margin of the proximal and larger division exhibits hardly a trace of the overlapping denticulation seen in other *Astacidae*.

	millim.
Length from tip of rostrum to the posterior margin of telson..	98
Length of carapace in middle line	42
Length of postabdomen	56
therefore the postabdomen : carapace (rostrum incl.) :: $1\frac{1}{3}$: 1 exactly,	
and the length of body : that of postabdomen :: $1\frac{3}{4}$: 1 ..	

The only specimen (a female) obtained was dredged in from 260 to 300 fathoms, about 25 miles off Ross Island, on the eastern coast of the Andamans. That the specimen was really brought up from this great depth is certain from the unmistakable signs of crushing from contact with the lip of the dredge, from its position in the dredge-bag, and from its firmly adherent greenish coating, which appears to indicate that, like *Calocaris Macandreae*, it was a burrower.

In conclusion, I have to thank Captain Beresford, the commander of the vessel, for his skilful management of the sounding-line and for the zeal displayed by him in carrying out my wishes during our too short cruise.

I have much pleasure in connecting with this extremely interesting species the name of Major-General Donald M. Stewart, C.B., Chief Commissioner of the Andaman and Nicobar Islands, to whose ever ready help the success of my trip was so largely due.

VIII.—Notes on some Mammalia from Fantee, including a new Species of *Macroxus*. By Dr. J. E. GRAY, F.R.S. &c.

THE British Museum has received a series of skins of Mammalia that were collected by Mr. Aubinn at Fantee.

Nandina binotata.

The collection contains a very large and perfect skin, with its skull, of this species, the head and body being 23 and the tail 22 inches long. It is marked with very distinct moderate-sized spots.

This species seems to vary very greatly in the size of the spots, these being in some much smaller and more numerous than in others, which is particularly the case in two specimens from the east coast of Africa, which we purchased of M. Verreaux. There is a small skin of a young Viverrine animal, but without tail and a great part of the head and without any bones, that appears to belong to this species, sent by Dr. Livingstone to the Museum in 1863.

In the British Museum there is the skin of an animal we received from Dr. Kirk in June 1861 ("it is called 'Nthoro,' which eats mice and poultry, and lives in the lower Shira valley"), which may be a specimen of this species; but the feet are destroyed: the tail is shorter and obscurely ringed with black on the upperside; and the back has only slight indications of small black spots.

Herpestes Pluto, Temminck, Esquisses, p. 93;
Gray, Cat. Carniv. &c. B. M. p. 150.

Hab. Fantee.

A skin and perfect skeleton of this species is peculiar for the fur not being grizzled like that of the other *Herpestes*.

Macroxus Aubinnii.

Fur blackish olive, closely and abundantly varied with minute rufous dots, rather paler beneath; tail black, lower part of the hairs brown, with black bands and black tips, the brown part occupying more of the hair as it reaches towards the tip of the tail, which ends in a pencil of long hair; whiskers black.

Length of the body 11 inches, tail $12\frac{1}{2}$ inches.

Hab. Fantee. Two specimens in the British Museum.

This species is at once known by its very uniform and minutely punctulated fur, its long, slender, uniformly coloured tail, which is black at the upper part of the base; but the

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underside shows that the tail is covered with hairs that are annulated with brown at the base and black at the end, the brown rings becoming more abundant and occupying a greater part of the hairs as they approach the end of the tail, where the black tips only occupy a small part of the ends of the hairs.

The two specimens differ in the brightness of the pale bands on the underside of the tail. In one the hairs are black, and the bands pale and very distinct; in the other the hair is brownish black and the brown bands are indistinct and only slightly paler.

This species I have named after Mr. Aubinn, who has sent many good specimens of Mammalia and birds from Fantee, and is a very intelligent native collector.

I cannot find this species noticed in the 'Esquisses de Zoologie sur la côte de Guinée' of M. Temminck; and it is different from any of the numerous species of African squirrels we have in the Museum.

Macroxus Wilsonii, Gray, Ann. & Mag. Nat. Hist. 1867,
xx. p. 328.

Hab. Fantee. B.M.

Anomalurus Beecroftii.

Hab. Fantee. B.M.

This species has hitherto been said to come from Fernando Po, but I think it is very doubtful.

IX.—Notes on the Family Chelydradæ.

By Dr. J. E. GRAY, F.R.S. &c.

IN my paper on the development of the bones of the sternum of the aquatic tortoises, I regretted that I had no materials to observe the change of form of the bones during growth in the animals of this family. I still have to regret the same want of young specimens which I could make into skeletons; but the examination of the sternum of the more adult animals shows very great differences to exist in their structure, which divide them into two distinct groups, which perhaps may eventually be considered as families, though they bear very great resemblances to each other.

The pelvic bones are slender and elongate, but they are much more elongate in the trap tortoises (*Eurysterna*) than in the cross-sternal tortoises (*Crucisterna*); they are very

long and bowed out on the sides, with a much longer central cavity than I have observed in the Chelonians.

Section I. CRUCISTERNA, Gray, Hand-list of Sh. Rept. p. 56.

The sternum cross-shaped, simple and acute behind, with more or less elongate lateral processes to the sternal costal suture, and united to the marginal bones by an osseous suture. The anterior pair of bones elongate, broad, with a well-developed odd internal bone; the two middle pairs are well developed, and, in the adult, united on each side by a straight dentate suture, and also by a medio-longitudinal suture. The hinder pair of bones are slender and united together in the middle, and in front to the hinder edge of the central pair of bones.

In the young animal the pair of lateral bones are not united by a longitudinal central suture, and there is a triangular cavity on the hinder sides of the odd central bone and at the front end of the lateral bone; but these bones increase in breadth, and more or less approach together, and are united by a linear suture.

These terrapins are furnished with two beards; one species, however, described as coming from Guatemala, has a second pair of beards; but this may be accidental in the specimen, as I do not recollect it to have occurred in any other water-tortoise; at least it wants confirmation.

Tribe I. Chelydraina.

The sternum with five pairs of shields; tail elongate.

1. MACROCHELYS.

1. *M. Temminckii*.

2. CHELYDRA.

1. *C. serpentina*. Beards 2.

2. *C. Rossignonii*, Bocourt, t. v. f. 2. Beards 4.

Tribe II. Staurotypina.

The sternal shields in four pairs; the hinder pair on each side sometimes united together into one shield; and there is sometimes a small central anterior shield, the representative of the anterior angular pair of sternal shields in other terrapins.

The anterior pair of bones and the odd bone are broad; the lateral pair of bones are united all together into one mass by a longitudinal central suture and by a linear transverse sub-central suture. The hinder pair of bones are elongate, united together by a linear longitudinal suture, and to the hinder

outer margin of the hinder lateral bones by a simple linear suture.

The tail of the animal is short; and the front or hinder lobes of the sternum have been said to be more or less movable; but they cannot be as they are in the true trap box tortoises, as the sutures between the bones are not the same as the sutures on the plates of the sternum.

This tribe contains three genera.

Section I. *The sternal plates in four pairs of shields, the hinder pair sometimes united into one plate, without any odd anterior or gular plate. The lateral processes broad, with distinct axillary and inguinal shields.*

1. STAUROTYPUS. Sternum broad, straight on the sides, roundly truncated in front. The front lobe separated from the middle part of the sternum by a well-marked transverse sinuous suture.

1. *S. triporcatus.*

2. STAUREMYS. Sternum narrow, narrowed in front, converging on the sides. The front lobe immovable, without any transverse suture.

1. *S. Salvinii.*

Mr. Cope believes "the genus *Staurotypus* belongs to the family Kinosternidæ, a family defined by the absence of the mesosternal bone;" but this is a mistake. In the adult specimen in the Museum, the mesosternal bone is visible both externally through the thin sternal plates and on the inner surface of the sternum. In the adult animal the front lateral pair of bones are very broad, approaching those of *Kinosternon* in form; but there is a large, well-developed, subtriangular odd or mesosternal bone between the hinder part of their inner edges. In the adult all these bones are strongly united together by a very narrow, almost obliterated suture. But it appears doubtful to me whether Mr. Cope speaks from having examined a specimen; at least his account does not lead one to believe that he had.

Section II. *Sternal plates in four pairs, with small odd central or gular plate in front; lateral processes very narrow; inguinal shields small or wanting.*

3. CLAUDIUS.

1. *C. angustatus*, Cope. *C. macrocephalus*, Boucard.

Mr. Cope established this genus for the above species, which I only know from Bocourt's figure, and which appears

from that figure to be distinct from *Stauremys*; but in his last paper Mr. Cope has enlarged *Claudiüs* and placed my *Stauremys* as a section of it, and refers *Staurotypus* to a different family.

He divides the specimens described into two species on account of the difference of the size of the head; but this is common to many terrapins, and appears to be a sexual character, or one liable to occur in specimens from the same locality.

Section II. EURYSTERNA. (Trap Terrapins.)

The sternum covered with five pairs of shields, and generally a small odd or gular shield, formed of the rudiments of the two geminate front shields, between the fore parts of the front lateral pair. The sternum without any odd internal or mesosternal bone, which is found in all the other Chelonians. The lateral pair of bones united together by a linear cross suture and by a dentate central longitudinal suture, forming a square disk which is covered by the abdominal pair of plates, the anterior and posterior pairs being very broad and united by a central longitudinal suture, and each being united to the front and back of the central abdominal portion by a more or less straight transverse suture at each end, which allows the front and hinder portions to be movable on the central one. The front portion is covered externally with two pairs of plates and the odd anterior one when present; the hinder portion with two pairs of plates.

The general structure of these terrapins is peculiar; the marginal plates are produced up to meet the dilated ribs. Indeed the whole osteology of this group deserves a monograph; and I only regret my inability to undertake it.

The only very young one that I have seen of this group leads me to suppose that the bones in the young state form a very broad ring, leaving a central longitudinal space between them, which becomes filled up as the animal grows; and in the adult state these bones are all united together, forming a most solid bone, which, in the more developed genera, is divided by two cross sutures so as to have a movable flap at each end.

This division was accidentally left out in the Hand-list of Tortoises in the Museum, at p. 57.

(In the account of the development of the sternum of Chelonians in the 'Annals,' xi. p. 163, I see that, by a mistake of the amanuensis, the front flap is said to consist "of the frontal pair of bones and *the* odd bone." It ought to be "and *no* odd bone.")

* *Sternum moderately broad, with extended sides of the abdominal plates united to the margin by a dentate bony suture. Hinder part of the sternum truncated; anal plates quadrangular. The pectoral plates quadrangular, nearly as broad in the central line as on the outside.*

1. GONIOCHELYS. Sternum truncated in front, without any odd anterior plate; the shields transverse, parallel.

1. *G. carinatum.*

2. AROMOCHELYS. Sternum rounded in front, with a triangular odd front shield; second pair of shields diverging.

1. *A. odoratum.*

** *Sternum broad, attached to the marginal plates by the elongated cartilaginous suture, which becomes more or less bony with age. The hinder part of the sternum entire or slightly truncated and notched in the middle; the anal plates triangular. The anterior and posterior lobes more or less broad and movable on the central portion by a straight mobile suture. The axillary, and especially the inguinal, plates elongate, covering the sternal costal suture. The pectoral plates triangular, very narrow in the central line.*

3. KINOSTERNON. The hinder sternal lobe not so broad as the cavity of the dorsal shell, leaving the legs exposed at all times.

1. *K. pennsylvanicum*, &c.

4. SWANKA. The hinder lobe of the sternum as broad and large as the cavity of the shell, covering the legs when withdrawn.

1. *S. scorpioides.*

BIBLIOGRAPHICAL NOTICES.

First, Second, Third, and Fourth Annual Reports on the Geological Survey of Indiana, made during the years 1869-72. By E. T. COX, State Geologist, assisted by MESSRS. BRADLEY, HAYMOND, LEVETTE, COLLETT, HOBBS, and WARDER. In three vols., with two Atlases of Maps. 8vo. Indianapolis, 1869-72.

STEP by step, and indeed with rapid strides, is the geological surveyor examining the North-American States in detail, mapping and recording the physical features, structure, mineral contents, and products of each State, as well as its natural-history characteristics.

Indiana, consisting almost wholly of Carboniferous strata, has its limestones, sandstones, fire-clays, ironstones, and coals in abundance, covered with glacial deposits and alluvium. All of these are being

defined on the maps, and have their characters, relative position, and economic capabilities duly pointed out. For those interested in coal- and iron-works, Prof. Cox's Reports afford much information; and the agriculturist finds instruction in them on many points as to hill-sides, flats, river-banks, &c. The mineral waters and oil of the coal-series, the salt wells and mineral springs, the great caves, especially of Wyandotte, rivalling the "Mammoth Cave" of Kentucky, and the cave-fauna, are among the special objects of interest to geologist and naturalist. The old Indian mounds of Martin and Sullivan Counties are also described. The Meteorology, Botany, and Zoology of certain parts are treated of in detail by various collaborators.

Prof. Cope supplies (1872) a Report on the Wyandotte Cave and its fauna, giving a detailed account of the Cave and its inhabitants, with woodcut illustrations. The following is his list of the species living in the caves, chiefly of Indiana and Kentucky:—

Vertebrata.

- Amblyopsis spelæus*, *De Kay*. Mammoth Cave and Wyandotte Cave.
Typhlichthys subterraneus, *Girard*. M. Cave.

Arachnida.

- Erebomaster flavescens*, *Cope*. W. Cave.
Acanthocheira armata, *Tellk.* M. Cave.
Phrixis longipes, *Cope*. M. C.
Anthrobia, sp. W. C.
 ——— *mammouthia*, *Tellk.* M. C.

Crustacea.

- Orconectes inermis*, *Cope*. W. C.
 ——— *pellucidus*, *Tellk.* M. C.
Cæcidotea microcephala, *Cope*. W. C.
 ——— *stygia*, *Pack*. M. C.
Cauloxenus stygius, *Cope*. W. C.
Stygobromus vitreus, *Cope*. M. C.

Insecta.

- Anophthalmus tenuis*, *Horn*. W. C.
 ——— *eremita*, *Horn*. W. C.
 ——— *Menetriesii*, *Motsch.* M. C.
 ——— *Tellkampfi*, *Erichs.* M. C.
 ——— *striatus*, *Motsch.* M. C.
 ——— *ventricosus*, *Motsch.* M. C.
 ——— *pusio*, *Horn*. Erhart's Cave, Virginia.
 ——— *pubescens*, *Horn*. Cave-city Cave, Illinois.
Quediis spelæus, *Horn*. Wyandotte Cave.
Adelius hirtus, *Tellk.* Mammoth Cave.
Lestera, sp. W. C.
Raphidophora, sp. W. C.

- Raphidophora subterranea, *Scudd.* M. C.
 Phora, sp. W. C. and M. C.
 Anthomyia, sp. W. C. and M. C.
 Machilis, sp. W. C. and M. C.
 Campodea, sp. W. C.
 ——— Cookei, *Pack.* M. C.
 Tipulid. W. C.

Myriopoda.

- Spirostrephon cavernarum, *Cope.* W. C.
 Scoterpes Copei (*Pack.*), *Cope.* M. C.

“The mutual relations of this cave-life form an interesting subject [observes Prof. Cope]. In the first place, two of the Beetles, the Crickets, the Centipede, the small Crustaceans (food of the blind Fish) are more or less herbivorous. They furnish food for the Spiders, Crawfish, *Anophthalmus*, and the Fish. The vegetable food supporting them is, in the first place, Fungi, which, in various small forms, grow in damp places in the cave; and they can always be found attached to excrementitious matter dropped by the Bats, Rats, and other animals which extend their range to the outer air. Fungi also grow on the dead bodies of the animals that die in the caves, and are found abundantly on fragments of wood and boards brought in by human agency. The Rats also have brought into fissures and cavities, communicating with the cave, seeds, nuts, and other vegetable matters, from time immemorial, which have furnished food for Insects. The Rats and Bats have, no doubt, had much to do with the continuance of land life in the cave; and the Mammals of the Postpliocene or earlier period, which first wandered and dwelt in its shades, were introducers of a permanent plant life.

“As to the small Crustaceans, little food is necessary to support their small economy; but even that little might be thought to be wanting as we observe the clearness and limpidity of the water in which they dwell. Nevertheless the fact that some cave-waters communicate with outside streams is a sufficient indication of the presence of vegetable life and vegetable débris in variable quantities at different times. Minute freshwater Algæ no doubt occur there, the spores being brought in by external communication; while remains of larger forms, as *Confervæ* &c., would occur plentifully after floods. In the Wyandotte Cave no such connexion is known to exist. Access by water is against the current of small streams which discharge from it.

“On this basis rests an animal life which is limited in extent and must be subject to many vicissitudes. Yet a fuller examination will probably add to the number of species, and of these no doubt a greater or less number of parasites on those already known. The discovery of the little Lernæan [*Cauloxenus stygius*, on the upper lip of *Amblyopsis spelæus*] shows that this strange form of life has resisted all the physiological struggles which a change of light and temperature must have produced; and that it still preys on the food of its host, as its ancestors did, there is no doubt. The blindness of

the Fish has favoured it in the 'struggle for existence,' and enabled it to maintain a position nearer the commissariat with less danger to itself than did its forefathers."

Illustrated Guide to the Fish, Amphibian, Reptilian, and supposed Mammalian Remains of the Northumberland Carboniferous Strata. By T. P. BARKAS, F.G.S. 8vo, pp. 117; and Atlas of Carboniferous Fossils from the Northumberland Carboniferous Strata, folio, 10 plates. Hutchins: London, 1873.

MR. BARKAS is willing that palæontological students shall fully profit by the rich collection of fossil bones, teeth, and scales which he has obtained both by personal search and by judiciously directing the intelligent observation of working miners in the Newcastle coal-field. With this view he has had nearly 250 figures carefully lithographed, and some chromo-lithographed, of natural size and magnified, in the handsome Atlas of his 'Manual of Coal-measure Palæontology.' These figures comprise several reproduced from other works, for comparison and to make this illustrated series of vertebrate remains from the Northumberland Coal-measures as complete as present circumstances permit. The descriptive portion, evidently from the pen of an amateur, contains abundant references to other publications and frequent acknowledgment of fellow workers. Doubtless Mr. Barkas's good intention of stimulating further research in this highly interesting field of geology will not be fruitless; collectors will see at a glance the natural groups to which their specimens may be referred; and naturalists have here much material before them ready for critical examination, and will find in Mr. Barkas's descriptions many suggestive observations on specimens having doubtful characters.

1. *The Physical Geology and Geography of Great Britain.* By A. C. RAMSAY, LL.D., F.R.S., &c. 3rd Edition. London: Stanford, 1872.
2. *The School Manual of Geology.* By J. B. JUKES, M.A., F.R.S., &c. Second Edition, revised and enlarged; edited by A. J. JUKES-BROWNE. Small 8vo. Edinburgh: Black, 1873.

THESE new editions are to be recommended; for the first is now a standard work on the physical geography of the British Isles and, correlatively, on the geological structure, not only of neighbouring lands, but of all parts of the world; for the same principles rule, and similar results are found, wherever the geologist betakes himself with educated eye and mature judgment. The bold treatment of physical features, on the large scale, by reference to ancient extensive planes of marine denudation and the subsequent long-continued excavation of all valleys by atmospheric, glacial, pluvial, and fluvial action, is a leading idea in Prof. Ramsay's masterly work, and has a powerful and wholesome influence in enlarging the mental views

of the geological student, and in enabling him to grasp the characters and meaning of all the geographical features met with in travel at home and abroad.

Jukes's 'School Manual' is much improved in this new edition, and is well calculated for beginners really intending to work at the science, and not merely amusing themselves with peeps into nature, empty admiration of physical novelties, and easy pursuit of sensational inquiries neither useful nor lasting.

Geological Stories. By J. E. TAYLOR, F.G.S. Small 8vo, pp. 301, with many Woodcuts. Hardwicke: London, 1873.

THIS is an elementary work, intended to lead amateurs to a knowledge of geology by "a series of autobiographies, in chronological order," supposed to be related by different constituent members of the several geological formations, as granite, quartz, slate, limestone, sandstone, coal, rock-salt, jet, Purbeck marble, chalk, clay, lignite, crag, boulder, and gravel. The attempt is praiseworthy, and, excepting in some details, is well carried out. The author should be more exact as to the characters of felspar, the structure of brachiopods, and other points in natural history, and more correct in his Latin words, in his next edition, if he wishes his well-intentioned and well-directed book to fulfil its purpose in advancing geological knowledge.

MISCELLANEOUS.

Note on the Scombrocottus salmoneus of Peters, and its identity with Anoplopoma fimbria. By THEODORE GILL, M.D., Ph.D.

THE distinguished zoologist of Berlin, Dr. Wilhelm Peters, has recently published a communication on a supposed new generic type of Cataphracti from Vancouver's Island, which he has named *Scombrocottus salmoneus*. This form was regarded as possessing the highest interest, on account of a combination of characters which allied it to the Scombroids, and thus corroborated Dr. Günther's views respecting the affinity between the Cataphracti and Scombroids of Cuvier.

It was at once apparent, after a perusal of the good description, that the supposed new type was identical with the form first discovered and named by Pallas *Gadus fimbria*, and subsequently, by Dr. Ayres, *Anoplopoma merlangus*. And it was with special interest that I also recalled the fact that both its former describers had failed to perceive any resemblance to the Scombroids (they equally failed, however, in detecting the relations to the Cataphracti), and both had believed they could perceive a resemblance to the Gadoids* ;

* Dr. Ayres noticed the enlarged suborbitals, but referred the genus near to *Stizostedion* (*Lucioperca*, Cuv.).

this was the more noteworthy, as the later observer was ignorant of the labours of his predecessor; and it was also with interest that I perceived that Dr. Peters had likewise been struck with a resemblance of the same form to the trout, naming the species *S. salmoneus*, and describing it as trout-like (“*Habitus forellenähnlich*”). Now it is evident, from a study of the anatomy, that these several forms are very dissimilar in fundamental characters, and most of them, at least, quite distantly allied. A likeness which is so ambiguous as to mislead persons equally familiar with the external appearance of the several forms, and to lead to such dissimilar results, must be of very slight importance. At any rate, the affinities of the form in question (*Anoplopoma fimbria*) with the *Cataphracti* (and more especially the *Chiridæ*) are evident from an examination of the external and internal structure; and I am unable to appreciate the likeness which others have seen to the cods, the mackerels, or the trout.

The synonymy of the species will now stand as follows:—

Anoplopoma fimbria, Gill, *ex* Pallas.

Gadus fimbria, Pall. Zoogr. Ross.-As. iii. p. 200, 1831.

Anoplopoma merlangus, Ayres, Proc. Cal. Acad. N. S. ii. p. 27, 1859.

Merluccius? [*fimbria*], Grd. Expl. P. R. R. viii. Fishes, p. 141, 1858.

Merluccius [*fimbria*], d. sp., Gthr. Cat. Fishes, iv. p. 344, 1862.

Anoplopoma [*fimbria*], Gill, Proc. Acad. N. S. Phil. 1863, p. 247.

Scombrocottus salmoneus, Pet. Monatsb. K. Akad. Wiss. Berlin, 1872, p. 569.

—*Proceedings of the California Academy of Sciences*, April 1873.

On the Occurrence of Ligidium agile in Belgium.

By M. F. PLATEAU.

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

Ghent, June 6, 1873.

GENTLEMEN,—In the interesting article published in the ‘*Annals and Magazine of Natural History*’ (ser. 4. vol. xi. p. 419) by the Rev. A. M. Norman, and entitled “*Note on the Discovery of Ligidium agile*, Persoon, in Great Britain,” the author says that this Crustacean has been found hitherto in England, Sweden, Denmark, Prussia, Bohemia, and France. To this enumeration we must add Belgium.

In a note entitled “*Matériaux pour la Faune Belge: Crustacés Isopodes terrestres*” * I have indicated the occurrence of *Ligidium agile* (*L. Persoonii*) in Belgium. With us this little Isopod often accompanies *Philoscia muscorum*, and occurs in the woods, under moss at the water’s edge. The locality where I have most frequently met with it is the village of Dickelvenne, near Gavre, about nine miles from Ghent.

Accept &c.,

F. PLATEAU.

* Bull. Acad. Sci. Belg. 1870, 2^e sér. tom. xxix.

A Sponge on Hyalonema. By Dr. J. E. GRAY, F.R.S. &c.

Mr. Tennant kindly brought to the Museum a very fine thick specimen of the Japanese glassrope (*Hyalonema*) with a small quantity of bark on it, and a triangular fan-shaped specimen of a true fibrous sponge on the smaller end of it, which I considered a very interesting specimen, as showing that a true fibrous sponge, as well as the friable sponge forming the genus *Carteria*, was found parasitic on the apex of this sponge.

Dr. Günther, on looking at the specimen, was suspicious that the sponge had been gummed on to the end of the glassrope; but I showed him that the fibres of the glassrope could be seen nearly to the upper edge of the sponge. However, to make sure, we soaked the sponge in the water; and, lo! the two sides of the fan-like body separated, and showed that it had been cut down on one side, opened, the ends of the fibres of the glassrope inserted, and the sponge then glued together with gum on the edges and round the narrow base! The sponge used for this purpose is the *Spongia aculeata* of Esper (Zooph. t. vii. a), or a species very nearly allied to it. It is very probable that more specimens of this kind have been prepared for sale in Europe. This is not like the square pieces of the bark of *Hyalonema*, that were stuck on the ends of the fibres and figured as isolated zoanthoid animals by Professor Wyville Thomson in his account of this genus.

It is a curious question if these artificial specimens are made by the Japanese or by a French dealer in objects of natural history. In both these cases the cement used is gum thickened with starch, just such as is used by the French bird-stuffers for such purposes.

On unequal Bivalve Shells. By Dr. J. E. GRAY, F.R.S. &c.

It has been generally believed, and I, think truly, that all equal-valved shells live sunk perpendicularly in the sand, mud, or rocks, attached by a byssus, which allows the water or food to enter on all sides of them, and that the bivalves with unequal valves naturally live lying horizontally on the surface of the rocks, or more or less sunk in the sand, and that the inequality of the valves depends on the permanence of this mode of life, and therefore is greatest in such genera as *Ostrea*, which are fixed to rocks by the lower surface of the under or attached valve. In some species of this genus, for example, the upper valve is so small as to look almost like an operculum. Unfortunately I have had little opportunity of verifying these facts in the genera which have the valves only slightly unequal, as the greater part of my time has been spent in the Museum, and the chief part of my vacations in visiting and examining the various museums of Europe.

It would be very useful if persons living on the coast would verify this theory, more especially as some genera (like *Pandora*) which have very unequal valves are said to live free.

My attention has been called to this fact by observing that Professor

Karl Möbius, in his very interesting lecture on the "psychischer Horizont der Thiere," figures the animal of *Mya arenaria*, which has unequal valves, and represents it as sunk perpendicularly in the sand. It would be very desirable that any body having the opportunity of observing the bivalve Mollusca in their living state should examine into the truth of this theory, and record the exceptions.

The Skeleton of Sphargis coriacea from Surinam.

By Dr. FERDINAND KRAUSS.

I have compared the adult skeleton in the Stuttgart Museum from Surinam with the figures of the skeleton of the French specimen in the 'Archives du Muséum.' I can find no difference between them; but I notice that no account of the length of the Paris specimen is given, so that we do not know if it is an adult or a young one.

The Surinam specimen in the Stuttgart Museum measures in a straight line, from the end of the skull to the tip of the tail, 187 centims.; the skull is 25 centims. long and 21.5 centims. broad, the fore foot (humerus to the point of the digit) 87 centims., hind foot 66 centims.

The Deal-fish (Trachypterus arcticus).

In the Report of the Montrose Natural-History and Antiquarian Society for 1873 there is the description of a Vaagmaer or deal-fish, found on the beach at Buddin Bay, near Montrose, and presented to the Society by Joseph Johnston and Sons. The description is accompanied by a very good photograph, $8\frac{1}{2}$ inches long. The Society's specimen appears to be the *T. arcticus* of Nilsson and Günther.

Damonia unicolor, a new Species of Water-Tortoise from China,
sent by Mr. Swinhoe. By Dr. J. E. GRAY, F.R.S. &c.

Mr. Swinhoe has sent a number of tortoises in spirits from Shanghai. They consist of:—

1. Several specimens of *Landemania perocellata*, all young; but Mr. Swinhoe says that it grows to the length of $2\frac{1}{2}$ to 3 feet.

2. Several specimens of *Damonia Reevesii*, most being of adult age, some being even between 4 and 5 inches long, larger than the adult specimen described by me in the Ann. & Mag. Nat. Hist. 1873, xi. p. 299.

They all have the shell of a nearly uniform pale brown colour, and are black beneath. The head is large and broad, uniform olive above, with a white streak from the middle of the back of the eye, which forks on the cheek, the upper branch being continued along the side of the neck, the lower branch forked again in front of the tympanum, with the upper branch reflexed and the lower arched; but the form of these lines is not important, as they vary on two

sides of the same specimen, viz. on one side being continuous and on the other broken up into oblong spots. In one specimen there is a ring-like spot, including a small white central spot, on the hinder part of the eye on one side, and not on the other. There are one or two obscure streaks on the side of the neck, parallel to the upper one. I described the head and neck of this species as being streaked when mentioning the species of the hairy tortoise of the Chinese in the *Ann. & Mag. Nat. Hist.* 1873, xi. p. 148.

3. Several specimens of what Mr. Swinhoe very correctly considers a new species of Terrapin, which I propose to name

Damonia unicolor. (The Black Damonia.)

Animal and shell black. Shell oblong, three-keeled. Vertebral shields oblong, broader than long, the first one nearly square, as broad behind as in front; vertebral keel broad and blunt in front, sharper and higher behind; the lateral keels blunt, rather above the middle of the plates.

Shanghai (Swinhoe). Brit. Mus.

This species is very like *Damonia Reevesii*. It chiefly differs from it in the animal and shell being black, in the front vertebral plate being more square, nearly as broad behind as in front, in the head being smaller and narrower, covered with a smooth hard plate, and the sides of the head and neck being uniformly black.

The inguinal plate varies in size: it is generally larger than in *Damonia Reevesii*; but in one specimen it is smaller and nearly of the same size; and it varies in size and form also in *D. Reevesii*.

This species is quite different from *Damonia nigricans* (also from China)—which has a single keel, and the neck marked with broad, pale, more or less interrupted longitudinal streaks.

A new and ingenious American Move in the Game of Priority.

The following circular letter, partly printed, partly written, which has just come to our knowledge, will, we think, somewhat amuse our readers:—

“BUFFALO SOCIETY OF NATURAL SCIENCES.

June 6, 1873.

“To the Secretary of the ——— Society.

“DEAR SIR,—You are hereby notified that a paper entitled “Contributions to a Knowledge of North-American Moths,” by A. R. Grote, has been read this evening before this Society, declaring that three new genera [*Litognatha*, *Meghlypena*, *Phæcasiophora*] and nineteen hitherto undescribed species [*Acronycta* 4, *Agrotis* 1, *Cloantha* 2, *Litognatha* 2, *Meghlypena* 2, *Botis* 1, *Eurycreon* 1, *Phæcasiophora* 1, *Penthina* 3, *Graptolitha* 1, *Æta* 1] occur in the North-American insect-fauna (*whereof these Presents, to which the Seal of this Society is affixed, are evidence*), and that this Society

considers the reading of the above paper as securing all rights to its author that he might acquire by publication.

“Mr. Grote’s paper has been accepted by the Publication Committee of this Society for publication in its Bulletin.

“Yours respectfully,

LEON F. HARVEY,

Corresponding Secretary B.S.N.S.”

In characterizing this proceeding on the part of one of the youngest publishing societies in the world we are forced to cull a phrase from the slang dictionary; it is simply the “cheekiest” thing we ever remember to have seen. The use of legal phraseology in the words which we have put in italics has quite a peculiar charm, and will doubtless produce its due effect in causing entomologists in all quarters of the world to avoid trespassing on those unknown premises which have been formally handed over by “these Presents” to Mr. Grote by the Buffalo Society of Natural Sciences. It seems hardly credible that experienced naturalists, such as Mr. Grote at any rate is, should have even dreamed of adopting so absurd a course as this. Another favourite American dodge of printing descriptions of new species, with a date attached to them, for private circulation and not for sale, is bad enough, but it must yield the palm to the Buffalo invention.

On Hylodes martinicensis and its Metamorphoses. By M. BAVAY.

The facts observed by M. Bavay display an exception in the development of the Batrachia which is perhaps more interesting than any of those previously known. They relate to a tree-frog which, before hatching, undergoes all the changes through which the tadpoles of the Anura pass.

Hylodes martinicensis, a very abundant species at Guadeloupe, deposits, under the remains of leaves in very damp places, a mass of about 20 eggs, each about 2 millims. in diameter at the moment of its deposition. The chorion is then separated from the vitellus by a very thin zone of gelatinous matter.

As early as the second day after deposition this gelatinous matter is observed to be swelled, and the lineaments of the embryo appear. On the evening of the second day the embryo already appears as a little white mass, widened at one end and furnished with four appendages, which are the first traces of the feet. Beyond the base of the posterior feet there is the rudiment of a tail. The embryo is endowed with a rotatory movement, due, no doubt, to vibratile cilia, which, however, M. Bavay was unable to detect.

On the third day the forms become more distinctly marked; the tail is visible, as also two prominences which indicate the future position of the eyes on the head. The heart appears a little before the anterior feet. On each side of the neck two little processes (the branchiæ) make their appearance.

On the fourth day the eyes are more developed; the branchiæ may

be distinguished in the form of a simple vascular loop: the limbs are still styliform; but the proper movements of the young animal are already manifested when the egg is pressed.

On the fifth day the heart, as well as the branchiæ, are visible to the naked eye. The circulatory system has become perfect.

On the sixth day the feet are well formed, and the toes appear. The tail, on the contrary, shows signs of atrophy. The branchiæ are still perceptible; but their absorption has also commenced.

On the seventh day the branchiæ have disappeared, and the tail withers and folds.

On the eighth day the coloration, which began to show itself on the fifth day, increases throughout; and even some markings are produced at certain points. The tail disappears, and then the vessels which nourished it.

On the ninth or tenth day the eggs hatch. The vitellus, which is pretty voluminous in the young tree-frog, is still very visible through the walls of the abdomen; but this does not prevent the animal from leaping and being very free in its movements.

During incubation the gelatinous mass interposed between the chorion and the vitellus swells up considerably, so that the diameter of the egg becomes as much as 6 millims. When one of these greatly inflated eggs is opened there issues from it a considerable quantity of a clear liquid, in which the young animal floated.

M. Bavy puts forward the supposition that nearly pure water penetrates through the chorion into the cavity occupied by the embryo and its vitellus, and that it is in this water that the rotatory and voluntary movements of the embryo are performed. It would be in this aerated liquid that it would respire—at first by its branchiæ, and afterwards by the whole surface of its blastoderm. Respiration would be effected especially, during this second phase, by vessels which, starting from each side of the neck, pass into the vitellus, at the surface of which they develop abundant ramifications. A remarkable fact is that the appearance of these vessels coincides with the commencement of the withering of the branchiæ.—*Revue des Sci. Nat.* tome i. 1872, p. 281, and *Journ. de Zool.* tome ii. 1873, p. 13; *Bibl. Univ.* June 15, 1873, *Bull. Sci.* p. 155.

Mode of Walking of the Armadilloes.

Mr. Bartlett has kindly examined for me the way of walking of the living armadilloes in the Zoological Gardens. He observes that *Chetophractus villosus* and *C. vellerosus* walk on the tips of their toes like *Xenurus*. *Euphractus minutus*, belonging to the same family as the preceding, and *Tatusia peba*, *T. hybrida*, and *Praopus Kappleri*, belonging to the family Tatusiadae, walk on the palms of the fore feet, with the claws spreading out and the tips elevated from the soil.—J. E. GRAY.

THE ANNALS
AND
MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 68. AUGUST 1873.

X.—*On the Invertebrate Animals of the Baltic.*
By Prof. KARL MÖBIUS.*

FAUNISTICALLY the Baltic is sharply divided into an eastern and a western basin. The western basin is separated from the Kattegat by the Danish islands. I do not include the Belts and the Øresund in the western basin when I speak of the fauna of the latter. The eastern basin meets the western one in the meridian of the west coast of the Isle of Rügen.

Of the 241 invertebrate animals catalogued, 216 species have been found in the western, and hitherto only 69 in the eastern basin.

Besides those mentioned, Acarina, Ostracoda, Infusoria, and Rhizopoda exist in the Baltic; but their enumeration must be postponed until the species have been determined with more certainty, for which purpose further investigations are necessary.

Among the Infusoria, however, I will refer to *Peridinium tripos*, Müll.†, which appears in great abundance during the summer and autumn in the bay of Kiel as a luminous animal, and is of importance as food for Copepoda and the swarming embryos of other Invertebrata.

* Translated by W. S. Dallas, F.L.S., from the concluding remarks appended by the author to the list of the Invertebrata of the Baltic, prepared by him with the assistance of Profs. K. Kupffer, E. Häckel, W. Schmidt, and of Dr. Bütschli, and published as part of the report on the scientific results of the expedition of the steamship 'Pommerania' in 1871 (pp. 138-141).

† Ehrenberg, 'Infusionsthierchen,' p. 255, pl. 22. fig. 18.

The shell-bearing Mollusca, to which the second volume of the 'Fauna der Kieler Bucht' is devoted, are particularly well fitted for comparisons between animals of the same species inhabiting both the North Sea and the Baltic. In all the shells are lighter than in specimens of the same dimensions from the North Sea*. Stunting occurs also in the other classes of animals. Thus at Kiel the fore part of the body of *Temora longicornis* is, on the average, only 1 millim. in length, whilst it becomes 2 millims. long in individuals from Arendal. At Kiel *Pectinaria belgica* only attains a thickness of 5 millims. in front; at Arendal this worm becomes so large that it attains a transverse diameter of 12 millims at its anterior end. Another worm, *Travisia Forbesii*, becomes 15 millims. long, and 3-4 millims. thick at Warnemunde, and 26 millims. long and 7 millims. thick (according to Rathke) on the Norwegian coast.

In the eastern basin of the Baltic the animals become far more stunted than in the western. Near Kiel *Mytilus edulis* becomes 8-9 centims. long; in the eastern basin (*e.g.* on the Stolper Bank, near Gotland, near Dularö) this mollusk only attains a length of 3-4 centims. *Mya arenaria*, *Tellina balthica*, and *Cardium edule* differ less in the eastern basin, as far as Gotland, from the individuals of the same species in the western basin, than the individuals of *Mytilus* in the two basins differ from each other. This phenomenon is due to the fact that even in the western basin these mollusca are surrounded for the greater part of the year with but slightly salt water, as they inhabit the smaller depths.

In *Mytilus edulis* and *Tellina balthica*, of the eastern basin, the calcareous layers of the shell are extraordinarily thin. After the death of the mollusk, the calcareous mass of the shell seems to disappear very speedily; for among the rocks of eastern Sweden, between Sweden and Gotland, and in the Calmarsund, we found in the clayey mud of the sea-bottom a great many cuticular membranes of *Mytilus edulis* and *Tellina balthica* most perfectly preserved. The two brown membranes were often united at the dorsal margin by the ligament, as in the perfect shell. If a sea-bottom of this kind were upheaved these cuticular shells in the clay would appear just like thin impressions of *Posidonia*, with all the curvatures and deformations by pressure with which we are acquainted in those fossils of the fine shales of secondary formations; and we should fall into a great error if we were to conclude from these bendings of the cuticular shells that the strata of clay had been bent after they were laid dry.

* See 'Fauna der Kieler Bucht,' Bd. ii. p. xvii.

By far the greater number of the Invertebrata of the Baltic are also inhabitants of the North Atlantic Ocean. Of many of them we know that they are spread into the icy polar sea, and as far as the African coast. With regard to the shell-bearing mollusca, this was demonstrated in detail in the 'Fauna der Kieler Bucht.' This wide distribution of the Baltic animals, their ability to live in warm, temperate, and cold seas, becomes intelligible when we have made ourselves acquainted with the temperatures which they have to endure in the Baltic. In the physico-chemical section of this Report it is shown by a table (xxxii.), founded upon three years' observations by Dr. H. A. Meyer, that the differences of temperature in the superficial layer rose to $14^{\circ}9-20^{\circ}$ ($=26^{\circ}8-36^{\circ}$ F.), attained $13^{\circ}3-17^{\circ}3$ ($=23^{\circ}9-31^{\circ}14$ F.) at 5 fathoms, and even at a depth of 16 fathoms still amounted to $9^{\circ}2-12^{\circ}2$ ($=16^{\circ}56-21^{\circ}96$ F.). In all the strata of the water, even in the deepest, at the coldest season, the animals of the Baltic have to endure a temperature which sinks to the freezing-point of salt water, therefore below zero ($=32^{\circ}$ F.). In summer and autumn, on the contrary, they are exposed to a pretty high temperature. The different temperatures which the individuals of a species experience in the course of a year in the Baltic are undergone *at the same time* by other individuals of the same species which live in the Mediterranean, the North Sea, and the north polar sea. *The Baltic contains only a selection of such Atlantic and Polar animals as are capable of supporting great differences of temperature.* For this reason they may be called *eurythermal** animals, in contradistinction to those animals which thrive only in warm or cold and tolerably constant temperatures, such as the tropical and exclusively arctic marine animals, both of which may on this account be denominated *stenothermal†* animals.

All the marine animals of the Baltic have further the faculty of living in sea-water containing a variable amount of salt; those Baltic animals which also occur in the Mediterranean can bear a larger amount of salt than the Atlantic ocean contains. This faculty of the Baltic animals is by no means indicated by calling them brackish-water animals; on the contrary, this expression carries our thoughts away from one of their most remarkable peculiarities; for animals which can live not only in *slightly* but also in *strongly* salt water are not brackish-water, but *euryhaline‡* animals.

A very perfectly euryhaline animal is *Hydrobia ulva*.

* From *εὐρύς*, wide, and *θερμός*, heat.

† From *στενός*, narrow, and *θερμός*, heat.

‡ From *εὐρύς*, wide, and *ἅλς*, salt.

This Gasteropod becomes developed in the slightly salt water near Gotland to the same size as in more than normally salt lakes on the shore of the North Sea.

Because the Baltic animals are eurythermal and euryhaline they are capable of living both at small and great depths and of maintaining their ground throughout long geological periods.

Among the animals catalogued there is only one true brackish-water animal, namely *Cordylophora lacustris*, a polype which lives only in very slightly salt water, and perishes both in fresh water and in water containing a larger amount of salt*.

Besides this brackish-water animal and the euryhaline animals, a number of freshwater animals live in the eastern basin. These are such as can bear slightly salt water. Nature has not succeeded in habituating them to the larger amounts of salt in the western basin, although probably she makes fresh attempts every year to diffuse freshwater animals from the mouths of rivers and brackish-water bays further into the sea. The pioneers constantly sent out, however, have been unable to force their way into the salter region. Such miscarriages of Nature in her constant forward march must render us very cautious in estimating the value of experiments made in aquaria for the purpose of habituating freshwater animals to salt water and marine animals to fresh water. I refer here especially to the recent experiments of Plateau upon *Asellus aquaticus* and some other animals†.

The number of species diminishes suddenly when we pass from the shallow and more saline western basin into the deeper and less saline eastern basin. We found most of the species of the latter at depths from 0–20 fathoms; they became fewer at 20–50 fathoms, and very few from 50–95 fathoms.

The following animals are inhabitants of the greater depths of the eastern basin:—

<i>Astarte borealis</i>	down to 46 fathoms.
<i>Tellina balthica</i>	„ 49 „
<i>Cuma Rathkei</i>	„ 49 „
<i>Idotea entomon</i>	„ 60 „
<i>Astemma rufifrons</i>	„ 50 „
<i>Nemertes gesserensis</i>	„ 60 „
<i>Halicryptus spinulosus</i>	„ 50 „
<i>Scoloplos armiger</i>	„ 46 „
<i>Terebellides Strömii</i>	„ 47 „
<i>Polynoë cirrata</i>	„ 95 „

* See p. 100 of the Report, and also E. Schultze, 'Bau und Entwicklung von *Cordylophora lacustris*,' 1871, pp. 43–48.

† Mém. Acad. Belg. 1870, and Ann. & Mag. Nat. Hist. ser. 4. vol. vii. 1871, p. 362.

Thus the Crustacea and Vermes go deepest. Bivalve mollusca were no longer found in the great depths, although organic substances still existed there, as is shown by Dr. Behrens from his investigations of samples from the bottom. As the bivalve mollusca are among those important animals which are capable of converting dead organic substances of the seabottom into living animal matter, the number of carnivorous animals must also be diminished where they are wanting, unless other mud-eaters carry out the business of the first preparation of flesh in their stead.

Our knowledge of the physico-chemical conditions of the greater depths is not sufficient to explain satisfactorily the disappearance of the animals. Besides the small amount of salt and the persistently low temperature, one of the causes of the impoverishment of the fauna in the greater depths of the eastern basin of the Baltic must be sought in the weakening of the currents which assist the change of gases and carry food with them.

The ten species which were found at depths of 46–95 fathoms are all inhabitants of higher regions. In general, the animals of the eastern basin of the Baltic, as may be seen from the list of their localities, accommodate themselves to various depths and to the most various conditions of the bottom. They possess a greater capacity of adaptation to differences in the amount of salt, in temperature, depth, and bottom, than those species which occur only in the western basin. This very pliable nature has given them the predominance over the whole eastern region; and here, therefore, they can develop into enormous multitudes of individuals without having to maintain a contest for their dwelling-place and nourishment with fresh immigrants from the west.

The species which occur in particular abundance are the following:—*Hydrobia ulvae*, *Mytilus edulis*, *Tellina balthica*, *Cardium edule*, *Palaemon squilla*, *Cuma Rathkei*, *Mysis spinulosa*, *M. vulgaris*, *Gammarus locusta*, *Pontoporeia femorata*, *Idotea entomon*, *I. tricuspidata*, *Jæra marina*, *Temora longicornis*, *Polynöë cirrata*, *Scoloplos armiger*, *Nephtys ciliata*, *Nereis diversicolor*, *Terebellides Strömii*, *Halicryptus spinulosus*, *Membranipora pilosa*, *Alcyonidium mytili*, and *Medusa aurita*.

The simultaneous production of many individuals of the same species at the same place is of importance for the nutrition of the edible fishes. As soon as these have found the dwelling-place of a great multitude of individuals of bivalve mollusca, worms, crustacea, or other eatable animals, they can feed themselves with ease. This also explains why we often find in the stomachs of fishes many animals of the same species.

A great quantity of uniform nourishment in a region is therefore favourable to the growth and fertility of fishes; and it is this that collects the fishes in particular places in such quantities that a profitable fishery can be carried on there.

The value which great quantities of animals of the same species may attain as fish-nourishment may be shown by an example. The oldest fishermen of Ellerbeck can number no year in which they took so many herrings in Kiel harbour as in the winter and spring of 1872. According to the estimates of MM. F. Holm and J. Schmidt, fish-dealers of Kiel, for three weeks, especially in January and February, 3000 *walls* of herrings (mixed with sprats) were taken daily. Each *wall* consists of 80 fishes. The contents of the stomachs of the herrings captured consisted chiefly of a small crustacean, *Temora longicornis*, the fore body of which is only 1 millim. in length. Here and there among them there was another equally small Copepod, *Dias longiremis*. Very rarely some larger crustacea (*Mysis flexuosa*, *Idotea tricuspидata*, or *Gammarus locusta*) were intermixed with the food. Very often nothing but *Temora longicornis* was to be observed in five or six samples of the contents of the stomach when examined microscopically. These little crustacea filled the stomachs of the herrings as a stiff paste of a pale reddish colour; in the intestines there was a soft red excrement, in which the legs, antennæ, and spermatophora [egg-sacs?] of the same Copepod were still recognizable. On the 28th of February I took from the stomach of a female herring, of 25 centims. length, 1.5 cubic centim. of the above-mentioned stiff *Temora*-paste, and placed it in spirits, in order to undertake subsequently an estimate of the number of animals eaten. The whole volume of the mass diluted with spirits amounted to 9 cubic centims. It was shaken up in the bottle in order to diffuse the crustaceans equally, and 1 cubic centim. of it was taken out. By counting this in portions I found in it 2130 specimens of *Temora longicornis*; this number multiplied by 9 gives 19,170 Copepods in the contents of the stomach, consisting of 1.5 cubic centim. of *Temora*-paste. This gives 12,780 specimens to 1 cubic centim. of the contents of the stomach.

A female herring, with a particularly full stomach, opened on the 24th of February, contained 4 cubic centims. of *Temora*-paste, three specimens of *Mysis flexuosa*, and one *Idotea tricuspидata*. The *Temora*-paste was diluted with spirit until the whole mass made 19 cubic centims. Of this 1 cubic centim. was poured off after the Copepods had been uniformly diffused by shaking the bottle. At my request, Dr. Bütschli counted the animals existing in it and found 3205 specimens.

$3205 \times 19 = 60,895$ was therefore the number of the Copepods devoured. 1 cubic centim. consequently contained 15,223 specimens. Counting the two ascertained numbers together and dividing them by two, we obtain 14,000 specimens as the average number in 1 cubic centim. of *Temora*-paste.

I did not find *Temora*-paste in the stomach of every herring or sprat that I opened, and in many only 1, or 0.75, or 0.5 cub. centim. But if we consider that those specimens whose stomachs contained from 1 to 4 cubic centims. of *Temora*-paste were taken quite at random from a great quantity of freshly caught animals, we shall certainly not go too far if we assume that every herring caught in Kiel Harbour had devoured 10,000 individuals of *Temora* during its sojourn there. Then, to the take of one day, of 3000 "wall," each of 80 fish, we get $3000 \times 80 \times 10,000 = 2400$ millions of individuals of *Temora longicornis*, and to the take of three weeks 43,200 millions of these little crustaceans.

That *Temora longicornis* existed in great abundance in Kiel Harbour at the time of the productive herring-fishery, was also proved by fishing with fine surface-nets. It was easy to collect many thousands of these animals. In herrings which had been taken near Eckernförde I also found many of them.

For the capture of Copepoda and other small swimming animals the herring possesses an excellent arrangement—we might say, a narrow-meshed *lobster-pot*, to which its mouth forms the entrance. This pot consists of the four branchial arches on each side, and of a close series of teeth on each arch. In herrings 20–23 centims. in length these teeth are of the following lengths:—on the first branchial arch 7–10 millims., on the second 3–4 millims., on the third 2–3 millims., and on the fourth 1.5–2 millims.; and they stand so close together that there are two teeth at least in a space of 1 millim. As these teeth are biconvex, the passages between them are much narrower than $\frac{1}{2}$ millim. In the neighbourhood of the inner margin of each tooth, or that turned towards the cavity of the mouth, there stand two rows of *spines*—one row on the anterior, the other on the posterior surface of the tooth. These spines are from 0.2–0.3 millim. from each other. As the anterior row of spines stands a little nearer the inner edge of the tooth than the posterior row, the anterior spines of each tooth overreach the posterior spines of that preceding it. The spines of neighbouring teeth also frequently push in between one another. The narrow-spaced latticework which is thus produced allows the passage of the water which is to flow over the branchial lamellæ; but small animals (down to 0.2 and 0.1 millim. in diameter) which get into the mouth of the

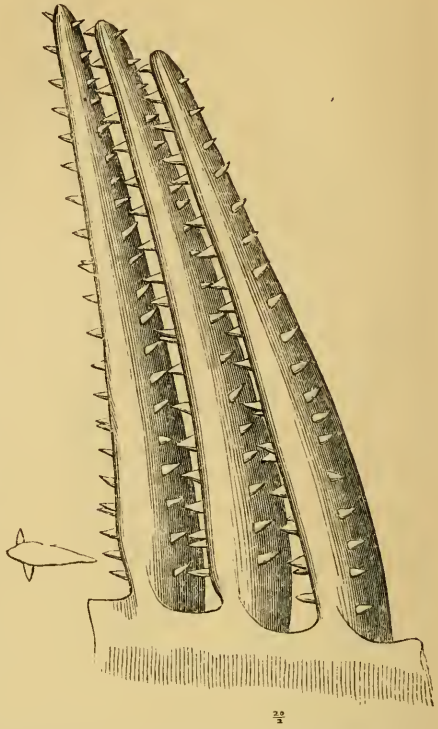
herring with the water are separated from it by this branchial basket, and accumulated at the back of the buccal cavity so as to be swallowed (*see* woodcut).

The branchial basket is constructed in the sprat exactly as in the herring.

In most other fishes which occur in abundance in Kiel Bay, such as *Belone rostrata*, *Zoarces viviparus*, *Anguilla fluviatilis*, *Platessa vulgaris*, *P. flesus*, *Gadus morhua*, *Gasterosteus aculeatus*, and *Gasterosteus spinachia*, the teeth of the branchial arches are shorter and further apart than in *Clupea harengus* and *C. sprattus*. These fishes, therefore, cannot be competitors for food with the herrings and sprats. And that

they are not so is proved by the contents of their stomachs, which usually consists of Mollusca and moderate-sized Crustacea (*Gammarus locusta*, *Mysis spinulosa*, and *Palaemon squilla*) or of small fishes, which they must seek chiefly at the bottom.

The mackerel (*Scomber scombrus*) alone is furnished with a branchial basket almost as close as that of the herring. As in the herring there are long teeth on their outer branchial arches; in a small mackerel, 18 centims. long, the longest were 8 millims. long, and 0·8 millim. from each other. At the sides also these teeth are furnished with spines, which are even longer and thinner than in the herring. The following



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three branchial arches of the mackerel, however, bear no long teeth, but an outer and inner series of tubercles with spines. By means of this latticework of teeth and spines the mackerel, like the herring, can easily filter great masses of Copepods from the water. According to A. Boeckh (Forhandl. Vid. Selsk. Christ. 1864, p. 227), the autumn mackerel on the Norwegian coast become fattened by abundant Copepod nourishment. On the east coast of Schleswig and Holstein the mackerel appears in considerable quantities only from the beginning of July to the end of September; from autumn to spring therefore, when the shoals of sprats and herrings appear here, the mackerel does not deprive them of any of their best food.

Where multitudes of food-animals occur, there also, as a general rule, multitudes of fishes collect. The herrings pursue the Copepods; and the cod (*Gadus morrhua*) follow the herrings. For a long time there had not been so many large cod taken between the fortress of Friedrichsort and the village of Labö as in the winter of 1871–72, when the herrings were so plentiful.

For carrying on the fishery, such a gathering together of great shoals of fishes belonging to the same species is of great value. Social animals of the same kind lead a similar life. They seek their food in common, become sexually mature at the same time, and collect, for the purpose of spawning, at definite spots. Thus the fisherman finds them at certain times in great numbers together, and can reckon beforehand on making a good haul with properly designed instruments of capture. But where many different species live, the fisherman cannot take an equal weight of fish with the same amount of labour, even when the sum of all the individuals in the same space is as great as the number of individuals of a single species, because each different species has a different nature, and consequently must be circumvented in a different manner. Hence, whilst the rich southern fish-fauna breaks up the work of the fishing-population and renders it less remunerative, the northern fish-fauna, which, although poorer in species, is rich in individuals, leads to a powerful and remunerative concentration of the business of fishery.

XI.—On some new Species of Stromatopora. By H. ALLEYNE NICHOLSON, M.D., D.Sc., F.R.S.E., &c., Professor of Natural History in University College, Toronto.

[Plate IV.]

THE affinities of the singular genus *Stromatopora* have always been more or less uncertain, though there has been a general

tendency to regard the genus as being referable either to the Foraminifera or to the sponges, or as constituting a connecting link between these two orders of Rhizopoda. In the present communication I propose to describe four new species of the genus from the Silurian and Devonian formations of Western Canada, all of which show certain points of relationship to the Spongiida which have not been noticed in the species already recorded by palæontologists.

1. *Stromatopora ostiolata*, Nich. Pl. IV. figs. 1, 1 a.

Spec. char. Fossil forming large hemispherical masses, several inches in diameter, composed of innumerable delicate laminae, arranged concentrically, and separated by interspaces which are broken up by numerous slender vertical pillars, giving the whole a finely reticulate structure. The laminae are as thin as writing-paper; and, with the intervening interspaces, there are about ten of them in the space of one line. The upper surface of the mass is undulated and is quite smooth, except for the presence of small rounded or conical elevations, perforated at the apex with rounded openings (Pl. IV. fig. 1 a) and arranged with tolerable regularity in diagonal lines. These elevations have a width of about half a line, and appear to be of the nature of exhalant apertures or oscula. The lines of oscula are placed at distances apart of from four to five lines; and the oscula in each line are about the same distance from one another. When the mass is broken, similar osculiferous surfaces are found to exist throughout the whole, arranged concentrically with one another, and separated by spaces varying from two to three lines in thickness, these spaces being occupied by the ordinary laminated or reticulated tissue of the fossil. Laterally the laminae and osculiferous surfaces, instead of being concentrically arranged as regards the entire mass, terminate in a series of rounded, nipple-shaped prominences, each of which is composed of thin concentric laminae which scale off like the coats of an onion. The lateral surfaces of the fossil thus come to exhibit an extraordinary nodulated and botryoidal appearance (Pl. IV. fig. 1).

It is impossible to give in a few words any adequate diagnosis of this most remarkable fossil, which appears to throw considerable light upon the affinities of the genus *Stromatopora*, if, indeed, it does not truly constitute a new genus. In the fact that its main bulk consists of a succession of thin calcareous laminae, with intermediate vertical props, pillars, or dissepiments, marking off minute cellular compartments, *S. ostiolata* agrees entirely with the typical species of *Stromatopora*; and in the great number of laminae in a given space it closely

resembles *S. striatella*, D'Orb. It exhibits, however, two peculiarities which, so far as I am aware, are altogether unique.

In the first place, it is not composed, as are *S. striatella*, D'Orb., and *S. concentrica*, Goldf. (which it most nearly resembles in general form), of a succession of laminae concentrically arranged round an imaginary centre or centres. On the contrary, in the present species, intercalated amongst the general enveloping concentric laminae of the mass is a series of cylindrical masses, each composed of laminae concentric with its long axis, and each terminating (probably at both ends, though this is not shown) in a rounded nipple-shaped extremity. Superiorly these laminated cylinders are enveloped by laminae which are concentric to the whole mass, so that the outermost surface is simply undulating. On two of the sides of the fossil the ends of the above-mentioned cylinders protrude as so many nipple-shaped conical prominences, giving these aspects of the mass very much the appearance of the peculiar inorganic structure known as "cone-in-cone."

In the second place, a still more remarkable feature is presented by the upper surface of the fossil. The specimens are so highly mineralized (as is always the case with the fossils of the dolomites of the Guelph formation) that the smooth undulating upper surfaces of the laminae exhibit no structure that can be made out with the lens. If any pores existed, as is most probable, they cannot now be detected. The upper surface, however, exhibits tolerably regular diagonal lines of small conical papillae, some of which at any rate are unmistakably perforated by rounded apertures. It is true that some of these eminences do not show any sign of being perforated; but this is probably, indeed almost certainly, due to the peculiar condition of mineralization of the fossil. The perforated eminences are distant from two to four lines from one another; and the diagonal rows stand about as far apart. The appearance presented by the upper surface, with its perforated papillae, thus comes to simulate somewhat the root of a fossil plant like *Stigmaria*, with the points whence the rootlets proceeded. The eminences themselves are but slightly elevated above the general surface; and the apical aperture has a diameter of about one thirtieth of an inch. Not only does the outermost or highest lamina of the fossil exhibit the above appearance, but the same structure reappears at intervals of two to three lines all through the mass, each surface being concentric with the preceding one, and separated from it by reticulated tissue. It is probable, therefore, that we should regard the fossil as really consisting of thin crusts, which are only accidentally superimposed one above the other.

A structure apparently analogous to the above has been described (M'Coy, Pal. Foss. pp. 12 & 65) as occurring in *Stromatopora striatella*, D'Orb., *S. concentrica*, Goldf., and *S. (Caunopora) placenta*, Phill. In the first of these, according to M'Coy, the general laminated structure of the mass is traversed nearly at right angles by "vertical vermicular perforations about one fourth of a line in diameter," at distances varying from one to two lines apart; and essentially the same thing is seen in the other two species above mentioned. In the present species, however, there is no evidence that the apertures on the surfaces of the successive osculiferous layers communicate internally with vermicular tubes, though it is possible that they do; whilst the apertures are placed at the summit of small rounded or conical elevations, and are comparatively remote and large.

It can hardly be doubted that the perforated eminences of *Stromatopora ostiolata* correspond with the "oscula" of the genuine sponges. Indeed the surface of this species reminds one very strongly of the well-known genus *Porospongia* or *Manon*. The probability that *Stromatopora* is truly referable to the Calcispongiæ is thus rendered stronger than it would have appeared from the evidence formerly in our possession. If, however, it should be found that these oscula are not present in all the species at present referred to *Stromatopora* (and they have certainly not hitherto been recognized in the majority of forms), then it might be advisable to divide the genus into two, retaining *Stromatopora* for the species without oscules, and forming a fresh genus for those in which these apertures are present. The former would thus be nearly allied to the Foraminifera, whilst the latter would lead from the Foraminifera to the Calcispongiæ.

The specimens of *Stromatopora ostiolata* from which the above description was taken were presented to the Museum of the University of Toronto by their discoverer, Mr. John Wilkie. The species itself cannot possibly be confounded with any previously described form.

Loc. and Form. In the yellow crystalline dolomite of the Guelph formation (Middle Silurian), Guelph, Ontario. Associated with numerous specimens of *Stromatopora concentrica*, Goldf.

2. *Stromatopora tuberculata*, Nich. Pl. IV. figs. 2, 2 a.

Spec. char. Fossil forming crusts of varying thickness and often covering large surfaces, composed of numerous concentric calcareous laminae, separated by delicate calcareous rods or

pillars, which are disposed at right angles to the laminæ and mark off minute cellular compartments or interspaces. The laminæ and intervening spaces are about five in the space of a line; and the vertical pillars are comparatively strong, and placed at proportionally remote intervals. The upper surface of the mass (Pl. IV. fig. 2) is more or less strongly undulated, and is covered with close-set, conical, clavate, or fungiform tubercles, the elevation of which is about one twenty-fifth of an inch above the general surface. The tubercles appear to be sometimes perforated, but are more commonly imperforate, and they are placed in irregular sinuous lines. They are separated from one another by about their own width (more or less), one twenty-fifth of an inch. Where this fossil is broken it is seen that similar tuberculated surfaces occur at various depths in the mass, concentric with one another, and separated by laminated and reticulated tissue.

This singular species is readily distinguished by its very coarse reticulation (coarser than in any other species of *Stromatopora* with which I am acquainted), and by the tuberculated nature of the surface. There is no proof that the vertical pillars which separate the different laminæ of the mass are hollow; and there is reason to believe that they are certainly solid. As a rule, also, no perforations can be detected in the surface-tubercles; and the true nature of the latter is thus rendered a matter of question. In some specimens, however, the tubercles appear to be distinctly perforated at their apices. Many examples exhibit rounded openings or tubes, from half a line to a line in diameter, descending at right angles to the mass, and placed at varying intervals. These openings are not elevated above the general surface. They are not constant in their occurrence, though very generally present; and I have not been able to satisfy myself that they are not truly extraneous to the fossil. They may, perhaps, be annelidous in their nature; or they may be due to the fact that the organism has enveloped a colony of *Syringopora*, which has subsequently been dissolved away. In one specimen the crust seems to have been supported upon a wrinkled calcareous base, very similar to the epitheca of *Favosites gothlandica*. The crusts vary in thickness from three or four lines to two inches or more; but the latter specimens are to be regarded as being composed of a succession of crusts superimposed, the younger upon the older.

Loc. and Form. Common in a silicified condition in the Corniferous Limestone (Devonian) of Ridgeway and Port Colborne, on the north shore of Lake Erie, Canada West. Collected by the author.

3. *Stromatopora granulata*, Nich. Pl. IV. figs. 3, 3 a.

Spec. char. Fossil forming thin crusts (usually about half an inch in thickness), often occupying very extensive surfaces. Composed of concentric calcareous laminæ, about ten in the space of a line, separated by interspaces which are minutely broken up into cells by numerous delicate vertical rods. Surface regularly undulating, often raised into chimney-like or conical elevations, which, however, are never perforated. The entire surface is covered with a fine miliary granulation, constituted by minute conical pustules, placed close together, about one hundredth of an inch apart, and apparently imperforate. Exfoliated and broken specimens show that similar granulated surfaces occur at small intervals throughout the crust.

Stromatopora granulata is nearly allied to *S. tuberculata*, from which, however, it can be readily separated, even in small fragments. It is recognized by the much finer reticulation of the laminæ and vertical rods (Pl. IV. fig. 3 a), and by the minute crowded tubercles which cover the whole surface being so closely placed as to be often nearly in contact. Though many of the specimens show larger or smaller crateriform elevations, I have been unable to detect any perforations or apertures in the surface. Usually the surface-layers exfoliate round numerous points, giving the upper surface of the fossil quite a characteristic appearance, which is wanting in *S. tuberculata*. One specimen observed by me covered a slab about three feet in length by two feet in width, with an average thickness of about half an inch.

Loc. and Form. Not uncommon in a silicified condition in the Corniferous Limestone (Devonian) of Port Colborne and Savage's Quarry, Wainfleet, on the north shore of Lake Erie, Canada West. Collected by the author.

4. *Stromatopora mammillata*, Nich. Pl. IV. fig. 4.

Spec. char. Fossil forming thin crusts, about two or three lines in thickness, often covering extensive surfaces. Crust composed of successive concentric calcareous laminæ, separated by interspaces, broken up by vertical rods. Surface undulating, and exhibiting a series of large conical elevations, about one fifth of an inch in height and the same in diameter at the base, placed at distances apart varying from one fifth of an inch to half an inch. Most of these conical elevations show no signs of being perforated; but some appear to have apertures at their summits. The surface between these elevations is roughened by small tubercles and irregular ridges.

Nothing could be more distinct than the aspect of this very

remarkable species, the large conical elevations which cover its surface giving it exactly the appearance of an undulating plain covered with numerous small volcanos. Superficially examined, it presents a striking resemblance to many recent sponges; but I have not been able to satisfy myself that the conical elevations just alluded to are really of the nature of oscula. Some of them certainly look as if they were perforated; but most show no signs of any aperture. This may be due to the manner in which the fossil has been preserved; but I cannot speak positively upon this point. The internal structure of all the examples which I possess of this species is much more imperfectly preserved than is the case with the other species here described, and I have simply been able to satisfy myself that it is essentially the same as is characteristic of *Stromatopora* in general. I have seen crusts of this species covering an area of several square feet; but it is by no means common in its occurrence.

Loc. and Form. Rare, in a silicified condition, in the Corniferous Limestone (Devonian) of Port Colborne, on the north shore of Lake Erie, Canada West. Collected by the author.

5. *Stromatopora concentrica*, Goldf.

Besides the preceding three species I have found in the Corniferous limestone of Canada specimens which are undistinguishable from *Stromatopora concentrica*, Goldfuss. As, however, none of these specimens exhibit their surface it cannot be positively asserted that they belong to this familiar Devonian species.

EXPLANATION OF PLATE IV.

Fig. 1. Fragment of *Stromatopora ostiolata*, Nich., natural size.

Fig. 1 a. Fragment of the same, enlarged, to show the oscula on the surface.

Fig. 2. Fragment of *Stromatopora tuberculata*, Nich., natural size.

Fig. 2 a. Lateral view of a fragment of the same, enlarged, to show the reticulate structure.

Fig. 3. Fragment of *Stromatopora granulata*, Nich., natural size, showing the granulated surface.

Fig. 3 a. Lateral view of a fragment of the same, enlarged to show the reticulate structure.

Fig. 4. Fragment of *Stromatopora mammillata*, Nich., natural size.

XII.—*A Sphæromid from Australia, and Arcturidæ from South Africa.* By the Rev. THOMAS R. R. STEBBING, M.A.

[Plate III. A. figs. 1-3 a.]

THE crustaceans described in this paper presented themselves among the sand and fragments shaken in transit from a variety

of sponges and gorgonias sent me by Mr. Wilson Saunders. The Sphæromid, shown in fig. 1, occurred in a collection from Swan River, S.W. Australia; the Arcturidæ, figs. 2 and 3, in one from Fort Elizabeth, Algoa Bay, South Africa. Fig. 1 appears to be a *Cymodocea*; it has the setose tail and tail-appendages of that genus, the tail-piece terminating in a deep notch, occupied by a produced central plate or lobe. The body is very convex, with the sides parallel; the flagella of both pairs of antennæ are multiarticulate; the branches of the tail-appendages do not close one under the other.

The species would be appropriately named *Cymodocea tuberculosa*; for though the first segment of the pereion is smooth and marbled, the five following segments are adorned and almost covered with rows of shining tubercles. Tubercles can be detected among the matted hairs of the pleon and uropoda; and notably a row of three is conspicuous on the lobe which runs out into the notch at the end of the tail-piece. The branches of the uropoda have a pair of smooth shining tips at the extremity of each. The head, which is nearly as broad as the body, is long and sloping; its frontal border has two small nostril-like prominences in the centre; a lower frontal margin is adorned with ten teeth or turrets, divided into two sets of five, and exhibiting between them a still lower frontal plate with two shining lobes. The colour of the mouth is red, of the claws brown. The length of the animal is rather under half an inch; but, in spite of the small size, the beauty of the details makes it an object of considerable interest.

Fig. 2 represents an animal of still more remarkable appearance, which pretty clearly belongs to the genus *Arcturus* of Latreille, a genus described by Spence Bate and Westwood as "remarkable among the *Isopoda* for its slender cylindrical form, the length of its lower pair of antennæ, and the delicate ciliated structure of the four anterior pairs of legs, whilst the hind ones are short and very robust." Our African species agrees with all these details, except that the bulging character of the fourth segment of the pereion is scarcely consistent with such a description as "a slender cylindrical form." It still seems an open question whether the British *Arcturi* ought not to be separated from *A. Baffini*, the type of the genus, which has the fourth segment of the body scarcely longer than the others, and the lower antennæ terminated by multiarticulate flagella. Were the genus *Leacia* or *Leachia* revived to receive them, the species now under consideration would join them in it, its fourth segment having a very conspicuous development, and the lower antennæ bearing three-jointed incurved flagella like those of our British species. Meanwhile

it may be described as *Arcturus corniger*, taking its specific name from its numerous horn-like protuberances, seven of which surmount as many separate segments; while the fourth segment carries no less than six cone-like swellings, the two largest of which are on the median line of the back, the front one being preceded, and the hinder one in like manner followed, by a smaller flanking pair of heights.

The upper antennæ extend only as far as the second joint of the lower ones; they are slender and apparently three-jointed, the last articulation being the longest and ending obtusely. The lower antennæ are stont, and equal in length to half that of the rest of the animal: the second joint is notched; the fourth joint is considerably the longest; the third and fifth are also long and about equal in size. The eyes are prominent. The marsupial pouch of the fourth segment has a row of tubercles just below the hinge-line; and in the rear of this, three small apertures are visible in the ventral surface.

The Rev. A. M. Norman kindly informs me that the drawing of this species which I sent him comes near to *Leachia nodosa* of Dana, but that he should hesitate to unite the species on the evidence of the figures which he has seen, the spiny processes on the segments being somewhat differently arranged.

Of fig. 3 four specimens occurred, obviously belonging to the same genus as fig. 2. Three of these had masses of red granular matter clinging to the lower surface; but whether this consisted of the eggs or of some extraneous substance it is not easy to say. All these four lie flat, in a posture very different from the strange angularity shown by *Arcturus corniger* in common with our British *Arcturidæ*: neither do they possess any remarkable protuberances; the segmentation, however, is the same. The anterior legs are slender and ciliated, the three hinder pairs being stout by comparison, though not absolutely very robust. The upper antennæ extend beyond the second joint of the lower, and terminate in a point. The lower antennæ display a prominent angle on the second joint; the third and fourth joints are each respectively longer than those which precede them; the fifth is not quite so long as the fourth. The fourth segment of the body, viewed from above, is coffin-shaped, and has two small tubercles on the median line. The eyes are prominent. The whole length, antennæ included, is about half an inch. The colour of the specimens is a more or less purplish brown, closely speckled all over with dark spots. *Arcturus lineatus* may be offered as a specific name for these creatures, as they seem to hold

themselves with body, tail, and antennæ all in one line, instead of assuming the angular prancing attitude of their congeners.

A fifth specimen differs from the other four in having the head wider and the fourth segment of the body much narrower, and in being without any dark markings on the skin. This is probably the male.

EXPLANATION OF PLATE III. A. figs. 1-3 a.

Fig. 1. *Cymodocea tuberculosa*; 1 a, underside of tail-piece; 1 b, leg.

Fig. 2. *Arcturus corniger*.

Fig. 3. *Arcturus lineatus*; 3 a, one of the upper antennæ.

XIII.—On a new Species of Cellepora.

By EDWARD PARFITT, Esq.

[Plate III. B. figs. 1-6.]

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

GENTLEMEN,

I beg to introduce to you a new species of *Cellepora* discovered by me at Exmouth in the autumn of 1872, a description and figures of which I enclose. I have named it *Cellepora hemisphærica*, from the cells forming little hemispherical masses. It appears to be perfectly distinct from any thing I can find, either amongst the fossil or recent species.

I am, Gentlemen,

Yours obediently,

EDWARD PARFITT.

Exeter, June 11, 1873.

Cellepora hemisphærica, n. sp.

Cells heaped together irregularly into, generally speaking, hemispherical masses; mouth simple, elliptical; cells variously formed, but generally ovate, white, shining, and thickly perforated; sometimes they are very much inflated, and in other specimens they are more or less depressed; many of the cells are mouthless, or open into other contiguous cells. Avicularium or vibraculum very rarely developed: I have only seen one; and this, I think, was abnormal, as it was in the back of the cell. Ovicell —? Animal —?

The minute masses of cells are attached by the somewhat flattened underside to the branches of *Sertularia abietina*: the edges of the mass slightly curve, so as to fix themselves firmly to the branch; they measure generally about one 25th of an inch in diameter.

The mouths of the cells are generally placed so as to come between two other cells, and they are so pressed down as to be discovered with difficulty; and it frequently happens that no mouth can be discovered over the whole upper surface, but one or two may be found on the edge of the mass.

The arrangement of the cells, if arrangement it can be called, reminds me more of *Cellepora informata*, a Miocene species described by Lonsdale in the first volume of the 'Quarterly Journal of the Geological Society,' p. 506. The form of the cells, and their heaping together and being foraminated, gives a certain resemblance to them; but in the fossil rather regular layers of cells can be traced, similar to those in old specimens of *C. pumicosa*, while in the recent species we have in view they are so minute that I cannot satisfy myself on this point.

Large masses of *Sertularia* were cast ashore last autumn and winter on the beach at Exmouth. I collected a good many of them, and on some I discovered this species; they are principally on the lower branches of the Sertularian. I shall send specimens to the British Museum.

EXPLANATION OF PLATE III. B. figs. 1-6.

Fig. 1. Groups of cells, natural size.

Fig. 2. Enlarged.

Fig. 3. Removed from the Sertularian.

Figs. 4, 5. Front and lateral views of cells.

Fig. 6. The beginning of a group with four cells, mouthless, or opening into a common elongated cell.

XIV.—*Descriptions of new Species of Fossorial Hymenoptera in the Collection of the British Museum.* By FREDERICK SMITH, Assistant in the Zoological Department, British Museum.

[Continued from p. 55.]

Family Crabronidæ.

Genus TRYPOXYLON, Latr.

Trypoxylon vagum.

Female. Length $5\frac{1}{2}$ lines. Black, adorned with golden pubescence; abdomen pale testaceous at the base. Head opaque; the face and clypeus with silvery pubescence, that above the insertion of the antennæ and in the sinus of the eyes has a golden lustre; the cheeks silvery; the mandibles and the apex of the scape ferruginous. Thorax: the antero

margin of the prothorax transverse and elevated, the posterior margin fringed with golden pubescence; the mesothorax smooth and shining, its lateral and posterior margins with golden pubescence; a band of golden pubescence crosses the postscutellum from the insertion of the posterior wings; the sides of the metathorax, which is smooth and shining, with pale golden pubescence; the tibiæ and tarsi ferruginous, the posterior pair more or less fuscous; the tips of the femora and the underside of the posterior pair ferruginous; wings subhyaline, with a fuscous cloud in the marginal cell. Abdomen: the first and second segments above, the base of the third, and the apical margins of the following segments narrowly pale testaceous; beneath, entirely testaceous, with a few irregular fuscous stains, and covered thinly with a fine changeable golden pubescence.

Hab. St. Paulo.

Trypoxylon superbum.

Female. Length 6 lines. Head and thorax black, and adorned with bright golden pubescence; abdomen and legs pale rufo-testaceous. Head: the face and clypeus covered with bright golden pubescence; the cheeks with a changeable pale golden pile, which, in certain lights, has a silvery brilliancy; the palpi and mandibles testaceous yellow, the latter rufo-piceous at their apex; the scape, and four or five of the following joints of the antennæ, ferruginous. Thorax: the prothorax and tegulæ pale ferruginous, the posterior margin of the former, the margins of the mesothorax, the postscutellum, and the metathorax adorned with bright golden pubescence; at the base of the metathorax is a subtriangular space covered with very short pubescence, or golden pile; the sides of the thorax and also beneath clothed with changeable fine golden pile, which, on the pectus, has a silvery lustre; wings flavo-hyaline and iridescent, the nervures ferruginous. Abdomen: the apical margins of the segments usually more or less black, sometimes rufo-piceous, and in some examples only faintly coloured with darker ferruginous.

Hab. Ega.

Trypoxylon rugifrons.

Female. Length $6\frac{1}{2}$ lines. Head and thorax black, and adorned with golden pile; the abdomen and legs pale ferruginous. Head: an ovate space on the face, below the anterior stemma, rugose; the head otherwise covered with pale golden pile, that on the cheeks and clypeus having a silvery brightness in certain lights; the scape and two basal joints of the fla-

gellum of the antennæ, as well as the mandibles, ferruginous. Thorax smooth and shining, and more or less covered with pale golden pubescence; the mesothorax, the scutellum, and metathorax usually destitute of pubescence; a deep longitudinal sulcation at the base of the metathorax, from which a groove runs down to its apex; wings flavo-hyaline, the nervures ferruginous. Abdomen smooth and shining, with the petiole more or less obscure at the base.

Hab. Ega.

Trypoxylon levifrons.

Female. Length $6\frac{1}{2}$ lines. Head and thorax black, and adorned with golden pile. Coloured the same as *rugifrons*, with these differences: the two apical joints of the antennæ ferruginous, and the petiole of the abdomen not discoloured. The specific differences are, that the space below the anterior stemma is covered with delicate shallow punctures, and it has a central longitudinal channel which terminates in a slightly raised tubercle above the insertion of the antennæ; the metathorax has no sulcation at its base, but has a central, broad, slightly impressed channel, which runs from its apex upwards, stopping short one third of its length before the base.

Hab. Ega.

Trypoxylon fabricator.

Female. Length $5\frac{2}{3}$ lines. Black, smooth and shining, with the basal margins of the second and third segments of the abdomen rufo-testaceous. Head: the clypeus, lower part of the cheeks, and the sinus of the eyes clothed with golden pubescence; the mandibles, base and apex of the scape, and the first joint of the flagellum at its apex, and also beneath, rufo-testaceous; the defined space in front of the anterior ocellus with a few irregular shallow punctures; from its anterior margin an elevated carina runs down to the insertion of the antennæ. Thorax: the margins of the pro- and mesothorax with golden pubescence; the sides of the metathorax have a paler pubescence; at its base is a deep central sulcation, which is indistinctly and transversely striated; the oblique truncation has a second broad groove, which runs to the apex; wings hyaline and iridescent, the nervures black; the articulations of the legs are pale; the anterior tibiæ and tarsi palest; the basal joint of the intermediate tarsi white at the base.

The male closely resembles the other sex, but has the defined space on the front rugose; the legs are darker, and the transverse striation on the metathorax is stronger.

Hab. Ega; Catagallo (Brazil).

Genus CRABRO, Fabr.

Crabro nasicornis.

Female. Length 3-3½ lines. Black, with yellow markings; the clypeus covered with bright silvery pubescence, and having an acute tooth in the middle of its anterior margin. Head large, subquadrate, and a little wider than the thorax; the cheeks covered with silvery pile; the scape of the antennæ bright yellow; the mandibles yellowish white. Thorax: the collar, tubercles, an ovate spot on each side of the scutellum at its base, and another which is united to it at its side, yellow; the wings hyaline and iridescent; the nervures black; the tegulæ honey-yellow; the coxæ and femora beneath yellowish white; the tibiæ pale ferruginous; the tarsi whitish; the femora above, and the intermediate and posterior tibiæ outside, rufo-piceous, sometimes blackish. Abdomen: the apical margins of the segments narrowly rufo-piceous; the basal margins have on each side a yellow fascia, which widens into a large macula at the extreme lateral margins; the apical segment canaliculated and bright ferruginous; beneath, the second segment is usually almost entirely yellow, and the third has two pale yellow spots; the markings beneath are variable in the three examples examined, as is also the colouring of the legs in its intensity.

Hab. Ega; St. Paulo.

Crabro pugnans.

Female. Length 2½ lines. Black; head and thorax marked and spotted with yellow. The scape of the antennæ, the palpi, and mandibles yellow; the flagellum fulvous; the clypeus covered with bright silvery pubescence; a longitudinal groove along the outer margins of the eyes, which is filled with silvery pubescence. Thorax: the collar, tubercles, an ovate spot at the lateral angles of the base of the scutellum, two curved lines on the metathorax laterally, immediately behind the insertion of the wings, yellow; the metathorax coarsely rugose; the mesothorax shining, and finely and closely punctured; wings subhyaline, iridescent, and with the nervures black; the tibiæ and tarsi yellow. Abdomen smooth and shining; the fifth segment with a fine cinereous pile; the apical segment ferruginous.

Hab. Para.

Crabro megacephala.

Female. Length 2¼ lines. Black; head very large, rather wider than the thorax, and oblong-quadrate. Head: the scape

of the antennæ and a line at the base of the mandibles yellow, the latter otherwise ferruginous; the flagellum fulvous. Thorax: the collar, tegulæ, two ovate spots on the scutellum laterally, and a line united to them, running up to its base, as well as the postscutellum, yellow; the legs yellow, with the posterior femora rufo-testaceous; wings hyaline and iridescent, with the nervures fusco-ferruginous. Abdomen: an ovate yellow spot on the second, third, and fourth segments laterally, close to the outer margins.

Hab. Para.

Crabro carinatus.

Female. Length 4 lines. Black; head and thorax marked with yellow; abdomen fasciated with the same. Head large, subquadrate above, and rather wider than the thorax; ocelli in a curve; the clypeus with silvery pubescence, and the cheeks with bright, changeable, silvery pile; the scape of the antennæ and a line at the base of the mandibles yellow. Thorax: the collar, tubercles, a line at the base of the scutellum, the postscutellum, and all the tibiæ in front yellow; the legs sometimes rufo-piceous; the mesothorax with two elevated abbreviated carinæ on the disk anteriorly; the disk rugose; the metathorax with a deep, central, longitudinal channel; the enclosed space at its base obliquely rugose; the truncation with shallow, transverse, coarse striæ; wings flavo-hyaline, the nervures pale ferruginous. Abdomen: the first segment strongly punctured, the second less strongly so, the following impunctate; the segments margined posteriorly, and with broad yellow fasciæ, which extend over the margination; the first segment without a fascia; the apical segment yellow and canaliculated.

Hab. St. Paulo; Ega.

Crabro sculpturatus.

Female. Length $5\frac{1}{3}$ lines. Black; the scape of the antennæ, scutellum, postscutellum, and legs beneath yellow. Head as wide as the thorax; ocelli in a triangle; coarsely rugose with confluent punctures; clypeus sharply carinate and densely covered with silvery pubescence. The anterior margin of the prothorax elevated into a sharp carina, which terminates laterally in an acute tooth; the anterior portion of the mesothorax, before the insertion of the wings, coarsely sculptured with divergent striæ or grooves; the posterior portion with oblong longitudinal punctures disposed in rows; the metathorax with a coarse reticulation, composed of large shallow punctures; at the sides it has an oblique coarse stria-

tion; the rest of the thorax beneath has large shallow punctures; the tarsi pale yellow, with the apical joints black; wings subhyaline, nervures fuscous. Abdomen: the basal segment strongly punctured, with its apical margin opaque and finely shagreened; the second, third, and fourth segments are transversely and evenly striated at their base; the middle portion is strongly punctured, and the apical is shagreened; the following segments are smooth and shining; the fifth segment has a few punctures at its apical margin, and the terminal segment is canaliculated and punctured, and has a tuft of golden setæ on each side; beneath, smooth and shining, the second segment having, on each side, a large ovate space, which is semiopaque, and covered with fine, thin, hoary pile.

Hab. Ega.

This species belongs to St. Fargeau's subgenus *Ceratocalus*, and is a most remarkably sculptured insect.

Crabro dentatus.

Female. Length $3\frac{3}{4}$ lines. Black, with yellow markings; a stout tooth in the middle of the anterior margin of the clypeus, and a smaller one on each side at the lateral angles; the cheeks have also a sharp tooth at their lower posterior angles. Head large, subquadrate, and wider than the thorax; the ocelli in a curve on the vertex; the scape and mandibles yellow, the latter rufo-piceous at their apex; the flagellum fulvous. Thorax: the collar, tubercles, two spots on the scutellum and another on each side of it, which unite with the former ones, and the postscutellum yellow; the anterior legs reddish yellow; all the coxæ, the intermediate and posterior legs yellow; all the femora above, and the posterior pair with a line beneath, black; the semicircular space beneath the postscutellum with coarse, divergent, longitudinal grooves; wings hyaline and iridescent, with the nervures fuscous. Abdomen subpetiolate; the basal margins of the segments more or less rufo-testaceous laterally; the second segment beneath, and the apical margins of the other segments, rufo-testaceous.

Hab. Para.

Crabro verticalis.

Female. Length 3 lines. Black; two large, yellow, ovate spots on the scutellum, and two smaller spots on the postscutellum; abdomen petiolate. Head: the posterior margin of the vertex raised, forming a transverse carina which terminates laterally in a small tubercle; the ocelli in an equilateral

triangle; the scape in front and the mandibles yellow, the latter ferruginous at their apex; the flagellum fulvous beneath; the palpi pale testaceous; the lower part of the face and the clypeus covered with bright silvery pubescence. Thorax: the collar, tubercles, anterior and intermediate tibiæ and tarsi, and all the femora at their apex yellow; the posterior tibiæ spinose externally, and their calcaria pale ferruginous; the wings hyaline and iridescent, with their nervures fuscous; the tegulæ testaceous; two yellow spots on the scutellum, and also *two* on the postscutellum. Abdomen shining, and thinly covered with a fine, pale, sericeous pile.

Hab. St. Paulo (Brazil).

Family Philanthidæ.

Genus CERCERIS, Latr.

Cerceris reversus.

Male. Length $3\frac{1}{2}$ lines. Black, with yellow spots and bands above; beneath yellow, with black markings. Head: the face, clypeus, mandibles at their base, and the scape of the antennæ in front yellow; the flagellum fulvous beneath. Thorax: an interrupted line on the collar, the tegulæ, scutellum, postscutellum, and the metathorax yellow; the latter with an abbreviated black line that runs halfway up from its base; and at its base a minute triangular black space, with a yellow dot in the middle; wings subhyaline, iridescent, and with a fuscous stain along the anterior margin of the fore wings; the legs are yellow beneath, except the posterior femora, which are only so at their base; an irregular-shaped yellow spot in the middle of the pectus; the anterior and intermediate tarsi yellow, the posterior pair fuscous. Abdomen: the first segment, a line on the posterior margin of the second laterally, and an entire fascia on that of the four following segments, with the seventh entirely, yellow; beneath yellow, with narrower black fasciæ.

Hab. Para.

Cerceris pullatus.

Female. Length $4\frac{1}{2}$ lines. Black; the wings fuscous; the legs varied with yellow. Head: the sides of the face, below the insertion of the antennæ, yellow; the clypeus black, its anterior margin slightly emarginate, and produced at the angles into a short acute tooth; the lower part of the face, on each side of the clypeus, with a bright silvery pubescence; the scape, and two basal joints of the antennæ, and the underside

of the other joints, ferruginous; mandibles ferruginous, with a yellow spot at their base. Thorax: an interrupted line on the postscutellum and the tegulæ reddish yellow; wings fusco-hyaline, with a dark fuscous stain along the anterior margin of the superior pair; the anterior legs ferruginous; of the other pairs the tibiæ and tips of the femora beneath are yellow, the posterior tibiæ being more or less black; the basal joint of the tarsi white, the other joints more or less rufo-fuscous. Abdomen: a minute spot on the basal segment and the apical margins of the second, fourth, and fifth segments with narrow yellow fasciæ. The insect covered with strong confluent punctures.

Hab. St. Paulo.

The markings of this species are evidently variable: of two examples only, one has a minute yellow spot behind the eyes, and also a very narrow interrupted line on the collar.

Cerceris modestus.

Female. Length $4\frac{1}{3}$ lines. Black, and adorned with bright yellow markings. Head: a yellow line at the inner margins of the eyes, widening towards the base of the clypeus, which is also yellow and elevated; the base of the mandibles and a spot behind the eyes yellow; the antennæ fulvous beneath. Thorax: the collar, a spot beneath the wings, the tegulæ, scutellum, two spots on the postscutellum, and another on each side of the metathorax above yellow; wings hyaline, iridescent, and with a dark fuscous stain in the marginal cell, which extends to the apex of the wings; the nervures dark fuscous; the tibiæ with a yellow line outside; the legs dark rufo-piceous. Abdomen: the second segment yellow, except its extreme base; the apical margins of the other segments yellow, the apical one entirely so. The head and thorax strongly punctured, the abdomen sparingly so.

Hab. Ega.

Cerceris nigriceps.

Female. Length 4 lines. Head black, and also the three apical segments of the abdomen; otherwise of a reddish yellow. Head: the face yellow, and with a pale golden glittering pubescence; a short conical tubercle at the base of the clypeus; mandibles yellow, with their tips black; the scape and four basal joints of the antennæ ferruginous, the following joints ferruginous beneath. Thorax: the postscutellum yellow; the tarsi and front of the tibiæ and femora, as well as the coxæ beneath, yellowish; wings subhyaline, iridescent, and with a fuscous stain along the anterior margin of the front wings;

the nervures fusco-ferruginous. Abdomen: the apical margins of the segments yellow. The insect covered with confluent punctures.

Hab. Para.

The colour of this species will probably be found to vary in being more or less red, and also in the amount of pure yellow with which it is variegated. It is unique in the National Collection.

Cerceris ruficeps.

Female. Length $4\frac{1}{2}$ lines. Head red, with the face and clypeus yellow; thorax and abdomen black, and spotted and banded with yellow. Head: the scape yellow in front, ferruginous behind; the four basal joints of the flagellum ferruginous, the following are only so beneath; the mandibles ferruginous, with their apex black; a large black spot on the vertex, enclosing the ocelli. Thorax: the collar, two spots beneath the wings, the tegulæ, a minute spot on each of the scutellum, and the postscutellum yellow, and more or less tinged with ferruginous; wings fusco-hyaline and iridescent; the costal nervures and the stigma pale ferruginous, the rest of the nervures dark fuscous; the legs ferruginous and more or less variegated with yellow; the posterior tibiæ and femora blackish within. Abdomen: a broad yellow margin on the basal segment, edged with ferruginous; the second and fifth segments with a narrow white fascia near their apical margins. The insect covered with confluent punctures.

Hab. St. Paulo.

Genus TRACHYPUS, Klug.

Trachypus disjunctus.

Male. Length $5\frac{3}{4}$ lines. Black, variegated with yellow and white. Head shining on the vertex, which is covered with large confluent punctures; the face more closely and finely punctured, and covered with silvery pubescence; the clypeus and cheeks with long fulvous pubescence; the scape in front, and a very narrow line at the inner margins of the eyes, yellow; six or eight of the basal joints of the flagellum yellowish beneath; tips of the mandibles rufo-piceous. Thorax shining; the mesothorax with three deep longitudinal furrows, which have a short impressed line between them and the tegulæ; the scutellum, postscutellum, and an enclosed space at the base of the metathorax smooth and shining; the latter has a small pit in the middle; beyond, the metathorax is punctured; wings

subhyaline, beautifully iridescent, the nervures rufo-fuscous; an interrupted line on the collar, two spots on each tegula, and a small oblong spot on each side of the insertion of the abdomen yellow; the tibiæ and knees of the anterior and intermediate legs, and also the tarsi of the former, yellow; the intermediate and posterior tarsi white, with the tips of the joints black. Abdomen smooth and shining; the extreme base of the second segment ferruginous; it has also a little before its apical margin an interrupted yellow fascia, which widens towards the lateral margins; the apical margins of the fourth, fifth, and sixth segments with narrow yellow fasciæ, the first slightly interrupted.

Hab. St. Paulo.

This insect may possibly be the male of *Trachypus basalis*, since both are from St. Paulo.

Trachypus basalis.

Female. Length $5\frac{3}{4}$ lines. Black, and variegated with yellow and ferruginous. Head rather strongly punctured, the punctures shallow and confluent; the face, as high as the antennæ, the clypeus, and a bilobed spot above it, also a minute spot between the lobes, the scape of the antennæ in front, the cheeks, and a line behind the eyes yellow; tips of the mandibles black; the flagellum of the antennæ fulvous beneath. Thorax: the disk with fine shallow punctures; an oblong central broad depression and a narrower one on each side; the base of the metathorax very smooth and shining; a slightly interrupted line on the collar, the tegulæ, tubercles, and two abbreviated lines at the apex of the metathorax yellow; the anterior and intermediate tibiæ, and femora in front, yellow, ferruginous above, and the tibiæ with a black line behind; the tarsi ferruginous beneath and more or less fuscous above; the posterior femora fusco-ferruginous; the apical joints of the tarsi pale ferruginous; wings flavo-hyaline, with the nervures ferruginous. Abdomen very smooth and shining, the second segment obscurely ferruginous; an interrupted fascia at the apex of the petiole; a fascia on the apical margin of the second segment, attenuated in the middle, and the margins of the fourth and fifth with a narrow fascia, yellow; the sides of the apical segment yellow; beneath, the second segment yellowish white, with a furcate black spot at the base; the apical margin of the fifth segment yellow.

Hab. St. Paulo.

XV.—*Notes on the Tortoises of the 'Zoology of Mexico' of MM. A. Duméril and Bocourt.* By Dr. J. E. GRAY, F.R.S. &c.

THIS is a part of the zoological researches of the scientific expedition to Mexico and Central America, published under the direction of M. Milne-Edwards, entitled, "Etudes sur les Reptiles et les Batraciens, par M. Auguste Duméril, Membre de l'Institut, et M. Bocourt, Naturaliste-voyageur, Membre de la commission scientifique de Mexique." The work seems to have been stopped by the Revolution; for this livraison appeared in 1870, and I have not seen any since.

This part contains 10 plates, marked i.–xii., the eighth and tenth not being published. The text only refers to the Chelonians, with the exception of a few pages about crocodiles; so I shall confine my observations to the Chelonians.

The work is written in a very slight and popular style; and the illustrations are more decorative than accurate, the figures appearing to be very much embellished. Indeed the descriptions are of the most prominent characters only, and far behind our knowledge of the structure of the Chelonians—no details of the skulls, or the palates, or the development of the sternum being given, which would at once have enabled us to ascertain the smaller groups to which the species belong, to determine easily their proper relations, and to be certain whether they are correctly identified.

Indeed the whole work is a lamentable exhibition of the very backward state of zoological science in the French capital; the principal part of it seems to be merely the production of probably an excellent collector of animals in foreign countries, but who has had no preliminary education.

Like many other zoological works of late years published in France, it is in great part a mere compilation by a "prentice hand," which often shows great industry but no zoological talent. It seems to be the system now for such works to be composed by a person who is taken from the zoological laboratory and sent out to collect, or desired to study the collections and works on a given subject, and write the best he can upon it, and publish it, generally in conjunction with the name of a Member of the Institute, who writes a few pages, differing in number according to his leisure or inclination, puts their two names in the title, and, if I have not been very incorrectly informed, takes the lion's share of "honorarium" paid for the preparation of the work.

1. *Emys incisa*, Duméril and Bocourt, *l.c.* p. 11, t. i. & ii.

From the mountains of Conchavona, in the province of La Union, one of the ports of Salvador on the Pacific. The inhabitants say it is never found in water.

It appears to be an *Emys*; but the head is so indistinctly figured that it is impossible to determine what modern genus or species it may belong to.

2. *Emys areolata*, Dum. Arch. du Mus. 1852, tome vi. p. 223, t. xiv.; Bocourt, *l.c.* p. 13.

Cholæpus areolatus, Cope, Proc. Acad. Nat. Sci. Philad. 1866, p. 123.

M. Bocourt observes that fig. 1 in the plate cited represents more plates than the species possesses, the artist being apparently misled by the irregularity in one side of the carapace.

In the 'Supplement to the Catalogue of Shield Reptiles,' p. 42, I observed that this species was probably a variety of *Malaclemmys concentrica*. The examination of the palate, which would at once settle this question, is not noted in MM. Duméril and Bocourt's essay, but the species is left in that magazine of incongruous species called *Emys* by these authors.

3. *Emys venusta*, Gray, Cat. Sh. Rept. 1855, p. 24, t. xii. a; Bocourt, *l.c.* p. 13.

He refers to a peculiarity in the genito-urinal organs described by Vautherin, Ann. Sci. Nat. ser. 5, p. 12.

4. *Emys Grayi*, Dum. & Bocourt, *l.c.* p. 13, t. iii. f. 2, 2 a.

This species is described as allied to, but different from, *Emys ornata*, Bell, MSS.; Dum. & Bibr. Erp. Gén. t. ii. p. 286; Gray, Cat. Sh. Rept. p. 24, t. xii.; Bocourt, *l.c.* t. iii. f. 1 & 1 a, figured from a specimen presented by Mr. Bell to the French Museum. *E. Grayi* is found on the east coast of Guatemala, at the mouth of the Nagualate.

I believe that this species is the same as *Callichelys concinna*, Gray, Ann. & Mag. Nat. Hist. 1873, x. p. 148; Hand-list Sh. Rept. p. 48*. Described from two specimens received from Tehuantepec, San Mateo.

This species has nothing to do with *Emys Grayi* of Günther, P. Z. S. 1869, p. 504, t. 38, from Bussora (*Emmenia Grayi*, Gray, Suppl. Cat. Sh. Rept. p. 38, and Hand-list Sh. Rept. p. 36).

* In the 'Hand-list of Shield Reptiles,' p. 48, the name accidentally dropped out in making up the pages, and the specimens are referred to as belonging to *C. callirostris*.

5. "*Emys pulcherrima*, Gray," Dum. & Bocourt, *l. c.*
p. 15, t. vii. figs. 1, 1 a, & 1 b.

This they regard as "the adult of the *E. pulcherrima*, Gray, Cat. Sh. Rept. B. M. 1855, t. xxv. fig. 1 (young)."

It is described from a specimen said to have come from Central America, which is living in the Menagerie of Reptiles.

Only the external form and the colouring of the upper part of the animal is figured; and the description is so general that it is impossible to determine to what subgenus this species should be referred; and I greatly doubt its being the adult of my *Emys pulcherrima* (from the colouring of the head, neck, and feet), which is, by the structure of its sternum, a *Rhinoclemmys*. The species described by Duméril and Bocourt, from the shortness of the toes and the form of the streaks on the head, may belong to the same genus. If it does, it is quite a new species, characterized by the streaks of the head and the broad orange streaks edged with black on the fore legs, which separate it from all the species of *Rhinoclemmys* known. I therefore propose to call it *Rhinoclemmys Bocourti*. The colouring of the shell is somewhat like that of, but very different from, *R. mexicana*.

6. *Emys marmorata*, Baird & Girard, Proc. Acad. Nat. Sci. Philad. vi. 1852, p. 177.

MM. Duméril and Bocourt observe that there are two specimens of this species in the French Museum from the province of San Francisco, California, sent by Professor Agassiz; but their description adds nothing to our knowledge of this species; they give the account of the synonyma compiled for Mr. Agassiz, which I believe contains two very different animals confused together.

Mr. Girard's figure very much resembles the animal which I described in 1855, from a specimen I purchased at Nantes, under the name of *Emys olivacea*, Cat. Sh. Rept. p. 30, t. xii. c, and which I now call *Redamia olivacea*; and the truth of this suspicion might have been confirmed if MM. Duméril and Bocourt had given us the details of its palate.

Cistudo mexicana, Gray; Duméril & Bocourt, *l. c.* p. 17, who add nothing new to the account of this species; indeed it appears doubtful whether the authors had ever seen a specimen.

- Dermatemys Mawii*, Gray; Duméril & Bocourt, *l. c.* p. 17,
t. viii. figs. 2, 2a.

They merely observe that this species is found in the fresh

waters of Belize, where it is eaten in the early months of the year, and several specimens were received from Mexico.

They give a very poor figure of the head, from the living animal, which, if correct, has not the black spot on each side of the pupil, so common in American water-tortoises; and this peculiarity is not noticed in the description.

In the synonyma the authors refer *Emys Bernardii* of M. A. Duméril, so badly figured in the Arch. du Muséum, 1852, vi. p. 231, t. xv., and *Ptychemys* (i.e. *Ptychemys*) *Bernardii* of Agassiz without any doubt as synonyma of this species, which I suppose, settles this question; but the species was so very badly described that it was a matter of great doubt.

Emysaurus Rossignonii, Duméril & Bocourt, *l. c.* p. 18,
t. v. f. 2.

This species, which is established on three young specimens, two from Guatemala and one from Mexico, is distinguished from the young *E. serpentina* from Pennsylvania (which they figure t. v. f. 1) by having four beards, two on each side of the symphysis of the chin, a broader sternum, less-marked cuticular processes on the neck and limbs.

This is a species that has not occurred to me among the many tortoises Mr. Salvin has brought from Guatemala.

CLAUDIUS, Cope, Proc. Acad. Nat. Sci. Philad. 1865.

Claudius angustatus, Cope, Proc. Acad. Nat. Sci. Philad. 1865, p. 187; 1869, t. ix.; Duméril & Bocourt, *l. c.* p. 20, t. vi. figs. 1, 2, 3, 4.

Claudius megalocephalus, Bocourt, Ann. Sci. Nat. Zool., 1868, x. p. 122.

Described from a single specimen in the Paris Museum, received from Mexico.

This species I have not seen. It is very interesting in the nose not being produced or cylindrical, the chin having two beards, the sternum being acute at each end and covered with four pairs of shields, and the lateral process of the second pectoral plate being slender. The tail is very short and marked with four longitudinal tubercular ridges.

1. *Staurotypus triporcatus*, Wagler; Duméril & Bocourt, *l. c.* p. 21; Gray, Cat. Sh. Rept. t. xx. b.

The authors add nothing to the account of this animal; indeed it is doubtful if they have seen it.

2. *Staurotypus Salvinii*, Gray, Duméril & Bocourt, *l. c.* p. 22, t. v. f. 3, 3 a; Gray, P. Z. S. 1864, p. 127; 1869, p. 179, fig. 5 (skull); Suppl. Cat. Sh. Rept. p. 65.

Received from Vera Paz, Guatemala, one of the affluents of the Polochie.

The figure only represents the underside of the living animal.

I do not see how *Staurotypus marmoratus* of J. von Fischer, from Tejas in Mexico, described and figured in Wiegmann's Archiv für Naturg. 1870, p. 265, t. x., differs from this species.

1. *Cinosternon cruentatum*, A. Duméril, Arch. du Muséum, 1852, vi. p. 238, t. xvi.

2. *Cinosternon albogulare*, Duméril & Bocourt, *l. c.* p. 24.

The Museum received three specimens from San José, Costa Rica.

3. *Cinosternon leucostomum*, A. Duméril, Arch. du Muséum, 1852, vi. p. 239, fig. 17.

4. *Cinosternon hirtipes*, Wagler, Icon. Amphib. t. xxx.

The three former are only in the Paris Museum; and the characters separating them seem very doubtful. The last is only known from Wagler's figure. The large number of specimens in the British Museum from different parts of tropical America show that the species of this genus are very liable to vary.

Chelonia Agassizii, Duméril & Bocourt, *l. c.* p. 26, t. vi.

Described from a single specimen in the Museum of Paris, taken at the mouth of the Naguale, on the Pacific shores of Guatemala.

From the form of its head-shields, it appears to be a species of the restricted genus *Chelonia*. The authors say it is well distinguished from *Chelonia virgata* by the dorsal disk being more elevated and sloping on each side like a roof, and more elongate and narrowed over the hinder limb, and by the presence of an interoccipital plate on the back of the crown. It may probably be a distinct species, perhaps one of those described by Mr. Girard.

It is very difficult to distinguish species of turtles when they are divided into small groups by the form of the skull, number of head-shields, &c., unless you have a series of specimens showing all the ages of the species; for the bones undergo such a change of form during the development of the animal.

I have just seen Mr. Cope's synopsis of the Chelydrinæ in the 'Proceedings of the Academy of Nat. Sciences of Philadelphia' for 1872, p. 22, which contains some remarks on M. Bocourt's paper. He observes that

1. *Staurotypus Salvinii*, figured by Bocourt, appears to him to be very different from that described by Dr. Gray, and perhaps pertains to another genus. "Dr. Gray describes the anterior lobe of the sternum in *S. Salvinii* as narrowed like the posterior, while it is broadly rounded in this animal." Mr. Cope forms for this a species, which he names *Claudius pictus*; but he seems to have a doubt if it is distinct from a species which he calls *Claudius severus*, p. 24,—which I think are both the same as *Stauremys Salvinii*.

Mr. Cope's paper induces me to believe that the first section of his genus *Claudius* is synonymous with my genus *Stauremys*, which differs from *Claudius* in having a broader sternal costal process and a distinct inguinal.

2. *Claudius angustatus*, Cope. He seems to consider that his species is different from that figured by M. Bocourt, and is inclined to think that Bocourt was right when he named it *megalcephalus* in 1868, though he afterwards gave it up, believing it to be the same as Cope's. From these observations it would appear as if the genus *Claudius* ought to be confined to this species, peculiar for having a very narrow costal lateral lobe and only a single or no inguinal shield.

XVI.—Answer to Dr. Stoliczka's "Notes on the Indian Species of *Thelyphonus*." By A. G. BUTLER, F.L.S., F.Z.S., &c.

DR. STOLICZKA has just forwarded to me a paper recently read before the Asiatic Society of Bengal, containing a criticism of my monograph of *Thelyphonus* (Ann. & Mag. Nat. Hist. ser. 4, vol. x. pp. 200–206), and supplemented by descriptions of several new species.

It is unfortunate that the author did not acquaint me with his intention to describe new Indian *Thelyphoni*, as I should willingly have deferred the publication of my own paper (Cist. Ent. vi. pp. 129–132) until his descriptions had appeared, and thus avoided adding to the synonymy of the genus. As it is, there can be little doubt that my paper has priority, since it was before the public on May 1, whereas the separate copies even of Dr. Stoliczka's paper appear not to have reached the author much before the middle of that month, the one forwarded to me having left Calcutta on the 15th.

I must now briefly refer to a few remarks which occur in Dr. Stoliczka's paper. He says, in the first place, speaking of the sections into which I have grouped the genus, "Turning now to the sections distinguished by Mr. Butler, there are some discrepancies to be noticed in the species referred to them by the author." He then proceeds to point out, amongst other unimportant details, that Koch has not accurately figured the cheliceres of *T. brasilianus* and *T. linganus*, provided that I have referred them to their proper sections. This I am at once willing to admit; but Koch's figures are exceedingly rude, and Dr. Stoliczka himself is evidently aware that that author laid no stress on the number of "denticles," as appears in his note on *T. brasilianus*, where he says:—"Their number, it is true, is not mentioned in the description; but if Koch's figure has been found to be incorrect, the correction should have been noticed;" and in his note on *T. linganus*, "Koch's original figure gives six denticles on the second joint of the cheliceres, but does not refer to that number in the text. Is the figure incorrect in that respect?"

It is certainly remarkable, considering how little dependence can be placed on Koch's figures of *Thelyphonus*, that any one can feel certain that "Koch's *T. rufipes* is clearly not the same species as the one originally described by Lucas under the same name;" and, considering the admission that, as regards two other species figured by him, "the differences which he notices as distinguishing the two are decidedly of no specific value," it is, I think, odd that Dr. Stoliczka should assume to believe that the "denticles" on the cheliceres were counted when Koch figured his species, though neglected when he described them. He says, however:—"If those descriptions and figures were found to be incorrect or not reliable, the mistakes had first to be pointed out and corrected before a determination, based upon them, was admitted or rejected." To this I reply that I consider the descriptions reliable, and the figures give a vague notion of the general outline, whilst the localities given assist still more in the determination of the species. I did not consider it necessary to state in full my reasons for every little change which I made; for I consider brevity as much the soul of science as it is the soul of wit.

As regards Guérin's *T. caudatus*, a figure is given, and by no means so careful a one as to enable any body with certainty to determine the species: the locality "Antilles" is therefore the only clue to the species; it is not the locality of *T. caudatus*, which, as Dr. Stoliczka remarks, is stated to be Java. Nothing, therefore, could be more reasonable than to refer it to *T. antillanus*.

My reason for considering Koch's figure of *T. proscorpio* identical with the *T. caudatus* of Lucas is that there is a great similarity in their general appearance, whilst they both have five denticles on the second joint of the cheliceres; the difference of width of joints is one often noticeable in a comparison of figures of the same species drawn respectively by German and French artists, and cannot be depended upon. As to *T. angustus* of Lucas, Dr. Stoliczka appears to be doubtful of his own identification of the species; and therefore I need not discuss it.

Dr. Stoliczka seems indignant at my considering his *T. assamensis* the adult form of *T. rufimanus*; and certainly, if his later figures are taken from the type (in which case the earlier ones cannot be), I should myself allow the two species to be distinct, and should correct the synonymy by considering *T. scabrinus* of Stoliczka identical with *T. rufimanus*, and *T. assamensis* of the later paper and plate as probably a malformed example of my *T. psittacinus*.

I may be allowed to state my view of the really well-executed plate which accompanies Dr. Stoliczka's notes, as follows:—

- Fig. 1. *Thelyphonus scabrinus*, Stol., = *T. assamensis*, Stol. (*rufimanus*, Lucas).
 2. *T. assamensis*, Stol., = ? *T. psittacinus*, Butl., malformed.
 3. *T. (conf.) angustus*, Lucas, = ? *T. proscorpio*, Latr., junior.
 4. *T. formosus*, Butl., = *T. formosus*, Butl., variety.
 5. *T. indicus*, Stol., = *T. sepiaris*, Butl.
 6. *T. Beddomei*, Stol., = n. sp.

It appears, notwithstanding the author's statement that "figures of single parts are undoubtedly very useful, but they are not sufficient," &c., that he has been successful in determining my *T. formosus*; and he does not hint at the possibility of any of my other new species being wrongly identified.

In conclusion, if in the above remarks I have felt bound to defend myself, from a consciousness that my determinations are worthy of more consideration than Dr. Stoliczka has shown them, it must be understood that I have done so with a view to the advancement of science, and from no wish to contradict the author of a really useful paper; and I may add that I shall look forward with great pleasure to Dr. Stoliczka's promised paper on the anatomy of the genus, which will, I doubt not, throw much light upon the affinities of this long neglected but most interesting group.

XVII.—*A Monographic Revision of the Genus Phrynus, with Descriptions of Four remarkable new Species.* By ARTHUR GARDINER BUTLER, F.L.S., F.Z.S., &c.

[Plates VI. & VII.]

THE last list of the species of *Phrynus* was that published by Gervais in the third volume of his 'Aptères;' since then the two Kochs, Horatio Wood, and M. Lucas have all added species, bringing the total number of known forms up to twenty; one or two of these, however, will probably prove synonymous with species previously described. In the present paper I have added four new species, one of which possesses the character, hitherto unknown in the genus, of a strongly serrated front margin to the œphalothorax.

In all published descriptions of *Phrynides* I have found one very important character overlooked, namely the arrangement of the teeth in the mandibles. This character will alone serve to distinguish most of the species, and therefore should not be neglected. The mandibles are easy to extract from dried specimens, whilst with specimens in spirit this is unnecessary, for they can be drawn forward and examined without difficulty.

I have sketched the mandibles of most of the species in the collection of the British Museum; and I find that all the New-World forms are characterized by the distinct bifurcation of the first tooth in the lower mandible, this type of tooth being rare in Old-World species. The tothing of the upper mandible differs more or less in the bulk of the species, even between species in which the tothing of the lower mandible is identical.

Genus *PHRYNUS*, Olivier.

American Species.

1. *Phrynus cheiracanthus*. Pl. VI. fig. 1.

Phrynus cheiracanthus, Gervais, Brit. Mus. 1842; Soc. Phil. Paris, in Journ. l'Inst. p. 72 (1842); Apt. iii. p. 3. n. 3 (1844).

Hab. Type, Demerara (*Bowers*); New Granada (*Stahlschmidt*). B.M.

2. *Phrynus gorgo*.

Phrynus gorgo, Wood, Trans. Am. Phil. Soc. vol. xiii., n. s., p. 440 (1869).

Hab. "Peru" (*Wood*); Pará? B.M.

We have one example of apparently this species, larger than

the type. The first pair of legs are enormously developed, as in *P. cheiracanthus*; and the palpi are longer and more slender than in Wood's figure.

3. *Phrynus Kochii*, n. sp. Pl. VI. fig. 2.

Phrynus medius, Koch (nec Herbst), Arachn. viii. p. 8, pl. 255. fig. 598 (1841).

Hab. America (*Koch*). B.M.

4. *Phrynus asperatipes*.

Phrynus asperatipes, Wood, Journ. Acad. Nat. Sci. Philad., n. s., vol. v. pt. iv. p. 375 (1863).

Hab. "Lower California" (*Wood*).

5. *Phrynus reniformis*. Pl. VI. fig. 3.

Phalangium reniforme, Pallas, Spicil. Zool. fasc. ix. p. 43, pl. 3. fig. 3 (1772); Lichtenstein and Herbst, Natursyst. ungefl. Ins., Phalang. p. 79, pl. 5. fig. 2 (1797).

Phrynus reniformis, Gervais, Apt. iii. p. 5. n. 6 (1844); Koch, Arachn. viii. p. 12, pl. 256. fig. 600.

Cancellus araneoides, Petiver, Pterigr. pl. 20. fig. 12 (see Gervais).

Hab. Haiti (*Tweedie*). B.M.

Some young specimens in spirits of what I believe to be this species have the abdomen much elongated and the spines on the palpi very feebly developed.

6. *Phrynus variegatus*. Pl. VI. fig. 4.

Phrynus variegatus, Perty, Delect. Anim. p. 200, pl. 39. fig. 10 (1830-34); Koch, Arachn. viii. p. 10, pl. 255. fig. 599 (1841).

Hab. River Amazon (*Perty*); Jamaica (*Gosse*); Venezuela; W. Coast. B.M.

7. *Phrynus palmatus*. Pl. VI. fig. 5.

Phalangium palmatum, Lichtenstein and Herbst, Natursyst. ungefl. Ins. p. 82, pl. 4. fig. 2 (1797).

Phrynus palmatus, Koch, Arachn. viii. p. 13, pl. 257. fig. 601 (1841).

Phrynus mexicanus, Bilimek, Verh. zool.-botan. Gesellsch. Wien, xiii. p. 905 (1867).

Hab. Colombia (*Goudot*); Mexico, Puebla (*Rouquette*). B.M.

8. *Phrynus pumilio*.

Phrynus pumilio, Koch, Arachn. viii. p. 15, pl. 257. fig. 602 (1841).

Hab. Brazil (*Koch*).

If correctly drawn, this species has a remarkably narrow cephalothorax; it seems allied to *P. fuscimanus* and *P. palmatus*.

9. *Phrynus fuscimanus*. Pl. VI. fig. 6.

Phrynus fuscimanus, Koch, Arachn. xv. p. 67, pl. 523. fig. 1463 (1848).

Hab. North America (*Koch*); Colombia (*Goudot*). B.M.

Closely allied to *P. palmatus*, but with the legs conspicuously banded.

Australasian Species.

10. *Phrynus australianus*.

Phrynus australianus, Koch, Verh. zool.-botan. Gesellsch. Wien, xvii. p. 231 (1867).

Hab. "Upolu" (*Koch*).

Asiatic Species.

11. *Phrynus Whitei*. Pl. VI. fig. 7.

Phrynus Whitei, Gervais, Brit. Mus. 1842; Bull. Soc. Phil. Paris (1842) Journ. l'Inst. p. 72 (1842); Apt. iii. p. 6. n. 9 (1844).

Hab. Burdwan (*Hardwicke*). Type, B.M.

12. *Phrynus marginemaculatus*.

Phrynus marginemaculatus, Koch, Arachn. viii. p. 6, pl. 254. fig. 597.

Hab. India (*Koch*).

I think there can be little doubt that this is the *P. Whitei* of Gervais; the spines on the palpi, however, are so much more robust in Koch's figure than in our type that I shall provisionally consider it distinct.

13. *Phrynus Grayii*. Pl. VII. fig. 1.

Phrynus Grayii, Gervais, Brit. Mus. 1842; Soc. Phil. Paris, in Journ. l'Inst. p. 72 (1842); Apt. iii. p. 4. n. 4 (1844).

Hab. Manilla (*Cuming*). In spirits and dry, B.M.

14. *Phrynus ceylanicus*.

Phrynus ceylanicus, Koch, Arachn. x. pl. 336. fig. 776 (1843).

Hab. Ceylon (*Koch*). Coll. O. P. Cambridge.

A large and (according to the Rev. O. P. Cambridge) common species; it is allied to *P. scaber*. I have examined a small example from Ceylon formerly in Mr. Saunders's collection; it is altogether much redder than Koch's figure. A larger example from Siam is intermediate in colouring between the two.

15. *Phrynus nigrimanus*.

Phrynus nigrimanus, Koch, Arachn. xv. p. 69, pl. 523. fig. 1464 (1848).

Hab. East Indies (*Koch*).

Allied to *P. scaber*.

African Species.

16. *Phrynus scaber*. Pl. VII. fig. 2.

Phryne scaber, Gervais, Apt. iii. p. 3. n. 2 (1844).

Hab. "Mauritius" (*Gervais*); Round Island (*Pike*). B.M.

17. *Phrynus medius*.

Phalangium medium, Lichtenstein and Herbst, Natursyst. ungefl. Ins., Phalang. p. 77, pl. 4. fig. 1 (1797).

Phrynus medius, Gervais, Apt. iii. p. 4. n. 5 (1844).

Hab. Fernando Po; Sierra Leone. B.M.

Gervais says that we once possessed a specimen of this species from Brazil; he probably means the *P. medius* of Koch, which is certainly distinct.

18. *Phrynus bassamensis*. Pl. VII. fig. 3.

Phrynus bassamensis, Lucas, Archiv. Entom. ii. p. 434 (1858).

Hab. "Grand Bassam in Guinea" (*Lucas*); W. Africa; Congo (*Curror*). B.M.

Nearly allied to, if not a mere variety of, *P. medius* of Herbst; the mandibles are identical in structure.

19. *Phrynus lunatus*. Pl. VII. fig. 5.

Phalangium lunatum, Fabricius, Sp. Ins. i. p. 549. n. 9; Lichtenstein and Herbst, Natursyst. ungefl. Ins., Phalang. p. 71, pl. 3 (1797).

Phrynus lunatus, Koch, Arachn. viii. p. 4, pl. 254. fig. 596 (1841).

Hab. Port Natal (*Argent*). B.M.

This is an African species allied to *P. scaber*; Koch says, however, that it comes from the East Indies.

20. *Phrynus annulatipes*. Pl. VII. fig. 4.

Phrynus annulatipes, Wood, Trans. Am. Phil. Soc. vol. xiii., n. s., p. 441 (1869).

Hab. "Zulu country" (*Wood*); Port Natal (*Gueinzius*); S. Africa; Cape of Good Hope. B.M.

A very common South-African species.

21. *Phrynus Batesii*, n. sp. Pl. VI. figs. 8, 9.

Cephalothorax dull black, mottled with ferruginous, irregularly reniform, somewhat truncated anteriorly, sparsely granulated, with well-marked marginal ridge, feebly denticulate posteriorly; median sulcus sharply defined, with four ill-defined lateral depressions; much elevated in front; the central oculiferous tubercle very prominent, subquadrate, projecting obliquely forwards; the eyes wide apart; lateral tubercles less

prominent, smaller; eyes yellow. Abdomen dull pitchy, sparsely granulated at the sides, and with regular series of minute granules in front of each segment; covered sparsely with short bristles; four longitudinal ochraceous parallel sulcæ on each side. Legs dull pitchy, becoming castaneous towards the tarsi, which are distinctly castaneous, ochraceous at the joints; the femora coarsely granulated and slightly pilose; tibiæ and tarsi covered with short hairs; palpi dull black, ochraceous at the joints, very long and slender, sparsely granulated; the coxæ pitchy, their opposing edges with numerous short tawny bristles; mandibular process pronounced; trochanter bearing four well-marked unequal spines on its antero-inferior margin (one of them considerably longer than the others), and a strong cylindrical process with ochraceous clavate termination on its postero-inferior margin; femoral joint cylindrical, its interior surface flattened and depressed, with nine well-marked spines on its basal half, most thickly grouped and longest at its basal extremity; tibial joint similar in general form to the femoral, but not flattened internally, with eleven well-marked unequal spines, the first three emitted above the middle, increasing in size, the first being about a line in length, the third about two lines; the three next, on the supero-interior margin, are the longest, being about 4 lines in length; nearly opposite to the first of these, but emitted from the inferior margin, is a fourth long spine, about $2\frac{1}{2}$ lines in length; four short curved spines on either side of the distal end complete the series: last joint elongate, cylindrical, coarsely granulated, quadrispinose at base, the anterior spines being long and curved; terminal claw long, curved, pilose internally. Mandibles pitchy, clothed internally with long tawny hairs, long, slightly roughened anteriorly above; upper mandible with four well-developed conical teeth, the three external ones slightly shorter than the other, equal in length, united at base; lower mandible with five teeth, the first and the last being the longest, the first unequally bifid at apex (as usual in American species).

Ventral surface pitchy; the coxæ and trochanters of legs of normal type, but the coxæ of second pair of legs with unusually well-developed anterior process; abdomen rather less granulated than above; ligular process tawny, rather shorter than usual, terminating in two short bristles.

Length of body 14 lines, of mandibles extracted and opened 3 lines, of palpi 56 lines; first pair of legs about 88, second 41, third 42, fourth 43.

Hab. Upper Amazons (*Bates*). Two dried examples, B.M.

A fine species, with remarkably long and slender palpi.

I have taken measurements from our larger specimen, the other being apparently not full-grown, and consequently paler in colour. The nearest allies of this species are *P. gorgo* of Wood and *P. cheiracanthus* of Gervais.

22. *Phrynus granulosus*, n. sp. Pl. VII. figs. 10, 11, 12.

Cephalothorax dark castaneous, reniform, slightly truncated in front, coarsely granulated, with fairly well-marked marginal ridge; slightly elevated in front; the central oculiferous tubercle ovate, with central keel; eyes wide apart; lateral tubercles rounded, smaller; eyes yellow. Abdomen reddish fuscous, the segments and sides (especially the lateral sulci) ochraceous; unequally granulated transversely. Legs bright reddish castaneous, with paler bands on the femora; the ligaments of the joints pale ochreous; femora coarsely granulated and clothed with very short bristles; tibiæ and tarsi finely granulated and pilose; palpi blackish pitchy, pale ochreous at the joints; the first four joints coarsely granulated; coxæ castaneous, their opposing edges pale ochreous, clothed superiorly with short hairs; mandibular process well developed; trochanters covered in front with short spines; femoral joint semicylindrical, bearing internally about thirty-two longer or shorter spines, eleven on the upper and nine on the lower edge being longer than the remainder, but still varying considerably in length; tibial joint subcylindrical, divided longitudinally into four surfaces, formed externally by spinose ridges, bearing internally fifteen distinct and numerous obsolete spines, three alone at the distal end above being well developed, the second and third being longest, divergent, curved, and springing from the same basis; terminal joint shining black, trispinose, the two external spines much longest, curved; terminal claw long, curved, pilose internally. Mandibles pitchy, clothed internally with tawny hairs; moderately long, granulated above; upper mandible with four well-developed teeth, the first and third from the base largest, the three external ones united below; lower mandible with five teeth, the first and last the longest, the first unequally bifid at apex.

Ventral surface reddish ochraceous; the coxæ of legs subcylindrical, with anterior well-defined ridge; abdomen nearly smooth; ligular process moderately long, castaneous.

Length of body 14 lines, of mandibles extracted and opened 3 lines, of palpi 22 lines; first pair of legs 66, second 25, third 26, fourth 26.

Hab. S. America. Two in spirit, one dry, B.M.

Egg globose, ochraceous, with two series of closely approxi-

mated lunate white spots on one side, the ends of the two series being united above and below so as to produce a distinct fusiform marking.

This interesting species is allied to *P. cheiracanthus*.

23. *Phrynus longicornis*, n. sp. Pl. VII. figs. 6, 7.

Cephalothorax dull black, mottled with ferruginous, irregularly reniform, somewhat truncated in front, sparsely granulated, with tolerably well-marked marginal ridge; median sulcus sharply defined, radiating depressions ill defined; moderately elevated in front; central oculiferous tubercle very prominent, subovate; eyes wide apart; lateral tubercles much smaller, rounded; eyes yellow. Abdomen black, pitchy at the sides, irregularly transversely granulated. Legs pitchy, becoming castaneous towards tarsi; ligaments yellow; femora coarsely granulated, with strong, conical, terminal, internal tooth; tibiæ and tarsi finely granulated and pilose; palpi dull black, yellow at the joints, and with coxæ and under surface of terminal joint castaneous, coarsely granulated; the coxæ with short hairs on their opposing edges; mandibular process well developed; trochanters with four or five short denticles on antero-superior edge, otherwise exactly as in *P. Batesii*; femoral joint semicylindrical, with ten spines on its interior margins—five above (that next to the proximal end double), and five below; tibial joint similar to the femoral, with thirteen spines on its inner margins, seven above and six below, the third, fourth, and fifth above considerably longer than the others ($4\frac{1}{2}$ lines) and subparallel; terminal joint long, shining, coarsely granulated internally, quadrispinose at base, the anterior spines being twice as long as the others and slightly curved; terminal claw long, curved, pilose internally. Mandibles black, pitchy behind, clothed internally with long reddish hairs, roughened and sparsely granulated above; upper mandible with four well-developed teeth, the first and third from the base the largest, the three external ones united below; lower mandible with five teeth, the first and last the largest, the first unequally bifid at apex.

Ventral surface ferruginous; the coxæ of legs subcylindrical, with anterior well-developed ridge; abdomen nearly smooth; ligular process castaneous.

Length of body 16 lines, of mandibles extracted and opened $3\frac{1}{2}$ lines, of palpi 29 lines; first pair of legs about 99, second 44, third 45, fourth 43.

Hab. Pará (*Bates & Wallace*). Three specimens, B.M.

We have only one example of this species full-grown: our smallest specimen is nearly as dark as the one described; the

third specimen, however, is of an olive-green colour, with the stigmatiform depressions on the abdomen and the spines on palpi pale ochraceous. It must, I think, have been killed in an immature condition.

P. longicornis is allied to *P. gorgo*, and agrees with *P. cheiracanthus* in the terminal spines on femora, and with *P. granulatus* in the toothing of the mandibles.

24. *Phrynus coronatus*, n. sp. Pl. VII. figs. 8, 9.

Cephalothorax pitchy or reddish castaneous, irregularly reniform, distinctly truncated in front; the anterior margin dentate-serrate (the larger denticles, about sixteen in number, pale ochreous), coarsely granulated all over; median sulcus sharply defined; lateral radiating grooves about five on each side; central oculiferous tubercle very prominent, subovate, black; eyes wide apart, pale yellow; lateral tubercles small; eyes yellow. Abdomen dull pitchy, crossed by dirty ochreous bands, or castaneous, more or less granulated transversely. Legs covered with short hairs; the femora dirty reddish ochraceous, becoming darker towards the knee, and then suddenly ochraceous, covered with coarse dark granules, which are more or less denticulate above and below; terminal compressed spine on exterior margin well developed; tibiae and tarsi reddish pitchy, more or less finely granulated; palpi reddish ochraceous, covered above and more sparsely below with distinct blackish granules; coxae smooth; mandibular process prominent; trochanters with three spines on their anterior surface, one emitted from antero-inferior angle longest, also a number of small denticles, all blackish; femoral joint semi-cylindrical, bearing a number of spines on its internal margins—ten, moderately long, on the superior, and six, rather longer, on its inferior margin, besides a number of smaller spines; tibial joint three-sided, sparsely covered with short hairs; internal surface flattened, its superior margin bearing fourteen black-tipped spines, the first, third, fifth, sixth, and eighth very short, the seventh and thirteenth moderately long, the ninth and eleventh longest ($2\frac{1}{2}$ lines); twelve spines on the inferior margin, the second, fourth, ninth, and twelfth somewhat prominent, the seventh and tenth moderately long ($1\frac{1}{2}$ line); terminal joint subcylindrical, its upper and lower interior surfaces each bearing a long curved spine and two denticles; terminal claw curved, long, hairy internally. Mandibles moderately long, smooth; upper mandible with four conical teeth, the first and third longer than the others; lower mandible of the ordinary American type, becoming blackish towards the tip.

Ventral surface smooth, dull ochraceous; coxæ and trochanters of legs normal; ligular process moderately long, pilose.

Length of body 15 lines, of mandibles extracted and opened $2\frac{1}{2}$ *, of palpi 22; first pair of legs 80, second 34, third 34, fourth 33.

Hab. California. Coll. Rev. O. P. Cambridge.

The measurements of this remarkable species are taken from an adult female.

The following species has just come to my notice:—

Phrynus bacillifer.

Phrynus bacillifer, Gerstäcker, Reisen in Ost-Africa, vol. iii. Abth. ii. p. 472. n. 13 (1873) †.

Hab. "Zanzibar" (*Gerstäcker*).

Belongs to the *P. lunatus* group. It differs from *P. scaber* in size, and in the number of teeth on the shank of the palpi, &c.

EXPLANATION OF THE PLATES.

PLATE VI.

- Fig. 1. Mandibles of *P. cheiracanthus*.
 Fig. 2. " *P. Kochii*.
 Fig. 3. " *P. reniformis*.
 Fig. 4. " *P. variegatus*.
 Fig. 5. " *P. palmatus*.
 Fig. 6. " *P. fuscimanus*.
 Fig. 7. " *P. Whitei*.
 Figs. 8, 9. *P. Batesii* and mandibles.

PLATE VII.

- Fig. 1. Mandibles of *P. Grayii*.
 Fig. 2. " *P. scaber*.
 Fig. 3. " *P. bassamensis*.
 Fig. 4. " *P. annulatipes*.
 Fig. 5. " *P. lunatus*.
 Figs. 6, 7. *P. longicornis* and mandibles.
 Figs. 8, 9. *P. coronatus* and mandibles.
 Figs. 10, 11, 12. *P. granulatus*, egg, and mandibles.

* They may be a little longer, as I was obliged to take the mandibles from a small example.

† In the above work several species of *Gasteracantha* are described, amongst these *G. resupinata* of Gerstäcker (which is figured) is probably identical with my *G. falcicornis*, recently published in my Monograph of the genus (*Trans. Ent. Soc.* p. 158. n. 18, pl. iv. fig. 10, May 1873); it, however, differs slightly and may be distinct.

Amongst the Lepidoptera figured on the plates, I notice "*Ismene Anchises*" very close to *I. Pansa* of Hewitson, previously described by Latreille and Doumet under different names.

XVIII.—*Contributions to the Study of the Entomostraca.*

By GEORGE STEWARDSON BRADY, C.M.Z.S., and DAVID ROBERTSON, F.G.S.

No. VIII. *On Marine Copepoda taken in the West of Ireland.*

[Plates VIII. & IX.]

THE following notes embrace the chief results of our work amongst the marine Copepoda during three visits to the coasts of Galway and Mayo. Had these little creatures been the primary object of attention, the list would doubtless have been very much longer. In addition to our own collections we have been favoured with some interesting gatherings made by means of the surface-net, off the coast of Ireland, by Mr. E. C. Davison, to whom our best thanks are due. Our notes have been considerably enriched from this source.

Fam. *Calanidæ*, Dana.

Subfam. *CALANINÆ*, Dana.

Genus *CALANUS*, Leach.

(*Cetochilus*, Roussel de Vauzème.)

Calanus finmarchicus (Gunner).

Abundant in the open sea and between tide-marks.

Genus *PARACALANUS*, Bocck.

(*Calanus*, Claus.)

Paracalanus hibernicus, n. sp. Pl. VIII. figs. 1-3.

Antero-inferior angle of the cephalothorax slightly produced. Anterior antennæ of male and female alike, slender, a little longer than the cephalothorax, thick at the base and tapering gradually to the extremity, twenty-five-jointed; the nine basal joints (except the first, which is very large) broader than long, the succeeding joints being from twice to thrice as long as broad, except the terminal one, which is very short; each joint bears on its outer margin one or two short setæ; and the seven or eight proximal joints are produced into a short median spine or tooth; the last joint has one long and two small setæ; the penultimate, one very long seta. Both branches of the posterior antennæ stout, and nearly equal in size, densely setose at the apex. Mandibles strong, with a largely developed palp. Maxillæ and upper maxillipeds stout, and densely beset with marginal setæ. Lower maxillipeds tapering, slender, and bearing fine plumose setæ. Swimming-feet having the inner

branch very short, about half the length of the outer branch, the last joint of which is very long and truncate at the apex; marginal and terminal spines very small. The fifth feet in both sexes are cylindrical and one-branched; in the male four- and in the female three-jointed, those of the *female*, however, being much shorter than those of the male, and having joints of nearly equal length terminated by two or three fine short setæ. In the *male* the first and fourth joints are much elongated, the foot of one side being swollen, and bearing a long, slender, curved process. Abdomen of female four-jointed (including caudal segments), first joint equal in length to the second and third. Caudal setæ scarcely equal in length to the last three segments. Length * $\frac{1}{16}$ of an inch.

Taken plentifully in the open sea in several places off Ireland: off the mouth of the Shannon; Galway Bay; off Loup Head; Dingle Bay; near Valentia; Rockall Bank; in lat. $51^{\circ} 22' N.$, long. $12^{\circ} 25' W.$, and lat. $53^{\circ} 24' N.$, long. $15^{\circ} 24' W.$

Genus PSEUDOCALANUS, Boeck.

(*Clausia*, Boeck, 1864.)

Pseudocalanus elongatus, Boeck.

Abundant in the open sea and in tide-pools.

The generic term *Clausia* has been recently (1872) withdrawn by M. Boeck, it having been previously applied by Claparède to a genus of parasitic Copepoda. M. Boeck proposes instead the name *Pseudocalanus*.

Genus DIAS, Lilljeborg.

Dias longiremis, Lilljeborg.

Abundant in the open sea and between tide-marks.

Genus TEMORA, Baird.

Temora longicornis (Müller).

Occurring very abundantly in the open sea as well as in tidal pools.

Genus ISIAS, Boeck.

Isias clavipes, Boeck.

On the fronds of *Laminaria* in Clifden and Roundstone Bays. Rare.

* The measurements are in all cases exclusive of the tail-setæ.

Genus CENTROPAGES, Kröyer.

1. *Centropages typicus*, Kröyer.

Frequently taken in the surface-net in the open sea, but never in any great abundance.

2. *Centropages hamatus* (Lilljeborg).

Taken in similar situations to the foregoing, and often in company with it.

Genus PSEUDOCYCLOPS, Brady*.

Forma *Cyclopi* similis: antennæ anticæ mediocres, multiarticulatæ, maris dextra in medio tumefacta non geniculans; antennæ posticæ parvæ biramosæ; mandibularum palpus biramosus; maxilla et maxillipedes iis *Paracalani* fere similes; pedes quinti paris femine biramosi, maris complexi, laminati, spinosi.

Though distinctly Cyclopid in general appearance, this curious genus, like the *Misophria* of M. Boeck, exhibits a distinct affinity to the Calanidæ in the structure of its mouth-apparatus: this, taken in conjunction with the biramose second antenna and the structure of the fifth pair of feet in the female, has induced us to transfer it to the position it here occupies.

M. Boeck thinks that this genus belongs to the male of his *Misophria*; but in this opinion we are unable to agree. Of the species described in a previous paper, *Pseudocyclops crassiremis*, it is true that we found only the male; but of that here noticed we have taken many specimens, both male and female. From *Misophria* the genus is clearly distinguished by several characters, notably the following: the basal joint of the secondary branch of the posterior antenna is excessively broad and truncate, the succeeding joint or joints being very narrow, and the fifth foot in the female is distinctly two-branched, each branch being triarticulate.

Pseudocyclops obtusatus, n. sp. Pl. VIII. figs. 4-7.

Cephalothorax very tumid, obtusely rounded in front down to the rectangular and almost obsolete rostrum; dorsum strongly arched; first segment very large, nearly equal in length to half the cephalothorax; abdomen slender, in the male five-, in the female four-jointed. Anterior antennæ eighteen-jointed, stout, and about equal in length to the first cephalothoracic segment; basal joints (except the first) extremely short, gradually increasing in length to the terminal joint, which is twice as long as broad, closely beset on the

* Ann. & Mag. Nat. Hist. 1872, vol. x. p. 7.

anterior margin with hairs of moderate length; right antenna of the male swollen in the middle, but having no true hinge-joint: posterior antennæ four-jointed, with a large biarticulate secondary branch springing from the basal joint. Mandible-palp large, having a uniaarticulate secondary branch. First four pairs of swimming-feet stoutly built, with short setæ and broad marginal lancet-shaped spines; branches subequal, triarticulate; the setæ of the inner margins are peculiar, consisting of short, slender, abruptly truncated rods, from the extremities of which spring solitary short hairs. Fifth pair in the female having the inner branch very short, and beset with a few short transverse rows of minute setæ; those of the male largely developed, each formed apparently of two modified three-jointed branches, the outer branch on each side forming a strong terminal spine, and on the left (?) having also a very large falciform claw; the remaining processes form a number of irregularly lacinated plates. Abdominal segments short; caudal segments scarcely twice as long as broad; the longest tail-seta about equal in length to the abdomen. Length $\frac{1}{33}$ of an inch.

P. obtusatus was taken, but in no great numbers, by the surface-net in Roundstone Bay, on a moonlight night in July 1871.

Subfam. *PONTELLINÆ*.

Genus *ANOMALOCERA*, Templeton.

Anomalocera Patersonii, Templ.

Often in great abundance in the open sea.

Genus *PONTELLA*, Dana.

Pontella brevicornis, Lubbock.

Taken sparingly in the surface-net in Westport Bay and Kinsale Harbour; also amongst *Zostera* and other weeds near low-water mark in Westport and Clifden Bays.

Fam. *Cyclopidæ*.

Genus *CYCLOPS*, O. F. Müller.

Cyclops æquoreus, Fischer.

In a pool near high-water mark, south of Clifden.

Genus *THORELLIA*, Boeck.

(? *Euryte*, Philippi, Wiegmann's Archiv, 1843.)

Thorellia brunnea, Boeck.

Taken sparingly in the surface-net in Westport and Ventry
Ann. & Mag. N. H. Ser. 4. Vol. xii.

Bays and in Kinsale Harbour; also on the fronds of *Laminaria saccharina* in Clifden Bay.

We can scarcely doubt that this genus is identical with Dr. Philippi's *Euryte*; but, considering the somewhat vague definition and figures given by that author, we should not feel safe in discarding M. Boeck's more recent generic name.

Genus OITHONA, Baird.

Oithona helgolandica?, Claus.

Of not uncommon occurrence in surface-net gatherings: Westport Bay, Kinsale Harbour, near Valentia, off the Skelligs.

We are not satisfied that the species referred to here, as well as in the previous list of the Copepoda of the north-east coast of England, is really identical with any of those described by Claus, Boeck, and other authors; but the differences appear to be so small that we are unwilling to run the risk of proposing another specific name, not having had the opportunity of examining undoubted specimens of the previously described forms.

Fam. Harpactidæ.

Genus LONGIPEDIA, Claus.

Longipedia coronata, Claus.

In rock-pools, Great Isle of Aran; and on *Laminariæ* in Clifden Bay, where it was also dredged on a gravelly bottom in a depth of four fathoms.

Genus ECTINOSOMA, Boeck.

Ectinosoma melaniceps, Boeck.

In rock-pools, Great Isle of Aran.

Genus MICROSETELLA, nov. gen.

Corpus angustissimum, fere lineare, antice attenuatum; fronte arcuata, appendicibus falciformibus carente. Antennæ anticæ breves, tenues, articulo tertio appendicem gerentes; antennæ posticæ ramo secundario præditæ. Partes manducatoriæ omnes perminutæ; maxillipedes posteriores perbreves, uncinati. Pedes natatorii tenues, elongati; quinti paris foliacei. Seta caudalis longissima.

Microsetella atlantica, n. sp. Pl. IX. figs. 11-16.

Body not unlike *Ectinosoma* in general shape, somewhat

curvate, tapering before and behind. First segment of the cephalothorax attenuated, nearly equal in length to the following five segments. Anterior antennæ slender, five-jointed, sparingly setose; posterior antennæ comparatively large, three-jointed, the first joint bearing a long secondary branch. The mouth-organs are all extremely small, and similar in structure to those of the Harpacticidæ generally; lower maxillipeds having an ovate hand terminated by two (?) slender claws. Four pairs of swimming-feet long and slender, having both branches three-jointed and of nearly equal length; fifth pair with three very long and three smaller setæ. Caudal segments very short, each bearing two principal setæ, one of which is short, and the other as long as the body of the animal. Length $\frac{1}{6}$ of an inch.

Taken in the surface-net by Mr. E. C. Davison in the open sea as follows:—lat. $53^{\circ} 24'$ N., long. $15^{\circ} 24'$ W.; lat. $53^{\circ} 15'$ N., long. $11^{\circ} 51'$ W.; lat. $51^{\circ} 22'$ N., long. $12^{\circ} 25\frac{1}{2}'$ W.; and at 40 miles off the Skelligs.

This very minute species appears to differ from *Setella* chiefly in the absence of the double falciform rostrum, described as belonging to that genus by both Dana and Claus, and in the presence of a secondary branch of the lower antenna. The mouth-organs are so excessively minute and crowded together that we have not been able fully to examine the mandibles, nor even to find the maxillæ at all. The mandibles probably have a palp, though we have not seen it.

Genus EUTERPE, Claus.

Euterpe gracilis, Claus.

A few specimens taken in the surface-net in Kinsale Harbour by Mr. E. C. Davison.

Genus PARATACHIDIUS, nov. gen.

Corpus lineare, rostratum. Antennæ anticæ breves 7-articulatæ, apud marem appendicem vesiculiformem gerentes, apicemque unguiculatæ; antennæ posticæ parvæ, ramo secundario minuto bi-articulato. Mandibulæ maxillæque iis *Tachidii* fere similes. Maxillipedes anteriores parvi, 3-digitati; posteriores 4-articulati cheliformes. Pedum quatuor parium priorum rami interni 2-, externi 3-articulati; paris primi ramus internus magnopere elongatus. Pedes quinti paris foliacei. Sacculus ovifer unicus.

Paratachidius gracilis, n. sp. Pl. VIII. figs. 8–16.

Body slender, resembling *Tachidius* in general appearance. Anterior antennæ of the female seven-jointed, having a small

flagelliform appendage; that of the male much swollen, the last joint forming a sort of claw in front of the large vesiculi-form swelling. Mandibles bearing a small one-branched (?) palp. Second pair of maxillipeds setose on the anterior margin, terminating in a long and slender claw. Inner branch of the first pair of swimming-feet nearly twice as long as the outer, its first joint longer than the entire outer branch; second joint short. Fifth pair of feet well developed, biarticulate in the female; in the male uniarticulate, much broader, rounded and fringed with shorter and stronger spines. Length $\frac{1}{3}$ of an inch.

This species was taken plentifully in a pool above high-water mark on the shore south of Clifden in Connemara.

Genus IDYA, Philippi.

(*Tisbe*, Lilljeborg.)

Idya furcata (Baird).

Extremely common in littoral situations on weeds; also taken in the surface-net in sheltered bays.

Genus WESTWOODIA, Dana.

1. *Westwoodia nobilis* (Baird).

On weeds in Ventry Bay, taken by Mr. E. C. Davison.

2. *Westwoodia minuta*, Claus.

Dredged in Westport Bay; rare.

Genus ILYOPSYLLUS, nov. gen.

(*ἰλύς*, mud; *ψύλλος*, a flea.)

Corpus tumidum, gibbosum. Antennæ anticæ brevissimæ, appendicem ensiformem gerentes, 5-articulatæ, parte basali magnopere dilatata; antennæ posticæ validæ, ramo secundario carentes. Mandibulæ parvulæ, palpo simplici bisetoso. Pedes primi paris valide armati, ramo interno 1-, externo 3-articulato; sequentium parium rami ambo 3-articulati. Abdomen breve, versus extremitatem attenuatum; setæ caudales spathulatæ.

Ilyopsyllus coriaceus, n. sp. Pl. IX. figs. 1-5.

Body very tumid; seen laterally the ventral line is almost straight, the dorsal excessively arched, so that the cephalothorax forms almost a semicircle; seen from below, the outline is like that of a spear-head rounded off in front; greatest width situate in the middle, and equal to half the entire length of the body; posterior half abruptly tapered. First cephalothoracic segment very large, forming half the length of the

animal. Anterior antennæ five-jointed, sparingly setose, very minute, the basal joint excessively dilated and produced anteriorly into an overlapping hood-like beak; posterior antennæ simple, biarticulate (?), the second joint armed with six strong spines, one of which is very long. Mandibles extremely small, with a small bisetose palp. First pair of feet short and thick: internal branch one-jointed, and bearing two strong terminal spines, one longer than the other; external branch three-jointed, bearing at the truncated apex of the last joint two spines similar to those of the inner branch, and also two very long curved setæ: second, third, and fourth pairs of feet having both branches triarticulate and nearly equal, more slender than the first pair, each joint bearing at its apex a subverticillate series of sharp slender spines. Abdominal segments beset round the posterior margins with fine spine-like setæ, the last two cut into rectangular notches. Caudal segments very small, each bearing one large and two small setæ, the larger ones curved, their anterior halves dilated and spatulate. Colour dark vinous red; skin excessively thick and tough. Length $\frac{1}{8}$ of an inch.

The habitat of this remarkable species is amongst the black peaty mud of the upper end of Roundstone Bay, near high-water mark. It is to be regretted that the specimens were not noticed until after the mud in which they were taken had been completely dried; had we been able to preserve them in spirit it is possible that more accurate knowledge of the mouth-apparatus and some other organs might have been obtained. As things stand we have been unable, with the most careful dissection, to find any trace of maxillæ or maxillipeds except (doubtfully) of a very feeble posterior maxilliped, neither have we seen any trace of a fifth pair of feet. The remarkably short and thick limbs of this little creature, together with its flattened ventral surface, its short, stout, and dilated tail-setæ, and general absence of delicate setose encumbrances, seem to fit it admirably for the sort of locality in which it was found, to which and similar situations it is probably exclusively confined.

Genus *HARPACTICUS*, Milne-Edwards.

1. *Harpacticus chelifer* (O. F. Müller).

On weeds in Westport Bay, Valentia Harbour, and in brackish pools near Clifden.

2. *Harpacticus fulvus*, Fischer.

Frequent in pools at and above high-water mark: coasts of Galway and Great Isle of Aran.

3. *Harpacticus flexus*, n. sp. Pl. IX. figs. 17-21.

Anterior antennæ rather short and stout, eight-jointed, first four joints in the female of nearly equal length, last four also subequal and less than one half the length of the preceding; anterior antennæ of the male short and stout, joints coalescent, so as to form four only, terminating in a large vesiculiform swelling: second antennæ having a minute biarticulate branch. Posterior maxilliped small; hand elongated, oval, with a slender, gently curved terminal claw. First pair of feet not materially different from those of *H. chelifera*, but more slender; fifth pair of feet in both sexes broader than in *H. chelifera*; third pair of feet in the male, as in all other species of this genus, largely developed and armed with very strong spines. Body suddenly bent forward at the junction of thorax and abdomen. Length $\frac{1}{40}$ of an inch.

Taken in the surface-net in Westport Bay; moderately plentiful.

We at first thought this might perhaps be a young form of some better-known species; but the uniform size of the specimens, the different proportions of the antennal joints, and the form of the posterior maxilliped point it out as entitled to distinct specific rank.

Genus ZAUS, Goodsir.

Zaus spinosus, Goodsir.

On weeds in Ventry Bay: dredged by Mr. E. C. Davison.

Genus ALTEUTHA, Baird.

1. *Alteutha oblonga* (Goodsir).

Carillus oblongus (♀), Goodsir, Ann. & Mag. Nat. Hist. vol. xvi. (1845), pl. xi. figs. 12-15.

? *Sterope interruptus* (♂), Goodsir, loc. cit. pl. xi. fig. 10.

Alteutha bopyroides, Claus, Die frei-lebend. Copepod. p. 143, Taf. xxii. figs. 10-17.

Taken commonly all round the British Islands in the open sea. Both males and females occur in surface-gatherings; but females with ova we have only rarely found, and those always in dredgings from several fathoms depth.

2. *Alteutha purpurocineta*, Norman.

On the fronds of *Laminaria saccharina* in Clifden Bay.

Genus ASPIDISCUS, Norman.

Aspidiscus fasciatus, Norman.

On *Laminaria* in Clifden and Ventry Bays.

Genus SCUTELLIDIUM, Claus.

Scutellidium tisboides, Claus.

Two specimens taken on weeds in a rock-pool in Clifden Bay.

Genus THALESTRIS, Claus.

1. *Thalestris harpactoides*, Claus.

Taken in the surface-net: Roundstone Bay, Ventry Bay, Killybegs.

2. *Thalestris mysis*, Claus.

In the surface-net, Westport and Roundstone, and on the fronds of *Laminariae* at Clifden.

3. *Thalestris helgolandica*, Claus.

On the fronds of *Laminariae*, Clifden Bay.

The fifth feet and gnathopods of our specimens differ slightly from the figures given by Dr. Claus; and the body and antennæ of the animal, especially in the male, are beautifully banded with dark vinous red.

4. *Thalestris hibernica*, n. sp. Pl. VIII. figs. 17-19.

Body slender, rostrum of considerable length. Anterior antennæ nine-jointed, of moderate length, rather thickly clothed along the anterior margin with shortish hairs; second, third, and fourth joints nearly equal in length, about twice as long as broad; fifth, sixth, seventh, and ninth also nearly equal, and about half the length of the foregoing; penultimate joint much smaller: anterior antennæ of the male shorter and swollen, third joint very short and constricted, fourth much the longest and as wide as the two basal joints, armed with a long falciform appendage, fifth and sixth joints about half the length and breadth of the fourth, seventh and eighth very small, last joint as long as the fifth, but very narrow; a few crowded setæ on the margin of the second joint, and three small ones at the apex of the last joint: posterior antennæ and mouth-organs as usual in the genus. Posterior maxillipeds terminating in a slender clawed hand, in shape approaching that of *T. longimana*, the propodos being irregularly angular and subcrescentic, with the internal angle slightly setose; the unguis strong and well curved. First pair of swimming-feet almost as in *T. longimana*, except that the terminal claws and setæ are longer and more slender, the two branches being nearly equal, and the long claw equal in length to the branch itself. The inner branch of the second pair of feet in the

male is only two-jointed. Longest tail-seta about as long as the body of the animal. Length $\frac{1}{30}$ of an inch.

T. hibernica was taken in no very great numbers in the surface-net in Westport Bay. Anatomically it bears a very close resemblance to, and we have some doubt whether it ought not to be considered as a variety of, the following species. It is, however, very much more slender in all its parts, has not the same tough leathery skin, the same vivid colouring, nor the gibbous outline. That it is not a young form of *T. longimana* is proved by many of the female specimens bearing fully formed ovisacs.

5. *Thalestris longimana*, Claus.

Valentia Harbour and Killybegs (*Mr. E. C. Davison*).

Genus PARATHALESTRIS, nov. gen.

Generi antecedenti similis; pedum vero secundi paris rami interni biarticulati; mandibulæ parvæ, tennes, palpo tenui elongato, ramo secundario minuto, ramo majore setis longis numerosis fimbriato.

Parathalestris Clausii (Norman).

Thalestris Clausii, Norman, Last Shetland Dredging Report, p. 297.

On weeds in Birtirbuy, Clifden, and Westport Bays.

We here follow M. Boeck in restricting the generic name *Thalestris* to those species of Claus's genus which have both branches of all the swimming-feet three-jointed, and the mouth-apparatus constructed as in *T. mysis* and *harpactoides*. The second pair of feet and the mandibles in the present species do not fulfil these conditions.

Genus DACTYLOPUS, Claus.

1. *Dactylopus Stromii* (Baird).

On weeds in Ventry Bay, Valentia Harbour, and Killybegs.

2. *Dactylopus tisboides*, Claus.

In pools near Clifden, and taken in the surface-net in Westport Bay; moderately abundant.

3. *Dactylopus* (?) *cinctus*, Claus.

Taken in the surface-net in Westport Bay; only four or five specimens, all males.

4. *Dactylopus* (?) *minutus*, Claus.

In the same locality as the preceding species; scarce.

Genus NITOKRA, Boeck.

Nitokra tenuicornis (Claus).

Dactylopus tenuicornis, Claus, Die frei-lebend. Copepod.

On *Laminaria saccharina* in Clifden Bay; taken also in the surface-net in Westport Bay, and more abundantly in Roundstone Bay.

Genus MESOCHRA, Boeck.

Mesochra Lilljeborgii, Boeck.

One specimen, apparently referable to this species, and agreeing closely, so far as our observation extended, with drawings kindly sent to us by M. Boeck, was taken in the surface-net in Westport Bay. M. Boeck doubtfully identifies the present species with that figured by Lilljeborg as *Canthocamptus Stromii*. This reference may possibly be correct, seeing that that author shows the inner branch of the second pair of feet as consisting only of two joints; but the descriptions of Baird and Claus refer to a species in which both branches of the second, third, and fourth pairs of feet are said to be three-jointed—not, therefore, to any species of the genus *Mesochra*.

Genus ASEELLOPSIS, nov. gen.

Corpus depressum, segmentis caudalibus laminatis, rotundatis. Pedum primi paris rami ambo biarticulati, interni elongati, valde uncinati, externi perbreves; quinti paris rami ambo subæquales: ceterum *Laophonti* omnino similis.

Asellopsis hispidus, n. sp. Pl. IX. figs. 6–10.

Body elongated, much depressed, lower thoracic segments distinctly narrowed, the margins of the first three abdominal segments produced downwards at the sides in an imbricated manner. Anterior antennæ short, densely setose, seven-jointed, first two joints not much longer than broad, third about the same length but much narrower, fourth very short and broad, fifth about twice as long as the fourth, sixth and seventh equal and very small, the proportionate lengths of the joints, beginning at the base, being as follows—9, 9, 9, 3, 5, 2, 2: posterior antennæ nearly as large as the anterior, biarticulate, bearing a very small one-jointed secondary branch. Mouth-apparatus as in *Laophonte*; second pair of maxillipeds three-jointed, with an oval hand and long slender claw. First pair of feet having the inner branch very long, biarticulate, the first joint much elongated, terminal claw thick and strong; outer branch also biarticulate, the entire length being less than half that of the

first joint of the inner branch ; second, third, and fourth pairs of feet with the outer branch long and three-jointed, the inner very short and two-jointed ; fifth pair rather narrow and elongated, the two laminae being of nearly equal length. Caudal segments very broad, rounded ; surface hispid towards the margins ; terminal setae very short, the longest not much exceeding the length of the segment itself. Length $\frac{1}{35}$ of an inch.

Several specimens of *A. hispidus* were taken in the surface-net in Westport Bay. We have also dredged it sparingly in a depth of from four to ten fathoms off the Durham coast, and more abundantly on a bed of fine clean gravel off Glen Sannox, Arran (N. B.).

Genus LAOPHONTE, Philippi.

1. *Laophonte similis* (Claus).

In tidal pools on Great Isle of Aran ; and on *Laminariæ* and other weeds in Westport, Clifden, Roundstone, and Ventry Bays : not uncommon.

2. *Laophonte forcipata* (?) (Claus).

Amongst weeds in Westport Bay.

Genus CLETODES, Brady.

Cletodes limicola, Brady.

Dredged in Westport Bay.

Genus ORTHOPSYLLUS*, nov. gen.

Lilljeborgia, Claus.

Cletodes, Boeck (not of Brady).

Orthopsyllus linearis (Claus).

One specimen, taken on a sponge dredged in Westport Bay.

The name *Lilljeborgia* having previously been applied to an Amphipod Crustacean, it became necessary to rename the genus so called by Dr. Claus. M. Boeck † considers it to be identical with *Cletodes*, Brady, and applies to it that name ; but the differences between the two are not unimportant. *Lilljeborgia* is stated by Claus to have the first antennæ four-jointed, the second antennæ with a secondary branch, the first pair of swimming-feet to have a two-jointed well-developed inner branch, while the three following pairs of feet have the inner

* ὀρθός, straight ; ψύλλος, a flea.

† Nye Slægter og Arter af Saltvands-Copepoder, 1872.

branch quite rudimentary. *Cletodes*, however, has the first pair of antennæ six-jointed, the second antennæ without a supplementary branch, and the four pairs of swimming-feet all alike, the inner branch ending in two long filaments. Under these circumstances we propose to call Claus's genus *Lilljeborgia* by the new name *Orthopsyllus*.

Genus PORCELLIDIUM, Claus.

1. *Porcellidium fimbriatum*, Claus.

?*Sterope ovalis*, Goodsir, Ann. & Mag. Nat. Hist. vol. xvi. (1845), pl. xi. fig. 11.

Dredged on a bottom of decaying vegetable mud in Birtirbuy Bay, and on *Laminariæ* in Clifden and Ventry Bays.

It seems to us most probable that Goodsir's figures and description (*loc. cit.*) apply to this species, and not to *Zaus ovalis* as supposed by Dr. Claus. If this could be ascertained with certainty, Goodsir's nomenclature would have to be adopted on the ground of priority.

2. *Porcellidium viride* (Philippi).

Thyone viridis, Phil. Archiv für Naturg. 1840, p. 190, Taf. iv. fig. 2.

Porcellidium dentatum, Claus, Die frei-lebend. Copepod. (1863) p. 140, Taf. xxii. figs. 2-5; and Beiträge zur Kenntniss der Entom. (1860), Taf. ii. figs. 19-22.

Dredged in Birtirbuy Bay in company with the preceding species; on weeds in Clifden, Westport, and Ventry Bays.

There can be little doubt that Dr. Philippi's figure applies to this species; and we therefore adopt his specific name; but the generic term *Thyone* is preoccupied, having been applied by Oken to a genus of Holothuriadæ.

3. *Porcellidium subrotundum*, Norman.

P. subrotundum, Norman, Last Shetland Dredging Report, p. 297.

Dredged in Birtirbuy Bay with the foregoing; also on the fronds of *Laminariæ* in Clifden Bay.

4. *Porcellidium tenuicauda*, Claus.

P. tenuicauda, Claus, Beiträge zur Kenntniss der Entom. (1860), p. 6, pl. ii. figs. 10-15; and Die frei-lebend. Copepod. p. 140.

A few specimens taken from the interior of the "bulb" of *Laminaria bulbosa* in Birtirbuy Bay; also on weeds in Clifden and Ventry Bays. Scarce.

Fam. *Corycæidæ*.Genus *CORYCÆUS*, Dana.*Corycæus anglicus*, Lubbock.*C. anglicus*, Lubbock, Ann. & Mag. Nat. Hist. ser. 2, vol. xx. (1857), pl. x. figs. 14-17.*C. germanus*, Leuckart, Archiv für Naturg. (1859), Taf. vi. fig. 9; Thorell, Bidrag till Kännedomen om Krustaceer (1859), tab. xi., xii. fig. 17; Claus, Die frei-lebend. Copepod. (1863), p. 156, Taf. ix. figs. 1-4, Taf. xxiv. figs. 5, 6, Taf. xxviii. figs. 1-4.

Taken in the surface-net in several localities, but nowhere plentifully. Between Cornwall and Cape Clear; Kinsale Harbour, Dingle Bay; in Valentia Harbour, and near the Skelligs. For all these gatherings we are indebted to Mr. E. C. Davison of Sunderland.

Fam. *Sapphirinidæ*, Thorell.Genus *LICHOMOLGUS*, Thorell.1. *Lichomolgus furcillatus*?, Thorell.*L. furcillatus*, Thorell, Bidrag till Kännedomen om Krustaceer, som lefva i Arter af Slägtet Ascidia (1859), p. 74, tab. xiii. fig. 20.

One specimen, which is probably referable to this species, was taken in the surface-net in Roundstone Bay.

2. *Lichomolgus fucicolus* (Brady).*Macrocheiron fuciculum*, Brady, Ann. & Mag. Nat. Hist. vol. x. (1872), p. 9, pl. iii. figs. 9-18; and Nat. Hist. Trans. North. and Durham, p. 434, pl. xviii. figs. 9-18.

This was described by one of us last year under a new generic name, the fact of its being taken amongst algæ having caused us to omit reference to M. Thorell's work, which deals only with species parasitic in Ascidians. The genus *Cyclopicera* proposed in the same paper seems also to be very closely allied to, though scarcely identical with, the previously established *Ascomyzon* of Thorell.

One specimen of *L. fucicolus* was found amongst weeds in Westport Bay, and one in a similar situation in Clifden Bay; two or three specimens have also been found on the Durham coast.

Fam. *Ascomyzontidæ*, Thorell.Genus *ASCOMYZON*, Thorell.*Ascomyzon Lilljeborgii*, Thorell.*A. Lilljeborgii*, Thorell, loc. cit. p. 78, tab. xiv. fig. 21.

Taken in the surface-net: three specimens in Roundstone Bay, and three in Westport Bay.

This species is described by Thorell as being a common parasitic inhabitant of *Ascidia parallelogramma*.

Genus SOLENOSTOMA, nov. gen.

Generi antecedenti simile. Antennæ vero primi paris breves, 12-articulatæ; secundi paris magnæ, biramosæ, ramo principali 4-articulato, in apice spinis 2 fortibus aculeatis armato. Maxillarum rami secundarii obsoleti, setis 2 ciliatis compositi.

Solenostoma scutatum, n. sp.

Body subpyriform; cephalothorax broadly ovate, first segment equal to half the entire length of the animal. Anterior antennæ very short, equal to scarcely one third the length of the first segment of the body, densely setose: posterior about equal in length to the anterior, stout; primary branch terminating in two strong lancet-shaped spines, one of which is much longer than the other, and bearing also one moderately long and two small setæ; secondary branch simple, uniarticulate, and bearing a long terminal seta. Mandible tubular, excessively long, reaching as far as the middle of the caudal segments; palp long, filiform, and setose. Caudal segments three or four times as long as broad, each bearing one short lateral and five long apical setæ, two of which are strongly plumose. Length $\frac{1}{30}$ of an inch.

Found sparingly on the fronds of *Laminarice* in Clifden Bay.

A very remarkable animal, differing from the genus *Ascomyzon* chiefly in the structure of the maxillæ and second pair of antennæ, but agreeing with that genus in the general conformation of the mouth-apparatus.

Genus ASTEROCHERES, Boeck,

Asterocheres Lilljeborgii, Boeck.

A. Lilljeborgii, Boeck, *Tvende nye parasitiske Krebsdyr* (1859), p. 6, tab. 2.

Three specimens were found on a sponge dredged in Westport Bay. M. Boeck's specimens were taken on the disk and rays of *Echinaster sanguinolentus*; but though after its first discovery that author sought for the little parasite diligently on many examples of the starfish, he did not succeed in finding any further specimens. It would appear, indeed, from the various positions in which we have found many of these suctorial or parasitic species, that they are not very fastidious as to the source from which they draw their nourishment.

EXPLANATION OF THE PLATES.

PLATE VIII.

- Fig. 1.* *Paracalanus hibernicus*, anterior antenna. *Fig. 2.* Fifth pair of feet of male. *Fig. 3.* Fifth pair of feet of female.
Fig. 4. *Pseudocyclops obtusatus*, right anterior antenna of male. *Fig. 5.* Right anterior antenna of female. *Fig. 6.* Posterior antenna. *Fig. 7.* Foot of fifth pair (female).
Fig. 8. *Paratachidius gracilis*, anterior antenna of female. *Fig. 9.* Anterior antenna of male. *Fig. 10.* Mandible and palp. *Fig. 11.* Maxilla. *Fig. 12.* Anterior maxilliped. *Fig. 13.* Posterior maxilliped. *Fig. 14.* Foot of first pair. *Fig. 15.* Foot of fifth pair (female). *Fig. 16.* Foot of fifth pair (male).
Fig. 17. *Thalestris hibernica*, anterior antenna of female. *Fig. 18.* Posterior maxilliped. *Fig. 19.* Foot of first pair.

PLATE IX.

- Fig. 1.* *Ilyopsyllus coriaceus*, female, seen from below : *a*, anterior antenna ; *b*, posterior antenna ; *c*, foot of first pair. *Fig. 2.* Anterior antenna. *Fig. 3.* Posterior antenna. *Fig. 4.* Mandible and palp. *Fig. 5.* Foot of second pair.
Fig. 6. *Asellopsis hispidus*, female, seen from side. *Fig. 7.* Anterior antenna of female. *Fig. 8.* Posterior maxilliped. *Fig. 9.* Foot of fifth pair. *Fig. 10.* Posterior abdominal segments.
Fig. 11. *Microsclella atlantica*, female (?), seen from side. *Fig. 12.* Posterior antenna. *Fig. 13.* Mandible. *Fig. 14.* Anterior maxilliped. *Fig. 15.* Posterior maxilliped (?). *Fig. 16.* Foot of fifth pair.
Fig. 17. *Harpacticus flexus*, anterior antenna of female. *Fig. 18.* Anterior antenna of male. *Fig. 19.* Posterior maxilliped. *Fig. 20.* Foot of fifth pair (female). *Fig. 21.* Foot of fifth pair (male).

XIX.—New Fishes from Angola.

By Dr. ALBERT GÜNTHER.

MR. MONTEIRO has brought home a small collection of fishes from Angola. Some of them were collected in a lake some 100 miles inland of Ambriz. Besides *Pellonula vorax* and *Ophiocephalus obscurus* (with thirty rays in the anal fin) and some other known forms, the following undescribed species were in this collection.

Gymnallabes apus.

D. ca 140. A. ca 126. Body exceedingly elongate, its depth being one twenty-third of the total length (without caudal), the length of the head one thirteenth. Pectoral fins reduced to a minute rudiment, ventrals entirely absent ; vertical fins only half as high as the body. The maxillary and outer mandibular barbels are nearly equal in length, extending somewhat beyond the gill-opening, and rather longer

than the other barbels. The distance of the vent from the end of the snout is two fifths of its distance from the root of the caudal. The branchial accessory organ is dendritic. Uniform brownish-black.

Length $8\frac{1}{2}$ inches. Interior of Ambriz.

This very singular form differs so materially from the type, described in the 'Annals' for August 1867, that it may be regarded at all events as a subgenus, for which the name *Channallabes* may be used. In appearance the head and body and the vertical fins resemble very much those of *G. typus*; but with the greater elongation of the body the paired fins became useless and disappeared. The typical specimen of *G. typus* has the postbranchial organ of a much more simple form than *G. apus*; but this is, perhaps, only due to age, as in *Anabas*.

BRYCONÆTHIOPS.

This genus is the African representative of the American *Brycon*, from which it is distinguished by its very small, toothless maxillary.

Dorsal fin placed in the middle of the length of the body, opposite to the ventrals; anal rather long. Body oblong, covered with scales equal in size. Belly rounded. Cleft of the mouth rather narrow. Intermaxillary with three series of teeth, the teeth of the two outer series being subconical, those of the inner broad, molarlike, with several cusps. Maxillary small, short, enveloped in the skin, toothless. Mandible with a series of strong tricuspid teeth, and with a pair of conical teeth in the middle behind the front series. Gill-openings wide, the gill-membranes being united for a short space in front, but not attached to the isthmus. Gillrakers short, feeble, slender, lanceolate.

Bryconæthiops microstoma.

D. 10. A. 20. V. 9. L. lat. 37. L. transv. $6/5$.

The height of the body is one third of the total length (without caudal), the length of the head two sevenths. The large eye is covered with an adipose eyelid in front and behind; it is equal in length to the postorbital portion of the head, and longer than the snout. The maxillary terminates under the front margin of the eye. Dorsal fin nearly midway between the extremity of the snout and the root of the caudal. Ventral nearly opposite to the middle of the dorsal. Pectoral not extending to the ventral. There are three series of scales between the lateral line and the ventral. Silvery; a bluish

spot at a short distance behind the gill-opening is more distinct after the scales are removed. Dorsal fin with a blackish line behind and parallel to each of the rays.

Two specimens, $4\frac{1}{2}$ inches long, from the River Congo.

Alestes holargyreus.

D. 10. A. 21. L. lat. 23. L. transv. $4\frac{1}{3}$.

Allied to *A. tæniurus*.

The height of the body is a little more than one third of the total length (without caudal), the length of the head two sevenths. The origin of the dorsal fin is immediately behind the base of the ventrals; pectoral just reaching the ventral. Bright silvery, without spots. Caudal with a very indistinct blackish median band.

Several specimens, $2\frac{1}{2}$ inches long, from the River Congo.

Distichodus affinis.

D. 16. A. 21. L. lat. 37. L. transv. $6\frac{1}{9}$.

Allied to *D. notospilus*.

The height of the body is two fifths of the total length (without caudal), the length of the head a little less than two sevenths. Nose scarcely protruding. Teeth in a double series, the lower jaw with fourteen teeth in the front series. Body uniform greenish, without spot. The membrane between the anterior three or four dorsal rays black.

A young specimen, only 2 inches long, from the River Congo.

Mormyrus Monteiri.

D. 30. A. 38. L. lat. 74.

Allied to *M. Petersii* and *M. senegalensis*.

Snout subconical, nearly straight, of moderate length, with a mandibular fleshy appendage in front, which is about as long as the eye. Eye of moderate size, situated before the middle of the length of the head, and one half of the length of the snout (without appendage). Pectorals extending beyond the middle of the length of the ventrals. The height of the body is two sevenths of the total length (without caudal), the length of the head two ninths. *The free portion of the tail as long as the head (without appendage)*. Coloration uniform, shining silvery.

Three specimens from Angola, the largest being $8\frac{1}{2}$ inches long.

XX.—Notes on, and Descriptions of, some Lizards with Rudimentary Limbs in the British Museum. By Dr. ALBERT GÜNTHER, F.R.S.

Delma Fraseri.

I have recently examined the typical specimen of *Delma Grayi* (Smith, Ill. S. Afr. Rept. pl. 76. fig. 2). It is identical with *D. Fraseri*, and there can be no doubt that it came from Australia, as supposed by Sir A. Smith himself.

I am also of opinion that *Delma Mölleri*, Lütken (Nat. Foren. Vid. Medd. 1862), is not specifically distinct. The specimen to which this name was given has the supranasal and anterior frontal of each side united into one shield, a peculiarity which I consider to be individual. Confluence of two shields into one is by no means of uncommon occurrence in this lizard; and the distinctness of the markings on the head is subject to great variation. Ten specimens in the British Museum are from Western Australia.

Aprasia pulchella.

All the eight specimens in the British-Museum collection (including the types) have 12 series of scales round the body, and not 14, as found by Prof. Peters (MB. Berl. Ak. 1863, p. 233). With regard to coloration, there is a gradual passage from specimens which show only a few faint rows of brownish dots to such as are ornamented with six or eight longitudinal black bands. Therefore *Aprasia octolineata* (Ptrs.) cannot be regarded as distinct from *A. pulchella* (Gray). Some of our specimens are from South, others from West Australia.

Chelomeles pseudopus.

Scales round the middle of the body in 22 series; about 104 scales in a longitudinal series between the fore and hind limbs. Four large præanal scales. Subcaudals not enlarged. *A longitudinal groove runs along each side of the abdomen for a distance of about 24 scales, commencing from the axil of the fore limb.* Fore limbs very short, about as long as the snout, with three rudimentary claws; hind limbs still shorter, undivided. The anterior frontal forms a rather broad suture with the rostral and vertical—this latter being bell-shaped, longer than broad. Four supraciliary shields. A pair of anterior occipitals; central occipital elongate. Seven upper labials, the third and fourth separated from the orbit by a series of shields which are as large as the labials below them. Mental as broad as the median lower labial. Ear entirely hidden. Coloration uniform.

One specimen, 14 inches long, the body measuring $7\frac{1}{4}$ inches. A portion of the tail is reproduced. It is not known where this specimen was obtained.

Chelomeles sumatrensis.

Scales round the middle of the body in 22 series; about 84 scales in a longitudinal series between the fore and hind limbs. Four large præanal scales; subcaudals scarcely enlarged; no longitudinal groove along the side of the abdomen. Fore limbs very short, a little longer than the snout, with two claw-like prominences; hind limbs longer than fore limbs, with a terminal claw, and a second, lateral one. The anterior frontal forms a rather broad suture with the rostral and vertical, this latter being scarcely longer than broad. Three supraciliary shields. Two anterior occipitals as long and as large as the central occipital. Six upper labials, the fourth of which enters the orbit. Mental as broad as the median lower labial. Ear entirely hidden. Uniform brown above; middle of the abdomen white; lateral scales with a brown central spot.

One specimen, from Agam, has a body $3\frac{1}{2}$ inches long, only about $1\frac{1}{2}$ inch of the tail being preserved. We obtained it, with other reptiles, from Dr. Bleeker.

Chelomeles reticulatus.

Scales round the middle of the body in 24 series; about 100 scales in a longitudinal series between the fore and hind limbs. Dorsal scales larger than the others; two large præanal scales; subcaudals enlarged. No lateral groove on the side of the abdomen. All the limbs three-toed, the toes being extremely short, clawed. Fore limbs somewhat longer than the snout, and rather shorter than the hind limbs. The anterior frontal is in contact with the rostral; but the nasal shields are closely approximate. The vertical forms a short suture with the anterior frontal, and is rather longer than broad, pentagonal, the anterior side being the shortest. The anterior occipitals form a broad suture together, whilst the posterior are nearly entirely separated by the intercalated central occipital. Four supraciliary shields. Mental as broad as the median lower labial. Ear entirely hidden. Upper parts olive-coloured, finely punctulated with brown; sides and abdomen bluish white, with black lines following the edges of the scales.

One specimen, from the Clarence river, 12 inches long, sent by Mr. Krefft (no. 26): the tail is 4 inches; but a great portion of it is reproduced.

SORIDIA and PHOLEOPHILUS.

In the British Museum there are:—

1. The types of *Soridia lineata*, Gray (1839), renamed *Præpeditus* by Duméril and Bibron. They were collected by Gilbert in Western Australia; and their Australian origin is confirmed by other specimens received by Mr. Buchanan from the same country, and by the occurrence of a second, closely allied species, *Soridia miopus* (Gthr.), in Champion Bay.

2. The types (two specimens) of *Pholeophilus capensis*, Smith (Ill. S. Afr. Rept. App. 1849). This author says, p. 15:—"The two specimens I possess were obtained in Little Namaqua Land, and were found under a loose stone, in a burrow like what is formed by an earthworm."

Now *all these specimens are specifically identical**; and as I am not yet prepared to admit that so singular a form as *Soridia* is common to South Africa and Western Australia, I can at present arrive at no other conclusion but that Sir A. Smith, who does not say that he himself found the examples, received them from some other person, either at Cape Town or in England, and was misinformed as regards their locality †.

Herpetosaura † *inornata*.

Lithophilus inornatus, Smith, Ill. S. Afr. Rept. App. p. 12 (1849; generic name preoccupied).

Herpetosaura arenicola, Peters, Wieg. Arch. 1855, p. 48.

Scales in 20 series round the middle of the body; 104–112 scales in a series between the chin and vent. In one specimen a minute rudiment of the hind limb is visible. The very small shield behind the nostril is sometimes confluent with the first upper labial. There are three specimens in the British-Museum collection:—

- a. Type of the species. S. Africa. Presented by Sir A. Smith.
- b. Adult. Port Natal. Presented by the Rev. H. Calloway.
- c. Half-grown. Port Natal. Purchased of Mr. T. Ayres.

Herpetosaura atra.

Scales round the middle of the body in 23 series; about

* Bibron has already recognized this fact; but he thought the species to be from the Cape.

† In this respect it may be of some importance to mention that these two specimens had been previously preserved in turpentine—a method which, as Mr. Ford informs me, had been frequently adopted by one of the Verreauxs, who is known to have collected in Australia, and from whom Sir A. Smith procured many specimens.

‡ This genus, as well as *Sepomorphus caffer* (Peters, 1861), is to be added to my Synopsis of *Sepidae* in Proc. Zool. Soc. 1871, p. 240.

160 scales in a series between the chin and vent. Dorsal scales not larger than the others; four præanal scales, the two middle ones largest; subcaudals not enlarged. No trace of limbs. Frontal separated from rostral by a pair of small intervening shields, but forming a short suture with the vertical; this latter shield is subtriangular in shape, with the posterior side the longest, and forms a very broad suture with an occipital shield, which is likewise triangular, its anterior side being the longest. The first upper labial is very large, ascending to behind the nostril, which is situated in a notch of the rostral. Ear entirely hidden. Black.

One specimen, from the Zambesi, is 8 inches long, the body being $6\frac{1}{4}$ inches, and part of the tail reproduced.

XXI.—*On the Longicorn Coleoptera of Japan.*

By H. W. BATES, F.L.S.

THE large collection of Coleopterous Insects made, during a residence of five years in Japan, by Mr. George Lewis, on which the present account of the family *Longicornia* is founded, furnishes materials for enabling entomologists for the first time to form a definite idea of the nature of the Japanese fauna in this department. Hitherto the number of species of *Longicornia* recorded from these islands has not reached a score. Mr. Lewis's collection contains 103, the total number now known being 107. Of these, 62 are new species discovered by Mr. Lewis. In a former paper, on the *Geodephaga**, I have recorded a similar great augmentation of our knowledge due to the labours of this entomologist, the number of known Japanese species in that group having been trebled by him, and 120 new species added to science.

With regard to the nature and relations of the Insect-fauna, an analysis of the list of *Longicornia* quite confirms the leading results arrived at in the memoir on the *Geodephaga* above cited. In the introductory notes to that paper, after describing the geographical position of the Japanese archipelago, and alluding to the views of many Russian and English entomologists in favour of the fauna being considered as forming part of the great Palæarctic province, I showed that the very large mixture of tropical genera and the striking absence of characteristic European and north-temperate forms were opposed to those views. The conclusion implied was

* Trans. Entom. Soc. 1873, part ii. p. 219.

that the composition of the Japanese Coleopterous fauna was essentially different from that of the Palæartic province, and required to be accounted for by a different set of antecedents. A similar conclusion has been arrived at long ago by Günther with regard to the *Reptilia*, and by other authors; and it is interesting thus to find the various groups of the animal kingdom corroborating these generalizations.

The total number of genera of *Geodephaga* known from Japan is 84, of *Longicornia* 64. The number of tropical genera in both cases is 21, of genera peculiar to Japan (so far as at present known) 9 and 7 respectively, genera common to Europe and Japan (most of them being widely distributed temperate forms) 44 and 22, characteristic or peculiar European genera absent from Japan 52 and 40 (more than one half the total number in each case). In the *Longicornia* there are 8 genera common and peculiar to Eastern or North-eastern China and Japan; in the *Geodephaga* there are only 2. The number of Longicorn species actually identical in Japan and Europe is only 4; but 6 others are so closely allied that they would be considered by some entomologists local varieties, making the total number 10.

The general aspect of the Longicorn collection is much more tropical and anti-European than that of the *Geodephaga*. This is owing to so many of the large and striking species being well-known Indo-Chinese and Malayan forms. Such are *Xystrocera*, *Neocerambyx*, *Pyrestes*, *Erythrus*, *Melanauster*, *Batocera*, *Apriona*, *Olenecamptus*, *Ælara*, *Glenea*, and others. Besides these, we find:—*Rhodopis*, hitherto known only from Sylhet; *Distenia*, a tropical and subtropical genus in both hemispheres, unknown to the Europæo-Siberian and Mediterranean faunas; *Thranis*, hitherto known only from the Moluccas and Ceylon; and a few common tropical genera represented in Japan by numerous species, such as *Ceresium*, *Praonetha*, *Apomecyna*, and *Sybra*—all totally foreign to the north-temperate continental fauna. The absence of many of the most familiar and characteristic European genera is equally striking, such as *Cerambyx*, *Hylotrupes*, *Hesperophanes*, *Gracilia*, *Necydalis*, *Stenopterus*, *Molorchus*, *Parmena*, *Dorcadion*, *Morimus*, *Lamia*, *Rhagium*, &c.

Many entomologists, authorities in their respective groups, are at work on other portions of Mr. Lewis's magnificent collection; and it is to be hoped this enterprising traveller may be enabled to republish all the scattered memoirs in a collected form, as a contribution to the fauna of Japan.

Mr. Lewis's collections were made chiefly at Nagasaki, Osaka, and Hiogo.

List of Species.

Fam. PRIONIDÆ.

- Prionus insularis, *Motsch.*
Ægosoma sinicum, *White.*

Fam. CERAMBYCIDÆ.

- Spondylis buprestoides, *Linn.*
Criocephalus rusticus, *Linn.*
Xystrocera globosa, *Oliv.*
Mallambyx japonicus, n. sp.
Pachydissus (?) fulvidus, *Pascoe.*
Neocerambyx chrysothrix, n. sp.
Ceresium sinicum, *White.*
— holophæum, n. sp.
Stenodryas clavigera, n. sp.
Stenygrinum quadrinotatum, n. sp.
Gracilia pygmæa, *F.*
Obrium longicorne, n. sp.
Stenomalus cleroides, n. sp.
Distenia japonica, n. sp.
Toxotus cæruleipennis, n. sp.
Acmæops criocerinus, n. sp.
Leptura scotodes, n. sp.
— tenuicornis, *Motsch.*
— dimorpha, n. sp.
— xanthoma, n. sp.
— ochraceofasciata, *Motsch.*
— anaspidoïdes, n. sp.
Thranium variegatum, n. sp.
Pyrestes cardinalis, *Pascoe.*
Erythrus congruus, *Pascoe.*
Callichroma tenuatum, n. sp.
Sympiezocera japonica, *Lacord.*
Semanotus rufipennis, *Motsch.*
Phymatodes albicinctus, n. sp.
Clytanthus notabilis, *Pascoe.*
— oppositus, *Chev.*
— quinquefasciatus, *L. & G.*
— muscosus, n. sp.
— diminutus, n. sp.
— annularis, *Fab.*
Xylotrechus Grayii, *White.*
— pyrrhoderus, n. sp.
Clytus caproïdes, n. sp.
Dere thoracica, *White.*
Purpuricenus Temminckii, *Guér.*
— spectabilis, *Motsch.*

Fam. LAMIADÆ.

- Echthistatus gibber, n. sp.
Monohammus subfasciatus, n. sp.
— tessera, *White.*
— luxuriosus, n. sp.
— fraudator, n. sp.
— sejunctus, n. sp.
— degener, n. sp.
Psaecothoa hilaris, *Pascoe.*

- Melanauster chinensis, *Forst.*
— glabripennis, *Motsch.*
— (?) ruber, *Dalm.*
Batocera lineolata, *Chev.*
Apriona rugicollis, *Chev.*
Uræcha bimaculata, *Thoms.*
Mesosa japonica, n. sp.
— perplexa, *Pascoe.*
— longipennis, n. sp.
Rhodopsis Lewisii, n. sp.
Olenecamptus cretaceus, n. sp.
Bumetopia oscitans, *Pascoe.*
Ælara furcata, n. sp.
Praonetha caudata, n. sp.
— zonata, n. sp.
— jugosa, n. sp.
— Bowringii, *Pascoe.*
— rigida, n. sp.
— angusta, n. sp.
— leiopodiina, n. sp.
Apomecyna neglecta, *Pascoe.*
— nævia, n. sp.
Sybra ordinata, n. sp.
— cribrella, n. sp.
Microlera ptingoides, n. sp.
Atimura japonica, n. sp.
Lasiapheles obrioides, n. sp.
Pogonocherus seminiveus, n. sp.
Aulaconotus pachypezoides,
Thoms.
Pothyne silacea, *Pascoe.*
Smermus bimaculatus, n. sp.
Calambius japonicus, n. sp.
Acanthocinus griseus, *F.*
Leiopus guttatus, n. sp.
Exocentrus fasciolatus, n. sp.
— lineatus, n. sp.
— tonsus, n. sp.
— guttulatus, n. sp.
Asaperda rufipes, n. sp.
— agapanthina, n. sp.
Agapanthia pilicornis, *F.*
Saperda sanguinolenta, *Thoms.*
Thyestes Gebleri, *Fulderm.*
Glenea Fortunei, *Saund.*
— galathea, *Thoms.*
— ocelota, n. sp.
— relictæ, *Pascoe.*
Phytœcia simulans, n. sp.
— ventralis, *Chev.*
Oberea japonica, n. sp.
— hebescens, n. sp.
— mixta, n. sp.
— nigri ventris, n. sp.
— marginella, n. sp.
— fulveola, n. sp.
Chreonoma Fortunei, *Thoms.*

Fam. Prionidæ.

Prionus insularis, Motschulsky.

Prionus insularis, Motschulsky, Etudes Entom. 1857, p. 36, ♀; *id.* 1861, p. 21, ♂; Solsky, Horæ Soc. Ent. Ross. t. vii.

P. tetanicus, Pascoe, Ann. N. H. xix. p. 412 (1867).

P. fossatus, Pasc. Trans. Ent. Soc. 2nd ser. iv. p. 90 (1857) ?

Japan, common; also North China.

I see no difference between Japanese specimens and others from Northern China, whence Pascoe described his *P. fossatus*; his description, however, does not precisely agree with the insect, especially as regards punctuation, and I cite the synonymy with doubt.

Ægosoma sinicum, White.

Ægosoma sinicum, White, Cat. Long. Col. Brit. Mus. p. 30, ♀.

Many examples; on fir trees.

White only knew the female, which resembles the same sex of *Æ. scabricorne*. The male is much more different from the corresponding sex of that species, having much shorter and thicker antennæ, with the scape shorter and more cubical. The thorax differs in shape, being gradually widened from apex to base, at which latter it is nearly equal in width to the elytra.

Fam. Cerambycidæ.

Section A. *Eyes coarsely faceted. Habits nocturnal.*

Spondylis buprestoïdes, Linn.

Spondylis buprestoïdes, Linn. Syst. Nat. xii. 2. p. 621.

Also found in N. China.

Criocephalus rusticus, Linn.

Criocephalus rusticus, Linn. Syst. Nat. xii. 2. p. 634; Kraatz, Berl. ent. Zeit. vii. p. 107.

Maiyasan; running over fir trees at night.

Japanese examples have punctured elytra and sutural apices briefly spinose, as in German specimens.

Xystrocera globosa, Oliv.

Xystrocera globosa, Oliv. Entom. no. 66. p. 27, t. 12. f. 81.

Stenocorus vittatus, Fab. Syst. El. ii. p. 309.

Many examples, agreeing with others from Cambodia, &c.

Fabricius erroneously cited Brazil as the locality of his *Stenocorus vittatus*, which is evidently the same as *Xystrocera globosa*.

Pachydissus (Mallambyx) japonicus, n. sp.

P. minus convexus, olivaceo-fuscus, pube subtili fulvo-grisca vestitus; thorace elytris multo angustiore, medio paulo dilatato, antice fortiter angustato, supra minus profunde flexuoso-plicato; elytris lævibus, apice singulatim rotundatis angulo suturali spinoso; antennis (♂) corpore dimidio longioribus, omnino inermibus, articulis tertio quartoque apice paululum incrassatis, 4^{to} quam 5^{to} multo brevioribus. Long. 1 in. 5 lin. to 2 in. ♂ ♀.

Japan.

Agrees with the typical (Australian) species of *Pachydissus* in the unarmed antennæ and thorax and the finely pubescent surface; but differs much in *facies* and in the very slight nodosity of the 3rd and 4th antennal joints. The combination of characters which the species offers renders it ill-placed in any of the genera hitherto proposed in this group; and it may be found convenient to separate it under the generic name *Mallambyx*. The sockets of the anterior haunches are angulate externally; but this character is not even of generic importance, although Lacordaire founded a section upon it; for some Australian species of *Pachydissus* possess strongly angulated acetabula, whilst others, very closely allied, have them only circular. The prosternal process is a little prominent at the edge of its posterior declivity; the mesosternum plane. The crown of the head has a single (central) groove, extending behind to the neck, as in *Cerambyx* and *Hoplocerambyx*, and not ending in a transverse groove at the level of the posterior margin of the eyes as in *Pachydissus*.

Pachydissus (?) *fulvidus*, Pascoe.

Pachydissus (?) *fulvidus*, Pascoe, Trans. Ent. Soc. new ser. iv. p. 236.

One example, Nagasaki; also North China.

The elytra are clothed with rather coarse, uniform, laid, tawny pubescence, and are rounded at the apex. The species may possibly come within the proposed genus *Mallambyx*; but I have seen only a female specimen, and therefore cannot decide.

Neocerambyx chrysothrix, n. sp.

N. forma et colore *Cer. aurifabro* (White) similis, at differt antennis nullomodo spinosis, nec thorace transversim plicato. Elongatus, subcylindricus, fulvo-fuscus, tomento sericeo mutabili vestitus; thorace utrinque medio spinoso, supra grossissime irregulariter rugoso et tuberculato, ad basin sulcis binis transversis; elytris apice breviter oblique truncatis, angulo exteriori paulo producto acuto, suturali longe spinoso; antennis (♀) articulis 3^o-6^{um} singu-

latim quam quinto distincte brevioribus ad apicem tumidulis.
Long. 1 in. 3 lin. ♀.

Nagasaki.

The pubescence is rich tawny golden, thick and adpressed; it is laid or, as it may be described, *brushed* in different ways, sometimes convergent, and is of lighter and darker shades, the darker forming two indistinct flexuous bands across the elytra. The tomentum is also thick and coarse on the head and thorax, and clothes the whole of the antennæ. The thorax has no trace of transverse furrows or of central smooth plate, as in *Cer. holosericeus*, F.

The species belongs, but imperfectly, to the genus *Neocerambyx*, differing from it in the spined thorax, and in the sockets of the anterior haunches being scarcely opened externally.

Ceresium sinicum, White.

Ceresium sinicum, White, Cat. Long. Col. Brit. Mus. p. 245.

Nagasaki.

Ceresium holophæum, n. sp.

C. quam *C. sinico* minus elongatum, omnino fulvo-testaceum, flavo-pubescent; capite grosse inæqualiter punctato; thorace oblongo-ovato, punctis magnis et parvis subcrebre impresso, linea abbreviata, elevata, dorsali, lævi; elytris crebre æqualiter punctatis; antennis articulis tertio quartoque subæqualibus, quinto vix longiore. Long. $4\frac{1}{2}$ lin.

Hiogo; three examples, apparently males.

STENODRYAS, nov. gen.

Genus inter *Callidiopsides* et *Gracilides* (Lacord.) locum tenens. *Corpus* elongatum, gracile, subglabrum. *Caput* thorace latius; oculi magni, convexi; genis brevibus. *Palpi* maxillares labialibus duplo longiores; articulis ultimis omnium dilatatis, triangularibus. *Antennæ* (δ) corpore dimidio longiores, tenues, filiformes, nullo modo sulcatæ, basin versus infra ciliatæ; articulo quarto quam tertio vel quinto multo brevior. *Thorax* elongatus, cylindroideus, medio paululum dilatatus, vix inæqualis. *Elytra* apice rotundata. *Coxæ* anteriores conico-globosæ exsertæ; prosternum inter coxas angustissimum. *Mesosternum* angustum, coxis globosis, acetabulis clausis; episterna metathoracica angusta, postice attenuata. *Pedes* elongati, gracillimi, femoribus abrupte elongato-clavatis; tarsi graciles, articulo primo secundo tertioque conjunctis æquali.

The numerous examples of this species that I have seen all appear to be males; at least I have observed no difference in the antennæ or the abdomen, which latter is quite normal; and consequently I am unable to say whether the ♀ offers the

curious abnormal structure presented by *Obrium* and many allied genera. The genus has much general similarity to *Ceresium*, except in the long slender legs and abruptly clubbed femora. The exerted anterior coxæ bring it, so far, within the definition of the *Gracilides* (Lacord.); but the tightly closed middle sockets exclude it from that group.

Stenodryas clavigera, n. sp.

S. angusta, fulvo-testacea, sparsim pubescens; antennarum scapo, femorum clava tibiæque apice piceo-nigris; capite supra rugoso-punctato; thorace subsparsum punctato, subopaco, plaga elongata mediana lævi, disco utrinque inæquali; elytris passim æqualiter discrete punctatis. Long. $4\frac{3}{4}$ lin. ♂.

Hiogo.

STENYGRINUM, nov. gen.

Facie generis *Stenygræ*, gen. *Ceresio* affine. *Thorax* cylindricus, sed femoribus abrupte valde clavatis et tibiis intermediis fortiter curvatis. *Corpus* elongatum, sparse setosum. *Caput*, cum oculis convexis, thorace paulo latius; palporum articulo ultimo dilatato triangulari, maxillaribus elongatis. *Antennæ* robustæ, filiformes, articulis 5^o-10^{um} apice extus productis, articulo quarto parvo, quam tertio vel quinto dimidio brevioribus. *Coxæ* anticæ globosæ; prosternum inter coxas modice angustum; mesosternum planum.

This new genus is closely allied to *Ceresium*, and still more so to the Australian genus *Bethelium*, from which latter it differs in the cylindrical (instead of cordate) thorax and less hirsute antennæ. The elytra are similarly coloured to the Tropical-American genus *Stenygra*, and they are also distinguished by two oblique depressions on each, one near the suture towards the base, and the other on the posterior part of the disk. The legs are rather short and stout; the femora of all abruptly and strongly clavate. The intermediate tibiæ are strongly bent outwards, as it appears, in both sexes. The antennæ in the ♂ are a little longer (in the ♀ a little shorter) than the body.

Stenygrinum quadrinotatum, n. sp.

S. elongatum, convexum, sparse setosum, rufo-castaneum; elytris medio fusco-nigris, maculis duabus utrinque discoidalibus flavo-testaceis, una paulo ante, altera apud medium; thorace juxta apicem constricto, ante medium paululum dilatato, subcrebre haud profunde punctulato, punctis majoribus rugulisque intermixtis, linea dorsali lævi; elytris punctis piliferis discretis, versus apicem minutissimis. Long. 5 lin. ♂ ♀.

Ipongi; three examples.

Gracilia pygmæa, Fab.*Gracilia pygmæa*, Fab. Syst. El. ii. p. 339.

One example, Osaka; not distinguishable from the European species.

Obrium longicorne, n. sp.

O. brunneo paulo majus et latius, fulvo-testaceum, subtiliter dense pubescens et longe setosum, haud nitidum; oculis (♂) maximis; antennis corpore duplo longioribus; thorace ut in *O. brunneo* tuberculato, postice magis angustato, sparsim punctulato; elytris supra subplanis, crebre punctulatis. Long. $2\frac{1}{2}$ lin. ♂.

One example.

By the magnitude of its eyes this species approaches *Stenhomalus* (White).

Stenhomalus cleroïdes, n. sp.

S. nigro-fuscum, pubescens, antennis pedibusque rufo-testaceis, femoribus tibiisque medio infuscatis; thorace aureo-pubescente, tubere laterali valido, basi constricto, supra sparsim punctato; elytris basin versus sparsim punctatis, pallido-testaceis macula communi basali rhomboidea, altera subquadrata pone medium antice obliqua, tertiaque parva transverse ante apicem nigro-fuscis. Long. $3\frac{1}{2}$ lin. ♀.

Two examples, Ipongi.

Differs from *St. fenestratus* (White) by the design on the elytra. Their ground-colour is pale testaceous, with a large spot at the base, touching the base on the scutellum, ending in a point on the suture posteriorly, and leaving the shoulders pale; a subtriangular spot follows this behind the middle, narrowing to a point towards the suture. These two black patches leave between them a very oblique V-shaped pale fascia. The pale apical part has in the middle a faint dusky spot. The abdomen of the ♀ has a similar abnormal structure to that of *Obrium*, the 2nd ventral segment having a long fringe of hairs, and the 3rd to 5th being hidden in its posterior concavity.

Distenia japonica, n. sp.

D. magna, elongata, fusca, subtiliter pubescens, antennis pedibusque subrufescentibus; capite pone oculos tumido; thorace lato, crebre punctulato, disco utrinque bituberculato; elytris apice angulo suturali longe dentato, supra sparsim lineato-punctatis, dimidio apicali lævi; femoribus inermibus. Long. 11–14 lin. ♂ ♀.

Maiyasan, Hiogo; many examples, found at night running over fir trees.

A typical *Distenia*, allied to *D. undata*, but differing from

all the American species, even those with only one apical spine to the elytra, by the spine (or sharp tooth) being a prolongation (a little divergent) of the sutural angle, and not distant from it; from the spine the apex is gradually rounded to the sides. The punctation of the elytra is scanty and in lines. The thorax is rather wider than usual in the middle, and the discoidal tubercles are very obtuse. The head is tumid behind the eyes, more distinctly so in the ♂ than in the ♀. The scape of the antennæ is roughly punctured. There is no long pubescence on body or limbs.

[To be continued.]

XXII.—*Notes on Chinese Mud-Tortoises* (Trionychidæ), with the Description of a new Species sent to the British Museum by Mr. Swinhoe, and Observations on the Male Organ of this Family. By Dr. J. E. GRAY, F.R.S. &c.

[Plate V.]

MR. SWINHOE has most kindly sent to the British Museum several specimens, preserved in spirits, of Mud-Tortoises from the neighbourhood of Shanghai.

The collection contains:—a large specimen of the most beautiful species of Mud-Tortoise which I have yet observed from any country; and I believe it to be new to science; three specimens of a very plain olive Mud-Tortoise, which are peculiar for having the crown of the head and nose covered with a hard very thin skin, somewhat like the skin which covers the head of the Terrapins; and several specimens of different ages, but all young, of *Landemania perocellata*, showing the change of colour in the young animals of this species as they increase in age.

This collection is also interesting as showing the form of the male organ and the external sexual character of the males of this group of Chelonians. The specimens having been killed by being placed in spirit, the male organ has been exerted in two of the specimens. It is expanded and fan-shaped, with the urethral grooves on the lower side forked and ending in conical claw-like terminations. In both specimens the tail is short, tapering to a very fine point, and ending in a hard spine; while the tails of the other specimens are all without points, soft, and rather blunt at the end. The armed tail is the character that Leconte gives of the males of *Kinosternon*.

The Reptiles have been divided into:—those which have a single male organ for intromission, as the Tortoises, the Crocodiles, &c.; and those which have a pair of organs for the

same purpose, as the Lizards and Snakes. In the 'Annals' some time ago I showed that the two organs above referred to were not for the purpose which they have generally been considered to serve, but claspers or cramps, like those found in Skates; only, instead of being exposed as in those fishes, they are retractile under the skin of the body when not required for holding the female. I am now able to show that Tortoises or at least the Mud-Tortoises (*Trionychidæ*), are provided with a well-developed organ for the intromission of the semen, differing in outline in two allied species.

OSCARIA.

Skull broad. Nose short, not half the diameter of the orbit. Palatal groove wide, deep, gradually narrowing from the back edge of the internal alveolar process, and rounded in front. Internal nostrils large, roundish, about half the length of the internal alveolar margin, with a deep broad concavity in front. The alveolar process of the lower jaw simple, concave in front, with a slight indication of a longitudinal ridge on the outer side of the middle of the front end, deeply concave and rather widened on each side, with a slightly elevated end and much more elevated outer edge. Tympanic cavity very deep, sub-triangular, with a rounded front edge.

This genus is very like *Trionyx*, but differs in the shape of the palatal groove and in the form of the alveolar surface of the lower jaw.

The genus *Oscaria* has the short broad face of *Trionyx*, and the internal nostrils more anterior than in *Isola*. The skull of *Trionyx Leithii* is very like the skull of *Isola peguensis*; and perhaps this species ought to be referred to the genus *Isola*, and called *Isola Leithii*. These species, in the form of the skull, the palatine, in the hinder position of the internal nostrils, and in the form of the alveolar surface of the lower jaw, bear a considerable resemblance to the skull of *Aspilus*.

1. *Oscaria Swinhoei*. Pl. V.

The body oblong, nearly flat, only slightly convex; upper surface smooth and polished, uniform dark olive-green, with very numerous yellow spots, and a great number of minute yellow circular dots between them, sometimes forming more or less irregular circles round the larger spots. The dots on the fore part of the back, and on the sides and hinder part of the back, are the largest, sometimes confluent into short curved lines, at others forming a ring enclosing a small olive dot.

The middle of the front of the back covering the oblong bony shield marked down its centre on each side with diverging, more or less elongate, transverse lines. On the sides of the broad central convex part of the back there are a number of short parallel longitudinal lines, placed in clusters between the diverging lines of elongated spots on the sides of the middle of the back.

The head, neck, and upper part of the limbs blackish olive above and yellow below, the underside of the hinder margin of the disk and the sternum more or less varied with lead-colour. The upper part of the head to the occiput with close, very irregular-shaped yellow spots, which are somewhat alike on each side, but can scarcely be called symmetrical. The sides of the neck and chin yellow, with narrow olive reticulations. The back of the neck and the upperside of the legs and feet olive, with numerous small yellow dots, giving it a mottled appearance. Tail very short, conical.

Skull $2\frac{1}{4}$ inches long, and 2 inches wide, very like *Trionyx gangeticus* in external appearance; but the palatal groove in front of the internal nostrils is very wide, and gradually narrowed and rounded in front; indeed the internal edges of the upper alveolar surface form continuous converging lines from the back to the front of the broad concave palatal groove. The alveolar surface of the lower jaw slightly concave in the front half; the centre of the front with a very slight longitudinal elevation, which is most visible on the outer edge; the sides deeply concave, with a well marked inner and a more elevated outer edge.

The palatal groove is very broad and short, as in *Trionyx gangeticus*, but is wide behind and rather narrowed in front, very unlike the narrow, deep, much longer groove of *T. Leithii*. The alveolar surface of the lower jaw differs from that of *T. gangeticus* in being slightly concave in front without any pit on each side of the keel in the centre of the hinder margin.

The specimen sent had the front and hind legs of the left side tied together by a string passed through the web of the feet, as if this were the way in which the Chinese fishermen prevented the specimen from escaping after it was caught, as it would cause the animal to constantly progress in a small circle. This seems to be the common way of the fishermen; for I find the feet of several other specimens of Mud-Tortoise so united. Length of dorsal disk 12 inches, width $10\frac{1}{4}$ inches.

This is the most beautiful species of *Trionychidæ* that has yet occurred, and most distinct by its beautiful coloration; the lines on the back have some resemblance to Chinese printing.

2. *Landemania perocellata*.

Mr. Swinhoe has sent a series of five young specimens of this species in spirit. They are all dark olive-green above, with more or less distinct black spots on the dorsal disk; beneath white, with a black triangle which reaches nearly across the middle of the sternum, the front angle being continued in a longitudinal line up to the front margin of the sternum. There is an oblong black spot on each side of the front portion of the sternum, and a pair of large black spots nearly united in the middle line of the hinder portion. The sides of the dorsal disk, the front of the thighs, the front of the hind legs, and each side of the hinder part of the thigh black. These black marks are very distinct in one of the individuals; in the other specimens they are more or less obliterated, but what spots do remain show that the above is the normal colouring. The upper part of the head is marked with peculiar bridle-shaped black stripes; the underside is marked with more or less symmetrical oblong white spots surrounded by a black edge, which are sometimes more or less confluent; and those on the hinder part of the gullet are the largest. Those on the sides of the throat sometimes form two lines converging towards the centre of the throat, the first one commencing from the black streak from the middle of the back edge of the eye.

Mr. Swinhoe had previously sent eight specimens of this species, of a rather larger size, the dorsal disk of the largest one being 7 inches long. The backs of the dorsal disks of all these specimens are black-spotted like the younger ones; the chin and throat dark, and spotted and varied with white. The underside of the body is white—the smaller ones being varied, like the smaller ones before described, with more or less distinct black marks.

Among the specimens of *Landemania perocellata* is a well-developed one (about 5 inches long and $4\frac{1}{2}$ broad) that has a contracted very convex dorsal shield, somewhat like a large limpet. It agrees with the other young specimens of this species by its having the narrow black bridle-like lines on the sides of the face, and the white spots on the throat, exactly like specimens of the usual form. There are in the British Museum, from North America, two specimens of *Platypeltis ferox* exhibiting the same malformation, which seems to be incidental to the species of this family. The Shanghai specimen is a male with the penis exerted, probably from its having been killed by being put in spirit; but the form of the dorsal disk is not a sexual character.

The penis is very peculiar in shape, being expanded and

folded together longitudinally; when it is spread out it is nearly triangular, rather longer than broad, and marked on the underside with a groove with raised edges, which is simple at the base and forks off into two branches about two thirds of its length, which fork again before they reach the margin, the margin of the end of each groove being furnished with two short, conical, curved, claw-like, fleshy tentacles; and in the middle, at the end of the central fold, is a broad half-ovate fleshy lobe, probably formed of two united processes, which are dark-coloured like all the rest. The end of the short tail of this male is also produced into a sharp conical claw-like point.

3. *Landemania irrorata*.

Head covered with a very thin skin. Temples, sides of occiput, and lips marked with a number of small sinuous and often anastomosing spots. Upper part of animal and margin of the dorsal shield olive, with very numerous distinct white dots, which are largest on the margin of the shield. Chin, throat, and underpart of body white. The expanded hinder part of the dorsal disk is only slightly tubercular, not so rough as the same part of the disk of *L. perocellata* of the same size. There are no bridle-like marks on the sides and top of the head, as in *L. perocellata*, but only a slight indication of a streak from the side of the nose to the front side of the eye. The front odd bone of the dorsal disk is very long and band-like, and united to the front edge of the first rib and vertebral disk by a straight continuous suture. The back does not show any indication of black spots, as in *L. perocellata*, nor the neck any indication of the white spots so characteristic of that species.

On reexamining the original specimen on which I established *Landemania irrorata* (Proc. Zool. Soc. 1869, pp. 212 & 216, fig. 18; Suppl. Cat. Shield Rept. p. 96, fig. 31), I have no doubt that it is of the same species as the specimens here described, and that they establish the fact that it is a second species of the genus *Landemania*, and not a half-dried specimen of *Landemania perocellata*, as I have considered it in the 'Hand-list Shield Rept.' p. 81. The first-described specimen shows the white marks much more distinctly than the two specimens in spirit received from Mr. Swinhoe; and the underside of the head and throat are marked with minute brown spots not seen in the new specimens. The under jaw of the half-dried specimen is figured in Proc. Zool. Soc. 1873, p. 53, fig. 6 a, showing that it is a true *Landemania*, and distinct from *L. perocellata*.

One of the specimens is a male with the penis exerted, which is of quite different form from that of *L. perocellata*. The penis is ovate, lobed and hooked on the edge, folded together, ending in a broad, oblong, triangular hard claw, with a groove on its underside; the two sides of the expansion are folded, but not exactly in half, so that the fold is on one side of the terminal claw. There is a distinct groove at the base, with raised edges, which fork off to each side a little above the base, and which again fork off on each of its sides just above their base; and on the end of one side of each groove are a couple of small, more or less hard, curved hooks. The end of the tail is tapering, acute, and hard.

XXIII.—*On the Deer of the West Coast of South America, with the Description of a new Species from Peru* (*Cervus Whitelyi*). By Dr. J. E. GRAY, F.R.S. &c.

MR. WHITELEY, Junior, has sent to the British Museum from the mountains of Peru the skull of an adult female, and the skull of a young smaller deer from the valley of Cosnipata, which, from its having rudimentary canine teeth, is perhaps that of a male. The skins belonging to these skulls were destroyed in the journey from the Indian country to Cuzco, he having been caught in the rain.

These skulls, and the other skulls of deer from the west coast of America, distinctly show that there are four deer, besides the Pudu (*Cervus chilensis*), which inhabit the Cordilleras from Patagonia to Peru, specimens of the skulls of which are all in the British Museum—and most distinct from each other, differing in the general form, size, and depth of the preorbital pit, and in the form and size of the intermaxillary bone.

It is to be observed that the two skulls of the adult female *Xenelaphus* in the Museum have well-developed, very slender, rudimentary canines; so that the existence of canines is not a certain mark that the skulls belong to the male sex. Canine teeth are observed in the two sexes of *Xenelaphus*, and in the skull of *Cervus Whitelyi*; I see no indication of the canine teeth in the skulls of the male or female *Huamela leucotis* or in those of *Furcifer antisiensis* in the British Museum.

The Peruvian Roebucks may be thus defined:—

1. *Xenelaphus chilensis*.

On recomparing the skull of the female from the Andes
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with M. Gay's figure of the skull of the animal on which he established *Cervus chilensis*, I have confirmed my former opinion expressed in the 'Annals,' 1873, xi. p. 309, and have very little doubt that it was described from a very young specimen of this species. The figure exhibits the triangular preorbital pit peculiar to the species, though it does not appear so deep as in our specimens; and the conical prominences on the sides of the forehead, which are found in the two skulls of this species in the British Museum, are well represented. Both the adult skulls have the hole on the side of the lower jaw in the centre of the diastema; but in M. Gay's figure of the young skull it is much nearer the front end of the jaw. The skulls of the males and females have small, slender canine teeth.

The very young animal figured by M. Gay is darker than those brought by Mr. Whitely, and appears to be in its summer coat. One of Mr. Whitely's specimens, which appears to be changing its fur, has some patches of hair of this dark colour.

It is quite clear that, even if the horns of the male brought home by Mr. Whitely are not of the normal form, they must be quite different from those of the much larger *Huamela leucotis* from Magellan's Straits.

As M. Gay's specimen was first described, I adopt his specific name, and thus avoid the inconvenience that might result should the horns I have described prove to be malformations and not the usual horns of the species, although I lay myself open to the objection of the purist that I use the name *chilensis* for a Peruvian species.

Huamela leucotis from Magellan's Straits is at once known from this species by its very much larger size: the animal belongs to a larger type; and the horns are peculiar. The skull of *Huamela* has the large, very deep, subtriangular tearpit of *Xenelaphus*; the upper outer edge of the orbit is thickened and produced behind into a conical prominence on the side of the forehead, somewhat as in *Xenelaphus*, but in a much greater degree; and the intermaxillary bones are broad behind, and reach up to the nasals. The skulls of the males and females are destitute of canine teeth.

2. *Furcifer antisiensis*.

The skull of the female, which has been received from Mr. Whitely, is very like the skull in the British Museum received from the Zoological Society's museum under the name of *Cervus antisiensis*, a species that is only known from a figure of the animal by M. d'Orbigny, the skull of which has not been described or figured.

The skull of this species differs from that of *Xenelaphus chilensis* in having a small, shallow, triangular pit in front of the orbit, and in the intermaxillary being narrowed above and not reaching quite so high as the nasal bones.

The skull of the female has no prominence on the side of the head behind the orbit, as in the two preceding species. The skull of the male, from the Society, has only rudimentary anomalous horns, that of the right side being forked, and of the left simple; it is therefore impossible to compare them with the figure of the horns given by D'Orbigny. The front of the upper jaw between the intermaxillary bones is much larger in the male than in the female; the front edge of the intermaxillary bone in the male is bifid, rugose on the underside. The forehead between the eyes and horns in both the male and female skulls is strongly keeled, the keel being highest in the male.

The reception of this skull from Peru proves that Dr. Philippi was wrong, and probably misled by believing that there was only one species of deer on the Andes instead of four, when he observed (in Wiegmann's 'Archiv,' 1870) that D'Orbigny's *Cervus antisiensis* was the same as Gay's *Cervus chilensis*; or at least this skull proves that there is another species found in the Peruvian Andes distinct from Gay's *Cervus chilensis*.

Cervus (—?) *Whitelyi*, n. sp.

It is impossible to refer this skull from the valley of Cosnipata to any of the modern genera, as it is quite destitute of any appearance of horns. It is the skull of a rather young animal, with only five grinders on each side, which yet appear to be fully formed, and is unlike the skull of any South-American deer in the Museum collection, the brain-cavity being much larger and more ventricose compared with the compressed face than in any other known skull; and it has rudimentary canines, which are not to be observed in any species of *Coassus* or smaller South-American deer.

The skull is $6\frac{3}{4}$ inches long, and $3\frac{1}{8}$ inches wide in the lower edge of the middle of the orbital opening (which is the widest part of the skull), and $3\frac{5}{8}$ inches from the end of the occiput to the front of the orbit, and $3\frac{1}{8}$ inches from the front of the orbit to the end of the intermaxillaries. There is a rather elongate groove over each orbit, as in the skull of *Coassus nemorivagus*; but the brain-case of this skull is very much narrower, and has a keel in the centre of the forehead, which is entirely absent in the flat broad forehead of *Cervus Whitelyi*. There is a moderately deep, concave, rounded pit for the tear-gland, and

two perforations for the passage of vessels through the orbit, just behind the lachrymal pit. The brain-case is oblong, narrowed above, at the upper edge of the orbits. At the lower edge of the orbits it is much expanded out, being the widest part of the skull. The face, from the upper edge of the orbits is gradually, and from the lower edge rapidly, attenuated as far as the front end of the grinders. The nose, from the front end of the grinders, slender, compressed, with the front half of its length rather narrowed on the sides. The nasal bones moderate, the middle of the hinder end being broadly produced between the fore part of the frontals, which I have not observed in any other deer. The intermaxillary bones very slender in front, the hinder half becoming much broader above, and attached to the sides of the front of the nasals—more so than in any South-American deer that I have yet observed.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

Feb. 6, 1873.—Sir George Biddell Airy, K.C.B., President, in the Chair.

“On the Osteology of the *Hypotamidae*.”

By Dr. W. KOWALEVSKY.

The paper laid before the Society is intended to fill a certain deficiency in our knowledge of the extinct creation by giving a complete osteology of a family of Paridigitate Ungulata, which, by the completeness of its skeleton, un-reduced number of digits, and rich development in generic and specific forms, I deem to be of great importance in our speculations on the pedigree of living Ungulata Paridigitata.

On theoretical grounds, as well as from the consideration of rudimentary parts in living Paridigitata, anatomists have always supposed that fossil representatives of this family, which could be regarded as the progenitors of the recent Paridigitata, would certainly exhibit a much less reduced skeleton and a more complete number of digits than the recent genera do. Yet, strange to say, such complete forms were not forthcoming; and if assumed on the evidence of their teeth, very little was known about the structure of their bony frame. My statement will sound like an exaggeration; but still it is true, that since the time of Cuvier, who shortly noticed the tetradactyle *Dichobune*, and Blainville, who gave a very imperfect description of *Cainotherium*, we have absolutely

not a single paper in which the osteology of an extinct genus of Paridigitata has been fully given*. This may partly be the reason that the pedigree of living genera has hitherto been so obscure.

The Paridigitata of the Paris gypsum, described in a masterly way by Cuvier (the *Anoplotherium* and *Xiphodon*), were clearly extremely reduced descendants of some earlier more complete forms; their feet presented, in fact, nearly the same degree of reduction which we find in our recent Ruminantia, save the confluence in a cannonbone. Seeing the reduced state of their skeleton, how could they be taken as progenitors of the very rich family of Ruminants, some of which have retained, even till our times, a tetradactyle limb? However, so great was the want of some form from which the living Ruminantia could be assumed to be derived, that nearly all comparative anatomists and palæontologists who speculated on these questions of descent, placed the *Anoplotherium* and *Xiphodon* at the head of the series, as the *fons et origo* wherefrom all living Ruminantia have descended.

The present paper is an attempt to introduce to palæontologists a new form, which, though known by its dental system more than twenty-five years ago, has remained totally unknown, so far as its skeleton is concerned. This skeleton, by its completeness, has proved to be a very interesting one, not only in a concrete way, but as furnishing a clue to the understanding of the skeletons of those forms which, though totally unknown, must have preceded *Anoplotherium* and *Xiphodon* in time, and from which these two may have descended.

Besides, the greater importance of the *Hyopotamidæ* in comparison with *Anoplotherium* and *Xiphodon* lies in the fact, that, while these two last were but poorly differentiated, presenting only two or three distinct specific forms, the *Hyopotamidæ*, on the contrary, strike us by the extreme diversity and richness of their specific and generic forms. Beginning in the Middle or Lower Eocene of Mauremont, they existed until the Lower Miocene period; and, judging by the great number of species and genera, they must have filled in the fauna of this period the same important place which the greatly diversified Ruminantia fill in the fauna of our own times. Indeed the differentiation of *Hyopotamidæ* may be said to be even greater, in point of size, as they range from the *Hyopotamus Renevieri*, not larger than a rabbit, to the great *Anthracotherium* of Rochette, which is as big as our Hippopotamus—all the intermediate stages between these two extremes being represented by different genera, subgenera, and species of the same family.

I hope that the rich development of this much neglected family will arouse the attention of palæontologists, and that the skeletons of the different members will be more thoroughly investigated. For

* No doubt we have excellent memoirs, like the works of Gaudry, Rütimeyer, Fraas, and H. v. Meyer; but the Paridigitata described in all these do not materially differ from those now living, at least so far as the skeleton is concerned.

my own part, though fully convinced that many of the Eocene *Hyopotamidæ* from Mauremont and Egerkingen present, even in their teeth, characters enough to separate them into distinct genera, I shall not do this, as the multiplication of fossil genera, founded solely on dental characters, without adequate knowledge of the skeleton, is more an obstruction than a help to the progress of palæontology.

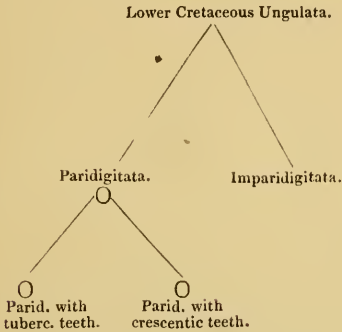
This refers to the Eocene *Hyopotamidæ* of Mauremont and Egerkingen; for, having found that among the Eocene members of this family there is one which has lost its lateral digits and acquired a didactyle foot, very like an *Anoplotherium*, I was obliged to separate this reduced form from its tetradactyle congeners under the name of *Diplopus* (double foot), while the tetradactyle species of the same family will form the genus *Hyopotamus*. This diversity among the representatives of the same family is very interesting; something of the same kind, however, is to be found in our own times in the *Hyomoschus*, subsisting side by side with the more reduced ruminants, though this is not an entirely parallel case. Moreover, as we have in the *Hyopotamidæ*, so to say, father and son existing together (the complete form together with the reduced), and as, besides, this son bears a great likeness in the typical structure of his limbs to the *Anoplotherium*, we may infer that the fathers of both reduced forms bore also a general likeness; and this gives us a clue to the skeletons of the ancestors of the *Anoplotheridæ*, which is still further strengthened by many other considerations, of which I speak more fully in my paper.

Whilst trying to gain a more complete knowledge of the skeleton of the extinct Paridigitata, I became convinced that we must make some change in our zoological classification of the Ungulata in order to admit the great quantity of genera which have no place in the present system. After the breaking up of the Pachydermata (a name that has long enough obstructed science and really checked progress by holding together the most heterogeneous assemblage of animal forms), all the Paridigitata came to be divided into Suina and Ruminantia. This introduction of a physiological function into a system based on the structure of the skeleton is objectionable in the highest degree; besides, in this classification there is no room for those fossil genera which are certainly not Suina, and most probably did not ruminate. The greater the number of such genera, the better their organization and history are known, the more pressing the necessity to give them some adequate place in our zoological system. As an instance that such a necessity is keenly felt, we may cite Professor Leidy, who, in describing the *Oreodontidæ*, *Agriochaeridæ*, &c. of Nebraska, says that they were "ruminating hogs;" but in reality they were not hogs at all, and most probably did not ruminate; what is, then, to be done with them?

The introduction of Professor Owen's* strict division between

* Proposed before him by French anatomists, but never carried out completely

Paridigitata and Imparidigitata was a great gain to science ; it radically separated two groups that previously were always hopelessly mixed together ; but now the same principle must be carried further. The separation of the two groups of *Paridigitata* and *Imparidigitata* took place in very ancient time, not nearer than the Cretaceous period ; and the striking diversity exhibited by both groups from the lowest Eocene is a proof of their ancient separation. But one of the branches, the *Paridigitata*, in its turn, split very anciently again into two distinct groups, one with tubercular, the other with crescentic teeth. This occurred at nearest in the Lower Eocene, perhaps even in the Cretaceous period. These groups, once separated, kept entirely apart and followed different lines of descent, although the modifications which both undergo along the descending lines are parallel and analogous even to the greatest details. Following these two divergent lines of descent, both groups culminate in the recent fauna in such forms as the *Phacochærus* and *Dicotyles* for one group, and the *Bovidæ* for the other. Links



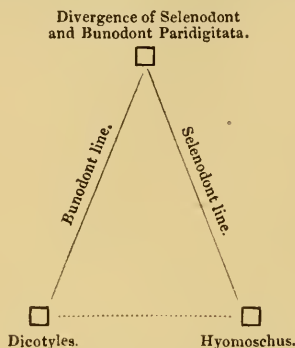
between them we discover none ; and to discover their parentage, we must pass along the ascending lines to the point at which they diverge, as the linking genera, which doubtless existed at the time of separation, are long ago extinct, and both groups are now widely separated. I suggested this view, whilst studying in the British Museum the remains of *Hyopotamidæ*, to Professor Owen ; and he finds no objection to it. He aided me in finding for the two groups convenient names ; and by his suggestion I should call the Paridigitata with crescentic teeth *Par. selenodonta*, and those with tubercular teeth *Par. bunodonta*.

To the *first* group would belong all the ancient and living Paridigitata having crescentic teeth, as the *Anoplotherium*, *Xiphodon*, *Dichobune*, *Anthracotherium*, *Bothriodon*, *Hyopotamus*, *Rhagatherium*, and the living Ruminantia.

The *second* would embrace all the Suina, Hippopotamina, and *Entelodon*.

Each one of these two groups may be again subdivided on the principles adopted in this paper.

By such division, we shall gain the advantage of having the Paridigitata arranged into two distinct lines of descent; every new discovered form will at once have its place along one of the lines, and the true pedigree of both will be ascertained much sooner and with greater accuracy. Whilst now making no such clear division, palæontologists, in projecting their genealogical tables, mix both groups together; and, according to the need of the moment, they place forms belonging to one line of descent in the other, and *vice versa*. Thus, for instance, all the Hyopotamoids and *Anthracotherium* are constantly moved about from one line to the other*, while their true place is along the line of Selenodont Paridigitata; and they have nothing to do with the Bunodont Suina, although groups quite parallel with them may be found on the descending line of Bunodont Paridigitata. Such parallelism, however, does not imply direct links along parallels drawn across both diverging



and descending lines; the links are to be found only by climbing along the ascending lines to near the point of separation. For instance, *Dicotyles* and *Hyomoschus* occupy analogous positions; but there is no link between them along the dotted parallel. Links will be found only by going up to the point near their separation.

There are, no doubt, to be found around the points of divergence many forms of which it is difficult to say whether their teeth are tubercular or crescentic, so thick are the lobes; but once this uncertain stage is passed, both groups keep unmistakably distinct.

Having once become convinced that these two groups of crescent-toothed and tubercular-toothed Paridigitata, after branching off from a common progenitor in the early Eocene (perhaps the Cretaceous) period, followed diverging lines of descent, never mixing together, I tried to ascertain accurately, by such data as were fur-

* In fact described constantly as Suina. See Gervais, 'Paléontologie de France.'

nished by fossil remains and by lawful induction, what are the exact modifications of the skeleton exhibited by each group along the ascending and descending lines. As these modifications were most clearly given by greater or less reduction of the manus and pes, I subjected these to a detailed comparison.

In tracing the Paridigitata in time, we cannot mistake the tendency clearly manifested by them to a gradual reduction of the manus and pes in such a way that each descendant is always somewhat more reduced than its immediate predecessor. The limbs in the Ungulata serving only for the support of the body, and not for prehension, the organism seems to derive a great advantage from their reduction and simplification.

By a comparative study of the least-reduced representatives on both lines, I tried to ascertain the probable structure of the manus and pes in the progenitor that has given rise to both groups, or to the whole assemblage of Ungulata; and this led me to construct a typical manus and pes. On the correctness of this scheme we may to a certain extent rely, as it is exhibited in nearly all its details by the living *Hippopotamus*, the most complete form of the living, and by the *Hyopotamus* and *Anthracotherium*, the most complete of the extinct, Paridigitata. Though such typical foot may be supposed to have been pentadactyle, still, as not a single living or fossil form has ever shown a trace or a rudiment* of the first digit (still less this first digit in a developed state), I thought it more convenient to adhere to facts, and give the foot as it is found in the most complete types, the first digit being always lost, and its carpal and tarsal bone helping to support the second digit. This fundamental typical structure of the manus and pes may be stated, in a few words, to be as follows:—

Supposing the foot to be pentadactyle, the two outer digits (the fourth and fifth) are always supported in the manus and pes by one single bone—the unciform in the manus, the cuboid in the pes; the three succeeding inner digits are supported each by a separate bone—the third, second, and first cuneiform in the pes, and the os magnum, trapezoideum, and trapezium in the manus. Besides, in the manus, the *third* digit, being supported by the magnum, also touches the unciform by a small ulnar projection, and the *second*, supported by the trapezoides, goes to touch the os magnum; the second digit of the pes is supported by the second cuneiform, and by its fibular projection is connected with the third cuneiform. The first digit is lost in all Ungulata, and its typical bone, the trapezium, or first cuneiform, helps to support the second digit.

* Prof. Huxley noticed this absence of rudiments of the first digit in his Anniversary Address of 1870 (Quart. Journ. Geol. Soc.). Such rudiments of the first digit, described in many cases, have proved always, on examination, to have been mistaken, the trapezium or the first cuneiform being taken as the rudiment of the first digit.

Diagram of a Typical Foot in Ungulata Paridigitata.

Manus.				Pes.					
Unciform.		Os magn.	Trapezoid.	Trapezium.	Cuboid.		Cunei-form 3.	Cunei-form 2.	Cunei-form 1.
v.	IV.	III.	II.		v.	IV.	III.	II.	

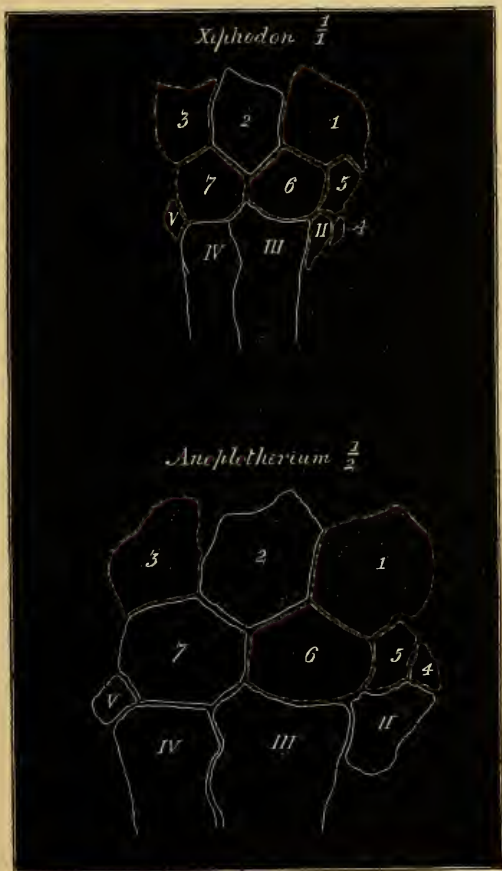
Beginning from this typical structure of the manus and pes, which was probably exhibited by the progenitors of the Paridigitata, we may follow its gradual reduction along both lines of descent in the crescent-toothed (*Selenodont*) and tubercular-toothed (*Bunodont*) Paridigitata. Both lines present a series of parallel modifications, and the parallelism is often carried to the minutest details. The only difference is, that along the crescent-toothed line (*Selenodonta*) the reduction is proceeding at a much quicker rate than along the tubercular-toothed (*Bunodonta*). The reason of this may consist perhaps in the commencing faculty of rumination in the former group, which faculty gave it an immense advantage over the latter. For the comparative anatomist this slow rate of change in the Suina is exceedingly welcome, as it brings the modification of the Suilline foot to our own time, and allows us to discover all the intermediate stages of modification, which, being passed over very rapidly, and in ancient periods, by the crescent-toothed group, have left none or but few traces of their existence.

By the reduction of the foot in Paridigitata, I simply mean that the function of locomotion which has been performed primitively by all the four (or five) digits begins to be carried on chiefly by the middle two, the lateral digits undergoing a gradual decrease. This, as I have said before, seems to be of great advantage to the organism, and is manifested by all descending lines of Ungulata.

In trying to ascertain the exact method of this reduction and its final results in recent and fossil genera, we come to very interesting facts that have not been duly noticed before, and which furnish us with the explanation of the presence of so many very reduced forms even in old Eocene and Miocene deposits. In both groups, the crescent-toothed (*Selenodonta*) and the tubercular-toothed Paridigitata (*Bunodonta*), we meet with a *twofold* mode of reduction of the manus and pes—a simple or *inadaptive*, and an elaborate or *adaptive* mode.

Following the first or *inadaptive* mode of reduction, the foot, whilst losing its lateral digits, acquires no better adaptation to altered conditions of locomotion and support of the body than that which is derived from the mere thickening of the remaining

digits. The relation between the carpal and tarsal bones and the remaining two middle metacarpals and metatarsals remains just the same as it was in the tetradactyle ancestor. The remaining digits do not exhibit any modification by which they receive more ample support from the carpal and tarsal bones, by taking the place formerly occupied by the now reduced and lost lateral digits. This mode of reduction I call *inadaptive*, or reduction in which *inheritance is stronger than modification*. As an instance of this inadaptive mode of reduction, I may point out the foot of *Anoplotherium* and *Xiphodon*. The annexed diagram clearly illustrates



this mode of reduction. The fourth digit does not even take the whole of the unciform, and a part of this bone is still occupied by the useless rudiment of the fifth digit; the third has not extended over the whole os magnum; and the useless rudiment of the second digit occupies its typical place on the trapezoid,

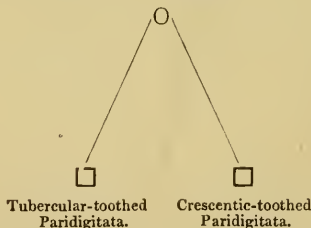
touching the os magnum, and being additionally supported by the trapezium.

Following the second or *adaptive* mode of reduction, the middle digits grow larger and thicker than in the first mode; but whilst broadening transversally they do not adhere to the ancestral pattern, but tend to gain a better support on *all* the bones of the carpus and tarsus; they deviate from the ancestral type, push the lateral digits (while these are yet completely developed) to the side, and usurp their typical carpal and tarsal bones for their (the middle digits') own use, thus gaining a better and more complete support for the body. The lateral digits, deprived of their typical carpal and tarsal bones, and taking henceforth no active part in locomotion, tend to disappear; and every millimetre that is lost by the lateral digits is immediately taken possession of by the enlarged middle ones; so that even before the entire disappearance of the lateral digits the two middle digits have usurped the whole of the distal surface of the carpus and tarsus, the fourth digit has spread over the whole unciform (manus) and cuboid (pes), and the third has taken possession of the trapezoid (manus) and second cuneiform (pes). This once attained, the two middle digits, being pressed from both sides by the carpal and tarsal bones, begin to coalesce, forming the so-called *cannon* of the recent Ruminantia, or of the hind foot of *Dicotyles*. This mode of reduction I call the *adaptive*, or reduction in which such *modification keeps pace with inheritance*.

As an instance of this mode, I may cite the foot of *Sus*, *Dicotyles*, *Hymoschus*, Ruminantia. Every anatomist will acknowledge that this second mode of reduction is much more useful to the organism than the first.

If we inquire further what are the genera which follow the first or *inadaptive* mode of reduction, we find that *all extinct* genera of Paridigitata follow it, while all *living** genera follow the second or adaptive mode of reduction.

Early Eocene Paridigitata.



This being the state of the case, the questions arise, Did they not become *extinct* because of their incapacity to adapt themselves completely to altered circumstances? and did not the others *survive* because they adapted themselves more fully to these circumstances? I will try to consider both cases in reference to the living and fossil Paridigitata.

* Or fossil forms which continue to live, or have left direct successors, as *Palæochærus* and the Miocene Ruminantia from Auvergne.

I said before that early in the Eocene period the group of Paridigitata split dichotomously into two secondary groups, one with crescentic teeth, the other with tubercular; the first I have called the Selenodonta, the second Bunodonta (or Suina). Now each of these secondary groups followed a twofold mode of descent, one of which I term the *inadaptive*, and the other the *adaptive*, thus, finally, giving rise to four distinct groups:—

Paridigitata with
crescentic teeth
(Selenodonta).

A. The group following the *inadaptive* reductions develope enormously in Eocene and Middle Miocene times: all have distinct metacarpalia and metatarsalia, five-lobed upper molars, smooth distal extremities of the metapodials. Genera: *Bothriodon*, *Dichobune*, *Rhagatherium*, *Cainotherium*. They reached their highest development and culminated in the didactyle *Anoplotherium*, *Xiphodon*, and *Diplopus*, which all became extinct without direct successors.

B. The group following the *adaptive* reduction separated from the group A somewhere in the Middle Eocene, by some of the small *Hyopotamidæ* acquiring four-lobed upper molars, as met with at Mauremont, and becoming *Dichodons*. Intermediate stages little known; the *Gelacus* is one of them. The least-reduced living form is *Hyomoschus*. Culminating in recent times in the didactyle *Bovidæ* and *Antilopidæ*.

A. Group following the *inadaptive* reduction very little known. *Acotherulum* and another larger hog-like animal from the Middle and Upper Eocene may belong to this group; they were certainly tetradactyle. Culminated in the lowest Miocene in the didactyle *Entelodon*: no successors.

B. Group following the *adaptive* reduction, branched from the group A in the Eocene; the most typical representative is the *Chærotherium* from Sansans, with the phalangeal ridge not yet extending over the whole distal end of the metapodium. *Palæochærus*: reduction has fairly set in on the adaptive mode, the phalangeal ridge passing over the whole end of metapodial. *Sus* still more reduced. *Dicotyles*: all the distal surface of the carpus and tarsus taken by the enlarged middle digits. Tending to become *didactyle*.

Paridigitata with
tubercular teeth
(Bunodonta or
Suina).

We must briefly consider each of these groups.

The Paridigitata with crescentic teeth following the *inadaptive*

mode of reduction, and whose skeletons are known, are the *Anoplotherium*, *Xiphodon*, *Anthracotheridæ*, and *Hyopotamidæ*. If it should be asked *why* they followed this mode of reduction, the reason is obvious. Admitting that an advantage is gained by the simplification of the foot and the reduction of the number of digits, this mode of reduction is the most simple course to be taken. We must imagine the enlargement of the middle digits to be accompanied by a broadening of their correspondent bones in the carpus and tarsus; the trapezoideum and the second cuneiform were simply pushed aside (not made use of) by the enlargement of the third digit, and their reduction kept pace with the reduction of the second digit. If we think how the process must have gone on "*in naturá*," we shall find that it required quite an unusual occurrence, some happy chance, for the third digit to go over the separating line between the magnum and trapezoideum, or the third and second cuneiform, and get a footing on these last bones, which typically belonged to the second digits. This was evidently the most advantageous mode; but it did not occur at once, and the organism has taken the more simple and obvious inadapative mode, which, once fairly set in, could not be changed. This branch of the Paridigitata then, starting from their tetra- (or penta-)dactyle progenitors in the Cretaceous or earliest Eocene, arrived at the close of the Eocene (from which strata alone we have Paridigitata whose skeletons are known) to the reduced didactyle forms, known as the *Anoplotherium* and *Xiphodon*. That these last had tetradactyle ancestors is supposed, on theoretical grounds, by the evolutionists; besides, their rudimental second and fifth digits point clearly to some form in which these rudiments were completely developed and used for locomotion.

Whilst trying to ascertain the structure of the skeleton of an extinct family (*Hyopotamidæ*) allied to the *Anoplotheridæ*, but which was supposed to be chiefly Miocene, I found that the Miocene genera could be regarded only as the last representatives of this exceedingly numerous family, whose chief development fell in the Eocene times, when it was represented by numerous subgeneric and even generic forms. I was fortunate enough to find, in the collection of M. Aymard, at Puy, a large assemblage of bones belonging to the oldest Miocene representative of this family, the *Hyopotamus*; indeed so much, that I could completely restore the limbs and nearly the whole skeleton. The limbs prove to be tetradactyle, with well-developed lateral digits. The same family is so richly developed in the Eocene, that we have a full right to suppose that the older genera had even a more completely developed manus and pes.

From Puy I came to London to complete my study, as teeth which were not to be distinguished from the *Hyopotamus* of Puy were known to be numerous in England; and whilst studying the bones found in England, I was struck by the fact that some of these belonged to a didactyle genus of the same family, which in England proved to be associated with the tetradactyle genus. To this new genus of the Hyopotamoid family I gave the name *Diplopus*. This

was indeed a welcome discovery—ancestor and descendant existing together, the complete with the reduced form living about the same period*. Moreover the didactyle form bore a great general likeness in the structure of the limbs to *Anoplotherium* and *Xiphodon*, being perhaps only a little more elaborate and better adapted than these first experiments of the Eocene times.

The likeness of the descendants allowed me to make inferences as to the likeness of the ancestors; and, taking into consideration the structure of the limbs in the tetradactyle *Hyopotamus*, and the rudimental second and fifth digit still existing in *Anoplotherium*, *Xiphodon*, and *Hyopotamus*, I feel confident that the supposed ancestor of the first two did really possess a *manus* and *pes* very like the projected typical diagram; indeed we may be nearly as confident of this as if we had found the actual thing imbedded complete in some early Eocene or even Cretaceous rock.

This, then, was the state of things in the earliest Eocene; large numbers of Paridigitata with tetradactyle feet like our *Hyopotamus*, and the supposed progenitors of *Anoplotherium* and *Xiphodon*, represented the group of Paridigitates with crescentic teeth (*Selenodonta*). Reduction in the number of digits, being an advantage to the organism, was steadily going on. But, be it observed, we follow now the *inadaptive* line of descent; and while the whole weight of the body was, by gradual steps, entirely transferred to the two middle digits, these thickened and grew larger, but entered into no special adaptation by means of which they should better perform the work which had fallen to their share; they did not enlarge so as to gain additional support from all bones of the second row of the carpus and tarsus; the reduction was *inadaptive*: inheritance is in them stronger than modification.

Seeing that old Paridigitata present only two free metacarpals and metatarsals, and that recent Ruminantia have the same two metacarpals and metatarsals coalesced into a single cannonbone, evolutionists generally rush at the seemingly obvious conclusion that once the tetradactyle foot reached the reduced state of two digits, these coalesced together, and were transformed into the cannonbone of Ruminants. No such thing, however, happened; nor could it have happened with the old didactyle Paridigitata, as the *Anoplotherium*, *Xiphodon*, and *Diplopus*; and the reason why it could not is clearly indicated by the structure of their feet. We have already shown that, following this *inadaptive reduction*, the two middle digits, whilst growing larger, continue to occupy only the inner half or more of the unciform and the greater part of the os magnum; so that from the outer as well as from the inner side the carpal bones which support useless rudiments overhang the two middle functional digits. In consequence of this, the distal surface of the carpus was much broader than the proximal surface of the two functional digits—an arrangement not calculated for firm equi-

* Such cases are numerous. In the Sewalik Hills the *Hipparion* is associated with the horse.

librium. Now the confluence of the two middle digits is always followed by a considerable contraction; and if this coalescence should occur in the imperfectly adapted foot of *Anoplotherium*, and especially *Xiphodon*, all equilibrium would be lost. If ever such confluence occurred, by reason of the tendency to the greatest possible reduction, the resulting form had not the least chance of being propagated and of holding its ground against the competing genera. The broadening of the middle digits could not occur after the entire loss of the laterals; and we shall see that, in genera which have left immediate successors (*Sus*, *Hyomochus*), the lateral digits are not allowed to go until the middle ones have obtained a secure footing on the entire distal surface of the carpus and tarsus. However, these inadaptively reduced genera of the Eocene could perhaps have lived till our own days; but the development of the competing and better adapted forms pressing them on all sides, they had no chance to stand their ground against them, and became extinct without any direct posterity, while the succession of the Paridigitata Selenodonta was carried by a side branch, and reached its culminating point in the Miocene, continuing from then to our own days.

We turn now to the same mode of *inadaptive* reduction as manifested by the tubercular-toothed Paridigitata (*Bunodonta*), or Suina. The old representatives of this group are very little known. The *Charopotamus* is a very doubtful genus, and may be inclining towards the crescentic-toothed Paridigitata, being supposed to be the progenitor of the *Anthrotheriide* and *Hyopotamidae*. Besides it we have the *Acotherulum saturninum*, Ger., a truly tubercular-toothed Paridigitate from the Upper Eocene, *Acotherulum Campichii* (*Dichobune Camp.*, Pictet) from the Lower Eocene of Mauremont, and a larger pig-like animal from the same deposit not yet described or named. These are undoubtedly the oldest tubercular-toothed Paridigitates we know; but unfortunately our knowledge is based only on dental characters. However, considering that even the recent Suina have not yet completely lost their two lateral digits, it may, with the greatest probability, be inferred that these old Eocene forms were tetradactyle. Our knowledge of the development of this group is very incomplete; but there can be no doubt that, though not nearly so rich as the Selenodonta group, they were still numerous, as may be inferred from the great quantity of the Suina in the Miocene, and such forms as the *Listriodon splendens**. We are so accustomed to look on the Suina as a group of tubercular-toothed *tetradactyle* Paridigitata, that no one ever thought of the possibility of a *didactyle* hog; but, strange as it may seem, such a Suilline animal existed; stranger still, it existed in such an ancient period as the close of the Eocene in the lowest strata of Ronzon at Puy. This is the *Entelodon*, Aym. (*Elotherium*, Pom., *Archæotherium*, Leidy). The Suilline characters are so striking in this form, that it was at

* I have not been so fortunate as to see any bones of the *Listriodon*; but as this miocene hog died without any successors, I should not be astonished if it prove to be didactyle, thus being a parallel to *Hyopotamus* in the same sense as *Entelodon* is parallel to *Anoplotherium*.

once placed among the Suina, and pronounced tetradactyle, though the confluent tibia and fibula (mentioned by Leidy) might have been taken as a warning against rash conclusions. I have found in the cabinet of M. Aymard, in Puy, some bones of this animal; few, it must be acknowledged, but still leaving no doubt as to the diactylism of *Entelodon*. Of this I shall try to adduce more extensive proofs in a forthcoming memoir on this genus. How can the presence of a hog with such reduced limbs be explained in such ancient deposits, when even the living *Suidæ* have not yet reached this stage of reduction? The fact, however, is intelligible when we consider that the *Entelodon* is the final result of the *inadaptive development* and reduction along the line of tubercular-toothed Paridigitata; it is the *culmination point* of this group, and in this sense quite parallel to the *Anoplotherium* in the other group. Thus the Paridigitata, which split dichotomously in the earliest Eocene (?) into two groups, the tubercular-toothed (*Bunodonta*) and the crescent-toothed (*Sele-nodonta*), following the *inadaptive* mode of reduction, reached their *culmination-point* in the Upper Eocene or just above it, in such forms as *Entelodon* for the first group, and *Anoplotherium*, *Xiphodon*, *Hyopotamus* for the second group, which all became extinct without any direct posterity. The living Suina and Ruminantia are not directly connected with them, but are the issue of lateral branches which followed the *adaptive* mode of development and reduction.

We may now consider the results of the *adaptive* mode of reduction. As I said before, the rate of this reduction is much slower in the tubercular-toothed Paridigitata, or Suina; and this gives us the means of following more closely all the stages of reduction. I propose, therefore, in the first place, to consider these.

Though the published materials, as far as the skeleton is concerned, are very poor, we have the means of giving nearly all the intermediate stages between those genera in which the manus and pes are conformable to the true tetradactyle type, every digit (except the fourth and fifth, which are always borne by one) being carried by a separate carpal and tarsal bone, and those in which the entire distal surface of the carpus or tarsus is taken by the enlarged two middle digits.

The adaptation of these two middle digits on the adaptive line forms a striking contrast to their rigidity exhibited by the other mode of reduction; and we shall briefly indicate the stages by which the typical Suilline foot actually passed to reach the stage exhibited now by *Dicotyles*.

We are at a total loss to indicate the precise time when the adaptive branch separated from the *inadaptive*; it was certainly somewhere in the lowest Miocene, as in the Middle Miocene we find already a large quantity of Suinæ in which the adaptive reduction has fairly set in. As the first stage I must consider a small Suilline animal, though not the oldest, but perhaps a remnant of the older type; this is the *Chærotherium*, Lart., from Sansans. The primitiveness of this small pig is indicated by the fact that the carpal and tarsal bones retain their typical relation to the four

metacarpals and metatarsals; the humerus is very *Anoplotherium*-like; and the distal extremity of the metapodium is smooth anteriorly, the phalangeal articular ridge being limited only to the palmar side, as in all ancient Paridigitata.

First Stage, *Chærotherium*, Lart. (Sansans).—The middle digits are enlarged, but the laterals still retain their typical relation to the supporting bones of the carpus and tarsus*. Distal end of humerus *Anoplotherium*-like (ancient); the proximal end of the radius, in correspondence with the humerus, is also *Anoplotherium*-like. The distal end of metapodium is smooth, the phalangeal ridge being limited to the palmar side.

Second Stage, *Palæochærus* (Allier).—The adaptive reduction of the *manus* and *pes* has fairly set in, its first indication being that the radial margin of the third digit (in the *manus* and *pes*) is raised in such a way as to exclude the second digit from going to its typical facet on the os magnum and third cuneiform, though leaving it still in the full possession of the trapezoid and second cuneiform. The phalangeal articular ridge is passing from the palmar side round the distal extremity to the anterior face of the metapodium.

Third Stage, *Suidæ*.—Adaptive reduction is proceeding further: the middle digits are greatly enlarged; and the third digits of the *manus* and *pes* spread over one half the trapezoideum and nearly the whole of the second cuneiform. The lateral digits touch the ground only very slightly, and are not important for locomotion.

Fourth Stage, *Dicotyles*.—The middle digits are so enlarged and adapted that the entire distal surface of the carpus and tarsus is taken by them; the lateral digits have no distinct facets on the distal surface of the carpus, and are merely hanging to the enlarged middle digits. The fifth digit of the *pes* is lost, and the two metatarsals are coalesced into a cannonbone; the metacarpals are also so closely pressed together that their confluence is imminent. The complication of the stomach, which is divided into three chambers, shows a beginning of rumination, slight traces of which are even exhibited by the common hog; the premolars become complicated, and begin to assume the shape of molars†, the first premolar is lost (as in all Ruminants), the incisors reduced to four, the canines are small.

Fifth Stage.—The culminating point is not yet reached by the tubercular-toothed Paridigitata following the adaptive mode of reduction; but as it was reached by the same group on the *inadaptive* mode (*Entelodon*), and as the parallel group of crescent-toothed Paridigitata, whose reduction is going at a quicker rate, has already reached it, there can be no doubt that the *Suina* are tending also

* That is, the second digit is supported by the trapezoideum, and has besides a facet on the os magnum, as in *Hippopotamus*, or in the typical tetradactyle foot generally.

† A very important circumstance, considering that we meet with the same fact in other groups where the premolars assume the shape of molars, as in *Palæotheridæ*, horses, rhinoceros, &c.

to the same culminating point. In reaching it the lateral digits will be entirely lost, the trapezium will coalesce with the magnum, and the second cuneiform with the third; the middle metacarpals and metatarsals will coalesce into a complete cannonbone; and probably the stomach will become still more complicated, and they will ruminate. That this state is the goal towards which the Suina tend I have little doubt; but it is more than probable that man by his influence will prevent them from ever reaching it.

Our task is more difficult when we come to inquire into the line of descent which has given rise to the Ruminantia. As stated before, I cannot put the *Anoplotherium*, nor the *Xiphodon*, in their pedigree. In my opinion, the line which ends in Ruminantia branched off from the small tetradactyle *Hyopotamidaë*, which were so numerous in the Eocene period. I find in the Eocene of Mauremont all stages of transition between the *five-lobed upper molars* of these *Hyopotamidaë* and teeth having a true ruminant four-lobed pattern; these last have belonged to some small species of *Dichodon*. Unfortunately we have no clue to the skeleton, though, seeing the tetradactyle living *Hyomoschus*, it may fairly be assumed that these early progenitors of Ruminantia were also tetradactyle. The small tetradactyle *Cainotherium* is a very tempting genus in speculations about the descent of Ruminantia; but I must exclude it for many reasons, though I cannot here give them in full. Some of these are as follows:—the *Cainotherium* retained till the Middle Miocene five-lobed teeth on the *Dichobune* pattern (with the three lobes on the posterior half of the tooth), while we have truly ruminant teeth already in the Eocene; it retained its upper incisors and free metatarsals, while the much older *Gelacus*, Aym., which is already a true ruminant, had no upper incisors and the metapodials were confluent in the adult. *Cainotherium* seems to be a direct descendant of *Dichobune*, and to have become extinct, without leaving any successors.

Supposing that the *Dichodon* had a foot true to the tetradactyle type, we do not find the earliest stages of reduction; they were passed rapidly, and in very ancient times: but there can be little doubt that the Ruminantia began with a tetradactyle foot, and ended by a cannonbone adapted to the whole distal surface of the carpus and tarsus. Such adaptation of the two middle digits could not be obtained at one leap; and certainly all stages between a tetradactyle foot (in which every digit was supported by a separate bone in the carpus and tarsus) and a didactyle foot (in which the two enlarged middle digits have taken the whole distal surface of all the carpal and tarsal bones) were passed by this group in the same manner as we have seen it in the Suina; but only a few traces of this passage remain. From the tetradactyle *Dichodon*, the group of adaptive Selenodonts may be said to have split into two subordinate groups. In one of these, represented by the *Hyomoschus*, the lateral digits are retained, and only the metatarsals become confluent, while the two middle metacarpals continue to be

free*. In the *Tragulidæ* the two middle digits coalesce, in both fore and hind limbs, into a complete cannonbone, but the lateral digits are still retained in their whole length as useless (nearly filiform) appendages. The distal surface of the metapodium remains smooth; the rumination is incomplete.

In the other group, as the representative of which we may cite the *Gelacus*, Aym., the lateral digits were soon lost, and the remaining two middle digits have taken the entire distal surface of the carpus and tarsus; still they remain separate, perhaps through life, in some of the Eocene *Gelaci* whose remains I have seen from the phosphatic limestone deposits in the south of France, near Cahors, in a locality called Caylux. In this deposit the bones of *Gelacus* are found, together with large *Anoplotheria* and *Palæotheria*; and even the completely ossified and not epiphysed metatarsals are found entirely free. In the lowest Miocene of Puy, however, we find a *Gelacus* whose metacarpals and metatarsals are free only in the young, and coalesce in the adult; but, even after their coalescence, the distal end of the metapodium is smooth, and the articular ridge is limited to the palmar side. In the somewhat newer (about the upper part of the Lower Miocene) deposits of Allier, in Auvergne, we meet at last with metatarsals and metacarpals entirely coalesced into a complete cannonbone, and the articular ridge taking the whole distal extremity of the metapodium. Small rudiments of the lateral digits (second and fifth) still remain as styliform appendages on both sides of the cannonbone, in the fore and hind limbs.

Such true ruminant forms are exceedingly numerous in the Miocene of Allier; they are all hornless, and some retain seven molars in the lower jaw, as in all ancient Selenodonts. In most, however, of these newer Miocene forms the first premolar of the lower jaw is lost, and they exhibit the same dental formula as the living Ruminantia, from which they seem not to differ in any of the essential characters. These true ruminant forms of the Lower Miocene may be considered to have reached the culmination point of their reduction, and we shall consider them as such. Thus the Selenodont *Paridigitata*, after branching off from the common stock in the Lower Eocene, reach the utmost stage of reduction on the adaptive mode a little below the Middle Miocene; this we consider to be the fifth stage, or the culmination.

The fifth stage, or the culmination point of the *Paridigitata* Selenodonta, following the adaptive mode of reduction, means that the reduction of the manus and pes was carried so far that it could not proceed further; this point was attained already in the Lower Miocene. When once the metapodium was reduced to *one* bone, and this one had taken the whole distal surface of the carpus and tarsus, any further reduction or improvement was quite impossible. Besides, the completely developed faculty of rumination gave these

* These middle metacarpals and metatarsals are enlarged and adapted to the whole distal surface of the carpus and tarsus.

forms an enormous advantage over the other, non-ruminant, *Paridigitata* occurring in the same strata. They could live on such matters as twigs, bark of trees, mosses, lichens, on which no other *Ungulata* can subsist; such food is found everywhere, requires no cunning and very little struggle to get it. All essential modifications were attained very early, and the chief of these are the confluence of the two middle digits in a complete cannonbone and rumination. Then began the luxury of all sorts of appendages—excrescences on the frontal bones covered with skin, uncovered by skin in the form of prickly simple horns (*Pudu*), or double (*Dicroceras* of Sanson, Muntjac), then branched and palmated. In other groups these bony cores were covered with horny sheaths, which at first differed but little from agglutinated hairs (*Antilocapra americana*), then became more compact, as in the smooth and hard horny sheath of the hollow-horned Ruminantia. These secondary characters were all acquired, thanks to abundant time, after the essential characters of the type had been assumed; if man had come on earth a little later than he did, he certainly would have found nearly parallel cases in the group of *Suina*, monodactyle (with cannonbone) hogs with different appendages. As it is, he stopped the course of events; all further improvement is out of the question, or only possible in such groups as the Rodentia, who prey on man's food, being at the same time independent of him.

It may be asked, How stands the matter in the *Imparidigitata Ungulata*? And though I cannot enter fully into the case, I may state that the same course of events is observable in them; only there could be no *inadaptive* reduction, as the body could not, under any circumstances, be held in equilibrium upon one single third digit, if this one had not taken the whole distal surface of the carpus and tarsus. But the task in this group was much more difficult; to get one middle digit to perform the work shared in the ancestors by five, and in the immediate progenitor by three, required time. To accomplish this, two geological periods were needed; but still, by the incessant tendency to reduction, the work was done, and the monodactyle horse spread over the surface of the globe, superseding all other *Imparidigitata*, which are evidently rapidly dying out. The only *two* genera which remain still, the Rhinoceros and the Tapir, cannot last long. But this spreading and multiplication of the *Equidæ* was also accompanied by a total change of diet: from an omnivorous animal it became a grass-eater; and indeed, by its teeth and many other characters, the horse is very *analogous* to the Ruminantia, being, as they are, the culmination-point of the group of *Imparidigitata*. The reduction of the horse-foot, however, is not fully accomplished yet; to attain this, the styliform metatarsals and metacarpals (the second and fourth) have to be lost.

MISCELLANEOUS.

Further Additions to the Ichthyological Fauna of Zanzibar.

By Dr. A. GÜNTHER.

IN the 'Annals and Magazine of Natural History' for 1868, i. p. 457, I have mentioned several species of fishes previously not known to exist on the coast of Zanzibar; and I have now the pleasure of adding some others, contained in a collection brought home by Bartle Frere, Esq., who accompanied his father, Sir Bartle Frere, on his mission to Zanzibar, and who kindly allowed me to select desiderata for the British Museum. The new additions to the Zanzibar fauna are the following:—

1. *Serranus sexmaculatus*.
2. *Diagramma crassispinum*.—This fish is new to the collection of the British Museum. The specimen differs from the description given by Rüppell and Klunzinger in having rather irregular oblique black bands on the body. It is nearly 8 inches long.
3. *Diagramma reticulatum*.—The Zanzibar specimen agrees very well with the typical specimens (see Fish. i. p. 334); but I have some doubt whether this species is not identical with *D. foetela*. Rüppell had ascribed twelve dorsal spines to this latter species; but Klunzinger states that it has thirteen; so that the number of dorsal spines can no longer be considered a specific difference. This species extends to Australia.
4. *Seriolichthys bipinnulatus*.—A. $\frac{1}{16}$ | II.
5. *Acanthurus lineatus*.
6. *Pseudoscarus strongylocephalus*.
7. *Carcharias Bleekeri*.—Previously known from a single specimen from the Seychelles.
8. *Galeocerdo tigrinus*.

On the Skull of the Spectacled Bear of Peru and of the Helarctos from Malacca and Java. By Dr. J. E. GRAY, F.R.S., &c.

The British Museum has lately received from Mr. Whitely, jun., two skulls of different ages of the spectacled bear of Peru, which are interesting as we have never before received any, and only knew it from the figures of the skeleton and skull in Blainv. Ostéogr. t. iv. and t. viii., which belonged to a specimen described when living by Frédéric Cuvier.

The skull of this bear has been referred to the genus *Helarctos*, of which the Malayan bear is the type.

The skull is very peculiar in the form of the large scar left by the temporal muscle at the hinder part of the lower jaw, the scar only occupying the end and the upper process, and being separated from the rest of the jaw by a very large elevated plate occupying the whole of the front edge of the muscle, thus giving a considerable extent of attachment and consequent power to the latter.

The outer side of the lower jaw, just in front of this elevated plate, is furnished with a large, oblong, subtriangular concavity, about an

inch in each direction, and so deep that it is only separated from the inner surface of the jaw by a thin translucent layer of bone.

In the more perfect adult skull the upper jaw is furnished with three nearly equal small false grinders, which are so compressed together that the middle one is on the outside of the other two. The front one is rather larger than the other two; but they are very nearly equal and have a slightly lobulated surface. The lower jaw has three similar, but rather larger lobulated teeth placed rather further apart, the two in front being the closest, and the front one rather the largest, and very close on the back edge of the canine.

It is very clear that this bear should not be referred to *Helarctos*, which ought to be thus characterized:—

1. *HELARCTOS*, Horsfield; Gray, Cat. Carniv. &c. p. 234.

False grinders 1.1 in the upper and 2.2 in the lower jaw: the upper one small, at the base of the canine, between it and the front edge of the flesh-tooth; the two lower ones smaller. Scar of the temporal muscle subtriangular, occupying the greater part of the end of the lower jaw, gradually shelving into the surface of the jaw. Claws compressed, very much curved.

Helarctos malayanus, Gray, Cat. Carniv. p. 234.

There is no difference between the skulls of *Ursus malayanus* and *U. euryspilus*.

As the skulls of the Malay bear in the Museum had lost their false grinders, in the paper on bears in the 'Proceedings of the Zoological Society' I took the account of them from De Blainville's figure of *Ursus ornatus*, which had them all complete; and therefore they do not agree with the proper generic character of *Helarctos* of Horsfield.

2. *NEARCTOS*.

False grinders in upper jaw 3.3, crowded together between the canine and the base of the flesh-tooth, forming an arched line, the middle one being more outward: in the lower jaw 4.4, conical, slightly 3-lobed, in a straight continuous line; the two middle equal, small; the front larger, and the hindmost largest. The scar of the temporal muscle oblong, deep, with a well-marked raised margin on its front edge, separating it from a large deep concavity on the hinder part of the outer surface of the jaw, which is only separated from the inner surface by a thin translucent layer of bone.

Nearctos ornatus.

Helarctos ornatus, Gray, Cat. Carniv. p. 236.

Hab. Cordilleras (*Whitely*).

De Blainville seems to have overlooked the peculiarity of the form of the lower jaw in the young skull which he figured (t. viii.), although it is represented in the figure, but not nearly so well defined as in the adult specimens; and I was induced by his observations to refer this bear to the genus *Helarctos* before I had the opportunity of observing its skull. And he appears also to have overlooked the differences in the numbers of the false grinders, although the artist figures them.

*On the Appearance of Danais Archippus in Australia.**To the Editors of the Annals and Magazine of Natural History.*University of Melbourne,
19th May, 1873.

GENTLEMEN,—Referring to the notice I sent you last month of the sudden appearance of the American butterfly, *Danais Archippus*, over a north and south area of ten miles about Melbourne, and my having the year before recognized it as an abundant visitor over the north-east part of the continent of Australia, I beg to say that I have since received specimens in a letter from Mr. Eastwood, showing that it appeared in abundance for the first time within the same week at Belfast, about two hundred miles west of Melbourne. I have now a letter showing that it appeared about a week later in the north of the island of Tasmania, to the south.

I have, &c.,
FREDERICK M'COY.*On the Habits of unequal Bivalve Shells.**To the Editors of the Annals and Magazine of Natural History.*

Burton-on-Trent, July 3, 1873.

GENTLEMEN,—Dr. Gray asks for information as to the habits of unequal bivalve shells.

In May last I found many specimens of *Pandora inæquivalvis*, L., in St. Aubin's Bay, Jersey. They were exposed at very low water, and were lying in furrows of sand which were filled with water. They lay indifferently on either valve, and were quite destitute of byssus or any marks of attachment. The animals were all alive and apparently healthy.

PHILIP B. MASON, M.R.C.S., F.L.S.

On the Skeleton of Kogia Macleayii.

By Dr. J. E. GRAY, F.R.S. &c.

The British Museum has received two skeletons of this interesting whale from Australia, of different ages. The skeletons have not been mounted yet; but the larger is about 9 feet long. The larger skull is about 16 inches, and the smaller one 13½ inches long.

The two skulls are very similar; but the opening between the upper surface of the intermaxillary bones is much wider in one than in the other. The comparison of these two skulls with the very young one figured as *Physeter simus* by Prof. Owen (Trans. Zool. Soc. vi. t. 12, 13, 14), obtained by Mr. Elliot on the coast of India, shows that they are only different ages of the same species. The young one chiefly differs in the sides of the frontal cavity being more convex and swollen, becoming sharper in the older specimens. The vomer is much more exposed below in the two young skulls than in the more adult one, where it becomes partly covered by the under inner edge of the intermaxillaries. The large ridge just over the very large left blower is much higher and more convex in the older specimens than in the middle-aged and young.

There is a good deal of difference in the shape and form of the blade bone, probably dependent on age. The blade bone of the smaller specimen is subtriangular, being about one 10th part wider than it is high from the front of the condyle to the upper edge; the acromion and coracoid processes are directed forwards, and only slightly bent outwards; the acromion is much broader, and rounded at the end. In the larger specimen the blade bone is much wider than high; that is to say, it is more than once and a half as wide as high; the coracoid and acromion processes are much elongated and strongly bent upwards. This difference may be sexual; for the young bone does not appear to be like a portion only of the larger one: and if there is a change of form, the whole bone changes as it grows; that is to say, the angular prominence on the front edge is lower down the front margin in the larger one.

In all these specimens the bones of the face are shorter than the distance from their edge to the crest round the nostrils; and in this respect it differs from De Blainville's figure of *Physeter breviceps*, which is said to have come from the Cape of Good Hope; but I have never had the opportunity of examining the skull, and therefore cannot vouch for the correctness of the figure.

A partial Comparison of the Conchology of Portions of the Atlantic and Pacific Coasts of North America. By ROBERT E. C. STEARNS.

A striking feature in the conchological fauna of that part of the Pacific coast included in the Californian-and-Vancouver zoological province, when compared with the molluscan fauna of the Atlantic coast from the arctic seas to Georgia, is the preponderance in the former of those forms of molluscan life which are embraced in the order of Scutibranchiata*.

The Scutibranchiate Gasteropods, or shield-gilled crawlers, comprise a great number of mollusks, all of which are marine, and which inhabit the sea-shore, principally the littoral and laminarian zones, subsisting on marine vegetation; thus we find the beautiful group of *Calliostoma* upon the larger algæ, as well as the unique *Trochiscus* (*T. Sowerbyi*), and *Chlorostoma* crawling over the sedimentary rocks, upon which grows the green *Cladophora* or some allied vegetable form upon which it feeds, and which also is the favourite food of several species of limpets.

The order of Scutibranchiata, according to Messrs. Adams, includes:—the family of *Neritidæ* (none of which are found in the Californian and Oregonian province, though they begin to appear on the coast of Lower California); the *Trochidæ*, which is largely represented by the following genera—*Eutropia* one species, *Leptothyra* three species, *Pachypoma* and *Pomaulax* one species each, *Liotia* one (perhaps two) species, *Thalotia* and *Trochiscus* one species each, *Calliostoma*, *Chlorostoma*, *Omphalius*, *Margarita*, and *Gibbula*, each by several species; the family of *Haliotidæ*, which is represented by several species, all of large size, widely distributed and exceedingly numerous in individuals—*Fissurella*, including *Lucapina*, *Glyphis*,

* *Vide* Adams, 'Genera of Recent Mollusca,' vol. i. p. 376.

and *Clypidella*, also *Puncturella* and *Emarginula*; *Dentaliadae* by two or more species; *Tecturidae* by several species of *Acmæa*, also by *Scurra*, *Gadinia* by one and *Nacella* by six or more species; *Chitonidae* by numerous species and great numbers of individuals.

It may be that some of the groups included by the Messrs. Adams in the order referred to, as our knowledge increases, will require to be separated or removed; but so far as the purposes of comparison as made herein are concerned, the result will not be materially impaired.

The total number of marine molluscan species and well-marked varieties within the Californian and Oregonian province, so far as known and determined, is not far from 630, of which about 200 are Bivalves; and of the remaining 430, 123 are included within the Scutibranchs; of this latter number about 40 belong to the Chitonidae, and the same number to the Trochidae.

Of the 247 marine gasteropods enumerated by the late Dr. Stimpson, in the Smithsonian-Institution Check-list, as found from the arctic seas to Georgia, 32 only, or less than one eighth, come within the order mentioned; of this comparatively small number, seven are *Chitons* and fourteen belong to the *Trochidae*, while *Haliotis** is without a representative: the *Trochidae* within this province are not characterized by such marked or unique characters as distinguish their relatives on the west coast.

Some revision may be required hereafter in the number of Scutibranchiate species credited to the west-coast province, as forms now catalogued as distinct may, in some instances, be united; but, on the other hand, it is not unlikely that new forms undoubtedly distinct will be detected when the coast is more thoroughly explored.—*Proceedings of the California Academy of Sciences*, October 7, 1872.

The Megalops Stage of Ocyropa. By S. I. SMITH.

The *Monolepis inermis*, long ago described by Say†, and partially figured by Dana‡, is undoubtedly a stage in the development of *Ocyropa arenaria*. The large size and peculiar structure of this megalops render it one of the most interesting forms of the group of larvæ to which it belongs. It is closely allied to the *Monolepis orientalis*, Dana, from the Sooloo Sea, figured in detail on plate 31 of the Crustacea of the Wilkes's Exploring Expedition. The carapax is very convex above and narrowed toward the front. The front is deflexed and the extremity tricuspidate, the median tooth being long and narrowly triangular, while the lateral teeth are small and obtuse. The sides are high and impressed, so as to receive the three anterior pairs of ambulatory legs. The third pair of ambulatory legs are closely appressed along the upper edge of the carapax, and extend forward over the eyes, the dactyli being curved down over the eyes and along each side of the front. The posterior legs are small and weak, and

* A solitary specimen of *Haliotis*, of small size, was obtained through dredging in the Gulf-stream, four or five years ago, by Count L. F. Pourtales, of the U. S. Coast Survey, but south of Georgia.

† Journ. Acad. Nat. Sci. Philad. 1817, vol. i. p. 157.

‡ Crustacea of Wilkes's Expl. Exped. pl. 31. fig. 6.

each is folded up and lies in a groove on the latero-posterior surface of the carapax. The external maxillipeds have almost exactly the same structure as in the adult *Ocypoda*; and, as in the adult *Ocypoda*, there is a tuft of peculiar hairs between the bases of the second and third ambulatory legs. This megalops is common upon the coast of the Southern States; it has been found at Block Island; and I have myself collected it, late in August, at Fire-Island Beach, Long Island. In the largest specimen from the last locality the carapax is 9.4 millims. long and 5.6 broad.

A large number of young specimens of the *Ocypoda*, collected at Fire-Island Beach, indicate plainly that they had only recently changed from this megalops. Some of the smallest of these specimens, in which the carapax is 5.6–6.0 millims. long and 6.1–6.5 broad, differ from the adult so much that they might very easily be mistaken for a different species. The carapax is very slightly broader than long, and very convex above. The front is broad, not narrowed between the bases of the ocular peduncles, and triangular at the extremity. The margin of the orbit is not transverse, but inclines obliquely backward. The ambulatory legs are nearly naked; and those of the posterior pair are proportionally much smaller than in the adult.

The adult *Ocypoda* is terrestrial in its habits, living in deep holes above high-water mark on sandy beaches; but the young in the zoëa state are undoubtedly deposited in the water, where they lead a free-swimming existence like true pelagic animals, until they become full-grown in the megalops state. Say mentions that his specimens were found cast upon the beach by the reflux tide and “appeared desirous to protect themselves by burrowing in the sand, in order to wait the return of the tide;” but they were more likely awaiting the final change to the terrestrial state. The tufts of peculiar hairs between the bases of the second and third ambulatory legs, and in the adult connected with the respiration, are present in the full-grown megalops, and are undoubtedly provided to fit the animal for its terrestrial existence as soon as it is thrown upon the shore. The young in the megalops stage occur on the shore of Long Island in August, and perhaps earlier. At Fire-Island Beach, in 1870, no specimens of *Ocypoda* were discovered till the last of August; and those first found were the smallest ones obtained; by the middle of September, however, they were common on the outer beach, and many of them were twice as large as those first obtained. Although careful search was made along the beach for several miles, not a specimen of the adult or half-grown crab could be found. Every individual there had evidently landed and developed during the season. Probably all those living the year before had perished during the winter; and it is possible that this species never survives long enough to attain its full growth so far north.—*Amer. Journ. of Science and Arts*, July 1873.

The Torpedo or Electrical Ray.

A specimen of this remarkable and somewhat rare fish was brought up in the trawl yesterday off Portland. It was about 40 inches in length.

Weymouth, July 10, 1873.

R. DAMON.

On a Salamander (Sieboldia) from Shanghai.

By Dr. J. E. GRAY, F.R.S. &c.

Mr. Swinhoe has sent to the British Museum a skin, including the bones of the head and feet, of an animal of this genus from Shanghai. It is about 27 inches long. I do not see any character by which it differs from the *Sieboldia* from Japan, and am inclined to regard it as a specimen of that species. I have compared the head with the skull on the skeleton of the latter animal, but do not find any difference, except that the Japanese specimen in the Museum is older than the one which Mr. Swinhoe has sent from Shanghai.

M. Blanchard, in the 'Comptes Rendus,' 1871, lxxiii. p. 79, describes a new species of this genus under the name of *Sieboldia Davidiana*, from Western China, which is noticed in the Ann. & Mag. Nat. Hist. 1871, viii. p. 212. M. Blanchard, though he gives it a name, gives no distinctive characters between it and the Japanese species.

The Ribbon Seal of Alaska. By T. GILL.

This species of seal (*Phoca fasciata*, Shaw, or *P. equestris*, Pallas) is found in the waters of Northern Alaska, and is, so far as known, only represented well in the museum of St. Petersburg. In the Smithsonian collection there are two skins, obtained by Dr. Dall from Cape Romanzoff, but no skull or other parts of the skeleton. The species is remarkable for colour as well as for structural peculiarities. The male is at once recognizable by the colour: this may be said to be a chocolate-brown, except (1) a band of whitish yellow bent forwards towards the crown around the neck, (2) an oval ring of the same colour on each side, encircling the fore feet, and passing in front just before them, and (3) another band, also bent forwards above, behind the middle of the trunk. There is considerable variation in the extent of these bands; and sometimes the peribrachial rings are more or less confluent with the posterior band. The females are simply whitish yellow, or have very indistinct traces of the postmedian band (*vide* Von Schrenck).

The structural (and especially dental) characters of this species, according to Von Schrenck, indicate a generic distinction from all the familiar forms of the subfamily *Phocinæ*. The molars (except the first) are two-rooted, as in the typical *Phocinæ*—but in external form are simply conic or have rudimentary cusps, thus resembling *Halichoerus*. The genus may be named *Histriophoca*.

The special object of this communication is to call the attention of travellers in Alaska to the species; and skeletons (especially skulls) and skins are earnestly asked for. The species has been found also in Kamtschatka, and at the mouth of the Kamtschatka river in March and April, arriving there later than the other seals named.

One of the skins in the Smithsonian collection has been peeled off from the animal almost entire, and by a cross slit below and between the fore feet, and, being tied in front, has evidently been used as a bag.—*American Naturalist*, vol. vii., March 1873.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 69. SEPTEMBER 1873.

XXIV.—*On a new Species of Synocladia from the Carboniferous Limestone Series of Midlothian.* By R. ETHERIDGE, Jun., F.G.S.

[Plate X.]

ONLY one species of *Synocladia* is at present recorded, so far as I am able to ascertain, from rocks of Upper Palæozoic age in Great Britain—the *S. virgulacea*, Phillips, from the Magnesian Limestone of Tunstall Hill and other localities in the north of England. A bed of bluish-grey shale was lately discovered overlying the Gilmerton Limestone (Lower Carboniferous Limestone series) at Gilmerton, near Edinburgh, by Mr. J. Bennie, crammed with the remains of *Fenestellæ* and other Polyzoa. Amongst a number of such fragments I was much interested with certain pieces evidently not referable to that genus, but clearly allied to *Synocladia*.

The specimens present the same habit as the Permian genus, but differ from the latter in the arrangement of the cell-apertures on the celluliferous or obverse face. This arrangement departs considerably from the hitherto recognized *Synocladia* type, in many points approaching that seen in *Fenestella*, yet distinct from it. Were it not that the other characters displayed in the habit of the carboniferous form so closely resemble those seen in *Synocladia*, I should feel considerable diffidence in referring my specimens to that genus. If it, *i. e.* the carboniferous form, is not a new species of *Synocladia*, then a new genus must be created for its reception—allied to *Synocladia*, yet differing from it.

As in the typical species, *S. virgulacea*, the frond is com-

posed of numerous rib-like stems, rising from a common root and frequently bifurcating. The branches are short and simple, and spring at an ascending angle from one stem to meet those of the opposite stem, and thus form the peculiar arch-like dissepiments so characteristic of the genus; these are sometimes modified into stems. The form of the dissepiments is regulated by the proximity to or remoteness from one another of the stems or interstices: when far apart the usual arch-like character is preserved; but when brought close together, the normal form is lost, and the dissepiments become irregular connecting bars, passing from rib to rib, either horizontally or at a more or less acute angle.

So far the resemblance between the Carboniferous and Permian forms is complete; but, as before stated, a considerable difference is noticeable in the detailed arrangement of the cells on the celluliferous face, although the general plan is the same. In *S. virgulacea* the cell-apertures on the stems are arranged in from three to five furrows, separated by sharp or angular ridges or keels, on which may be seen small, open, node-like elevations ("gemmuliferous vesicles," King); the cell-apertures on the branches are restricted to two rows, with a dividing ridge between them, the cellules set alternately. In the Carboniferous species, on the other hand, there is only one dividing ridge or keel on each stem, separating two rows of cell-mouths, and that not angular, but somewhat round, with the open node- or pore-like elevations arranged in the same manner as in *S. virgulacea*. Furthermore, scattered in a most irregular manner amongst the cell-apertures proper are a number of supplementary openings, without any attempt at arrangement; sometimes one may be seen between two of the cell-apertures proper, more commonly at the side of a primary opening, or occasionally as many as three have been observed clustered close together; this usually takes place at the base or setting-off of one of the branches, upon which they are also to be found. The disposition of the cells on the branches is similar to that seen in *S. virgulacea*, with this one exception; viz. the "gemmuliferous vesicles" (?) are continuous from the keel of the stems on to that of the branches. This I cannot ascertain to be the case in the Permian form.

From the foregoing remarks it is evident that our Carboniferous Polyzoon, whether it is a *Synocladia* or not, differs from that genus, as defined by King, as follows:—

1st. Obverse of the main stem supplied with two rows of cells only, separated by a rounded keel.

2nd. Reverse provided with irregularly scattered supplementary cell-apertures.

3rd. Keel of the branches supplied with node-like pores, the "gemmuliferous vesicles" (?) of King.

The points of difference expressed in the first paragraph do not to my mind present an insurmountable difficulty to the admittance of the Carboniferous specimens into the genus *Synocladia*. I feel the greater confidence in so placing them, because Prof. King in his generic diagnosis does not lay particular stress on the number of rows of cellules, but simply says "distributed in longitudinal series," whereas it is only in the specific diagnosis we find it stated that the cellules are "in from three to five furrows."*

The second and third points of difference are those only which make me doubt the propriety of referring these peculiar *Polyzoa* to *Synocladia*, viz. the possession of the supplementary irregularly scattered cell-apertures (if that is their true nature) and the occurrence of the gemmuliferous vesicles on the keels of the branches as well as on the stems.

The reverse or non-celluliferous face of *S. virgulacea* is represented by Prof. King as smooth; but in the Carboniferous specimens it is seen to be delicately and regularly striate, with (scattered over the surface of both stems and branches) small, round, open, pore-like apertures. The question arises, are these the bases of the "root-like processes" on the underside of the fronds mentioned by Prof. King as seen in the Permian specimens? or, if not, what are they? If the former, then the processes must have been broken off in the course of fossilization. They occupy exactly the position of the root-processes as shown in the 'Permian Fossils' †.

I propose to describe this form provisionally as a new species of *Synocladia*, under the specific name of

Synocladia carbonaria, sp. nov.

Polyzoarium a flattened plumose expansion, springing from a small root of attachment.

Interstices or stems rib-like, frequently bifurcating, much stouter and stronger than the branches; obverse celluliferous, with a median rounded keel; reverse rounded and striated.

Dissepiments or branches short and simple, opposite branches given off at an oblique angle from their respective stems, which meeting, give rise to arched interspaces or fenestrules; obverse celluliferous; reverse rounded and striate; sometimes modified into stems.

Dividing ridges or keels on both stems and branches se-

* Permian Fossils, pp. 38 & 39.

† Plate iv. figs. 7 & 8.

paring the two rows of cell-apertures; those on the stems rounded, those on the branches slightly angular; both bear the wart-like bodies termed by King "gemmaiferous vesicles" (?).

Fenestrules, when the stems and branches assume their normal condition, are arch-shaped, otherwise irregular; margins not indented by cells.

Cell-apertures arranged in two subalternating rows, both on the stems and branches, separated by the median keel; with prominent margins.

Supplementary cell-apertures scattered irregularly amongst the primary cell-apertures, either singly or in twos and threes.

Gemmaiferous vesicles (?) open node-like protuberances placed on the keels of both stems and branches, alternating with the cell-apertures.

Reverse or non-celluliferous face regularly and finely striate, or rather granulo-striate; scattered at random over the surface are open wart-like projections, which may be the broken bases of the "root-like processes" of King.

EXPLANATION OF PLATE X.

Fig. 1. *Synocladia carbonaria*, nat. size. The dotted lines show the extent of the specimen and direction of the stems and branches.

Fig. 2. Portion of a specimen, showing the celluliferous face: (*a*) the cell-apertures, and indistinctly the keel (*d*).

Fig. 3. Portion of another specimen, showing the celluliferous face, on which are seen:—*a*, cell-apertures; *b*, gemmaiferous vesicles; *c*, smaller cellule apertures; *d*, median keel; *e*, the same on the branches; *f*, gemmaiferous vesicles (?) on the keels of the branches.

Figs. 4 & 5. Reverse or non-celluliferous face, showing the arch-like dissepiments and the bases of the root-like appendages (?).

Figs. 2 to 5 are all very considerably enlarged.

Note. Since writing the above I have submitted the facts mentioned in the foregoing remarks to Prof. King, who considers this to be a species of *Synocladia*. The late Dr. Prout described, in the 'Transactions of the Academy of St. Louis,' a form very similar to the above under the name of *Septopora cestriensis* (vol. i. p. 448, pl. xviii. fig. 2). Dr. Prout established the genus *Septopora* on characters which cannot be distinguished from those of *Synocladia*, King, with this exception, that the cell-apertures on the interstices are in from one to four rows; whereas, so far as I can ascertain from Prof. King's description and figures of *Synocladia*, there never appear to be more than two rows in the latter genus. This could scarcely be construed into a generic difference, but may be regarded as specific only. In framing the genus *Septopora* it is strange that so

acute an observer as Dr. Prout should have overlooked the characters of Prof. King's genus *Synocladia*. Our Scotch form and *S. cestriensis*, Prout, agree very closely, so far as I can judge from descriptions and figures, and appear to differ only in a much greater irregularity of branching in the case of *S. carbonaria*, and also in its having, as in *Synocladia*, the cell-apertures arranged in two rows on the interstices. Dr. Prout's figure does not give a good idea of this peculiar polyzoon; but I have been favoured by Prof. King with extracts and photographs from a letter to himself from Mr. F. B. Meek, of Springfield, Illinois, regarding the question of *Septopora* and *Synocladia*. These photographs show that the American specimens are in a much better state of preservation than the Scotch; and although the points of difference between the two are slight, I think they are of sufficient importance to warrant a specific separation; however, should Mr. Meek have previously elsewhere described any form nearer *S. carbonaria* than *Septopora cestriensis*, my designation can give place to his; in the mean time I retain for the Scotch fossil the name of *S. carbonaria*. Mr. Meek states that fuller descriptions and figures will be given in the forthcoming fifth volume of the 'Geological Survey of Illinois.'

Edinburgh, August 11, 1873.

XXV.—On the Longicorn Coleoptera of Japan.

By H. W. BATES, F.L.S.

[Continued from p. 156.]

Fam. Cerambycidae.

Section B. *Eyes finely faceted. Habits diurnal.*

Toxotus caeruleipennis, n. sp.

T. elongatus, subparallelus (♂), niger, thoracis margine antico vitætaque laterali, et annulo basali femorum anticorum flavo-testaceis; elytris saturate caeruleis, planis, confertim ruguloso-punctatis, interstitiisque subtilissime coriaceis, apice truneatis, angulo suturali dentato, exteriore late rotundato. Long. 9 lin. ♂.

Japan? (*Fortune*). Possibly from North China, as Mr. Fortune's collections from the two countries were mixed together when I saw them.

Elytra more elongate than in the same sex of *T. meridianus*, and of quite different shape, being broad and rectangular at the base, then slightly narrowing to beyond the middle, and widening again before the apex; the whole surface roughly, but not very coarsely, sculptured. The thorax is much more strongly tuberculated, glabrous on the disk; there are two strong rounded tubercles on each side the median sulcus, and

the lateral tubercle is much larger and more conical. The antennæ are more slender, but the proportions of the joints are very similar.

Mr. Lewis did not meet with this species.

Acmæops criocerinus, n. sp.

Pachyta minuta, Gebler, Nouv. Mém. Moscou, ii. 1832, p. 69?

A. parvus, *Crioceri puncticollis* similis, niger, nitidus, sparsim subtiliter setosus, elytris cyaneis; capite et thorace sparsim punctulatis, hoc convexo, lævi, medio haud dilatato sed antice valde angustato; elytris breviter oblongo-ovatis, apice rotundatis, supra sparsim setifero-punctulatis; corpore subtus, pedibus et antennis cinereo-pubescentibus; antennis (♂) corpore multo longioribus. Long. 3 lin.

Awomori, Nipon (*Mr. Moor*).

Distinguished from *Acm. collaris* by its shorter and broader form and much finer and scantier pubescence, as well as by its colour. It agrees with Gebler's description of his *P. minuta*, except in the scutellum—black and glabrous in *A. criocerinus*, and "albo-tomentosum" in *P. minuta*.

Mr. A. Adams obtained a species from the coast of Manchuria considerably larger (4 lines) and rather more strongly punctured, which can scarcely be separated from the present one.

Leptura scotodes, n. sp.

L. cinctæ forma simillima, nigra, opaca, subtus cinereo-pubescentis, ♀ elytrorum basi sanguinea; capite et thorace confertissime reticulato-punctatis, illo postice ante collum recte truncato, hoc antice sensim angustato, lateribus ♂ vix, ♀ paulo, rotundatis, angulis posticis rotundatis, basi transversim modice depresso, linea dorsali obsoleta; scutello cinereo-tomentoso; elytris apice recte truncatis, supra confertim punctatis, punctis singulis seta minuta ferentibus. Long. $4\frac{1}{2}$ –6 lin.

♂ segmento ultimo ventrali late sinuatim truncato et concavo; tibiis posticis rectis.

♀ pygidio elongato-triangulari, apice obtuso; segmento ultimo ventrali late rotundato, apice depresso; elytris basi fascia angusta sanguinea, supra callum humerale dilatata, marginem haud attingente.

Three examples, Nagasaki.

Leptura tenuicornis, Motsch.

Leptura tenuicornis, Motsch. Etudes Entom. 1861, p. 23.

Nagasaki; many examples.

Motschulsky's description applies tolerably well to the ♀ of

one of Mr. Lewis's species, which appears not uncommon in Japan. It is closely allied to *L. atra* (Laich.), the ♂ having similar flexuous hind tibiæ; but it is longer, and has the elytra of a tawny-testaceous hue, with the shoulders, tips, and sutural edge dusky. The thorax has the same form as in *L. atra*, but is clothed with tawny-golden pile. The antennæ of the male are very long and black; of the female almost equally long and slender, and generally of a tawny-testaceous hue, but sometimes nearly black, except the three or four apical joints. It is in this latter point that the chief discrepancy with Motschulsky's description lies; for he states "articulis duobus penultimis albidis." On the twofold consideration that the antennæ are variable in colour in the female, and that Motschulsky's descriptions are well known to be recklessly inaccurate, I do not venture to give a new name to the species.

Var. ♂. Mr. Lewis has a male variety in which the elytra are blackish, with a curved streak on each side of the scutellum and a fascia near the apex tawny yellow. The anterior and middle femora and tibiæ are also varied with tawny yellow, thus resembling the female, in which yellow is the prevailing colour.

Leptura dimorpha, n. sp.

L. atra (Laich.) simillima, differt solum thorace feminae supra rufo. Nigra, vix nitida, supra breviter nigro-setosa, infra griseo-pubescentis; capite thoraceque confertim punctatis, hoc convexo, juxta basin fortiter depresso, angulis posticis productis; elytris apice sinuatim truncatis, angulis externis productis, supra crebre punctulatis.

♂ tibiæ posticæ versus apicem dilatatae et intus flexuoso-carinatae; segmentum ultimum ventrale quadratum, apice late rotundatum, medio late sulcatum.

♀ thorax supra et lateraliter saturate rufus.

Many examples.

L. atra (Laich.) is apparently common in Eastern Siberia. I have several examples from Maack's collection which do not differ from German specimens. *L. aterrima* (Motsch. Schrenck's Reisen, Coleop. p. 147) is no doubt the same species; in fact the author indicates no difference of the slightest importance in his description.

Leptura xanthoma, n. sp.

L. nigra (Lin.) forma similis, at major. Elongata, supra longitudinaliter convexa, nigra, nitida, pubescens, humeris macula subquadrata, femoribusque et tibiis anticis subtus flavis, palpis rufo-testaceis; capite medio usque ad collum sulcato, punctulato; thorace elongato, ad trientem anticum rotundato-dilatato, deinde sinuatim angustato, angulis posticis longe productis, supra juxta

basin transverse (lateraliter profundius) impresso, subsparsim punctulato, fulvo-pubescente; elytris postice gradatim attenuatis, apice oblique truncatis, punctulis nigro-setiferis passim impressis, corpore subtus cinereo-pubescente. Long. 6 lin. ♂.

One example.

Leptura ochraceofasciata, Motsch.

Leptura ochraceofasciata, Motsch. Etud. Entom. 1861, p. 21.

Taken by Mr. Lewis in great abundance. A handsome species, allied to *L. quadrifasciata* (Linn.), but with head and thorax densely clothed with golden pubescence, and elytra with four golden-yellow pubescent belts.

♂ tibiæ posticæ flexuosæ, a medio abrupte dilatatæ, intus flexuose carinatæ. Segmentum ultimum ventrale apice truncatum, angulis rotundatis, medio vix concavum.

In Nipon and on the hills the antennæ are always, as Motschulsky describes, black; but in the plains near Nagasaki they have the five terminal joints tawny (var. *ochrotela*). I can discover no other differences.

Leptura anaspidoïdes, n. sp.

L. figura Anaspidis (Sectionis *Heteromerorum*), elongata, subparallela, convexa; capite et thorace brevissimis; antennis elongatis, robustis; nigra, elytris fusco-rufis, pilis elongatis decumbentibus rufis vestitis; thorace campanuliformi, angulis posticis productis, subtiliter punctulato, fulvo-pubescente; elytris oblique obtusissime truncatis, subtiliter punctulatis. Long. 5-7 lin. ♀.

Segmentum ultimum abdominale longe productum; pygidio et segmento ventrali apice late obtuse truncatis.

Two examples.

Thranis variegatus, n. sp.

T. fusco-obscurus, opacus; corpore subtus medio, femoribus subtus, tibiis et tarsis, fasciisque duabus clytrorum (prima prope basin latiore et valde irregulari) fulvo-testaceis; thorace disco antice compresso-gibboso, cum capite punctato-scabroso, cinereo-tomentoso. Long. 9 lin.

One example, found in the window of a house, Nagasaki.

In the gibbosity of the thorax resembling *Thr. gibbosus* (Pascoe) of Ceylon. The anterior tawny fascia of the elytra is irregular, and may be described as a broad basal belt, indented from the base by a bicuspid black spot on each side of the scutellum. The second fascia is very narrow and transverse. The elytra are each narrowed from the base to the

middle, thence continuing as a narrow blade to the apex, which is pointed; their surface is thickly punctured throughout, with a faint raised line down the middle. The abdomen is prolonged much beyond the tip of the elytra (female?), the pygidium being very long, convex, and sinuate at the apex; its surface, as well as that of the preceding segment, is fulvous. The antennæ are three fourths the length of the body, filiform, stout, and ruddy brown.

Pyrestes cardinalis, Pascoe.

Pyrestes cardinalis, Pascoe, Journ. Entom. ii. p. 50.

Three examples. Found also at Hongkong.

Erythrus congruus, Pascoe.

Erythrus congruus, Pascoe, Journ. Entom. ii. p. 51.

One example; Hiogo. Found also at Hongkong.

Callichroma (*Chloridolum*) *tenuatum*, n. sp.

C. angustum, elongatum, quoad colorem et elytrorum sculpturam *Aromice moschatae* simillimum, sed antennis ut in gen. *Chloridolo* gracillimis; viride, subtus subtiliter cinereo-tomentosum, antennis pedibusque violaceis; thorace angusto, tuberculis laterilibus validis, supra passim transversim et oblique strigoso; elytris creberrime subtiliter scabrosis, lineis duabus tenuibus elevatis; pedibus elongatis, gracilibus, tarsis posticis articulo primo longissimo. Long. 8 lin. ♂ ♀.

Kobe, several examples; also taken by Mr. Fortune on the island of Nipon.

This remarkably slender species differs from *Chloridolum* in having the fourth antennal joint distinctly shorter than the third, instead of being of the same length. It does not agree either with *Leontium*, having the antennæ long and slender, instead of robust, and serrate or spinose. The antenniferous tubercles, however, are obtuse, as in *Leontium argentatum*. In the naked and finely scabrous elytra, and also in colour, it agrees with *Aromia moschata*; but it differs in its antennæ and long slender hind legs and tarsi. As the genera allied to *Callichroma* are at present very unsatisfactorily defined, I hesitate to add to the confusion by instituting a new one for this insect.

Sympiezocera japonica, Lacord.

Sympiezocera japonica, Lacord. Genera des Coléopt. ix. p. 47.

Rare, in pinewood, on Maiyasan, Hiogo.

Semanotus rufipennis, Motsch.

Callidium rufipenne, Motsch. Etudes Entom. 1860, p. 19.

Many examples. Varies in size from $3\frac{1}{4}$ to 6 lines. The prosternal process is much narrower, and the mesosternum more attenuated behind, in the male than in the female; but their breadth in the former sex is much greater than in the genus *Callidium*. The femora are less clavate, especially in the female, and the thorax less dilated in the middle than in *Rhopalopus*. Breeds in fir rails, and appears in first warm days in March.

Phymatodes albicinctus, n. sp.

- * *P. vario* (Fab.) affinis, at differt colore nigro, elytris fascia angusta alba. Niger, pubescens, elytris medio fascia angusta alba; capite retractili, fronte et vertice planis, punctulatis; thorace creberrime sed discrete punctulato; elytris planatis crebre punctulatis. Long. $3\frac{1}{4}$ lin. ♀.

One example; Omura.

Closely resembling in size and form the North-American *P. varius*. The pubescence is much shorter and more adpressed; the thorax is narrower, rather more narrowed behind than in front, very evenly punctulated over its entire surface. The elytra have in the middle a nearly straight, narrow, pure white belt.

Clytanthus notabilis, Pascoe.

Clytus notabilis, Pascoe, Journ. Entom. i. p. 360.

Clytanthus alphabeticus, Chev. Clytides d'Asie et d'Océanie (1863), p. 56 (*Anthoboscus*).

Many examples. Taken by Mr. Fortune also at Yokohama.

Clytanthus oppositus, Chev.

Clytanthus oppositus, Chev. Clytides d'Asie et d'Océanie, p. 52.

C. japonicus, id. p. 46?

Many examples. Abundant in June.

The markings agree best with Chevrolat's description of *C. oppositus*; but they vary a little in the direction of *C. japonicus*, and I suspect the two to belong to one and the same species.

Clytanthus quinquefasciatus, Lap. & Gory.

Clytanthus quinquefasciatus, Lap. & Gory, Mon. p. 101, t. 19. f. 120.

Many examples.

Clytanthus muscosus, n. sp.

C. elongatus, gracillimus, pube viridi-grisea vestitus; elytris utrinque maculis duabus transversis nigris, una mox pone medium, altera

inter medium et apicem; antennis pedibusque plus minusve obscure rufescentibus. Long. $5\frac{1}{2}$ lin. ♀.

Hiogo, three examples.

Of the same ashy-green colour as *C. 4-punctatus*, F., but of much narrower and more cylindrical form. The antennæ are slender and half the length of the body in the female. The thorax is long, very gradually narrowed in front and abruptly narrowed near the base. The elytra are sharply and obliquely truncated, with the exterior angle dentiform; each has, behind the middle, two transverse black spots, the first a little after the middle, and the second nearly midway between the first and the apex; near the base there are also two small black specks, one near the scutellum, the other on the humeral callus. The legs are long and slender; and the hind femora reach the tips of the elytra.

Clytanthus diminutus, n. sp.

C. parvus, cylindricus, angustus; niger, elytris macula communi pone scutellum, altera utrinque discoidali longe ante medium, fascia pone medium et margine apicali griseo-albis; antennis pedibusque pieceo-rufis. Long. 2 lin.

Nagasaki, two examples.

Smaller and much narrower than *C. massiliensis*, Linn., more cylindrical. Antennæ filiform, as long as the body; third joint twice as long as the fourth. Front broad and plane, without ridges; antenniferous tubercles slightly elevated. Thorax oblong-ovate, rather more narrowed behind than in front, closely punctured; the base on each side bordered with light grey. Scutellum black. Elytra cylindrical, transversely truncated, exterior angle dentiform; a sutural spot behind the scutellum, a discoidal spot behind, a fascia remote from this behind the middle, and the apical border light grey. The sides of the breast and abdomen are spotted with light grey. The legs are moderately elongated, the thighs rather thickened.

Clytanthus annularis, Fab.

Clytanthus annularis, Fab. Ent. Syst. ii. p. 337.

This widely distributed eastern-tropical insect is abundant in Japan after the second week of August.

Xylotrechus Grayii, White.

Xylotrechus Grayii, White, Cat. Long. Col. Brit. Mus. p. 261, pl. vi. f. 4.

Nagasaki; also taken by Mr. Lewis at Shanghai.

Xylotrechus pyrrhoderus, n. sp.

X. elongato-oblongus, niger, thorace globoso-ovato, rufo, grosse reticulato-punctato, sparsim nigro-pubescente; elytris regione scutellari fulva, fasciisque duabus flavis, prima paululum obliqua (ad suturam versus scutellum ascendente), altera longe post medium recta. Long. 5-6 lin.

Nagasaki; Yokohama.

Belongs to that section of *Xylotrechus* which has only the marginal ridges of the forehead distinctly raised; the whole head is coarsely scabrose-punctate. The antennæ are rather short and much thickened from the fifth joint; velvety black, with the basal part inclining to piceous. The thorax is oblong-ovate, as broad as the elytra, strongly convex and rounded on the sides; it is blood-red above and beneath; its vestiture consists in very short black bristles planted in the large closely packed punctures. The scutellum and a patch around it are tawny testaceous. The apex of the elytra is obtusely rounded; but the exterior angle is marked by a strong pointed tooth. The legs are black; all the femora gradually thickened, not clavate. The mesosternum is red, like the prothorax; the metasternum and abdomen are deep black, coarsely punctured; the episterna and the second (sometimes also the first) abdominal segment have a stripe of whitish tomentum.

Clytus caproïdes, n. sp.

C. caprae (Germ.) proxime affinis, at differt elytrorum humeris late fulvo-testaceis etc. Valde elongatus, parallelus, nigro-fuscus, fulvo-hirsutus, fronte vittis duabus, thoracis marginibus anticis et posticis, fasciisque duabus elytrorum (antica valde obliqua, angulata, abbreviata) læte flavis; elytris humeris plaga magna fulvo-testacea; antennis et pedibus testaceo-rufis. Long. 7½ lin.

Two examples, Ipongi.

Of very similar shape to *C. capra*; elongate and parallel. Body and limbs rather less densely clothed with long pale hairs. Thorax globose-ovate, rather narrower than in *C. capra*; very densely granulate-punctate. The humeral tawny patch of the elytra is triangular, obliquely defined posteriorly, and not extending to the humeral margin; it encloses in the middle a dusky spot (and there is no oblique yellow linear fascia as in *C. capra*); behind this, on the margin, is a short yellow streak, as in *C. capra*; the oblique yellow stripe towards the middle is much shorter than in *C. capra*, and is bent in the middle; the posterior belt is much widened towards the margin; and there is no yellow apical

fascia. The femora, as well as the tibiæ and tarsi, are rufous. Beneath, the colour of the abdomen is shining black, with yellow belts across the segments.

Dere thoracica, White.

Dere thoracica, White, Cat. Long. Col. Brit. Mus. p. 249, pl. 8. f. 1.

On flowers in June. Found also in N. China.

Purpuricenus Temminckii, Guérin-Ménév.

Sternoplistes Temminckii, Guérin-Ménév. Icon. R. A. Ins. texte, p. 224.

P. sinensis, White, Cat. Long. Col. Brit. Mus. p. 139.

P. japonus, Motsch. Etud. Entom. 1857, p. 37.

Not uncommon in Japan; also N. China.

The conical tubercle of the mesosternum being present in other species of the genus, there is no reason for retaining *Sternoplistes* of Guérin. As to the form of the thorax, short and transverse, *Purpuricenus* including a great diversity of form of this organ (e. g. *P. Angasii*, White), this character is quite insufficient as a generic difference.

Purpuricenus spectabilis, Motsch.

Purpuricenus spectabilis, Motsch. Etud. Entom. 1857, p. 36.

Mr. Lewis did not meet with this species (or variety?), which is distinguished from *P. Temminckii* (according to the description) only by the suture and a point on the posterior disk of the elytra being black. I have a specimen of *P. Temminckii* possessing the black discoidal point, but none in which the suture is black.

[To be continued.]

XXVI.—On the Primary Divisions of the Brachiopods.

By THEODORE GILL, M.A., M.D., Ph.D.

THE article in the July number of the 'Annals & Magazine of Natural History' (xii. pp. 1-17), by Prof. King, on *Lingula*, exhibits the insight into relations and skill in discussion characteristic of its author; and his views respecting the classification of the Palliobranchs or Brachiopods into two primary groups will probably be accepted. Indeed they had already been quite generally adopted; but as Prof. King had overlooked the fact, it is presumed that it is not as well known as might have been supposed; and the object of this note is to direct attention to the anticipation by others of Prof. King's views. The essential distinctions of Prof. King's groups are that in one (*Tretenterata*) the intestine has an anal aperture,

and in the other (*Clistenterata*) none. With these characters, be it remarked, are *generally* coincident structural modifications of the hinge of the shell—the species with an anal aperture having an inarticulating hinge generally, and those without the anal aperture having a more or less interlocking one. On one or other (or both) of these characters (and with coordinate ones) these groups have been repeatedly recognized, first by Owen, and then by Bronn, Huxley, and others. Owen, it is true, vigorously opposed the assertion that any forms had a cæcal intestine; but the groups he recognized were, as to their constituents, exactly equivalent to the *Tretenterates* and *Clistenterates*, although based only on the simple or interlocking hinge and relative proportions of the viscera and brachia. All other naturalists who have adopted the groups, however, have especially recognized the perforation or non-perforation of the intestinal tube in their diagnoses; and the groups have been adopted by the following naturalists, viz. :—

I.

- Lyopomata*, Owen, *Encycl. Brit.* 8th edit. vol. xv. p. 301, 1858*.
Pleuropygia seu *Ecardines*, Bronn, *Klass. u. Ordn. Thierreichs*, p. 301, 1862†.
Inarticulata, Huxley, *Int. Class. An.* p. 116, 1869‡.
Lyopomata, Gill, *Arr. Fam. Moll.* p. 26, 1871; Dall, *Am. Journ. Conch.* vol. vii. p. 71, 1871.
Tretenterata, King, *Ann. & Mag. N. H.* (4) vol. xii. p. 15, 1873.

II.

- Arthropomata*, Owen, *Encycl. Brit.* 8th edit. vol. xv. p. 336, 1858§.
Apygia seu *Testicardines*, Bronn, *Klass. u. Ord. Thierreichs*, p. 301, 1862||.
Articulata, Huxley, *Int. Class. An.* p. 116, 1869¶.
Arthropomata, Gill, *Arr. Fam. Moll.* p. 25, 1871; Dall, *Am. Journ. Conch.* vol. vii. p. 60, 1871.
Clistenterata, King, *Ann. & Mag. N. H.* (4) vol. xii. p. 15, 1873.

* The conclusions of Prof. King (he being unaware of the labours of his predecessors) are noteworthy, as being inde-

* “Shell-valves inarticulated, and, save in the annectant family *Cranidæ*, subcalcified; viscera occupying one half, brachia the other half, of the shell-cavity” (*l. c.* p. 339).

† “Nahrungskanal (in den fossilen Sippen nur vermuthungsweise) lang, gewunden, durch einen After (rechterseits?) ausmündend,” &c. (*l. c.* p. 301).

‡ “The intestine terminates in an anus on one side of the body” (*l. c.* p. 116).

§ “Shell-valves articulated, calcareous; viscera occupying one third, brachia two thirds, of the shell-cavity” (*l. c.* p. 336).

|| “Nahrungskanal (bei den ganz fossilen Familien nur vermuthungsweise) mit einfachem abwärts gebogenem blind endigendem Darm-Anhange (Afterlose),” &c. (*l. c.* p. 301).

¶ “The intestine ends in a blind sac” (*l. c.* p. 116).

pendent corroboration, by an acute naturalist, of the importance of the groups in question; but it will be obvious that, if we follow the rules of priority, the names of Owen must be adopted; and even if we feel obliged to accept more characteristic names (those based on intestinal characters), Bronn's excellently chosen ones had already long existed, and there is no obvious reason why they (if any should supersede Owen's) should not be adopted.

Smithsonian Institution,
July 28, 1873.

XXVII.—*Notes on the Siliceous Spicules of Sponges, and on their Division into Types.* By Dr. J. E. GRAY, F.R.S. &c.

THE existence of spicules was mentioned by Ray, Ellis, and others; but I believe that Savigny was the first zoologist who exhibited them *in situ* in living sponges, in Napoleon's great work on Egypt—though, like many of the plates drawn by Savigny in that work of imperial ostentation, confined to the libraries of the few, the figures were without text, as the object for which the Emperor had undertaken the work was past. These figures have been greatly overlooked by zoologists, and the importance of the spicules in the determination of species and genera has only been more recently recognized.

Savigny, in the plates of the work above-mentioned, which he executed in 1805 to 1812, letters his plates "Eponges charnues," "Eponges à piquans," and "Eponges à réseau," and gives admirable figures of the spicules forming the second division, and of the horny skeletons of his "Eponges à réseau." The figures of the sponges are superior to any thing that has been done since. These groups were afterwards regarded as genera:—1. *Halisarca*; 2. *Halichondria*; 3. *Spongia*.

Prof. Ehrenberg names the spicules of these sponges as if he were describing a perfect animal or the shell of a mollusk, and gives to each kind of spicule a generic and specific name! overlooking the fact that there are several forms (and therefore what he considers different genera and species) of spicules in the same species of sponge.

Dr. Bowerbank, in his paper in the 'Philosophical Transactions,' which was reprinted and forms the first part of his work on British Sponges, figures a number of the different forms which these spicules assume, and names them, but in an irregular manner; and some of the names are of extraordinary length and composition. He gives different names to

spicules which are only modifications or more or less imperfect developments of the same spicule.

The spicules are divided by Dr. Bowerbank into classes according to the uses to which he believes them to be applied, and the positions which he says they occupy in the sponge; but as Dr. Bowerbank had no preliminary study of anatomy, many of his ideas are most crude and not consistent with physiological knowledge.

I am not aware of any attempt to divide the spicules into regular types; but Dr. Oscar Schmidt, in his work on Atlantic Sponges, proposes to divide the Sponges into four great divisions or orders, to which, however, he does not as yet give definite names, thus:—

I. Spicules of sexradiate type: *Hexactinellidæ* and (extinct) *Ventriculitidæ*.

II. Spicules anchor-shaped or of pyramidal type: *Lithistidæ*, *Ancorinidæ*, *Geodinidæ*, and (extinct) *Vermiculatæ*.

III. Spicules monaxial, polyaxial, or wanting: *Halisarcinæ*, *Gummineæ*, *Ceraospongiæ*, *Chalinææ*, *Chalinopsidæ*, *Renierinæ*, *Suberitidæ*, *Desmacidinae*.

IV. Spicules calcareous: *Calcispongiæ*.

I do not understand what spicules Dr. Schmidt means by mono- and which by polyaxial.

The siliceous spicules of Sponges are divisible into a few types; and it has often occurred to me that it would greatly simplify the determination and the description and figuring of the species and genera of sponges if the spicules were arranged in series, showing the forms and modifications in which the different types present themselves to our notice. If this were done after study of the subject and with consideration, it would only be necessary in describing a sponge to mention the kind of spicule that occurs in it, instead of figuring the same modification of spicule over again every time that it occurs in any species of sponge.

I have made such a systematic distribution of the spicules in my own mind. As I am unable, from my bodily infirmities, to draw them myself or use the microscope, I have tried to induce several persons who do draw spicules and use the microscope to carry out the idea, and have even offered to pay the expense of drawing and lithographing four or five octavo plates, which I believe would be sufficient to show all the chief forms under which spicules occur, and how the spicules of each type vary by abortion, position in the different parts of the sponge, and by accidental circumstances. I have hitherto failed in having the plan carried out (though more than one person has undertaken to do it), and therefore

think it better to write a short essay on the subject, referring to the figures that are at present accessible in the works of Bowerbank, Schultze, Oscar Schmidt, Carter, and others.

The spicules are sometimes entirely absent in some horny fibrous sponges; and at others there are only a few, sunk in the substance or in the fibres; but these become gradually more abundant until the sponge seems formed of groups of spicules only kept together by a very small quantity of animal matter. Others are scattered on the external surface of the horny skeleton.

They are generally quite separate from one another; but in some sponges, which have been called Coralloid Sponges, the siliceous matter secreted by the animal is so abundant that it is deposited round the spicules, more or less uniting them together by a hard siliceous coat; but the spicules ought to be described in their separate state, in which they can almost always be seen through the siliceous matter by which they are agglutinated together. Such agglutinated spicules are figured in the 'British Sponges,' t. xv. f. 274, 275, 276, 277, 278, and also in Schmidt's 'Atlantic Sponges,' t. i., ii., & iii.

In observing the spicules of sponges, one should look out for the normal forms, and carefully abstain from being misled in the description of the species by the observation of the undeveloped or irregular forms which they sometimes assume, though it may be very interesting to trace these accidental forms to the usual state of the spicule. Dr. Oscar Schmidt, in his work on the Sponges of the Adriatic and Algiers, seems to delight in figuring the abnormal forms and the agglutinated spicules, instead of the regular typical forms which give the real characters of the species.

The siliceous spicules may be divided into several types:—

1. *Needle-like*, subcylindrical spicules, sometimes tubercular.
2. *Hamate* spicules, which are unilateral, curved at each end, subcylindrical, or more or less expanded.
3. *Quinqueradiate* spicules, which have three rays diverging from a central point, from the sides of the more or less elongated axis.
4. *Sexradiate* spicules, with four equidistant rays diverging from a central point from the sides of the more or less elongated axis.
5. *Multiradiate* or stellate spicules, with five or more rays arising and diverging from a common centre.
6. *Spicular spherules*, formed of a multitude of needle-like spicules diverging from a centre, forming a solid globular or oblong mass, with an areolated surface.

7. *Biotulate* spicules, consisting of a cylindrical axis, which is furnished with a more or less circular disk at each end.

1. The *needle-like, simple, subcylindrical* spicule is the most usual, and is present in its various modifications in almost every spiculiferous sponge, very often by itself, but at other times in combination with one or more of the other kinds of spicules.

The spicules are generally cylindrical, slender, and elongate; but they are sometimes short and thick.

They generally become thinner at one end, like a needle (British Sponges, t. i. f. 8); but they often taper at both ends, as in 'British Sponges,' t. i. f. 1, 2, 3.

Some spicules are like a pin and have a more or less distinct rounded head at one end (B. S. t. i. f. 23, 24, 25, 26). Sometimes instead of one head they have several globular projections (B. S. t. x. f. 228 to 233).

Some are swollen at each end or biclavate (B. S. t. i. f. 18, 19, 20, & 27).

In general the spicules are smooth; but they are sometimes partially or entirely covered with small asperities (B. S. t. i. f. 28-30, 32, 33, t. iv. f. 90, 91, 93, t. ix. f. 204-207).

The surface of the simple spicules is often more or less tubercular or spinulose in part or over the whole surface (B. S. t. i. f. 28-32).

Sometimes the spines on the spicules are placed in whorls (B. S. t. i. f. 33, t. iii. f. 67, 68, t. x. f. 238).

Sometimes the tubercles form conical elongate spines (t. i. f. 35, t. iii. f. 72).

Sometimes these spines, instead of being scattered, are placed in whorls or transverse circular lines (B. S. t. i. f. 33, t. iii. f. 66-68, 70, t. x. f. 238, 239, t. xi. f. 244-246, t. xvii. f. 289-291, t. xviii. f. 296).

Sometimes the tubercles on the surface are very long and spinose; but these may belong to another form (B. S. t. ii. f. 41, t. iii. f. 69).

The simple, fusiform or cylindrical spicule sometimes has a subcentral belt (B. S. t. i. f. 4, t. iv. f. 95); but this must not be confounded with the very much dwindled simple form of the sexradiate spine (B. S. t. iii. f. 65), which has the central thickened belt marked with four internal radiating canals.

2. The *hamate spicules* are characterized by being unilateral, and having most generally three, but sometimes only one well-developed recurved hook at each end of the spicule; but those that are attached (and they sometimes form groups and are fixed to the harder parts of the sponge) have the end

by which they are attached more or less distorted, and have the parts well developed which are at the free extremity, like those free in the sarcode. Dr. Bowerbank calls the free form "equianchorate," and the attached spicule "inequianchorate." They are very abundant in their most perfect form; they occur free in the flesh of the sponges.

The most perfectly developed spicule of this form has three well-developed spreading lobes at each end, all on the same side.

The stem between the lobes is cylindrical, more or less arched (B. S. t. vi. f. 140, "tridentate equianchorate spicule," and t. vi. f. 141-149) &c.

Sometimes the part of the stem between the hooks is dilated on the sides, as in B. S. t. vi. f. 150. For the attached or inequianchorate spicules of this form see B. S. t. vi. f. 135-137, 142, 146, 148.

Sometimes the end of the spicule is more or less expanded, and only the central lobe or spine is developed: B. S. t. vi. f. 138, with the central stem rather elongate and the expansion half-ovate; B. S. t. vi. f. 139, with the expanded ends half-oblong and the intermediate slenderer portion comparatively short.

Sometimes the spicule is very slender and only recurved at the end, as in B. S. t. vi. f. 144, 145. Indeed one would not believe that they belonged to this series; but in B. S. fig. 145 there is a slight dilatation on each side below the hook, and fig. 146 is intermediate in form between them and the more typical hamate spicule. See Carter, *Ann. & Mag. N. H.* 1871, viii. t. iv. f. 8; 1872, ix. t. x. f. 5.

Many of the spicules of this series are not so perfectly developed, being much more simple, subcylindrical, unilateral, with recurved ends. In one, the ends are longer, recurved, sharp-edged on the inner side (see B. S. t. v. f. 112, "trenchant contort bihamate").

Others are cylindrical in the body; and Bowerbank calls them "simple hamate spicules" (B. S. t. v. f. 109, 114). These spicules sometimes have the terminal hooks turned in opposite directions, forming an S, thus losing their unilateral character; but this is only a malformation (B. S. t. v. f. 110, 111). They have a close resemblance to the least-developed bihamate spicule, figured in B. S. t. vi. f. 144, referred to above, showing the passage of the two forms of spicule into one another. Some of these more slender spicules have a prominence or knob on the middle of the inner side of the body (B. S. t. v. f. 116), some on the middle of the outer side (B. S. t. v. f. 115), and some on both the inner and outer sides (B. S.

t. v. f. 117). Some of these unilateral spicules, instead of having a hook, have a broad rounded disk at each end. Bowerbank shows, by a series of figures of a spicule of this kind, which he calls "bipocillated bihamate," from *Halichondria Hyndmani* (B. S. t. v. f. 123-127), the various forms which the spicule assumes before it is fully developed, and the various states in which it is to be seen in the same sponge; and the biclavate and bihamate spicules (B. S. t. v. f. 118-120) appear to belong to the same series.

The spicules which Bowerbank calls inequitrirotulate and eccentric trirotulate (B. S. t. x. f. 131-134) are evidently allied to those last described and t. v. f. 118-120.

That these spicules are variations of the same spicule I think is proved by their occurring mixed together in the same sponge, and generally in conjunction with the bihamate spicules (see Schmidt, Spongienf. t. v. f. 2, 3, 5, 6, 7, all different species of *Esperiadæ*); indeed they may be undeveloped or rudimentary hamate spicules.

The "tricurvato-acerate" spicule (figured by Dr. Bowerbank, B. S. t. iv. f. 96-98, where the spicule is slightly sinuous and the end only recurved in the most perfectly developed spicule, f. 96), appears to belong to this type, or to be intermediate between it and the simple needle-like spicule.

3. The *quinqueradiate* or "trifurcate" spicules are distinguished by always having only three equidistant lateral rays from the sides of the more or less elongated axis.

They do not very generally occur in a perfect state of development, with an elongate axis having three equidistant rays coming from the middle of its length; but they are sometimes found in this state mixed with the more usual form, where the upper part of the axis is very short or absent, and the rays are very generally recurved (see B. S. t. ii. f. 58, where the spines are directed towards the shorter end; t. ii. f. 55, 56, where the spines are directed from the shorter end of the axis, which is bent outwards).

Bowerbank calls the first spicule (fig. 58) "spiculated porrecto-ternate," and f. 55, 56, 57 "spiculated recurvo-ternate," keeping the term "recurvo-ternate" for the spicules in which one part of the axis is entirely absent (f. 54).

Most generally the axis does not reach beyond the rays, as in the last referred to; and the lateral rays are generally short and recurved, as in B. S. t. ii. f. 48, 54, t. iv. f. 81 & 82; but the rays are sometimes directed forwards (t. iv. f. 77-80, t. v. f. 128, 129), and they are often expanded horizontally (t. ii. f. 45, 47, t. iv. f. 95). Of course, all these spicules have different names, though you may find them combined in the same specimen.

Schmidt figures several spicules of this form (t. iii. f. 28, 29, t. iv. f. 2, 7, &c.), and Bowerbank (P. Z. S. 1872, t. v. f. x. & xi., t. xlv. & xlvii.; 1873, t. i.—iii. & vii.).

Sometimes one of the lateral rays (B. S. t. ii. f. 48), more frequently all, especially when expanded, are forked at the end (t. ii. f. 50, 51, called "furcated attenuato-patento-ternate spicules," and t. v. f. 130, where they are called "bifurcated expando-ternate"). The difference between the two spicules figured is that in f. 50 & 51 the rays are expanded horizontally, and in f. 130 they are directed rather backwards from the axis.

Schmidt figures this kind of spicule at t. iv. f. 5; but he also figures (Suppl. t. iii. f. 3), with the forks well defined, spicules with only short recurved rays—one, two, or three of the rays being bifid at the end—showing how these forms pass into one another, even in the same sponge.

Bowerbank figures (t. xxxi. f. 362) a portion of *Tethea cranium*, in which he shows the exceeding difference of form of the spicules of this group which are found in a single fragment of a single species. If carefully examined, in it will be found almost all the forms of trifurcate spicule with simple rays I have noticed above, including those with the central axis produced beyond the rays, the rays bent from or recurved towards the axis of the same small slice of a sponge.

The "verticillately spined" triradiate spicule (B. S. t. iv. f. 84, t. x. f. 235, 236) appears to belong to this type, with its axis reduced to a minimum on each side.

The *quinqueradiate* spicules generally have an elongated axis compared with their lateral rays; but in one modification the axis is not produced on the outer side, and is very short and rudimentary on the other side; and the bifurcate rays are very broad and spreading, like the bifurcate rays of the more typical spicules of the series (B. S. t. ii. f. 52, the irregular furcated patento-ternate spicules, and t. ii. f. 53, which has the axis slightly developed on both sides of the rays). Spicules of this form have sometimes on one side a very short axis, and a broad, expanded, terminal disk, which is sometimes orbicular, nearly entire, and at others crenated or divided into lobes on the edge. When lobed it is usually divided into three greater portions, which are lobed on their surface; but whatever may be the form of the disk, they are always marked with three short lines diverging from the central spot, and sometimes forked at the end (B. S. t. iv. f. 102, 103, t. v. f. 104–108), and are called "foliato-peltate." Carter, Ann. & Mag. N. H. 1871, vii. t. vii. & viii. These spicules occur in the different species of Coralloid or Lithistidine sponges, and show the existence of quinquerradiate spicules in that family, as the spherules which are character-

istic of Tethyadae are sometimes found with well-developed quinquerradiate spicules (see Schmidt, Suppl. t. iii. f. 8).

Mr. Carter figures a beautiful modification of this spicule found in *Corticium abyssii*, which has branches at the ends of the lateral rays. The lower end of the axis and the lateral rays are crenated on the sides (see Ann. & Mag. Nat. Hist. 1873, xii. t. i. f. 3-6).

Dr. Bowerbank, in his representation of the spines of the very young *Tethya cranium*, represents the long clasping spicules as having only one hook, on one side, at the end (B. S. t. xxv. f. 343). Mr. Carter has well observed that this is a "monstrous representation" (Ann. & Mag. Nat. Hist. 1872, ix. p. 420, t: 20); and at p. 430 (t. xxii. f. 16) he gives four representations showing how the one-armed spicule gradually develops into a three-rayed one, and (f. 17) the variations of shape that occur, and that the spicules belong to the quinquerradiate form, and (in t. xxii. f. 3) how the axis is sometimes produced beyond the lateral spicules.

Bowerbank (B. S. t. ii. f. 41 & 42) figures a curious spicule, which appears to have three diverging trifid rays on each end of a very short broad axis, and may be a reduplication of this. Indeed B. S. fig. 197 may also be something of the same kind, but with a shorter axis; probably B. S. fig. 69 may be a series of branched rays arising from a cylindrical axis. B. S. figs. 199 & 200 may be modifications, of the same kind, of double series of three simple or branched rays arising from two centres of the axis; but these modifications have not occurred to me.

4. The *sexradiate spicules* form a large group. They consist essentially, in the most simple and perfect state, of an elongated axis giving out from the centre of its length four equidistant arms diverging at right angles from the axis, as in B. S. t. vii. f. 184, 185.

The various modifications of this spicule have been well shown by Schultze in his essay on *Hyalonema*, t. iii. & iv.

Bowerbank figures several variations in B. S. t. vii. f. 184-195, as they occur in different parts of *Alcyonocellum*. Sometimes 1, 2, 3, or all the lateral arms are wanting; in others, as fig. 183, the four lateral arms are complete, and one arm of the axis is wanting; but Bowerbank gives to each of these spicules a different name.

The *sexradiate spicules* are abundant and of the usual form in *Carteria*, the sponge that grows parasitic on the top of the glassrope (*Hyalonema*) from Japan; but when this sponge occurs, as it sometimes does, under the bark of the *Hyalonema*, then the spicules seem to change their character. Instead of

the axis and arms being long, slender, and subulate, they are short, thick, and truncated at the end, and are more or less covered with spicules (see Schultze, *Hyalonema*, t. iii. f. 14, 15). Dr. Bowerbank gives five figures of the spicules (all in a more or less imperfect state) of the sponge from this situation. He does not figure one in its perfect state, with all the six arms developed; but he figures one with one end of the axis wanting and the rest present (B. S. t. vi. f. 157). Then he figures other cross-shaped spicules with both ends of the axis wanting (B. S. t. vi. f. 154–156), and one in which the unbranched axis alone is developed (B. S. t. vi. f. 153).

O. Schmidt figures several modifications and adhesions of spicules of this type in his 'Spongienf.' t. i. & ii., showing many peculiarities.

When all the lateral arms in this kind of spicule are wanting, the axis, which is simple and needle-like, is known from the simple spicule by having a well-marked cross in the minute belt in the centre of the spicule (B. S. fig. 65).

Schmidt figures a spicule of this type in which the axis and lateral arms are of equal length, all tapering and acute, and with irregular spines on the side (Spongienf. t. i. f. 5), so that it might almost be taken for a stellate spicule.

When the sexradiate spicules are placed on the surface of the sponge, as they often are, forming a kind of armour to it, with the inner axes of the spicules diverging from the centre and the lateral arms forming the outer surface of the sponge, the outer part of the axis (which would otherwise project beyond the sponge) is more or less completely wanting. This form of spicule is called "*the nail-like spicule*" (see Schultze, *Hyalonema*, t. iv. f. 5–9). See Carter, *Ann. & Mag. Nat. Hist.* 1869, iv. t. i. & ii.; 1871, vii. t. x. & xvii.; 1872, ix. t. x., t. xxi. & xxii.; 1872, ix. t. xx.

When these sexradiate spicules arise from the outer surface at the base of a sponge, and are used as anchors to keep the free sponge in its place, the axes of the spicules are often very long and hair-like, and have four short, recurved, broad rays at the end, the axis not extending beyond the rays (B. S. t. iii. f. 59). Bowerbank calls these "apically spined recurvo-quaternate prehensile spicula." Probably the spicule figured in B. S. t. iii. f. 73–76 as "spinulo-recurvo-quaternate spicula" is also a sexradiate spicule; but I have not seen it. The spicule figured B. S. t. xviii. f. 292 also belongs to this modification of the sexradiate spicule. These spicules are not to be confounded with the "fusiformi-recurvo-ternate spicula" (B. S. t. iv. f. 81, 82) with three terminal rays, which evidently belong to the quinqueradiate spicula. Mr. Carter

has shown the change of form in the elongated clasping basal or rooting spicules of this group in *Rossella*, where the spicules often have, as well as the four recurved lateral rays (*l. c.* (t. xxi. f. 2), the shaft produced beyond the lateral rays, as in t. xxi. f. 1, 3.

In some, especially of the superficial sexradiate spicules, the arms of the different spicules are placed so that the arms of the neighbouring spicules are parallel to each other; but in some sponges they are oblique, compared with the axis of the sponge, and in others they are perpendicular and transverse to the axis of the sponge, producing rhomboidal or rectangular areolæ on its surface, which are especially visible when the arms of the neighbouring ones, which form the square areolæ, coalesce and form a solid network, as in the genus *Farrea* (B. S. t. xv. f. 277, t. xxi. f. 311, which represents a part from the interior of a sponge which has the axis of the spicules developed at both ends).

Most of the spicules of this division are smooth; but Dr. Schultze figures several varieties of forms which have the arms more or less tuberculated (*Hyalonema*, t. iii., t. iv. f. 6), and others, which are scattered, with elongated acute spines directed from the centre (*Hyalonema*, t. iv. f. 2, 4, 7, 8, 9, all being figured from one sponge, and showing the folly of naming spicules in Dr. Bowerbank's way).

The elongate tapering rays of the spicules of this form are sometimes furnished with a branch on each side not far from the base (B. S. t. viii. f. 188, 189), which form a passage to the more stellate spicules of this group (see B. S. t. viii. f. 188, "bifurcated rectangulated hexaradiate stellate spicules," and t. viii. f. 189, "trifurcated attenuato-hexaradiate spicules"). These spicules show the passage between the long-armed forms and the short divided-rayed ones which follow.

Many sexradiate spicules, instead of having long, conical, tapering, acute axes and rays, have all the rays short and of equal length, sometimes terminating in a kind of cup (B. S. t. viii. f. 196, "pocillated hexaradiate stellate spicule"), or in a broad expansion deeply divided into lobes (B. S. t. viii. f. 195, called "coronato-hexaradiate stellate spicule"). In others each ray of the spicule ends in a cluster of four or more elongate linear arms, ending in a tubercle (B. S. t. viii. f. 190-192). They are called spinulo-trifurcated, spinulo-quadri-furcated, and spinulo-multifurcated hexaradiate stellate spicules. In others the rays terminate, like the former, in a group of linear arms; but they assume a bell-shape, and each lobe is dentated and reflexed at the end (B. S. t. viii. f. 193, 194), and are called floriform-hexaradiate spicules.

In *Carteria* there is a very extraordinary form of the sex-radiate spicule, which, in its perfect state, has six short arms of nearly equal length, each arm ending in a series of four or eight elongate oblong reflexed radiating lobes. Dr. Bowerbank only represents this form of spicule, which he calls "multi-dentate birotulate spicule" (B. S. t. iii. f. 62), as simple with the lobes at each end; and Dr. Schultze (*Hyalonema*, t. iv. f. 11, 12) has figured the same rudimentary spicule; but Mr. Carter has found it perfectly developed into six rays, and different specimens with the lateral rays more or less perfectly developed, some with terminal radiating lobes, and others with the arms reduced to mere conical processes, as may be seen in Dr. Schultze's figure.

Schultze, in his '*Hyalonema*,' figures a minute spicule having four short recurved conical arms at each end (t. iv. f. 10); and Bowerbank (B. S. t. v. f. 122) figures this spicule, which he says is "dispersed in considerable abundance in the interstitial membrane" of *Carteria*, and calls it "quadrihamate spicule;" but this spicule, I suspect, from the spinules on its stem, is very probably only an imperfect state of a sexradiate spicule, like the one which Bowerbank calls "birotulate," having only four lobes instead of many.

Mr. Carter figures a very minute birotulate spicule of this kind occurring in *Corticium abyssii* (Ann. & Mag. Nat. Hist. 1873, xii. t. i. f. 7). In *Echinospira* there is a solid octahedral spicule, each of the six angles produced into a cylindrical ray dentated at the end; this is found with two flat three-rayed stars placed one on the other, figured in the '*B. Sponges*,' t. x. f. 197 (see Ann. & Mag. Nat. Hist. 1870, vi. pp. 272 & 340). Dr. O. Schmidt, in his '*Atlantic Sponges*,' t. ii. f. 16, figures a hollow octahedral formed by marginal tubes, and having six diverging rays.

5. The *multiradiate* or *stellate spicules* have five or more rays, arising and diverging from a common centre or very short axis, as the stellate spicules figured by Bowerbank (B. S. t. vi. f. 158-161) found along with the spherules in *Pachymatisma* and *Tethea*. (See also Bowerbank, P. Z. S. 1872, t. xlvi.-xlviii., and 1873, t. i.-iii. Schmidt, '*Sponges*,' t. iii. f. 22, 26, t. iv. f. 1, 2, 4, t. v. f. 1; '*Algiers*,' t. iii. f. 2, 4, t. iv. f. 5, 6, 8, Suppl. t. v. f. 5. Carter, Ann. & Mag. Nat. Hist. 1867, iv. t. i. & ii.)

Probably the candelabrum-like spicule (Schmidt, *Spongienf.* t. iii. f. 25) should also belong to this series.

There are very probably many more forms to be referred to this type; but all this will require much more study than I am able to bestow upon the subject. (See B. S. t. vi. f. 164, 165,

the "sphero-stellate with conical points," and f. 166, with "cylindro-subfoliate rays.")

It is doubtful if some of these stellate specimens are not produced by some of the layers being placed upon one another; but this must be left for further study, as also such elongate spicules with diverging spines as B. S. t. i. f. 35, and the "elongato-attenuated" spicule, t. iii. f. 72.

Mr. Carter figures beautiful forms of this spicule as occurring in *Chondrilla australiensis*, and calls them *sphæro-stellate* and *radio-stellate* (Ann. & Mag. Nat. Hist. 1873, xii. t. i. f. 16).

6. The *spicular spherules* differ from the isolated spicules before described by being formed of a multitude of parallel needle-like or clavate spicules diverging from a central point, and forming a solid globular or oblong mass with an areolated surface.

These spherules sometimes form the greater part of the sponge, and at other times are found in conjunction with quinquerradiate or trifurcate spicules. (See B. S. t. xxiii. f. 326-328, t. xxiv. f. 329-334, t. xxvii. f. 353, t. xxviii. f. 354; P. Z. S. 1872, t. x. & xi., and 1873, t. i. f. 6; Schmidt, Spongienf. t. iv. f. 4.) Dr. Bowerbank, who compares the anatomy of sponges to the anatomy of man, calls this mass of spicules an "ovarium"—as he does the spicules of the sponge, of which he observes that "those of *Farrea* have a very close approximation to the tubular form of the bones of the higher animals." The spherules certainly do not contain any eggs, and are not even allied to the spore-cases of *Spongilla*: the tubes of the latter are produced by the absorption of the spicule which the fibres originally enveloped.

7. The *birotulate* spicules in their most perfect state of development consist of cylindrical axes with an expanded more or less circular disk at each end. They are almost exclusively found in the substance of the case which surrounds the spore, or, as Bowerbank calls it, the "ovary" of freshwater sponges (*Spongilla*). Bowerbank figures several (B. S. t. ix. f. 210-227). Sometimes the disks are very small, and the axis very long (f. 210, 211); and sometimes the axis is very short and the disk very large (f. 213). Sometimes one of the disks is partially and at others almost entirely wanting (f. 223, 224); and at others there is only a single circular disk, with the axis reduced to a small central prominence (B. S. f. 225, 227). In the two latter cases they have other names, being called "boletiform slender" and "umbonate scutulate." The axes in several of these spicules are more or less spinulose.

It is very easy to arrange the sponges which have only one of these types of spicules in company with simple unbranched

spicules ; but it is much more difficult with those sponges where two or even more types of spicules are found in connexion with the usual simple ones (in fact, having the characteristics of more than one group)—as, for example, in the coral-loid sponges, where we have the sexradiate spicules well developed in conjunction with the more or less discoidal spicules, which have a resemblance to the trifurcate spicules, typical of another group.

In the same way it is not uncommon to find the spicular spherules (which are spherical masses of spicules so characteristic of *Geodia*) in conjunction with quinquerradiate spicules (which are characteristic of a different group); and hamate spicules, which are frequently only found in conjunction with simple unbranched spicules, are also found with quinquerradiate spicules, and, I believe, rarely with sexradiate spicules.

These facts only go to prove that there are in reality no very broadly marked groups, especially of a secondary degree, in Nature, and that there are a number of intermediate forms which are to be arranged along with the other genera of the group to which they bear the greatest resemblance in other respects.

However, there is one evil particularly to guard against, especially with regard to hamate spicules—to make sure that they really belong to the sponge in which they are found, and are not accidentally intermixed with it from the sea and other external sources.

When the spicules of a species are figured, it is very desirable that the comparative size of the different forms of spicules should be carefully preserved, and, if any spicule is figured of a larger size than the others, that the difference of its scale should be stated. The want of attention to this point greatly detracts from the value of Dr. Schmidt's figures. I could not believe that the slides of the spicules of the different species that he had sent me were correctly named, when I compared them with his figures, until I observed that he had paid no attention to this circumstance, and that in a figure that appeared to be taken from one group of spicules in a slide, the smaller spicules were represented on a much greater scale, and therefore appeared to be larger than the greater ones.

One must not confound the siliceous spicules of sponges with the horny stars described and figured by Mr. Carter as occurring in *Aplysina corneostellata* from the coast of Spain (Ann. & Mag. Nat. Hist. 1872, x. p. 105, t. vii. f. 1), which is most probably the sponge that the Germans have described and written so much about under the name of *Darwinella*; but these horny-fibred, six-rayed stars have no relation to

the siliceous spicules of other sponges, but seem to be modifications of the horny skeleton of the *Aplysinae* and other horny sponges, as Mr. Carter considers them. They differ from spicules in their mode of development, their structure, form, and the manner in which they adhere together; indeed it would hardly occur to any one but a theorizing German to regard them as such.

The results of this paper may be thus epitomized:—

1. *Needle-like spicules.*

- a. Cylindrical.
- b. Tapering at each end.
- c. Tapering at one end.
- d. Club-shaped.
- e. With a head at one end. Sometimes this head is double or treble.
- f. With a head at each end.
- g. With a thick belt in the middle.

Each of these is straight or sinuous, has the surface smooth, tubercular, or spinulose, the tubercles or spines being sometimes scattered, at others placed in whorls.

2. *Hamate spicules.*

- a. The ends dilated and divided into three acute processes; but sometimes the lateral processes are wanting. When free in the sarcode, both ends are equally dilated; when attached in groups, the attached end is only imperfectly developed.
- b. The spicules compressed, with a sharp edge at each end.
- c. The spicule more or less cylindrical, curved at each end. These spicules are sometimes bent like an *s*, at others only slightly doubly curved or nearly straight.

3. *Quinqueradiate.*

- a. Spicules with the axis very long and the rays tapering and sometimes forked.
- b. Axis very short, the rays elongate, slender, forked, or expanded into a broad, circular or more or less lobulated disk.

Bowerbank figures some spicules which appear to belong to this division, without any axis; but I have not had the opportunity of seeing them.

4. *Sexradiate spicules.*

- a. With the rays simple, elongate, attenuated, smooth or spinulose.
- b. Rays cylindrical, blunt, rugose at the end.
- c. Rays short, thick, entirely rugose or spinulose.
- d. Rays attenuated, with side rays.
- e. Rays enlarged at the end, simple or torn.
- f. Rays divided into elongated simple branches at the end.
- g. Axis elongate, ending in short recurved rays at the end used for anchoring.
- h. Axis and rays ending in 4 or 8 recurved lobes.

5. *Multiradiate spicules.* Rays tapering or cylindrical, smooth or tubercular.

6. *Spicular spherules.* Orbicular or oblong, smooth or tubercular.

7. *Birotulate spicules.*

XXVIII.—*Note respecting the Tracheal Pouch of the Emu.*

By MILLEN COUGHTREY, M.B., Demonstrator of Anatomy, Liverpool Royal Infirmary School of Medicine. (Communicated by Dr. J. MURIE, Professor of Anatomy, Royal Veterinary College, Edinburgh.)

[AMONG other items of intelligence from my friend Dr. Coughtrey is one relative to some points in the anatomy of an Emu (*Dromæus novæ-hollandiæ*, Vieill.) examined by him. He mentions having found a hitherto unnoticed valve guarding the orifice of the right precaval vein, a detailed account of which he intends shortly to publish. As regards a probably similar structure in the ostrich (*Struthio camelus*), I have called his attention to Professor Macalister's paper on the anatomy of this bird (Proc. R. I. A. 1864, p. 541). Dr. Coughtrey's observations on the tracheal pouch I subjoin in abstract, his further minutiae forming a separate communication to the Literary and Philosophical Society of Liverpool. As his researches partially corroborate and partially differ from my own, I have thought a short notice might appropriately be inserted in the 'Annals.' Dr. Coughtrey says :]

In a specimen of this creature which I had the opportunity of dissecting on the 8th of March last I found the tracheal pouch, which is a marked character of the Emu as distinguished from other Struthious birds. The sac in question has already

been so well described by previous observers, that I shall content myself with simply pointing out a few of the more important peculiarities in the present specimen.

The slit in the anterior part of the trachea is caused by the deficiency of ten rings in front. The right lip of the slit has eleven cartilaginous elements, the left only ten. The extra or eleventh cartilaginous element is owing to a small bar of cartilage being attached to the lower border of the right half of the uppermost incomplete ring. This corresponds somewhat curiously with the adult male and adult female of Dr. Murie's dissection (*vide* P. Z. S. 1867, p. 409). In his specimens the lowest incomplete ring bifurcated; in my specimen it was the uppermost incomplete ring, but it did not bifurcate.

As regards the number of incomplete rings my specimen agrees with that described by Mr. Robert Anderson (quoted by Murie, *l. c.* p. 407).

The sac markedly springs from the lips of the fissure, and is evidently continuous with the elastic band intervening between the cartilaginous rings. Its walls were composed chiefly of the white or areolar tissue, but with much of the yellow variety diffused through it.

In Dr. Murie's adult female bird there were certain band-like duplications of the wall of the sac partially dividing it; in my specimen these were not present, the sac being simple and undivided. It may further be remarked of the latter that there was no *cul-de-sac* at the left upper end; but otherwise the general form agreed with that figured and described by Dr. Murie.

I am rather inclined to take exception to the close nature of the homology between it and the air-sac of the chameleon. In the Emu we have undoubtedly a tracheal pouch; in the chameleon it may be regarded more as a laryngeal pouch.

The specimen herein commented on is preserved in the Liverpool Free Library and Museum; and I may mention that I am indebted to the courtesy of the curator, T. J. Moore, Esq., for permission to examine the bird.

XXIX.—*List of Lepidoptera in a small Collection sent from Peru by Mr. Whitely, with Descriptions of the new Species.*
By ARTHUR GARDINER BUTLER, F.L.S., F.Z.S., &c.

THE present collection was made at Huasampilla, 9000 feet elevation. As regards the butterflies it is decidedly peculiar,

the whole of the species being referable to the subfamilies Satyrinæ, Morphinæ, and Nymphalinæ of the Nymphalidæ. The bulk of the species are either identical with or closely allied to Bolivian forms, ten of the butterflies previously described having come from Bolivia.

RHOPALOCERA.

Family Nymphalidæ.

Subfamily SATYRINÆ, Bates.

Genus 1. EUPTYCHIA, Hübner.

1. *Euptychia rustica*. B.M.

Euptychia rustica, Butler, Cat. Diurn. Lep., Sat. p. 32, pl. 1. fig. 4 (1868).

Previously known from Bolivia only.

Genus 2. ORESSINOMA, Westwood.

2. *Oressinoma sorata*. B.M.

Oressinoma sorata, Salvin, Ann. & Mag. Nat. Hist. ser. 4, vol. ii. p. 144. n. 6 (1868).

Hitherto only known from Bolivia and of a smaller size.

Genus 3. LYMANOPODA, Westwood.

3. *Lymanopoda ocellifera*, n. sp. B.M.

Allied to *L. obsoleta*, Westwood. Above red-brown; a white point near anal angle of secondaries: primaries below ferruginous at apex; two large black ocelli between median branches, a third small one near external angle, and a white point between lower radial and third median; secondaries with a discal irregular series of seven white points crossing the wing obliquely from apex to anal angle, the fourth to seventh with black circling.

Expanse of wings 2 inches 2 lines.

4. *Lymanopoda ferruginosa*. B.M.

Lymanopoda ferruginosa, Butler, Cat. Diurn. Lep., Sat. p. 169. n. 5, pl. 4. fig. 3 (1868).

The type was from Bolivia.

5. *Lymanopoda rubescens*, n. sp. B.M.

Wings above dark brown; apical half of secondaries castaneous in male, tawny in female, with the inner edge paler;

the apex and outer margin diffusely fuscous: wings below as in *L. Leena*.

Expanse of wings: ♂ 1 inch 7 lines; ♀ 1 inch 8 lines.

We have the allied *L. Leena* from Quito and Eastern Peru.

6. *Lymanopoda venosa*.

B.M.

Lymanopoda venosa, Butler, Cat. Diurn. Lepid., Sat. p. 171. n. 14, pl. 4. fig. 5 (1868).

The type was from Bolivia.

7. *Lymanopoda eubagioides*, n. sp.

B.M.

Wings above white; base metallic green, irrorated with black: primaries with costa, apex, and outer margin dull ferruginous; apical area from costa to outer margin at termination of first median branch, apical half of discoidal cell, a spot at base of second median interspace, and another in first median interspace and almost touching apical area black; an irregular sigmoidal spot at end of cell, an oblique fasciole halfway between cell and apex, and four unequal subapical discal points white. Wings below white: primaries with discocellular area from basal third of cell red-brown, interrupted by two obliquely placed whitish spots opposite to emission of second median branch; white spots as above; costa, apex, and outer margin pale ochreous; base and apical area pale cinereous; two dusky spots on median interspaces—the upper one white-pupilled, partly encircled by an ochraceous lunule; secondaries dirty white, irrorated, especially towards the base, with fuscous atoms; two costal, three discoidal, two internal, and three median oblique brown streaks on basal area; a strongly arched series of seven black dots running from apex to interno-median interspace, near anal angle; cilia pale ochreous.

Expanse of wings 1 inch 9 lines.

Two examples.

This species is more nearly allied to *L. lactea* of Hewitson than to any other *Lymanopoda*: it has somewhat the aspect of *Eubagis pieridoides* of Felder; but the secondaries above have no black margin.

Genus 4. STEROMA, Westwood.

8. *Steroma superba*.

B.M.

Steroma superba, Butler, Cat. Diurn. Lepid., Sat. p. 172. n. 3, pl. 5. fig. 6 (1868).

The type was from Bolivia.

9. *Steroma umbracina*, n. sp.

B.M.

Form of *S. pronophila*. Wings above olivaceous brown; primaries with the apical third slightly paler, the fringe alternately black and dull tawny: below nearly as above; secondaries with apical area cinereous brown, interrupted by a submarginal, interrupted, waved, dark brown line.

Expanse of wings 1 inch 7 lines.

Two examples.

Genus 5. PEDALIODES, Butler.

10. *Pedaliodes Ereiba*, local form *peruviana*. B.M.

Pronophila Ereiba, Felder, Reise der Fregatte 'Novara,' iii. p. 469. n. 800 (1867).

A somewhat modified form of this species occurs in the collection. It differs from the typical race in its deeper coloration above and below, the obsolete character of the bands below, and the more ferruginous tint of the internal area; the white point is also rather further from the margin. The type of *P. Ereiba* was from Bogota.

11. *Pedaliodes ferratilis*, n. sp.

B.M.

Wings above pitchy: below, primaries paler, externally hatched with blackish; fringe greyish, varied with dirty white; secondaries pitchy, hatched with blackish; internal area, excepting at base, ferruginous; a quadrate patch of the same colour, irrorated with fulvous, from first median branch to anal angle, bounded internally by an irregular central blackish line; outer margin broadly red-brown, bounded internally by a waved submarginal black line; a white point on first median interspace.

Expanse of wings 2 inches 5 lines.

Allied to *P. Pheretias* of Hewitson.

12. *Pedaliodes niveonota*, n. sp.

B.M.

Wings above pitchy: primaries below ferruginous; the costa brown, hatched with blackish, and clothed towards the base with yellowish hair-scales; a quadrate brownish spot at end of cell, beyond which, upon costa, is a cuneiform patch of pale yellowish scales; outer margin broadly brown, the internervular folds black; a squamose submarginal grey band, enclosing three white points and sinuated externally, near apex; secondaries olive-brown, hatched with blackish, and irrorated

at base with silvery grey; some squamose submarginal markings of the same colour, and a broad central band slightly undulated and widening from apical costa to inner margin, where it becomes distinctly white; also a silver-grey subquadrate spot, interrupted by subcostal nervure; five or six snowy white points passing through centre of disk, the three uppermost crossing the central band in an oblique line; fringe grey.

Expanse of wings 2 inches 5 lines.

13. *Pedaliodes Pausia*.

B.M.

Pronophila Pausia, Hewitson, Trans. Ent. Soc. Lond. ser. 3, i. p. 8. n. 16, pl. 4. fig. 25 (1861).

Slightly different from the type from Bolivia, but scarcely sufficiently so to be worthy of a different name.

Genus 6. OXEOSCHISTUS, Butler.

14. *Oxeoschistus mirabilis*, n. sp.

B.M.

Form almost of *O. Prochyta*; but primaries shorter, less falcated. Wings above pitchy, with beautiful green shot in certain lights; fringe alternately black and pale sulphur-yellow, more distinct on primaries than on secondaries: primaries below dark brown; the apex varied with yellow scales; interrupted by a very irregular apical submarginal black line, edged internally with white, and bounding a series of three increasing black blind ocelli, bounded internally by a bifid white subcostal spot; two or three obsolete ocelloid spots on disk: secondaries olive-brown, irrorated with white and yellow scales; a broad, very irregular, and angulated central band, edged on both sides with black, bounded by diffused silver bands; a discal series of eight large black discal ocelli with white pupils and squamose yellow irides; a very irregular submarginal black line.

Expanse of wings 2 inches 10 lines.

One of the most beautiful species in the collection, somewhat similar in the character of the under surface to some species of the genus *Dædalma*.

Genus 7. LASIOPHILA, Felder.

15. *Lasiophila orbifera*.

B.M.

Lasiophila orbifera, Butler, Cat. Diurn. Lepid., Sat. p. 182. n. 4, pl. 5. fig. 6 (1868).

Previously known from Eastern Peru, Bolivia, and Bogota.

Genus 8. DÆDALMA, Hewitson.

16. *Dædalma Dorinda*?

B.M.

Dædalma Dorinda, Felder, Wien. ent. Monatschr. vi. p. 28 (1862);
Reise der 'Novara,' iii. pl. 67. figs. 3, 4 (1867).

May be distinct, the type of Felder's species being from Bogota. The one specimen in the collection is somewhat different from Felder's figure, being larger, with the white marginal spots of primaries elongated; there are also several differences on undersurface of secondaries.

Genus 9. PRONOPHILA, Westwood.

17. *Pronophila variabilis*, n. sp.

B.M.

Allied to *P. Porsenna*; above more brilliantly shot with bronze, green, and purple, without indication of whitish spots, but with three black spots towards apex of primaries, and with two or three black spots towards anal angle of secondaries. General arrangement of markings below as in *P. Porsenna*, but no orange lunule in primaries; the latter brown, deeper on disk, with the nervures and a band enclosing the ocelli whitish-brown; margin broadly brown: secondaries brown, more or less inclining to whitish, with central and subbasal bands darker than in *P. Porsenna*; eight discal ocelli black, white-pupilled, with pale brown iris, surrounded by darker brown, and encircled by a whitish zone; a broad dark brown marginal border, edged internally with lilacine.

Expanse of wings 3 inches 4 lines.

The allied *P. Porsenna* comes from Quito and Bogota.

18. *Pronophila venerata*, n. sp.

B.M.

Upperside black, shot with purple; primaries with a quadrate white spot crossing the centre of the first median interspace; three subapical white spots, the uppermost bifid, running obliquely from costal to just beneath lower radial nervure: secondaries with fringe ferruginous; a large white patch, crossed by the third median branch, and trisinate externally, on disk beyond end of cell. Primaries below black, white spots as above; apex broadly ferruginous, irrorated with orange; three subapical dusky white-pupilled ocelli, forming an angular series to second white spot: basal half of secondaries red-brown, the ordinary bands of *Pronophila* indicated by deeper brown; apical half variegated with yellow, red-brown, pale ochreous, and silver, as follows:—apex red-brown;

anal angle blackish; second median interspace to marginal border pale ochreous; anal margin to third median branch yellow irrorated with red-brown, deeply undate internally and edged with silver; above the third median the margin becomes red-brown, and is partly edged with silver and partly with yellow scales; eight discal ocelli black, white-pupilled, with squamose yellow irides, excepting on second median interspace; anal area irrorated with silver scales.

Expanse of wings 3 inches 5 lines.

One of the most remarkable butterflies that has come for years. It is utterly unlike any other *Pronophila*; and in the shape of the secondaries, which project somewhat at termination of third median branch, it reminds one of the species of *Hetera* and *Pierella*.

Genus 10. CORADES, E. Doubleday.

19. *Corades Iduna*, local form *marginalis* *. B.M.

Corades Iduna, Hewitson, Ann. & Mag. Nat. Hist. ser. 2, vi. p. 437 (1850); Hewitson & Westwood, Gen. Diurn. Lep. p. 355. n. 2, pl. 63. fig. 1 (1851).

The typical form is from Bolivia; the species has a third form in Eastern Peru (not Nauta on the Amazons), described at p. 185 of my Catalogue of Satyridæ, and which may take the name of *C. peruviana*.

20. *Corades fuscipлага*, n. sp. B.M.

Allied to *C. Cybele*. Above like *C. Sareba*; differs below from *C. Cybele* in the dusky tint of all the wings, and in the orange patch of primaries being replaced by a somewhat smaller pale brown patch.

Expanse of wings 3 inches 2 lines.

C. Cybele is from Bogota, *C. Sareba* from Bolivia.

21. *Corades Cistene*. B.M.

Corades Cistene, Hewitson, Exot. Butt. iii. p. 72, pl. 36. figs. 4, 5 (1863).

Specimens previously in the Museum from Quito and Bogota differ from the typical form in the smaller size of all the tawny spots above.

* The orange patch on secondaries carried on to the margin, without marginal ferruginous border.

Subfamily MORPHINÆ, Butler.

Genus 11. MORPHO, Fabricius.

22. *Morpho Lympharis*, n. sp.

B.M.

Allied to *M. Sulkowskyi*; considerably smaller; the blue tint deeper on male, paler on female.

♂. Above, primaries with costa more convex and outer margin more concave; brown border of apex and outer margin less than half as wide: secondaries more produced at anal angle, with black margin reduced to a narrow line; spots at anal angle considerably smaller, the red spots paler. Below, all the markings more dusky: primaries with markings in cell more regular, the fasciole at end of cell strongly angulated; five distinct ocelli on disk; marginal bands narrower: secondaries with all the transverse bands, excepting the fourth and seventh from base, reduced to lines; the ocelli blacker, broader, those on anal area subcordate; submarginal band reduced to a dark brown line; red spots obsolescent.

Expanse of wings 3 inches 8 lines.

♀. Above, primaries with outer margin less convex, less yellow-tinted; costa pale brown to end of cell; discal brown band containing four distinct white spots; its outer edge nearly straight; submarginal white spots ill-defined, forming a continuous increasing band from subcostal nervure to inner margin; submarginal brown band much narrower: secondaries with ochraceous area half the width, more dusky, especially internally; the anal angle distinctly black, exhibiting three red spots; a distinct white spot on each side of the caudal process. Below, all the markings more dusky, the bands being either olivaceous brown or black: primaries with base brown; bands in cell more regular, the first brown with black margin, the second black, its upper two thirds wide, the lower third suddenly narrower; terminal fasciole dull pale ochreous, with black margin; lunated transverse band beyond cell black; ocelli larger, five in number, the first four being united and equal in size; a regular brown band on either side of the series; submarginal band dark brown: secondaries with the broader bands narrowed, olivaceous brown, with dark brown margins; narrow bands black; ocelli five in number, large, the lower four united, black, with large elongated silver pupils, brownish ochraceous irides, and indistinct whitish zones; area beyond them olivaceous brown, beyond which is a slightly undulated silver submarginal band, intersected by a narrow dark brown

band; anal angle dull griseous, intersected by a black band, and bearing two red spots, brighter than in *M. Sulkowskyi*.

Expanse of wings 3 inches 10 lines.

Quite distinct from the New-Granadan *M. Sulkowskyi*.

Subfamily *NYMPHALINÆ*, Bates.

Genus 12. *PAPHIA*, Fabricius.

23. *Paphia tyrianthina*.

B.M.

Paphia tyrianthina, Salvin & Godman, Ann. & Mag. Nat. Hist. ser. 4, vol. ii. p. 148. n. 17 (1868); Hewitson, Exot. Butt. iv. *Paphia*, pl. 2. fig. 4 (1869).

The type was from Bolivia.

Genus 13. *HETEROCHROA*, Boisduval.

24. *Heterochroa Aricia*.

B.M.

Heterochroa Aricia, Hewitson, Ann. & Mag. Nat. Hist. xx. p. 263, pl. 21. fig. 11 (1847).

The type was from Bolivia.

Genus 14. *CYBDELIS*, Boisduval.

25. *Cybdelis Whitelyi*, n. sp.

B.M.

Primaries above as in *C. Diotima*; secondaries with broad silvery greenish outer border, from which to end of cell extends a metallic subtriangular blue patch: primaries below nearly as in *C. Diotima*, but with two lilacine spots between median branches; secondaries as in *C. Cecidas*.

Expanse of wings 1 inch 8 lines.

C. Diotima has been taken in Bolivia and Quito, *C. Cecidas* in Eastern Peru.

I have named this pretty little species after its indefatigable collector.

Genus 15. *EUREMA*, E. Doubleday.

26. *Eurema Lethe*.

B.M.

Papilio Lethe, Fabricius, Ent. Syst. iii. 1, p. 80. n. 250 (1793).

Hypanartia Demonica (part.), Hübner, Samml. exot. Schmett. ii. pl. 26. figs. 3, 4 (1806).

Rather larger than the typical form from Brazil, Venezuela, and Mexico, and with the secondaries above darker.

27. *Eurema Dione*.

B.M.

Vanessa Dione, Latreille, in Humboldt and Bonpland's Obs. Zool. ii. p. 87, pl. 37. figs. 1, 2 (1811-19).

Genus 16. *DIONE*, Hübner.28. *Dione Moneta*.

B.M.

Dione Moneta, Hübner, Samml. exot. Schmett. (1816-24).*Agraulis Glycera*, Felder, Wien. ent. Monatschr. v. p. 102. n. 75 (1861).

Felder erroneously renamed Hübner's species, supposing that the insect figured in the 'Genera of Diurnal Lepidoptera' was a representation of it; the species there figured, however, is identical with that figured by Poey, and is clearly distinct from *D. Moneta*. I therefore propose to call it *D. Poeyii*.

29. *Dione Telesiphe*.

B.M.

Colænis Telesiphe, Hewitson, Trans. Ent. Soc. ser. 3, vol. v. p. 564. n. 8 (1867).

The type was from Ecuador.

HETEROCERA.

Family *Zygænidæ*.Genus 17. *PÆCILOSOMA*, Hübner.30. *Pæcilosoma Vesparis*, n. sp.

B.M.

Wings hyaline, with nervures and a very slender marginal border black; primaries above with base and costa irrorated with pale yellow; secondaries with costa pale yellow, inner margin golden yellow; body blue-black, the thorax streaked with golden yellow, the abdomen banded with the same colour; palpi yellow; antennæ black; legs black above, yellow below; wings below nearly as above; primaries with basal half of inner margin yellowish white; secondaries with costa bright yellow.

; Expanse of wings 1 inch 3 lines.

Genus 18. *CHRYSOCALÉ*, Walker.31. *Chrysocale florella*, n. sp.

B.M.

Primaries above burnished copper, with greenish reflections; apical third of cell, enclosing a hyaline spot, black; outer and inner margins broadly dark brown; secondaries dark brown, costa whitish; abdominal half of wings and a spot beyond the cell irrorated with metallic green; apical third of cell hyaline; body black, dorsum coppery red; abdomen above clothed with metallic-green and brassy scales, a row of whitish spots on each

side; head black, with collar green; tegulæ black, with large white central spot; antennæ black: wings below altogether paler than above; hind wings with costa metallic green.

Expanse of wings 1 inch 7 lines.

Family Lithosiidæ.

Genus 19. CHRYSAUGE, Hübner.

Group *Flavinia*, Walker.

32. *Chrysauge limbata*, n. sp. B.M.

Wings above and below golden-yellow, with the margins rather broadly black-brown; body brown; abdomen with a lateral yellow streak; a brush of white hairs, slightly ochreous at base, emitted from side of thorax at base of secondaries.

Expanse of wings 1 inch 6 lines.

Family Arctiidæ.

Genus 20. ANAXITA, Walker.

33. *Anaxita sannionis*, n. sp. B.M.

Allied to *A. decorata*. Primaries above with basal half ochraceous, apical half crimson; the nervures and internervular folds black; the median nervure and all the nervures on disk enclosed in greyish-olivaceous ("hoary," Walker) bands, edged with dark brown; a fasciole of the same character at base, a second crossing basal third, and a third just before end of cell, the second continued to inner margin, and another, corresponding to the terminal discoidal fasciole (although not continuous with it), running from base of first median branch to inner margin; a basi-costal spot, a streak above median nervure (extending from the second to the third transverse fasciole), the interno-basal area, and a round spot between the two fascioles beyond it crimson: secondaries rosy-crimson; the apex, outer margin, a triangular patch at anal angle, and the nervures from the median upwards, excepting at base, brown: body crimson; collar and tegulæ golden-yellow, brown-edged; abdomen with brown dorsal line; anus and venter blackish, with three golden-yellow spots on each side; legs and antennæ brown. Wings below nearly as above; primaries with all the bands brown, a black costal spot on each of the discoidal fascioles, basal area rosy; secondaries with a yellow subcostal striole.

Expanse of wings 3 inches 2 lines.

Much like *A. decorata*, but differing in colour and with

none of the nervular bands of primaries continued to the cell; the nervular brown streaks of secondaries also continued nearly to base of wings.

Family *Erateinidæ*.

Genus 21. *ERATEINA*, Doubleday.

34. *Erateina latipennis*, n. sp. B.M.

Primaries above as in *E. undulata*, but the transverse yellow band reduced to a line; secondaries very similar to *E. undulata*, but broader, with central band deep orange instead of red, and much broader: below somewhat similar to *E. undulata*, more orange in tint, with narrower central transverse band; the silvery area reduced to a narrow squamose streak limiting a broad subbasal chocolate band; the discal yellow band much widened, especially on primaries; the area between subbasal and discal bands orange; fringes varied with orange instead of pale yellow.

Expanse of wings 1 inch 8 lines.

35. *Erateina cometaris*, n. sp. B.M.

Nearer to *E. Neæra* than to any other described species. Wings above with basal half greenish cinereous, with bronzy reflection, apical half black; primaries with central abbreviated, broad, white, oblique, hyaline band: secondaries with central white streak, obsolescent towards costa; a subanal crimson spot; fringe alternately black and white. Wings below plum-coloured; nervures of basal area and two oblique central bands, broadest on primaries, silver, an oblique transverse discal streak gold; primaries with internal area silver, outer central band hyaline in the centre; secondaries with golden discal streak abbreviated, disappearing as it reaches outer central band; fringe alternately black and white.

Expanse of wings 1 inch 7 lines.

36. *Erateina discalis*, n. sp. B.M.

Primaries above black, basal area and a trifold hyaline spot crossing median branches and end of cell snow-white; costal and subcostal nervures red; secondaries snow-white, a broad marginal black border, fringe alternately black and white. Body black, thorax clothed with whitish hairs; abdomen white-banded above, white below, with lateral series of red spots; head white, front and antennæ red, palpi and legs black and white. Primaries below plum-coloured; internal area and central transverse band silvery white, the band hyaline in the centre; basal half of costa irrorated with orange; the base and

a small oblique dash in cell white : secondaries silvery white ; a cuneiform spot and two dots in cell ; a large cuneiform patch on inner margin, a somewhat broad marginal band terminating above in a quadrate spot upon subcostal nervure, and spots on the fringe opposite to terminations of nervures reddish plum-colour irrorated with orange.

Expanse of wings 1 inch 1 line.

Allied to *E. Cynthia* from Bolivia.

Family Ennomidæ.

Genus 22. AZELINA, Guenée.

37. *Azelina*, sp. ?

Allied to *A. xylinaria*. The specimen is scarcely in a sufficiently good condition for accurate determination.

XXX.—*Additions to the Australian Curculionidæ.* Part V.

By FRANCIS P. PASCOE, F.L.S. &c.

LEPTOPINÆ.

- Leptops argillaceus.
- musimon.
- muricatus.

RHYPAROSOMINÆ.

- Dysostines cellaris.

CYLINDRORHININÆ.

- Perperus urticarum.
- variegatus.
- Ocynoma, n. g.
- antennata.
- cordipennis.
- Decienus, n. g.
- sphasodes.

GONIPTERINÆ.

- Oxyops Mastersii.
- memnonius.
- calidus.
- pruinus.
- meles.
- sparsutus.
- floreus.
- rutilus.
- Syarbis semilineatus.
- nervosus.
- Pantoreites cretatus.
- Breweri.

ATERPINÆ.

- Rhinaria perdix.
- fasciata.
- Æsiotes leucurus.
- morosus.

BELINÆ.

- Pachyura vestita.
- Belus ganglionicus.
- Isacantha exigua.

EURHYNCHINÆ.

- Eurhynchus maculatus.

LÆMOSACCINÆ.

- Læmosaccus ocularis.
- longiceps.
- semiustus.
- funereus.
- gibbosus.
- querulus.
- tarsalis.
- magdaloides.
- fulvirostris.

CRYPTORHYNCHINÆ.

- Tentegia, n. g.
- favosa.
- Poropterus prodigus.
- Axides, n. g.
- dorsalis.
- Tychreus sellatus.

Leptops argillaceus.

L. subovatus, niger, omnino dense albido-squamosus, squamis aliis elongatis setulisque adpersus; rostro prothorace vix brevior, modice robusto, medio carinato, lateraliter sulcato; scrobibus ante partem inferiorem oculi evanescentibus; scapo modice tenuato, a basi ad apicem gradatim sed sat cito crassiore; funiculo articulis ultimis subturbinatis; clava nigra, anguste ovata; prothorace subtransverso, rude irregulariter impresso; elytris lateribus parum rotundatis, humeris obliquis et fortiter tuberculatis, apice anguste rotundatis, striato-punctatis, punctis sublinearibus, interstitiis convexis, integris, dorso postice tuberculis quatuor subvalidis, acutis, transversim positis, instructis; femoribus in medio modice incrassatis. Long. 5-7 (♀) lin.

Hab. Queensland.

This species belongs to the section represented by *L. quadrifidus* and allied forms. Its diagnostic characters will be found in the form of the scape, combined with those of the rostrum, scrobes, and the absence of tubercles on the elytra, except at the shoulders and the four at the posterior part. In the freshest of my specimens the scales have a very decidedly pearly lustre. *Curculio clavus*, Fab. (unknown to Schönherr, but referred to by him as probably congeneric with *Hipporhinus*, and so placed in the Munich Catalogue), is a *Leptops*, and belongs to this section. *L. Hopei*, Fahr., seems to me to be identical with *L. squalidus*; indeed Fahræus himself queries "An femina *Leptopis squalidi*?"

Leptops musimon.

L. ovatus, fuscus, opacus, sat dense umbrino-squamosus; rostro crasso, antice profunde flexuoso-sulcato, supra oculum tuberculo valido munito; scrobibus brevibus, subtransversis; antennis robustis; clava brevi, funiculo haud crassiore; prothorace transverso, basi quam apice paulo latiore, supra vermiculato-sulcato; scutello transverso, apice late rotundato; elytris ovalibus, singulis quadriseriatim tuberculatis, serie suturali tuberculis minoribus antice obsoletis, serie externa tuberculis tribus, seriebus intermediis æqualibus, singulatim sextuberculatis, interstitiis impresso-punctatis, haud granulatis; corpore infra pedibusque dense squamulosis, parce griseo-setulosis. Long. 7 lin.

Hab. Rockhampton.

In *L. polyacanthus* and *L. ebeninus* there are also interocular tubercles. The latter is a glossy black species with granules on the elytra as well as tubercles; the former has the rostrum longitudinally grooved, the interspaces forming five carinæ, and the scrobe is longer and not transverse.

Leptops muricatus.

L. ovatus, niger, subopacus, squamulis albidis præcipue in cavitatibus indutus; fronte convexa, parum punctulata; rostro longiusculo, antice quinquecarinato; scrobibus ad medium oculi currentes; antennis tenuatis, parce squamulosis; funiculo longiusculo; clava elongata; prothorace latitudine vix longiore, basi haud dilatato, supra granulis majusculis inæqualibus confertim munito; scutello angusto; elytris oblongo-ovalibus, singulis tuberculorum seriebus circa decem instructis, seriebus tertia, quinta, septimaque majoribus, postice tuberculis spiniformibus, interstitiis rude impresso-punctatis; corpore infra pedibusque, tibiis confertim squamulosis exceptis, squamulis parce vestitis. Long. 8 lin.

Hab. Nicol Bay.

Like the last in general appearance, but with slender antennæ, which in thickness are nearly intermediate between the above and *L. spinosus*. From a comparison of various species the characters of the antennæ, although very marked in extreme cases, do not appear to have more than specific value in this genus; the same may be said of the scrobes. The five carinæ on the rostrum are very marked, the middle one is the narrowest.

Dysostines cellaris.

D. oblongo-ovalis, niger, supra pedibusque indumento fusco tectus, sparse setulosus; rostro latitudine sesquilongiore, antice paulo convexo; antennis subferrugineis, articulis quatuor ultimis subæqualibus; prothorace modice ampliato-rotundato, in medio linea longitudinali impressa; scutello nullo; elytris prothorace vix latioribus, subcordatis, seriatim punctatis, interstitiis alternis elevatis, pone humeros calloso-tuberculatis; mesosterno verticali, haud producto; coxis anticis modice sejunctis; tibiis posticis paulo curvatis, intus fortiter bisinuatis; tarsis ferrugineis. Long. $2\frac{1}{2}$ lin.

Hab. Sydney.

Probably most nearly allied to *D. hoplostethus*; but with the posterior tibiæ only slightly curved, and a normal mesosternum. That species has a slightly impressed line on the rostrum anteriorly, but partly hidden by the scales with which it is closely covered, and a short crest-like carina nearly between the eyes, but of which there are no traces in the species before us. Mr. Masters says that it is common in the cellars of houses at Sydney.

Perperus urticarum.

P. fusco-squamosus, albo maculatim varius; rostro prothorace parum brevior, antice subrotundato, apicem versus multo latiore; an-

tennis ferrugineis, pilosis et parce setulosis; funiculo articulis duobus basalibus æqualibus; prothorace subtransverso (♀ manifeste latiore), apice quam basi paulo angustiore, rugoso, vittis tribus fuscis ornato; lobis ocularibus prominulis; elytris ovato-cordatis, tenuiter striato-punctatis, punctis linearibus, interstitiis latis, parum convexis, postice verticaliter declivibus, argenteo, præsertim lateraliter, variis; corpore infra pedibusque argenteo-squamosis. Long. $2\frac{1}{2}$ (♂), 3 (♀) lin.

Hab. Queensland (Gayndah).

Mr. Masters, to whom I am indebted for this prettily marked species, tells me that it is found on nettles. In two of my three specimens the principal white mark curves up from the shoulder to behind the middle of the elytron; the others consist of several well-limited spots; in the third specimen the spots are more broken up and indefinite; the rostrum is nearly as broad again at the apex than at the base.

Perperus variegatus.

P. fusco-squamosus, albo maculatim varius; rostro prothorace multo brevior, basi minus tenuato, antice subplanato; antennis ferrugineis, pilosis, parce setulosis; funiculo articulis duobus basalibus brevioribus; prothorace magis ampliato, apice quam basi magis angustiore, rugoso, albo, vittis duabus latis fuscis ornato, lobis ocularibus prominulis; elytris ovato-cordatis, brevioribus, tenuiter striato-punctatis, punctis linearibus, interstitiis latis, paulo convexis, postice minus declivibus, niveo, præcipue lateraliter, variis; corpore infra pedibusque dense subargenteo-squamosis. Long. $2\frac{1}{2}$ –3 lin.

Hab. Rockhampton.

Closely resembling the last species; but, *inter alia*, with larger prothorax, the apex considerably narrower than the base, especially in the female, and with two brown stripes only, separated by a well-defined narrow white line; the rostrum is shorter and nearly of the same breadth throughout.

OCYNOMA.

Rostrum modice elongatum, in medio tenuatum, versus apicem incrassatum; *scrobes* apicales, triangulares, postice cito evanescentes. *Oculi* rotundati. *Antennæ* longæ; *scapus* pone marginem anteriorem prothoracis attingens; *funiculus* articulis obconicis; *clava* distincta. *Prothorax* lateraliter rotundatus, basi truncatus; lobis ocularibus nullis. *Scutellum* invisum. *Elytra* subcordata, prothorace basi haud latiora, postice leviter declivia, apice rotundata. *Femora* in medio incrassata; *tibiæ* intus bisinuata, apice ampliata; *tarsi* normales. *Abdomen* segmentis duobus basalibus

amplis. *Processus* intercoxalis truncatus. *Corpus* squamosum, setosum.

The absence of ocular lobes and the greater length of the scape are the principal characters differentiating this genus from *Perperus*. The elytra, also, are not vertically declivous behind; and the eyes are round or nearly so and away from the prothorax, not contiguous to, or, in some cases, partly covered by the ocular lobes. The corbels of the posterior tibiæ, so far as I can make out from gummed specimens, are precisely as in *Perperus*.

Ocynoma antennata.

O. fusco-castanea, squamis griseis fuscisque, setulis longis interjectis, subtus sparse argenteo-squamosa; capite rostroque griseo-squamosis, hoc in medio carinulato, apice vage setuloso; antennis ferrugineis, pareius niveo-pilosis; funiculo articulo basali longiore cæteris gradatim brevioribus; prothorace vittis tribus fuscis valde indeterminatis notato; elytris anguste cordatis, seriatim punctatis; dorso utrinque vitta determinata fusca notatis; pedibus ferrugineis, tibiis tarsisque pallidioribus. Long. $1\frac{2}{3}$ –2 lin.

Hab. Swan River.

Ocynoma cordipennis.

O. fusea, squamis silaceis, setulis breviusculis interjectis, subtus sejunctim albido-squamosa; rostro longiore, minus tenuato, haud carinulato; antennis minus elongatis; prothorace longitudine vix latiore, vage nigro-punctato; elytris cordatis, tenuiter striatis, singulis linea pallida, in medio interrupta, indeterminata, notatis; pedibus squamosis, tibiis tarsisque ferrugineis. Long. 2 lin.

Hab. Swan River.

DECIENUS.

Rostrum modice robustum, breviusculum; *scrobes* flexuosæ, postice leviter impressæ, oculos attingentes. *Oculi* rotundati. *Scapus* medium oculi vix superans; *funiculus* articulis quinque ultimis breviter obconicis, subæqualibus. *Prothorax* lobis ocularibus obsolete. *Elytra* subcordata, postice leviter declivia. *Pedes* antici majuseuli, elongati; *tibiæ* antiçæ apice calcaratæ, posticæ corbellis apertis. Cæteris ut in *Perpero*.

From its appearance I had originally placed the species described below with *Prosayleus*; but an examination of the mouth shows that it is phanerognathous, and is in many respects similar to *Perperus*, although from its open posterior corbels it is probable that Lacordaire would have found another place for it. It is a dark, somewhat spider-like looking insect, with a few indistinct greyish stripes; in the female,

which is much more massive, the elytra are more uniformly grey, at least in my example.

Decienus sphasodes.

D. nigricanti-squamosus griseo varius; rostro antice tricarinato; antennis ferrugineis, griseo-pilosis; funiculo articulis duobus basalibus longitudine fere æqualibus, primo vix crassiore; prothorace lateribus rotundatis, basi quam apice vix latiore, rugoso, vittis duabus griseis notato; elytris ovato-cordatis, substriato-punctatis, punctis leviter impressis, interstitiis latis, parum convexis, dorso lateraliter griseo maculatim variegatis; corpore infra argenteo-squamoso; pedibus fuscis, parce argenteo-squamosis. Long. $2\frac{2}{3}$ lin.

Hab. Western Australia.

Oxyops Mastersii.

O. angustior, nitide ater, squamis niveis omnino sejunctim vestitus; rostro latitudine parum brevior; oculis prominulis, postice abrupte subtruncatis; prothorace supra fere obsolete tricarinato, lobo scutellari vix emarginato; scutello elongato, postice gradatim latiore; elytris modice ampliatis, convexis, humeris vix prominulis, apice rotundatis, inæqualiter punctato-sulcatis, interstitiis fortiter convexis, tertio quintoque carinato-elevatis, sulcis suturalibus foveatis, squamis versus et paulo pone medium interruptis, fascias duas formantibus; tibiis anticis valde curvatis. Long. $4\frac{1}{4}$ lin.

Hab. New South Wales (Rope's Creek).

I have only one specimen of this pretty little species, which will be found to have a leading character, if it be not a sexual peculiarity, in its strongly curved anterior tibiæ. In the (faintly) tricarinate prothorax and the sculpture of the elytra it approaches *O. concretus*. The species of *Oxyops* have in general a shortly oval contour, the apex of each elytron appearing to be produced into a short blunt mucro; but this is almost entirely owing to a gradual thickening of the sutural interstice as it approaches its termination.

Oxyops memnonius.

O. obovatus, niger, omnino setulis parvis albis parce adpersus; rostro crasso, rude punctato, in medio lævigato; funiculo articulis ultimis longiusculis, obconicis; prothorace transverso, sat rude crebre punctato, in medio haud carinato, basi lato, margine postico ferrugineo-squamoso; scutello ovali; elytris amplis, convexis, humeris prominulis, punctis magnis seriatim impressis, interstitiis sat angustis, tertio basi tuberculo elevato alteroque postice instructis, apicibus obsolete mucronatis. Long. 7 lin.

Hab. Champion Bay.

Compared with *O. squamulosus*, Boh., this species is more convex, the rostrum and prothorax not carinated, and the elytra with rounded punctures and with a prominent tubercle at the base of each.

Oxyops calidus.

O. obovatus, niger, tibiis tarsisque rufescentibus, setulis parvis albis omnino adpersus, supra squamositate rosea in cavitatibus obsitis; rostro latitudine sesquolongiore, antice rotundato haud sulcato; antennis sat dense pilosis; funiculo articulis ultimis obconicis, haud elongatis; prothorace transverso, basi minus lato, confertim granulato, disco utrinque granulis majoribus, singulis setulam gerentibus, munito; scutello elongato; elytris amplis convexis, humeris prominulis, seriatim punctatis, dimidio basali et in medio punctis majoribus impressis, spatiis denudatis, ad latera ductis, notatis, interstitiis basin versus, praesertim tertio, paulo elevatis, postice utrinque tuberculo parum elevato instructis, apice rotundatis. Long. $6\frac{1}{2}$ lin.

Hab. Nicol Bay.

A well-marked species. The larger granules on the prothorax appear to the naked eye as two dark blotches; on the elytra there are four indeterminate naked band-like spaces with punctures, the two intermediate bands slightly connected, the punctures much larger than on the rest of the elytra.

Oxyops pruinus.

O. obovatus, niger, setulis parvis albis parce adpersus; rostro latitudine fere sesquolongiore, apicem versus paulo excavato, in medio linea laevigata instructo; oculis minoribus; antennis sat dense pilosis, funiculo articulo secundo quam tertio sesquolongiore; prothorace angustiore, magis elongato, confertim granulato, disco utrinque granulis paucis majoribus; scutello oblongo; elytris ampliatis, modice convexis, humeris prominulis, seriatim punctatis, spatiis transversis denudatis elevatis munitis, interstitiis basi haud tuberculatis, postice tuberculis parum elevatis instructis, apice rotundatis. Long. 6 lin.

Hab. Nicol Bay.

Allied to the preceding; but, besides the colour (which to the naked eye is dark ashy grey), the prothorax is longer and narrower posteriorly, and the elytra have several little elevated, transverse, slightly glossy patches.

Oxyops meles.

O. paulo angustior, fuscus, setulis albis omnino sejunctim adpersus; oculis minusculis; rostro latitudine paulo longiore, antice haud sulcato; antennis ferrugineis, funiculo articulo secundo quam

tertio paulo longiore; prothorace transverso, æqualiter crebre granulato-punctato; scutello angusto, albo; elytris modice convexis, striato-punctatis, interstitiis latiusculis, subplanatis, crebre granulatis, singulis tuberculis tribus modice elevatis (uno basali, duobus posticis, exteriore marginem versus) instructis. Long. 5 lin.

Hab. Champion Bay.

Somewhat like *O. crassirostris*; but with a longer rostrum, much smaller eyes, elytra with the interstices broader and more convex, and furnished with posterior tubercles; the scales also are completely setuliform.

Oxyops sparsutus.

O. angustior, nitide ater, squamulis niveis maculatim adpersus; rostro brevissimo; oculis prominulis; antennis ferrugineis; scapo brevi; funiculo elongato; prothorace transverso, profunde crebre, quasi reticulatim punctato, punctis plurimis squamigerentibus, in medio nigro bivittato; scutello angusto; elytris convexis, haud tuberculatis, striato-punctatis, punctis sat profundis, approximatis, interstitiis latiusculis, convexis, granulatis, humeris haud prominulis, apicibus paulo divaricatis; pedibus tarsis subtetaceis, fuscis, sejunctim albo-setulosis. Long. 4 lin.

Hab. Champion Bay.

This prettily mottled species has a remarkably short rostrum; and the scape is also unusually short. The black marks on the prothorax and elytra are due to the very slender bristle-like scales imperfectly clothing those parts.

Oxyops florens.

O. angustior, nitide fuscus, squamulis niveis, supra modice, infra minus adpersus, elytris squamulis majoribus condensatis maculas formantibus; rostro latitudine paulo longiore, antice leviter gibboso; antennis ferrugineis, squamulosis; prothorace subtransverso, subconico, utrinque rotundato, granulato-punctato, granulis prominulis; scutello angusto; elytris modice convexis, rude striato-punctatis, interstitiis angustis, grosse granulatis, maculis numerosis niveis, singulis una pone medium majore, ornatis, apicibus obsolete mucronatis; pedibus ferrugineis, albo-squamosis. Long. $4\frac{1}{4}$ lin.

Hab. West Australia.

The white scales on the elytra are somewhat fasciculate in their arrangement.

Oxyops rutilus.

O. angustior, rufo-fulvus, supra squamulis parvis albidis adpersus; capite pone oculos constricto; rostro brevi, crasso, granulato-

punctato; oculis prominulis; antennis leviter pilosis; prothorace subconico, basi minus lato, crebre granulato-punctato, fere esquamoso; scutello oblongo; elytris modice convexis, striato-punctatis, interstitiis latiusculis, tertio quintoque basi elevatis, singulis postice subcallosis, apicibus obsolete mucronatis; corpore infra pedibusque squamis albis adpersis. Long. $3\frac{1}{2}$ lin.

Hab. Champion Bay.

A fulvous species, with a sort of amber lustre; the scales, principally confined to the elytra, have a slightly golden tint. It is more like a *Gonipterus*, but it has a prominent mesosternum as in *Oxyops*.

Syarbis semilineatus.

S. obovatus, fuscus vel ferrugineus, squamulis albis lineatim congestis ornatus; rostro crasso, sparse albo-squamuloso; oculis subrotundatis; funiculo elongato, articulis liberis; prothorace transversim conico, grosse punctato, vittis quinque, quarum tribus discoidalibus indistinctis, notato; elytris subcordatis, modice convexis, fortiter striato-punctatis, humeris vix productis, lineis quinque bene determinatis, ad basin haud protensis, una suturali, duabus lateralibus, e squamulis albis condensatis, munitis; corpore infra pedibusque squamulis albis plus minusve tectis. Long. $1\frac{2}{3}$ -2 lin.

Hab. Western Australia.

The well-marked lines on the elytra and sides of the prothorax—the former (except the outer line) not extending more than halfway towards the base—will at once differentiate this apparently common species from its congeners.

Syarbis nervosus.

S. oblongus, fuscus, squamulis albis, plerumque sublineatim adpersus; rostro crasso, infra oculos longitudinaliter elevato, in medio sulcato; oculis ellipticis, minus prominulis; funiculo crassiusculo; prothorace subconico, rugoso-punctato, subtrilineato; scutello elongato; elytris subobovatis, modice convexis, substriato-punctatis, punctis majusculis, interstitio tertio dimidio anteriore elevato, sutura albo-squamulosis, singulis linea pallida, in medio obliqua, notatis; corpore infra indumento fusciscente squamulisque albis adpersis munito; pedibus breviusculis, parce albo-squamulosis. Long. 2 lin.

Hab. Queensland.

Allied to *S. emarginatus*, Roel., also from Queensland, but differently coloured and the third interstice elevated at the base. Of *S. nubilus*, Roel., I have specimens from Sydney, Albany, and Champion Bay.

Pantoreites cretatus.

P. ferrugineus, supra interrupte, subtus dense albo-squamosus; rostro breviusculo; scrobibus magis arcuatis, supra fere transversis; antennis paulo validis; funiculo articulo basali parum incrassato, quam secundo paulo longiore, tertio manifeste brevior; prothorace subconico, utrinque leviter rotundato, basi dilatato et bisinuato, confertissime punctato, punctis singulis squamulam albam gerentibus, vittis quinque e squamis ovatis formatis, notato, punctis cæteris squamulis minutis piliformibus instructis; scutello ovato; elytris humeris prominulis, lateribus gradatim angustioribus, apice rotundatis, substriato-punctatis, punctis subremotis, interstitiis angustulis, vix convexis, lateribus suturaque irregulariter dense squamosis, reliquis denudatis; mesosterno producto; pedibus validis; tibiis intus fortiter dentatis. Long. $3\frac{1}{2}$ lin.

Hab. Champion Bay.

The mesosternum is also produced in *P. scenicus*, from which this species may be known, *inter alia*, by its prominent shoulders and more lightly sculptured elytra.

Pantoreites Breweri.

P. rufo-testaceus, squamulis piliformibus, aliis ovatis intermixtis, albis, plerumque sat dense tectus; rostro antice leviter tricarinato; funiculo articulis duobus basalibus parum elongatis, fere æqualibus, tertio multo brevior; prothorace utrinque rotundato, basi quam apice haud latiore, illa truncata, in medio squamulis piliformibus, ad latera squamulis ovatis magis condensatis, vecto; scutello ovato; elytris humeris rotundatis, lateribus parallelis, apicem versus cito gradatim angustioribus, striato-punctatis, punctis elongatis, interstitiis latis, subplanatis, tertio postice leviter tuberculato; corpore infra minus squamoso; mesosterno haud producto; pedibus parce pilosis; femoribus in medio crassioribus, tibiis anticis intus bisinuatis. Long. $2\frac{3}{4}$ lin.

Hab. Swan River.

The tricarinated rostrum and narrow base of the prothorax will at once differentiate this species, which must be considered an aberrant form if retained in the genus. It is dedicated to Mr. Brewer, who has done so much by his collections to elucidate the entomology of Swan River.

[To be continued.]

XXXI.—*Report on a Collection of Fishes from China.* By Dr. ALBERT GÜNTHER, F.R.S., Assistant Keeper of the Zoological Department, British Museum.

MR. R. SWINHOE, H.M. Consul at Shanghai, having sent to the

British Museum a collection of freshwater fishes made at that place, I have thought it worthy of a separate report, as it contains an unusually large proportion of new species or such as are but imperfectly known. Their number would have been still larger if a great part of the collection had not unfortunately perished during transit to Europe. Only too frequently specimens are sent off by collectors before they are thoroughly saturated with strong spirits; and the inevitable consequence is that they are softened by internal decomposition and knocked to pieces by the rough treatment to which packages are subjected during a long journey. All specimens collected in a hot climate and placed in spirits ought to be retained by the collector for at least four weeks before they are sent off, and the spirits changed two or three times.

I have included in the following list only a few species obtained from other sources, which are therefore specially mentioned. Where no locality is given, the species is from Shanghai, and collected by Mr. Swinhoe.

1. *Siniperca chuatsi*, Basil.

2. *Siniperca chuatsi*, Basil.

This species has a much lower body than the first.

3. *Percalabrax japonicus*, C. & V.

D. 12 | $\frac{1}{13-14}$. A. $\frac{3}{8-9}$.

Præoperculum with four or five spinous hooks.

4. *Hapalogenys nigripinnis*, Rich.

5. *Dentex hypselosoma*, Blkr.

6. *Cottus pollux*, sp. n.

D. 9 | 19. A. 13.

Skin smooth. No spines on the head, except on the præoperculum (which is armed with a small, flat, and slightly curved spine) and on the suboperculum, the spine of which is still smaller. Lateral line reaching to the caudal fin. The vent is conspicuously nearer to the root of the caudal than to the end of the snout. First dorsal very low. Origin of the anal opposite to the fourth dorsal ray. The ventrals extend somewhat beyond the vent. In general appearance and in colour very similar to *Cottus gobio*.

Two specimens, $4\frac{1}{2}$ inches long, were found by Captain St. John in a river at Otarranai, Japan.

7. *Platycephalus japonicus*, Tiles.

8. *Trigla kumu*, Less.

9. *Lepidotrigla microptera*, sp. n.

D. 9 | 17. A. 17. L. lat. 75.

Scales regular, finely serrated. Lateral line without spines. Snout rather short, with the upper profile nearly straight. Præorbital terminating anteriorly in three or two conical spines. Dorsal spines rather strong, the first four fifths the length of the second, which is as high as the body. The pectoral reaches to the fourth anal ray. A large blackish spot between the fourth and seventh dorsal spines. The whole of the inner side of the pectoral black, with the exception of the four lower rays.

One specimen, $10\frac{1}{2}$ inches long.

10. *Gobius hasta*, Schleg.

11. *Gobius stigmatias*, Rich.

LOPHIOGOBIUS (g. n. Gobiin.).

Body rather elongate, covered with scales of moderate size; gill-openings rather wide. Head large, depressed; cleft of the mouth wide; jaws with a series of rather large subhorizontal teeth distant from each other, and not covered by the lips. A series of very small teeth within the outer series. Palate smooth. The spinous is separate from the soft dorsal, and composed of seven spines, of which the first is stiff and pungent. Ventral fins united, not adherent to the belly. Pseudobranchiæ.

12. *Lophiogobius ocellicauda*, sp. n.

D. 7 | 17. A. 17. L. lat. ca 38.

Head much broader than the body, its width being nearly as much as the length of the postorbital part; eyes small, directed upwards, distant from each other, situated in the anterior part of the length of the head; lower jaw prominent, maxillary extending behind the eye. The length of the head is nearly one third of the total (without caudal). Tail very low; caudal pointed, elongate. Vent somewhat nearer to the root of the tail than to the end of the snout. Pectoral very large, extending to the vent in females and beyond it in males. Scales thin, rather deciduous, finely crenulated. Light greenish, each scale with darker margin; a black white-edged ocellus on the base of the caudal rays; lower parts white.

Several specimens, fully mature, from 4 to $4\frac{1}{2}$ inches long.

13. *Tricenophorichthys trigonocephalus*, Gill.14. *Tricenophorichthys barbatus*, Gthr.

This species has been collected by Mr. Swinhoe in considerable numbers; and many of the specimens have the head less broad than the types, the greater or lesser fulness of the cheeks depending apparently on the abundance of food.

15. *Eleotris potamophila*, Gthr.16. *Eleotris Swinhonis*, sp. n.

This species belongs to the group with compressed body and head (*E. cyprinoides*, &c.).

D. 7 | 12. A. 9. L. lat. 32.

Snout and interorbital space scaleless, the remainder of the head scaly. Body compressed, its depth being one fourth of the total length (without caudal), the length of the head two sevenths. The diameter of the eye is one fourth of the length of the head, equal to that of the snout, and more than the width of the interorbital space. Snout pointed, with the lower jaw longest. The maxillary extends to the vertical from the front margin of the eye. Greenish olive (in spirits), with more or less distinct darker markings on the side of the body; sometimes the markings are in the form of seven broad cross bands, some of which may be divided into two; sometimes a vertical band below the eye. Dorsal fins black, the second with series of lighter spots.

Several specimens, 2 inches long.

17. *Eleotris sinensis* (Lac.).18. *Periophthalmus Kœlreuteri* (Pall.).19. *Boleophthalmus viridis* (Buch. Ham.).20. *Callionymus olidus*, sp. n.

D. 3-4 | 9. A. 9.

Præopercular spine nearly as long as the orbit, cylindrical, slightly curved, terminating in from four to six hook-like processes directed upwards; a straight process at the base of the spine points forwards. Gill-opening a very small foramen at the upper surface of the neck. The length of the head is contained thrice and one fifth in the total length (without caudal). Vent in the middle between the end of the snout and the base of the caudal. Upper parts greyish, powdered with darker;

the first dorsal black, with the rays somewhat elongate in the male.

Numerous adult specimens, 2–3 inches long.

21. *Mastacembelus sinensis*.

Rhynchobdella sinensis, Bleek. Versl. & Meded. Ak. Wet. Amsterd. 1870, p. 249, c. fig.

D. 30–34 | 60. A. 3 | 70.

Præoperculum without spines. Rostral appendage extremely short. The maxillary extends to below the front margin of the eye. Vertical fins continuous. Brownish, with a broad, straight, blackish-brown band along the side of the body; the parts below the band marbled and reticulated with brown.

	inches.
Total length	7½
Length of the head	1¼
Length of the tail	3½

Differs from *M. maculatus* in having the cleft of the mouth wider.

22. *Polyacanthus opercularis*, L.

23. *Mugil soiuy*, Basil.

A very slender species, with adipose eyelids, nine anal rays, and forty-four scales in the lateral line.

24. *Cynoglossus robustus*, sp. n.

? *Cynoglossus oligolepis*, Steindachner, Wien. Sitzsb. Iv. 1867, p. 587 (not Bleek.).

D. 131. A. 102. L. lat. 83.

Two lateral lines on the left side; when counted at the end of the abdominal cavity, the upper line is separated from the middle by ten longitudinal series of scales. One lateral line on the right side. One ventral united with the anal. Two nostrils—one anteriorly between the eyes, the other in front of the lower margin of the lower orbit. The upper eye is scarcely in advance of the lower; the width of the interorbital space is less than the diameter of the eye, which is a little nearer to the end of the snout than to the gill-opening. Lips not fringed. Length of the snout contained twice and a fourth in that of the head. The angle of the mouth is opposite to the posterior margin of the eye, and exactly in the middle of the length of the head. The rostral hook terminates behind the symphysis of the mandible. The height of the body is two ninths of the total length, the length of the head one fifth. Uniform light brownish.

One specimen, 12½ inches long.

25. *Cynoglossus abbreviatus*, Gray.26. *Cynoglossus gracilis*, sp. n.

D. 139. A. 106. V. 4. L. lat. 150.

Three lateral lines on the left side. On the level of the end of the abdominal cavity the upper line is separated from the middle by 21 rows of scales, and the lower from the middle by 24. One lateral line on the right side. Scales ctenoid on both sides. One ventral united with the anal. Two nostrils—one between the eyes, the other opposite to the lower margin of the lower eye. Eyes extremely small, the upper not in advance of the lower; interorbital space much wider than the orbit. Lips not fringed. The length of the snout is contained twice and one third in that of the head. Angle of the mouth a little nearer to the end of the snout than to the hind margin of the gill-cover, below the eye. The rostral hook terminates behind the symphysis of the mandible. Tail much tapering behind. The height of the body is scarcely more than the length of the head, which is one fifth of the total (without caudal). Uniform light brownish; basal half of the vertical fins darker than the outer half.

One specimen, 9 inches long, and several young ones.

27. *Silurus asotus*, L.

MACRONES, LIOCASSIS, and PSEUDOBAGRUS.

In my systematic arrangement of the Siluroid fishes, I refused to acknowledge the presence or absence of a thin integument on the upper surface of the head as a generic character, whilst I admitted Bleeker's generic divisions of *Liocassis*, based on the absence of an orbital fold, and of *Pseudobagrus*, based on the many-rayed anal fin. However, the discovery of a few new forms shows that, also, the two latter characters are quite useless for a generic arrangement of the species, and that *Liocassis* and *Pseudobagrus* should not be separated from *Macrones*.

28. *Macrones (Pseudobagrus) fulvidraco*.

Pimelodus fulvidraco, Richards. Ichth. Chin. p. 286.

Silurus calvarius, Basilewsky.

Pseudobagrus fulvidraco, Gthr. Fish. v. p. 85.

Pelteobagrus calvarius, Bleek. Ned. Tydschr. Dierk. 1864, p. 9.

Numerous examples.

29. *Macrones (Pseudobagrus) tenuis*, sp. n.

D. 1/7. A. 22.

Head smooth above, covered with a thin skin, but the occi-

pital process and the basal bone of the dorsal spine are exposed and finely granular*. Occipital process narrow, four times as long as broad; basal bone of the dorsal spine elongate, triangular, two thirds as long as the occipital process, from which it is separated by an interspace. Body much elongate, its depth being one eighth of the total length (without caudal), the length of the head being one fifth. Snout depressed, obtuse, rather broad, twice as long as the eye, which is of moderate size, one seventh of the length of the head. Mouth inferior, as wide as the broad snout. Teeth on the palate in an uninterrupted crescentic band, which is not much narrower than that of the intermaxillaries. Barbels very short and thin, the nasal filaments extending not beyond, and those of the maxillaries but little behind, the orbit; chin-barbels still shorter. Dorsal spine not serrated, at least as high as the body; pectoral spine stronger, strongly denticulated interiorly. Adipose fin at least as long as anal. Caudal rounded. Uniformly dark-coloured.

One specimen, $10\frac{1}{2}$ inches long.

30. *Macrones (Liocassis) longirostris*.

Liocassis longirostris, Gthr. Fish. v. p. 87 (1864, Febr.).

Rhinobagrus Dumerilii, Bleek. Ned. Tydsch. Dierk. (1864, April) p. 7.

See Zool. Record, i. p. 165.

The outer wall of the air-bladder is thicker than I have seen it in any other fish; it is comparatively thicker in old examples (20 to 24 inches) than in younger ones.

31. *Macrones (Liocassis) taniatus*, sp. n.

D. 1/6. A. 18.

Head nearly entirely covered with a thin skin above; but a portion of the occipital process and basal bone of the dorsal spine is exposed and finely granular. Occipital process short, not longer than, and separated by an interspace from, the triangular basal bone of the dorsal spine. Body rather elongate, its depth being one sixth of the total length (without caudal); the length of the head is one fifth. Snout depressed, broad, obtuse, twice as long as the eye, which is rather small, one sixth of the length of the head. Mouth anterior, the upper jaw being but little longer than the lower. Teeth on the palate in an uninterrupted crescentic band, which is rather narrower than that of the intermaxillaries. The nasal barbels extend somewhat behind the eye, those of the maxillaries to the gill-opening; and the chin-barbels are about half as long as

* Thus offering additional evidence of the trivial nature of the genus "*Pelteobagrus*."

the head. Dorsal spine not serrated, lower than the body; pectoral spines as long as, but stronger than, that of the dorsal fin, strongly denticulated interiorly. Adipose fin shorter than the anal. Caudal rounded. Dark brown, with a broad blackish band along the side of the body.

One specimen, 6 inches long.

32. *Carassius auratus*, L.

Original form, with the colours as in *Carassius vulgaris*. L. lat. 28.

33. *Gobio nigripinnis*, sp. n.

Although this species lacks barbels, I nevertheless refer it to the genus *Gobio*—because it has one, and probably sometimes two small pharyngeal teeth in an inner series, whilst *Pseudogobio* has only one series of pharyngeal teeth.

D. 10. A. 8. L. lat. 37. L. transv. $4\frac{1}{5}$.

The height of the body is nearly equal to the length of the head, and one fourth of the total (without caudal). Snout rather compressed, obtusely conical, longer than the diameter of the eye, which is one fourth of the length of the head. Mouth small, inferior; the lower jaw with the lips well developed, interrupted at the symphysis. Suborbitals (with the exception of the præorbital) very narrow. The origin of the dorsal fin is considerably nearer to the end of the snout than to the root of the caudal; ventrals inserted below the hinder half of the dorsal. Caudal forked. Pectorals rather shorter than the head, not extending to the ventral. There are three series of scales between the lateral line and ventral fin. Light yellowish brown, with or without large, dark, irregular, cloudy spots. Nearly all the fins are black, or at least partly black. Generally a vertical deep-black spot on the shoulder. Head and throat of males during the spawning-season orange-coloured.

Numerous examples, up to 5 inches long.

34. *Gobio nitens*, sp. n.

Without barbels, like the preceding species, and with the same dentition.

D. 10. A. 8. L. lat. 35. L. transv. $3\frac{1}{5}$.

The height of the body is one fifth of the total length (without caudal), the length of the head one fourth. Snout not compressed, obtusely conical, scarcely as long as the diameter of the eye, which is two sevenths of the length of the head. Mouth very small, inferior. Suborbitals (with the exception of

the præorbital) very narrow. Origin of the dorsal fin considerably nearer to the end of the snout than to the root of the caudal; ventrals inserted below the middle of the dorsal. Caudal deeply forked. Pectorals rather shorter than the head, extending to the ventrals. There are two series of scales between the lateral line and the ventral fin. Back with a light reddish tinge, below silvery; a silvery blue band along the middle of the side. Dorsal and caudal faintly dotted with blackish.

Three specimens, $2\frac{3}{4}$ inches long.

35. *Pseudogobio sinensis* (Kner).

Whether this species or one of the other gudgeons common in China has been mentioned by Basilewsky under the name of *Gobio rivularis*, will be a question open to discussion, although of but little importance. The fact is, Basilewsky was unable to characterize the fishes observed by him; whilst Kner has given a scientific description of this species. Therefore I adopt the name given by the latter. Neither Kner nor Bleeker has had adult examples; but Mr. Swinhoe has sent immature as well as mature individuals in considerable number. This species attains to a length of $5\frac{1}{2}$ inches. In adult males the dorsal fin becomes very high, higher than the body, with rounded upper margin; like the caudal, it is ornamented with numerous short black streaks, arranged in bands. The anal extends to the caudal. Most of the scales have a brownish dot at the base, and also the snout is dotted. The blackish spot at the base of the caudal fin disappears.

36. *Pseudorasbora parva*, Schleg.

37. *Myloleucus cethiops*, Basil.

The *Leuciscus cethiops* of Basilewsky is clearly the type of a distinct genus, for which I propose the name of *Myloleucus*, and which is characterized by extremely broad, molar-like pharyngeal teeth, in a single series.

38. *Ctenopharyngodon idellus*, C. & V.

39. *Acanthorhodeus tænianalis*, sp. n.

D. 18. A. 15. L. lat. 36. L. transv. $5\frac{1}{2}/6$.

Barbels none. The height of the body is contained twice and one fourth in the total length (without caudal), the length of the head four times. Snout shorter than the eye, the diameter of which is one third of the length of the head, and a little less than the width of the interorbital space. The origin

of the dorsal fin is midway (or nearly so) between the end of the snout and the root of the caudal; its last ray is opposite to the fourteenth of the anal fin. The second ray of the dorsal and anal fins is a strong spine; but sometimes the dorsal spine terminates in a flexible top*. Pectoral extending nearly to the ventral. There are five longitudinal series of scales between the lateral line and ventral fin. Dorsal and anal fins with two rows of white spots, which are on the rays themselves, and particularly distinct in males on the dark ground-colour of the anal fin, which has also a white margin.

Four examples, up to 5 inches in length.

40. *Acanthorhodeus atranalis*, sp. n.

D. 14-15. A. 12-13. L. lat. 35. L. transv. $5\frac{1}{2}/6$.

Barbels none. The height of the body is two fifths, or a little less than two fifths, of the total length (without caudal), the length of the head a little less than one fourth. Snout shorter than the eye, the diameter of which is rather more than one third of the length of the head, and somewhat less than the width of the interorbital space. The origin of the dorsal fin is midway between the snout and the root of the caudal; its last ray is opposite to the eighth of the anal fin. The second ray of the dorsal and anal is a strong spine. Pectoral extending nearly to the base of the ventral. There are five and a half longitudinal series of scales between the lateral line and ventral fin. Dorsal and anal rays longitudinally edged with black, these black streaks being interrupted by two whitish bands crossing the rays. Males with a more or less extensive deep-black broad margin of the anal fin.

Numerous examples, males and females with the egg-tube, upwards of 3 inches long.

41. *Achilognathus barbatulus*, sp. n.

D. 13. A. 11. L. lat. 36. L. transv. $6/6$.

A pair of very short barbels. The height of the body is two fifths of the total length (without caudal), the length of the head a little less than one fourth. Snout a little shorter than the eye, the diameter of which is one third of the length of the head, and equal to the width of the interorbital space. The origin of the dorsal fin is somewhat nearer to the root of the caudal than to the end of the snout, a little behind the root of the ventral; its last ray is opposite to the ninth of the anal fin; its second ray is stiff in its basal half, but flexible in its

* I have no doubt that the *Acanthorhodeus*-species will be referred to *Achilognathus* before long.

upper half. The second anal ray is stronger than the second of the dorsal, spine-like, but flexible at the top. Caudal fin forked. The pectoral fin extends nearly to the root of the ventral. Lateral line but slightly bent downwards. There are four longitudinal series of scales between the lateral line and ventral fin. Silvery, a narrow bluish band along the middle of the side of the tail. Each dorsal ray longitudinally edged with black; anal fin with two bands composed of short vertical blackish markings.

An adult female is 3 inches long.

42. *Rhodeus ocellatus*, Kner.

43. *Opsariichthys acutipinnis*, Blkr.

44. *Opsariichthys bidens*, sp. n.

D. 10. A. 13. L. lat. 44. L. transv. 9/5.

Mouth wide, the maxillary extending beyond the front margin of the eye. The end of the lower jaw is received in a notch of the upper, and has on each side, in front, a notch to receive a strong projection of the upper jaw. The diameter of the eye is contained nearly five times in the length of the head, and once and two thirds in that of the snout. Anterior anal rays rather elongate, but not extending to the caudal if laid backwards. Origin of the dorsal opposite to that of the ventral, and nearer to the root of the caudal than to the end of the snout. Caudal deeply forked. The pectoral does not extend to the ventral. The length of the head is contained thrice and two thirds in the total (without caudal), the height of the body five times. Sub-orbital ring broad, its width below the orbit being rather more than one half that of the eye. Snout without grooves or pores. Uniform silvery.

One specimen, 4 inches long.

45. *Squaliobarbus curriculus*, Rich.

46. *Hypophthalmichthys nobilis*, Gray.

47. *Chanodichthys pekinensis*, Basil.

48. *Hemiculter leucisculus*, Basil.

TOXABRAMIS (g. n. Abramidin.).

Body elongate, much compressed, the entire abdominal edge being trenchant. Scales of moderate size; lateral line bent downwards behind the pectoral, and rising again to the

middle of the tail behind the anal. Mouth oblique, lower jaw prominent; barbels none. Dorsal fin short, with a strong serrated spine, placed above the interval between ventral and anal; anal fin long, many-rayed; caudal forked; pectorals long. *Pharyngeal teeth in a double series (5 . 2).*

49. *Toxabramis Swinhonis*, sp. n.

D. 10. A. 20. L. lat. 62. L. transv. 9/4.

The height of the body is contained four times and two thirds in the total length (without caudal), the length of the head four times and a half. Snout shorter than the eye, which is two sevenths of the length of the head, and more than the width of the interorbital space. Upper profile of the head and nape straight; tip of the snout nearly on the same level with the upper margin of the eye. Mouth narrow, not extending to the front margin of the orbit. Origin of the dorsal midway between the root of the caudal and the eye. Pectoral just reaching the ventral. Silvery.

Numerous examples, to 4 inches in length.

50. *Culter brevicauda*, Gthr.

51. *Misgurnus anguillicaudatus*, Cant.

52. *Coilia nasus*, Schleg.

53. *Salanx chinensis*, Osbeck.

54. *Monopterus javanensis*, Lac.

55. *Anguilla bengalensis*, Gray.

56. *Triacanthus brevirostris*, Schleg.

57. *Tetrodon ocellatus*, Osbeck, var. *bimaculata*.

58. *Acanthias vulgaris*, Risso.

59. *Psephurus gladius*, Martens.

An example nearly five feet long, sent by Mr. Swinhoe, and several others obtained nearly at the same time have enabled me to make an autoptical comparison of *Polyodon gladius* with *P. folium*; and I have convinced myself that there are sufficient grounds for separating the former in a distinct genus, for which I propose the name *Psephurus**, and which is distinguished by comparatively short gill-rakers in moderate number, and by enormously developed fulcra; they are of larger size and in less number than in any fossil Ganoid.

* From ψήφος, pebble.

XXXII.—Remarks on certain Species of Mollusca described and figured in the 'Microdoride Mediterranea' of Prof. O. G. Costa. By the Marquis DE MONTEROSATO. (Communicated by J. G. WYN JEFFREYS, F.R.S.)

[THE work referred to by my correspondent purports to be a description of a few well-known or entirely unknown minute and microscopic animals of the Mediterranean. The first volume only was published in 1861. The Marquis is thoroughly acquainted with Mediterranean shells, perhaps no one more so; and the following endeavour to identify certain obscure species is of considerable value.—J. G. J.]

1. *Trochus elegantissimus*, p. 55, tav. ix. f. 1, = *Mathilda quadricarinata*, Brocchi.
2. *Trochus horridus*, p. 56, t. ix. f. 6, a, b, c, = *Craspedotus Tinei*, Calcare, juv.
3. *Murex spinulosus*, p. 56, t. ix. f. 2, a, b, = *Pseudomurex bracteatus*, Br., var. *Babelis*, Requier. [I should be inclined to refer this to the *Murex imbricatus* of Brocchi, = *M. lamellosus*, Cristofori and Jan, var. *Babelis*.—J. G. J.]
4. *Murex rugulosus*, p. 57, t. ix. f. 4, a, b, = *M. cristatus*, Br., var., juv.
5. *Solarium calcar*, p. 58, t. ix. f. 5, a, b, c, = *Turbo rugosus*, Linné, juv.
6. *Murchisonia*, p. 59, t. ix. f. 3, = *Turritella triplicata*, Br., pullus.
7. *Scissurella decipiens*, p. 61, t. x. f. 1, A, = *S. costata*, D'Orbigny, var. *ecostata*. [Var. *levigata*, D'Orb. = *S. striatula*, Philippi.—J. G. J.]
8. *Scissurella cingulata*, p. 61, t. xii. f. 8, A, B, and f. 9, A, B, = *Schismope elegans*, D'Orb. [*Schismope cingulata*, not D'Orbigny's species, which belongs to the genus *Scissurella*; and I would add figure 10, A, which does not seem to have been noticed by Costa.—J. G. J.]
9. *Scissurella affinis*, p. 62, t. x. fig. 2, B, = *S. costata*, D'Orb., var. *elevata*. [*S. plicata*, Ph.—J. G. J.]
10. *Heliciella costellata*, p. 63, t. x. f. 3, A, B, C, = *Craspedotus Tinei*, Calc., pullus.
11. *Heliciella mutabilis*, p. 64, t. x. f. 4, A, B, C, and f. 5, A, B, C, = *Cyclostrema Cutlerianum*, Clark, and *C. nitens*, Ph. [I cannot agree with these determinations, unless the author has made a mistake in the description of the sculpture as well as in the figures.—J. G. J.]
12. *Spirolidium mediterraneum*, p. 66, t. xi. f. 2 & 4, = *Cæcum trachea*, Montagu, pullus (Jeffr.). [*C. glabrum*, fry: see 'British Conchology,' vol. v. p. 209.—J. G. J.]
13. *Ammonicerina pulchella*, p. 71, t. xii. f. A, B (a sinistra), = *Homalogyra rota*, Forbes & Hanley (Jeffr.). [*A. paucicostata*, p. 72.

- t. xi. f. 1, *a, b*, is apparently a younger state of the same species. *A. simplex*, p. 72, t. xi. f. 3, *a, b*, is *Homalogyra atomus*, Ph.—J. G. J.]
14. *Ammonicerina mutabilis*, p. 72, t. xii. f. A, B (a dextra), = *Solarium fallaciosum*, Tiberi, pullus.
15. *Protomedea elata*, p. 74, t. xi. f. 5, *a, b, c*, = *Embolus rostralis*, Souleyet.
16. *Protomedea ornata*, p. 74, t. xi. f. 6, *a, b, c*, = *Capulus hungaricus*, L., juv.

XXXIII.—*On the Black and Ashy-grey Double-horned Asiatic Rhinoceroses* (*Ceratorhinus sumatrensis*, *C. niger*, and *C. lasiotis*). By Dr. J. E. GRAY, F.R.S. &c.

SINCE I described the skull of the black double-horned rhinoceros from Malacca as *C. niger*, and figured its skull, the third part of the 'Proceedings of the Zoological Society' for 1872 and the first part for 1873 have appeared, both containing observations on this animal.

The Secretary to the Zoological Society describes and figures the black rhinoceros from Malacca (P. Z. S. 1872, p. 790, t. lxvii.) and figures the head in detail (p. 793. f. 4 & 5). This animal was purchased by the Museum when it died; and its skin and skeleton have been preserved; and it was on its skull that I established *Ceratorhinus niger*.

Mr. Garrod (P. Z. S. 1873, p. 92) published a paper on the visceral anatomy of the above animal, illustrated with several interesting woodcuts. Mr. Bartlett (P. Z. S. 1873, p. 104, t. xi.) gives an account of the birth of a young specimen, and a figure of it when it was two days old, and some details of its feet and tail. This specimen was born on board the ship at the Victoria Docks, when its mother was being transferred from a vessel that brought it from Singapore to send it to the United States. The mother and young were both intensely black.

The Secretary of the Zoological Society, Mr. Garrod, and Mr. Bartlett all call this black rhinoceros "*R. sumatrensis*, Cuvier," though Mr. Bell distinctly says that the Sumatran rhinoceros he described, which is the type of the Sumatran species, is "brownish ash."

Mr. Garrod observes that the skull of the skeleton of the aged animal of *R. sumatrensis* in the College of Surgeons, brought by Raffles from Sumatra, differs materially in several points from the skull of the black rhinoceros, and also that another skull in the College of Surgeons, from Raffles, agrees

with the head of *C. lasiotis* of Dr. Sclater in being broader in the parietal regions.

That is to say, Mr. Garrod has found that Sir Stamford Raffles's specimens from Sumatra, on which *R. sumatrensis* is founded, differ from the skull of the animal that the Secretary to the Zoological Society has called *R. sumatrensis* by the very characters that he himself represents as occurring in the heads of his *R. sumatrensis* and *R. lasiotis*.

Dr. Anderson, in the 'Proceedings of the Zoological Society,' 1872, p. 129, describes a female rhinoceros from Chit-tagong, which he names *Rhinoceros sumatrensis*, Cuvier, as "ashy grey," and covered with bristles about an inch in length, and long drooping hair on the margin of the ears. The specimen described by Dr. Anderson was purchased by the Zoological Society, and is noticed and figured by the Secretary under the name of *Rhinoceros lasiotis* (P. Z. S. 1872, p. 493, t. xxiii.). The animal is represented on this plate, I am informed, far darker than it is in nature; and in pp. 791 & 792 the ear and crown and side of the head of this animal are figured to show its distinctness from the black *rhinoceros*, which the Secretary erroneously calls *R. sumatrensis*, overlooking the fact that Mr. Bell, who originally described the Sumatran rhinoceros, especially says the male is "brownish ash," and "the female more of a lead-colour."

The hairy fringe on the ears is common to both species; and I am told that the length of the fringe differs at different periods, and often is not of the same length on the left and right ears.

I think all this proves that the Secretary to the Society has renamed the Sumatran rhinoceros described by Bell, Raffles, and Cuvier, and has applied Cuvier's name to a new species, which I have called, from its very decided difference in colour, *Ceratorhinus niger*.

XXXIV.—*Descriptions of new Species of Fossorial Hymenoptera in the Collection of the British Museum, and of a Species of the rare Genus Iswara belonging to the Family Dorylidæ.* By FREDERICK SMITH, Assistant in the Zoological Department of the British Museum.

Family Dorylidæ.

Genus ISWARA, Westw.

Iswara fasciata.

Male. Length 6 lines. Black, variegated with yellow and
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white spots and fasciæ, with the legs entirely pale. Head black: antennæ fulvous; the scape in front, the clypeus, and mandibles yellowish white; the tips of the latter ferruginous. Thorax black: the prothorax, a large square spot tridentate at its anterior margin, the tegulæ, scutellum and postscutellum, a large subquadrate macula beneath the wings, and the legs pale yellow; the coxæ and femora at their base above more or less fuscous; wings hyaline, the nervures of the anterior pair black, those of the posterior pair fuscous. Abdomen black: the first segment with a white apical fascia, on the other segments it is basal, broad, occupying two thirds of the segments, and each fascia is narrowed in the middle, being angularly incised at the posterior margin; beneath, the fasciæ on the segments are very deeply incised and become oblong divergent maculæ.

Hab. Sind. This species is in the Indian Museum.

This genus was established by Prof. Westwood in the new series of the Transactions of the Entomological Society of London, vol. i.; a figure of the type, *Iswara luteus*, is given. This Indian genus is at once separated from the other genera of the family of Thynnidæ by the form of the marginal cell of the anterior wings, it being truncate at the apex, and emitting a short appendicular vein.

Family Pompilidæ.

Genus SALIUS, Van der Lind.

Salius bipunctatus.

Male. Length 4 lines. Black, smooth, shining, and impunctate, with a subovate white spot at the lateral angles of the metathorax. Head ovate; the antennæ inserted on each side of a prominence above the clypeus, the prominence has a central impressed line; a minute white line on the face at the lower orbits of the eyes. Thorax: the posterior margin of the prothorax subangular; wings slightly fuscous, with the apical portion of the anterior pair darkest; the intermediate and posterior tibiæ and tarsi with a few fine short spines. Abdomen as long as the head and thorax united. The entire insect with a fine changeable hoary pile, which is only observable in certain lights.

Hab. Tuscany.

This species agrees with the *Salius sexpunctatus* of St. Fargeau in having two white spots on the metathorax; but it has no trace of the large white spots, on the second and third segments of the abdomen, which distinguish that insect. St.

Fargeau does not mention any spots on the face of *sexpunctatus*: that species is found near Paris; *S. bipunctatus* may prove to be an extreme variety of it.

Salix dorsalis.

Female. Length 4 lines. Black, with the pro- and metathorax red. The anterior margin of the clypeus and tips of the mandibles ferruginous. Thorax: the metathorax with the posterior lateral angles produced and spiniform; the wings slightly fuscous, the nervures black; the calcaria at the apex of the tibiæ white; the intermediate and posterior tibiæ and tarsi with a few slight short spines. Abdomen: the base, the apical margins of the first and second segments, and the basal margin of the latter also, with silvery-white pubescence.

Hab. Angara (Siberia).

Genus *CHIRODAMUS*, Halid.

Head narrower than the thorax, convex in front; antennæ short, thick, and convolute in the female; labrum exposed. Thorax: narrowed anteriorly from the base of the wings; prothorax short and transverse; the metathorax short, not abruptly truncate, the margins being rounded; wings with one marginal cell, pointed at its apex; three submarginal cells; the first one third longer than the third, which is narrowed towards the marginal one; the second much narrower than the third, and subquadrate, being a little longer than broad; legs of moderate length, anterior pair raptorial, short, and incrassate; the claws stout, with a large pulvillus between their fork. Otherwise as in the genus *Pompilus*.

Mr. Haliday has not given any characters whereby to distinguish the insects belonging to this genus; they are, however, indicated by him in his remarks. It will be seen that the characters which separate this genus from that of *Planiceps* are the narrow head, non-prominent eyes, and the wings having three submarginal cells, and the conspicuous distinction of having the front of the head convex. The abdomen is of the ordinary form of *Pompilus*, convex, and in no degree compressed. As indicated by Mr. Haliday, the situation of this genus is next to *Planiceps*.

Chirodamus distinctus.

Female. Length 6 lines. Black: the head, thorax, and femora with long erect black pubescence, not very dense. The clypeus widely truncate, the truncation slightly incurved; the labrum subangular; the apical portion of the mandibles fer-

ruginous. The posterior margin of the prothorax angulated; wings slightly fuscous; the knees, tibiæ, and tarsi reddish yellow. Abdomen subsessile, smooth, and shining; the two apical segments with a few long, erect, black hairs.

Hab. Chili (Coquimbo).

In the collection of the British Museum there is a single example of this insect, and three of the typical species (*C. Kingii*, Haliday)—two from the Straits of Magellan, and one from Bahia Blanca, North Patagonia, Argentine Confederation.

Genus MYGNIMIA, Shuck.

This genus was proposed by Shuckard in Lardner's 'Encyclopædia,' published in 1840; he gave the name, and pointed out sufficient characters for the discrimination of the species. In 1855 I gave fuller generic distinctions; in consequence, some authors adopt the genus as being mine; others adopt the generic name proposed by Dahlbom, namely *Hemipepsis*, which appeared in 1845. The name proposed by Shuckard must take precedence, it having the priority of date.

Mygnimia bellicosa.

Male. Length 15 lines. Black; the antennæ, clypeus, labrum, palpi, mandibles, tibiæ, and tarsi ferruginous; wings dark fuscous at their base and apex. The clypeus truncate anteriorly; the mandibles black at their apex; the scape of the antennæ black above. The pro- and metathorax with thin short black pubescence; the metathorax truncate, the margin of the truncation elevated, with a transverse shallow striation above, and an abbreviated impressed longitudinal line in the middle at the base; wings black at their base, becoming lighter at the base of the first discoidal cell, from thence it is flavo-hyaline, the apical margins of the wings having a narrow fuscous border; the nervures are pale ferruginous in the subhyaline portion of the wings, and black in the darker part. Abdomen with the base shining, beyond opaque.

Hab. Bengal.

Mygnimia sævissima.

Female. Length 9–12 lines. Black; head, legs, anterior part of the thorax, and two apical segments of the abdomen ferruginous; the ferruginous parts have a fine short bright golden or fulvous pubescence. The mesothorax at the sides and beneath, and the metathorax entirely, black; the latter is usually more or less tinged with ferruginous above at the base, truncate at the apex, and transversely irregularly striated, the lateral margins sharply elevated; the coxæ and

trochanters black; wings dark fuscous and with a purple iridescence in certain lights. Abdomen subsessile, obscurely blue, and with a fine obscure purple pile or bloom.

Hab. India (Bombay Presidency).

This species, together with *M. perplexa* of India and *M. insignis* of Africa, belong to a section having the abdomen sessile or subsessile.

Mygnumia læta.

Female. Length 7–8½ lines. Black; head, thorax anteriorly, legs, and abdomen, except its base, reddish yellow; wings dark fuscous, with a purple and violet iridescence. Antennæ pale ferruginous. Thorax: the pro- and mesothorax above reddish yellow, the latter more or less black at its anterior margin; the tegulæ ferruginous; the metathorax truncate, and transversely and irregularly striated; the coxæ and trochanters black, with their apex ferruginous. Abdomen smooth and shining; the basal segment black with a blue tinge.

Hab. Birmah.

Mygnumia intermedia.

Female. Length 16 lines. Black; the head, pro- and mesothorax, and the legs, except the coxæ, trochanters, and base of the femora, reddish yellow. The antennæ yellow; tips of the mandibles black. The anterior margin of the pro- and mesothorax more or less blackish; the metathorax black, truncate posteriorly, and transversely striated; the wings flavo-hyaline. Abdomen smooth and shining.

Hab. N. India; Ceylon.

The *Sphex flava* of Fabricius very closely resembles this species, which occasionally has the apical segment more or less yellow, but its metathorax is always black; the wings have their apical margins only occasionally very narrowly bordered with fuscous: the *S. flavus* (*Pompilus flavus* of the 'Systema Piezatorum') has the thorax reddish yellow, except the pectus, which is black; and the species is smaller, varying from ten to twelve lines.

Mygnumia vitripennis.

Female. Length 14 lines. Black; the antennæ obscurely ferruginous beneath; the clypeus with scattered fine punctures, and its anterior margin slightly emarginate; the cheeks and the sides of the thorax with short thin black pubescence; the metathorax obliquely rounded, the sides margined, transversely striated, most strongly so at the lateral margins; the wings dark brown, and having a brilliant lustre of coppery

and purple tints above and also beneath. Abdomen smooth, shining blue-black, and with fine scattered punctures.

The male resembles the female in coloration, the abdomen being of a brighter blue.

Hab. Sumatra.

Mygnumia purpureipennis.

Female. Length 12 lines. Black; the head, pro- and mesothorax blue, with tints more or less vivid in different lights; the legs partaking of tints of blue and purple, spinose, the posterior tibiæ with a double row of strong serrations; the metathorax with raised lateral margins, and with irregular transverse carinæ; the wings brilliant purple. Abdomen smooth and shining, and with vivid changeable tints of blue and purple.

The male resembles the female, but has the legs less spinose, and the posterior tibiæ not serrated.

Hab. Java.

Mygnumia momentosa.

Male. Length $18\frac{1}{2}$ lines. Black, with brown wings, the two apical segments of the abdomen pale. Head and thorax of a velvet-black, the latter covered above with a short black pile; the clypeus truncate, the labrum rounded, its margin with a small notch in the middle, and narrowly and obscurely ferruginous. The postscutellum compressed and forming a small ferruginous tubercle; wings dark brown, darkest toward their base, their apical margins with a narrow pale border. Abdomen smooth and shining towards the base, and velvet-black on the fourth and fifth segments; the two apical ones of an olive colour, and covered with a short hoary pile.

Hab. Borneo.

This fine species was obtained from the late Dr. Ormerod.

Mygnumia pulchripennis.

Female. Length 13 lines. Black; the cheeks and thorax with thinly scattered black pubescence, the coxæ also pubescent; the clypeus narrowed anteriorly, where it is truncate and slightly emarginate; the mandibles ferruginous at their apex; the legs spinose, the spines short, thickly set on the tarsi; the posterior tibiæ with a double row of serrations; the metathorax pubescent, and, posteriorly, with a few lateral transverse elevated lines; wings very dark brown, with a vivid tint of green; the apical and posterior margins narrowly purple. Abdomen smooth, slightly shining, and finely, but

not very closely punctured, having, in certain lights, obscure tints of blue and purple.

Hab. Philippine Islands.

Mygnimia australasica.

Female. Length 14 lines. Head, thorax, legs, and apical segment of the abdomen ferruginous; the clypeus truncate; the tips of the mandibles, the pectus, and base of the posterior coxæ black; the tibiæ and tarsi with short spines, the posterior tibiæ with a double row of serrations; the mesothorax with a longitudinal black stripe on each side; the wings fulvo-hyaline, the nervures ferruginous; the metathorax truncate and transversely striated. Abdomen black, with tints of blue.

The male is both coloured and sculptured like the other sex.

Hab. North-west coast of Australia.

This is the only known species of the genus from Australia.

Family Sphegidae.

Genus AMMOPHILA, Kirby.

Ammophila spinosa.

Female. Length $12\frac{1}{2}$ lines. Black; the petiole and legs red; the spines on the tibiæ and tarsi black. Head smooth, the cheeks shining; the face with silvery pile; the clypeus thinly covered with erect black hairs; the scape of the antennæ bright ferruginous. Thorax: transversely striated above; the mesothorax with a central longitudinal channel which runs from the anterior margin to the middle of the disk; the scutellum longitudinally striated; the central portion of the metathorax rugose, the sides striated; the coxæ and trochanters black, the legs bright red; two or three of the apical joints of the tarsi fuscous or black; the wings subhyaline, the nervures ferruginous. The abdomen blue-black; the apical segments with a changeable cinereous pilosity.

Hab. Hong Kong.

Ammophila leviceps.

Female. Length 9 lines. Black; with the legs and abdomen, except the two apical segments, ferruginous. Head smooth, slightly shining, and with distant fine shallow punctures; the clypeus and face anteriorly with stronger and larger punctures, the former with a central depression. Thorax: a central impressed line in the middle of the prothorax, which extends to the disk of the mesothorax, the latter punctured; the scutellum and postscutellum longitudinally strongly stri-

ated; the enclosed space on the metathorax above transversely striated, coarsely so in the middle, and finely so at the sides; beyond the space it is rugose; the wings subhyaline, the nervures black; the coxæ and trochanters black. Abdomen: the base of the second joint of the petiole black.

Hab. Santiago.

Ammophila barbata.

Female. Length 13–13½ lines. Black; the wings hyaline, their apical margins fuscous beyond the apex of the marginal cell, the fuscous border sharply defined. Head: the face and cheeks with silvery pile, and covered thinly with long black hairs. Thorax: very thinly covered with hoary pubescence; a silvery spot at the posterior margin of the prothorax; the tubercles, two oblique stripes at the sides of the thorax, and the apex of the metathorax silvery; the coxæ, trochanters, and femora beneath covered with changeable silvery pile; the prothorax coarsely transversely striated; the mesothorax with a central longitudinal impressed line, and transversely and coarsely striated, the striæ punctured; an elongate small space before the scutellum punctured and without striæ; the scutellum longitudinally punctate-striate; an elongate angular space at the base of the metathorax rugose, on each side of which is an oblique striation. Abdomen black, with a blue tinge, the petiole two-jointed.

Hab. Mexico.

This species closely resembles *A. gryphus* of N. America, California, and Texas; but the prothorax is shorter, the sculpture of the thorax coarser, and the insect much more pubescent.

[To be continued.]

BIBLIOGRAPHICAL NOTICES.

Researches in Zoology. Illustrative of the Structure, Habits, and Economy of Animals. By JOHN BLACKWALL, F.L.S. London: Van Voorst, 1873.

THAT frequent inquiries should have been made for this book, originally published in 1834, is, we think, sufficient proof, if any were wanting, of its value, and fully justifies Mr. Blackwall in issuing a second edition, "comprising," as he says, "such additions and emendations as subsequent investigations have enabled me to effect." For ourselves we have read through this work attentively, and have been struck with the amount of careful observation it contains, and still more with the *wise caution* exercised wherever any attempt is made by the author to form conclusions from the facts observed. Take

as an example of this latter feature only the very first essay in the volume, that on the migrations of birds. Then, as regards some moot points of natural history, the student will do well to turn from the pages of his "Wallace" or "Darwin" and compare what they have said with what Blackwall here tells us concerning the notes and instincts of birds in reference to the question so often raised as to their being innate or acquired. The Cuckoo furnishes the subject of a long and interesting article; and when to this we add that other pages are specially devoted to the problems of birds becoming torpid, deserting their young (like the Swallow), and diving, as do many aquatic species, we have, while omitting to mention some shorter essays, said enough to show that the interests of the ornithologist have not been neglected; and turning next (at page 184) to the growth of the Salmon and of the Sewin, we may make the same remark also in reference to the student of fishes.

Our space will only suffice for mentioning that the remaining pages are devoted chiefly to observations upon insects and Spiders, in which last group we encounter Blackwall upon a field of inquiry that, in the pages of this Journal and elsewhere, he may be said to have made peculiarly his own. If any one asks himself, how the gossamer spider manages to float through the air, or how the geometric species contrive to make their nets, he will turn in vain to many a goodly-looking volume of natural science or of comparative anatomy for any thing approaching an intelligible or satisfactory answer. But here, in Mr. Blackwall's volume, the reader will find a solution of much of, and more than, what he is in search after. In many cases, too, both *observation* and *direct experiment* have been brought to bear upon the points immediately under investigation; and it is by this double process that our author determines the means by which various animals adhere to or move upon polished vertical surfaces, and whether the poison of spiders is as fatal instantaneously to their prey as it is commonly supposed to be. A valuable paper on the structure and economy of spiders concludes a volume of no less than twenty-five separate essays, out of which we have, for the purpose of this cursory notice, made mention only of a few. To the reader we will only add, get the book itself. As a contribution to our zoological literature of an independent kind Blackwall's pages stand alone—a type the like of which we would, in this age of improved biological speculation, gladly see more of.

On some Remarkable Forms of Animal Life from the Great Deep off the Norwegian Coasts.—I. *Partly from the Posthumous Manuscripts of the late Prof. Dr. Michael Sars.* By GEORGE OSSIAN SARS. Christiania, 1872. 4to, pp. 82, with six copper plates.

THIS work is written in English, with the characters of the genera and species in Latin. It contains the descriptions of:—two species of Polyzoa (1. *Rhabdopleura mirabilis*, 2. *Flustra abyssicola*); two Conchifera (1. *Yoldia obtusa*, 2. *Pecchiolia abyssicola*); three Cephalophora (1. *Dentalium agile*, 2. *Triopa incisa*, 3. *Gonieobis typica*);

two Annelida (1. *Umbellisyllis fasciata*, 2. *Paramphinome pulchella*); two Anthozoa (1. *Mopsea borealis*, 2. *Fungiacyathus fragilis*); three Spongiæ (1. *Trichostemma hemisphæricum*, 2. *Cladorhiza abyssicola*, 3. *Hyalonema longissimum*). Each species is illustrated by numerous beautiful figures of the animals and their details by Mr. George Sars, which are engraved on six closely packed quarto plates. Many of the species described were found and described by Prof. Sars; and the account of them has been carefully revised by his son. The work will be continued if Mr. Sars can "obtain the necessary assistance." It is to be hoped that the sale of so important and so conscientious a contribution to this branch of zoology will obtain sufficient support to enable it to be completed.

MISCELLANEOUS.

On Noctiluca miliaris, Sur. By M. L. CIENKOWSKI.

M. CIENKOWSKI has found *Noctiluca miliaris* in abundance at Odessa, from which place it extends on one side into the Sea of Azov, and on the other as far as Smyrna.

The only new information on the organization of the adult animal that we find in his memoir is—the description of a papilla upon which is inserted the vibratile filament discovered by Krohn, and some details as to the movements of the protoplasm which take place in the interior of the nucleus. But the portion relating to the reproduction of this curious organism is of more importance, and contains interesting observations which extend and correct our knowledge on this subject.

M. Cienkowski confirms the facts of reproduction by division described by Mr. Brightwell. This division is observed both in encysted *Noctiluca* and in those which present the normal structure. In the encysted *Noctiluca* the tentacle appears before the separation of the two individuals is completed; in the normal *Noctiluca*, on the contrary, two tentacles may be found at the commencement of the period of constriction.

Numerous observations on the regeneration of the different parts of the animal, checked by artificial removals of larger or smaller portions of the body, have convinced M. Cienkowski that the forms described by Busch as young *Noctiluca* produced by an internal gemination cannot be so interpreted. They are simply portions of protoplasm in process of reproduction. When an individual has been deprived of a portion of its substance, it is able to complete itself. It would even seem that portions of protoplasm issuing from the body under the action of compression may give birth to new complete individuals.

The author has followed more completely than before* the mode

* Cienkowski, "Ueber Schwärmerbildung bei *Noctiluca miliaris*," Arch. für mikr. Anat. vii. (1871) p. 131.

of origin of the zoospores which are found in great numbers in the encysted *Noctiluca*.

The encysted *Noctiluca*, which are met with at all periods of the year at the same time with individuals of normal organization, present the appearance of spherical vesicles, having neither the depression at the bottom of which the mouth is situated, nor the tentacle, nor the tooth, but always possessing the nucleus and the streaks of protoplasm.

Individuals are met with showing transitions between the normal *Noctiluca* and these vesicles, deprived of many of the characteristic organs of the species. The tentacle may disappear in a *Noctiluca* by its being drawn in; it may also become completely detached in *Noctiluca* which are becoming united. The buccal depression may also become effaced in consequence of the approximation and amalgamation of the projections which border it.

The zoospores originate at the surface of these encysted *Noctiluca* by a development of tubercular prominences, which afterwards become constricted at their base and finally separate and swim away by means of a long cilium.

First of all, four of these buds are produced at the surface (perhaps originally only two). They divide and become in a manner segmented and increase in number until they form a sort of superficial disk. While this phenomenon is going on, the protoplasm presses towards the side of the buds, leaving the other parts of the vesicle.

The zoospores at the moment of their becoming detached are formed of an inflated hood, covering a flattened oval vesicle containing a nucleus. To the sides of this vesicle is applied a prolongation which is connected on the one hand with the hood, and terminates in a fine point. In one of the angles formed by the union of the prolongation a long cilium is inserted. In many cases also an immovable cylindrical appendage starts from the hood and extends in the direction of the base of the vesicle.

M. Cienkowski was unable to keep these zoospores living for more than 24–28 hours, and consequently did not witness their transformation into *Noctiluca*.

Besides these zoospores, which may be regarded as representing the normal form, there may be found, attached to the surface of the *Noctiluca* by a short slender peduncle, vesicles which are often furnished with a cilium, a short appendage, an aculeus, and a nucleus sending some protoplasmic filaments to the periphery. These bodies, which have more resemblance than the former to complete *Noctiluca*, may become detached and move in the water. Their further fate is still unknown.

The production of the zoospores in the *Noctiluca* seems to be in relation with copulation; this copulation may take place between encysted or non-encysted individuals. The encysted individuals become united by the points which are nearest the nuclei. After a contact of one or two hours, one or several small apertures are seen at the spot where the union has taken place; and through these the filaments of the protoplasm combine. The amount of perforation increases, and

gradually causes the disappearance of the partition which separated the two vesicles.

In the non-encysted individuals nearly the same phenomena occur. The two *Noctiluca* unite by their buccal notches, which become gradually effaced; and the tentacles disappear, sometimes by becoming detached, sometimes by their being absorbed into the body.

Although M. Cienkowski has repeatedly witnessed all the phases of the copulation, and been able to preserve its products alive for two or three days, he has never seen in them any changes which would indicate a commencement of the formation of zoospores. Nevertheless the dimensions, and the lobate form, of most of the vesicles borne by the disks of zoospores are in favour of their relation to the products of copulation.

It is difficult, however, to pronounce an opinion as to the nature of this copulation, which seems to have nothing to do with a sexual act, but probably facilitates the formation of zoospores and has much analogy with the formation of the plasmodium in the Myxomycetes.

M. Cienkowski concludes, from the sarcodic nature of the contents of the *Noctiluca*, from the presence of the flagellum discovered by Krohn, and, finally, from the occurrence of a reproduction by active zoospores, that this organism must take its place in the class of the Flagellata, in which it should form a distinct group, in consequence of its striated tentacle.—*Archiv für mikr. Anat.* ix. (1872) p. 47; *Bibl. Univ.* 1873, *Bull. Sci.* p. 167.

Natal Sponges. By Dr. J. E. GRAY, F.R.S. &c.

In the Proc. Zool. Soc. 1873, pp. 17 & 21, Dr. Bowerbank has described two sponges, which he says were received from his friend Captain Charles Tyler, "who obtained them from Port Elizabeth." Captain Tyler kindly informs me that he bought these sponges of Mr. Cutter. The British Museum had the first pick of this collection from Port Elizabeth, so that they are both in the British Museum.

1. *Leuconia glomerosa*, Bowerbank (P. Z. S. 1873, p. 17, t. iv.), is the same as the species I long ago described and figured under the name of *Aphroceras alicornis* (P. Z. S. 1858, p. 113, t. x.), from a specimen Dr. Harland received from Hongkong; but we have many specimens in the British Museum from Natal.

2. *Ciocalypta Tyleri*, Bowerbank (P. Z. S. 1873, p. 21, t. iv.). We have several specimens of this "interesting species" in the Museum from Natal; and Mr. Carter informs me that he can find no difference between it and the crumb-of-bread sponge (*Halichondria panicea*) of Ellis, Johnston, and Bowerbank, and it certainly cannot be more than a variety of that species. Dr. Bowerbank says that it is very like the typical species of the genus *Ciocalypta*. The genus *Ciocalypta* has always been a puzzle to me. Is that also described from a specimen of *Halichondria*, which he says is exceedingly closely allied to the Natal species?

If, as we have observed, *Haliphysema tubulatum* is a *Dictyocylindrus*, it is not strange that his *Ciocalypta* should prove to be nothing but a common *Halichondria panicea*.

Notes on a new African Squirrel from Gaboon.

By Dr. J. E. GRAY, F.R.S. &c.

Mr. Ansell has sent from the Gaboon to the Museum a small squirrel which appears to be new to the catalogues—

Sciurus Sharpei.

The fur soft, olive, very closely and finely punctulated with yellow. End of nose, upper lip, underside of head, neck, and body, and inner side of limbs white. Back blackish, separated from the grey of the sides by a distinct margin, with an indistinct, pale, central, vertebral streak and a short broad streak on each side of the upper part of the back. Tail blackish, with white and yellowish tips to the hairs, which form close, irregular, interrupted cross bands and a pale margin to the sides of the tail; the hair of the tail reddish at the base, with a broad black band in the centre and with pale tips; of the end of the tail nearly entirely black, without any pale tips.

Hab. Gaboon (*Ansell*).

This species is most like *Sciurus Isabella*, Gray (P. Z. S. 1862, p. 180, t. xxiv.; Ann. & Mag. Nat. Hist. 1867, xx. p. 326), in colour; but the fur is shorter and harsher, the central stripe is more indistinct, and the lateral ones much narrower. The underside is white.

Note on a Specimen of Macroxus annulatus, var. Frerei, from Zanzibar. By Dr. J. E. GRAY, F.R.S. &c.

Mr. Bartle Frere has kindly sent to the Museum the skin of a small squirrel from Zanzibar, which at first sight I was inclined to regard as a new species, on account of its distinct pale olive cheeks showing vividly against its black whiskers, and the pale but bright orange-colour of the underside of the body, rump, and inside of the limbs, and of the pale rufous colour of the tips of the hairs of the tail forming a pale margin on the sides of the hinder half of the tail. I at first proposed to call it *Macroxus Frerei*; but on comparing it with the specimens of *M. annulatus* in the Museum (which generally has the cheeks and underside white, and the tail pale varied with blackish), I found one specimen, brought from Abyssinia by Mr. Blanford, found at an elevation of 4000 feet, which had the cheeks and underside of body reddish and the rump reddish, approaching to but not near so dark and bright as the Zanzibar specimen, and the tail intermediate in colour between the Zanzibar and the common state of this species. There is in the Museum a specimen of *Macroxus annulatus* brought by Mr. Jesse from Abyssinia, exactly like the common colour of that species, which seems to be common to the west, south, and eastern parts of Africa.

Habit of Pandora. By Dr. J. E. GRAY, F.R.S. &c.

I have often observed living specimens of this animal lying in burrows of sand, as described by Mr. Mason ('Annals,' xii. p. 184); but I cannot get at its natural habitat. The shells are only washed up there by the tide; and if they do not get into their natural situation they die, and will be found with the valves gaping open.

On the Genus Oceanapia, Norman (Rhizochalina of Oscar Schmidt).
By Dr. J. E. GRAY, F.R.S. &c.

Mr. Norman, in his "Report on the Shetland Dredgings," in the Report of the British Association for 1868, p. 334, describes a genus under the name of *Oceanapia*, founded on a sponge which Dr. Bowerbank had described under the name of *Desmacidon Jeffreysii*; and he considers a sponge which Dr. Bowerbank referred to another genus and called *Isodictya robusta* to be founded on fragments of the same sponge.

Dr. Bowerbank not only refers the sponge and the fragments to two different genera, which, according to their characters, have a most distinct organic structure, but in the specific character he describes *Isodictya robusta* as being possessed of simple bihamate retentive spicules, which he does not describe as existing in *Desmacidon Jeffreysii*.

Oscar Schmidt, in his work on Atlantic Sponges, published in 1870, overlooking Mr. Norman's genus *Oceanapia*, republishes the sponge under the name of *Rhizochalina*, and figures two species (*R. olivacea* and *R. carotta*) which appear to be separated on very slight characters.

Dr. Bowerbank, in the 'Proceedings of the Zoological Society' for 1873, describes and figures a species (*Desmacidon fistulosa*, t. iv.) which he compares to *D. Jeffreysii*, evidently forgetting that Mr. Norman made this species into a new genus having a very peculiar external form and habit.

Sponges from Ceylon. By Dr. J. E. GRAY, F.R.S. &c.

E. W. H. Holdsworth, Esq., has kindly presented the specimens of sponges which he obtained on the Pearl-banks and on the beach near his house at Aripo, on the north-west side of the island of Ceylon, to the British Museum.

These specimens have been reported upon by Dr. Bowerbank (P. Z. S. 1873, p. 25), and four of them figured and described. Dr. Bowerbank considers them as belonging to 18 species. I do not venture to give any opinion as to their distinctness; but they appear to be separated on wonderfully slight characters.

Mr. Holdsworth some time ago sent to the Museum a specimen of *Xenospongia patelliformis* in spirits from the same locality (*loc. cit.* p. 32).

The sponge that Dr. Bowerbank has figured as the type of a new species under the name of *Spongionella Holdsworthii* (P. Z. S. 1873, t. v. and t. vi. f. 7) is the same as *Spongia papyracea*, Esper (Pflanzenziere, part ii. p. 38, t. lxx. and t. lxx. a), who received it from the missionaries John and Rottler, from Tranquebar. The larger specimen is figured as attached to a pearl-oyster, on one of the banks of which Mr. Holdsworth found his specimen; but it is a very variable species, sometimes being cup-shaped, at others expanded and ear-like. This sponge has been formed into a genus under the name of *Phyllospongia*. It has very little affinity and quite a different structure to *Spongionella pulchra*, which is considered the type of the genus.

Mr. Carter informs me that the *Haliphysema tubulatum* (P. Z. S. 1873, p. 29, t. vii.) is a massive form of his *Dictyocylindrus* of the British coast; the colour and spicules are nearly the same. There is, in the collection of Ceylon sponges, a specimen whose complement of spicules equals, if not surpasses, all sponges of its kind. See Mr. Carter's description and illustration of this species, Ann. & Mag. Nat. Hist. 1871, vii. p. 268, t. 17, from a small piece found on *Ectyon sparsus*. Mr. Holdsworth's specimen is half as big as a man's head. This sponge is my *Acarus innominatus*.

Mr. Carter informs me, *Isodictya Donmani* of this paper is no *Isodictya* at all! It is allied to *Dictyocylindrus*. It is of a fibrous horny structure, the spicules in distinct fibres in little tufts on the surface at the end, whereas *Isodictya* has no horny fibre, only spicules matted into a kind of fibre with amorphous sarcode. This sponge is very abundant on the Pearl-banks; indeed we have specimens of it in the British Museum, presented by Captain Belcher; and I greatly doubt its being an unnamed species.

Mr. Carter finds *Spongionella* has a simple horny fibre, not enclosed in any sand or spicule, confirming its being *Spongia papyracea* of Esper.

On Ursus euryrhinus, Nilsson. By Dr. J. E. GRAY, F.R.S. &c.

In the 'Catalogue of Carnivorous Mammalia in the British Museum,' p. 235, I referred to the genus *Helarctos*, with doubt, a bear described by Prof. Nilsson in his account of Swedish Mammalia, under the name of *Ursus euryrhinus*, which he described from a skull in the Museum of Lund, said to have come from Hungary.

Prof. Nilsson, in February of this year, kindly presented to the British Museum a plaster cast of this skull, by which I observe that the skull is evidently from an animal long kept in confinement, and much altered from its usual shape, so that I should be unable to determine to what species it really belongs, or even whether it is distinct from the common European bear.

File-fish (Balistes capricus) at Weymouth.

A specimen of the file-fish was taken on the 14th of May off the Portland Breakwater, on a pout-line baited with a lobworm, and has been sent to the British Museum by Mr. William Thompson, who has kindly made the following notes:—

"The fish was $14\frac{1}{2}$ inches long to the centre of the caudal fin; the length from the caudal to the extremity of the longer outer ray 2 inches, making the entire length $16\frac{1}{2}$ inches; the greatest depth $7\frac{1}{2}$ inches. The colour dark smoky grey, very much lighter (almost white) on the under parts; the two dorsal, the anal, and caudal fins spotted, lined, and blotched with ultramarine blue." Mr. Thompson observes that the illustrations of Couch and Yarrell must have been taken from a fish that had lost the outer ray of the caudal fin, which is the case with Couch's specimen which he sent to the British Museum. Mr. Thompson says that he has taken two anchovies, a sea-lamprey 14, and a sand-launce $12\frac{1}{2}$ inches long.

The file-fish has been several times during the summer season

on the south-west coast of England, especially towards the western side of it. I suppose it wanders here from the Mediterranean, perhaps accompanying several of the Cetacea and fish of those seas or the warmer parts of the North-east Atlantic, and must be considered an occasional visitor; and it would be curious to learn whether any of these wanderers ever find their way back to their breeding-grounds or native regions.—J. E. GRAY.

Necessity of a Common Language in Natural Science.

By Professor T. THORELL, of Upsala.

“It may be asked why I, in my catalogue of arachnological literature, have not included any other works than those written in Latin or in the living languages of Teutonic or Roman origin. The reason is, not that I undervalue what may have been written in other languages (which I am very far from doing), but simply that I am unable to understand even the titles of works written in, for example, Russian, Polish, Bohemian, Finnish, or Magyar; and thus I have only by accident come to learn that a couple of works in these languages treat on arachnological subjects.

“It may in general be taken for granted that a person of liberal education has some acquaintance with Latin, and knows at least one Teutonic and one Romanic language; and when this is the case, he can, without any great waste of time, learn so much of the others as to be able, with the help of a grammar and dictionary, to understand the purely descriptive works within his own department that are written in those languages. This is probably the reason why, in determining questions of priority, it is customary to attribute as much importance to works written in, for instance, Portuguese or Swedish as to those written in any of the more generally studied languages. But it is, of course, impossible to assign the same weight to *all* languages. No naturalist can have time to acquire the knowledge of all the *European* languages which have already a scientific literature to show; and the languages of this part of the world will assuredly not long continue to keep exclusive possession of that territory. It would seem, therefore, to be absolutely necessary, even for the future, in the selection of the works of which a zoologist or botanist ought to be expected to possess a knowledge, and which, in the determination of questions of priority, ought to be taken into account, to confine one's self to those which are written in the living languages of Teutonic or Roman origin and in Latin.

“The want of a *common* scientific language will unquestionably become gradually more and more felt; and as a return to Latin can hardly be expected, it is not improbable that *English* may some time or other acquire that rank, not only because that language is far more widely diffused over every part of the earth than any other culture-language, and that already two of the greatest nations publish in it the results of their scientific labours, but because English, on account of its simple grammar and as combining in nearly the same degree Teutonic and Romanic elements, is by most Europeans more easily acquired than any other language.”—*Remarks on Synonyms of European Spiders*, 1873, p. 583 (a work written entirely in elegant idiomatic English).

THE ANNALS

AND

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[FOURTH SERIES.]

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XXXV.—*On a remarkable Fish of the Family of Sturgeons discovered by M. A. P. Fedchenko in the River Suir-dar.*
By K. F. KESSLER.*

AMONG the fishes brought by A. P. Fedchenko in 1871 from Turkestan there was one which, in many respects, deserves special attention. This fish belongs to the family of sturgeons, but differs much from all the species of the genus *Acipenser*, in which Russia is so rich, and greatly resembles one of the species of the North-American sturgeons, fully described some time ago by the well-known Viennese ichthyologist Heckel under the name of *Scaphirhynchus Rafinesquii*. The affinity between the specimen discovered by M. Fedchenko and the above-named North-American fish, in spite of a few differences, is on the whole so great that, in my opinion, these fishes belong to one and the same genus; and accordingly I propose to call our Turkestan fish *Scaphirhynchus Fedtschenkoi*.

I proceed now to the description of this new species.

Generic Characters of Scaphirhynchus.—The body is fusiform, the fore part rather thick. The broad head ends in a more or less long spade-like snout; the transverse mouth, situated on the lower side of the head, does not contain any teeth, but is surrounded by a fleshy, eight-lobed, tubercular lip; in front of the mouth, but at a little distance from it, there are placed in a transverse series four barbels; the so-

* Translated by J. T. Naaké, Esq., Assistant in the Department of Printed Books, British Museum, from the Russian text in *Mém. Soc. d'Hist. Nat. Mosc.* vol. x. 1872.

called spiracles are wanting. Down the body there are five rows of scutes, of which the upper (dorsal) row ends at the commencement of the dorsal fin, and the abdominal rows at the base of the ventral fins, the lateral rows extending to the end of the tail. The tail, behind the dorsal and anal fins, is slightly flattened and completely covered with osseous scutes; the end of the tail terminates in a more or less long filament.

Specific Characters of Scaphirhynchus Fedtschenkoi.—The length of the spade-like snout is subject to great variation, but never less than three fourths of the whole length of the head, or less than one fourth of the length of the whole body to the base of the caudal fin; the barbels are not fringed, placed in a curved line, and are distant further from the end of the snout than from the opening of the mouth; the diameter of the little eyes does not exceed 2 millimetres; the distance from the anus to the commencement of the anal fin is a little greater than that from the end of the anal fin to the beginning of the caudal.

Detailed description.—The length of the snout, together with that of the whole head, is subject to very great variation. In some of those specimens which might be called short-snouted the length of the head consists of a little more than one third of the length of the whole body to the base of the caudal; in others with long snouts the length of the head is as much as four ninths of the length of the whole body. The breadth of the head at the gill-openings is contained in the length of the body (without caudal) from seven to eight times, the breadth of the basal part of the snout being a little greater than that of the head at that point. The head is flat-convex above, quite flat below. The snout has the shape of a more or less long spade, which from the centre to the margins gradually becomes thinner, and from the base to the end both thinner and narrower. The end of the snout is sharp, rounded, and the margins are rather soft, in consequence of which they slightly bend inwards in dried specimens, giving to the snout the appearance of a shallow gutter. The posterior ends of the margins of the snout form two bony prominences or hooks, directed towards the gill-covers. A little in front from these hooks is the widest part of the snout; and behind them, close to the gill-covers, the breadth of the head is a little smaller than that of the snout.

The whole upper surface of the head is covered with shields, which, however, are less prominent and less distinct than in the American species—the less so, as they are covered with a thick layer of skin forming many longitudinal folds. There are seven principal shields—one occipital, two parietals, two

frontals, and two temporals. The small occipital shield is almost of a triangular form, with a scarcely observable longitudinal ridge, and with its anterior acute end deeply buried between the two parietals. The central points of the parietals are almost opposite to the front margin of the gill-covers, and appear as very slight elevations; the interspace between these central elevations is slightly hollow, like a shallow gutter, and its breadth is considerably less than that of the interspaces between each central elevation and the corresponding gill-cover. Outside of the parietals there are the flat temporals, whose central points are in a diagonal line with the central elevations of the parietals. Posteriorly the parietals, as well as the temporals, rest against the upper dorsal shields, which, like the temporals, are completely flat. The slightly projecting central points of the frontal shields are opposite to the front border of the eye. On the outer side of the frontal shields there are two little cavities, at the bottom of which the frontals are separated from the supraciliary shields by a little narrow membranaceous interspace. The interspace between the frontals is partly occupied by the acute front ends of the parietals, and partly by a separate odd interfrontal shield. In front of the above-named shields the whole of the upper part of the snout is covered with elongate lanceolate shields, which gradually become smaller and thinner and more difficult to distinguish. Between them, towards the margins of the snout, there are skinny interspaces, mostly of irregular oval shape and of various sizes, and occupied by those peculiar organs which are called by Heckel "Schleimdrüsen" (mucous glands).

The lower side of the snout is completely flat; only in dried specimens the borders of the snout are turned inside, and give it the shape of a shallow gutter. There may be seen sometimes in the centre of the lower side of the snout a longitudinal prominence, caused by a bony rib passing there. The whole of the lower side is covered by a thick soft skin containing a dense network of folds, in the loops of which are little pores crowded together (according to Heckel the openings of the mucous glands). Four completely smooth barbels, situated on the lower side of the snout, are placed in a transverse, slightly curved line. The outer barbels are from two to three times as long as the inner, and when adressed to the snout they reach to the mouth. The interspace separating the two inner barbels is almost twice as wide as that between each inner and outer barbel. The outer barbels are generally close to the margin of the snout: their distance from the end of the snout is the greater the longer the snout; but even in short-snouted

specimens it is greater than the distance from the opening of the mouth.

At the hinder end of the snout, opposite its lateral hooks, there is the transverse mouth, placed in a separate transverse cavity. The breadth of the mouth is equal to about half that of the whole snout. Both lips, the upper and lower, are divided in the middle by a notch into two curved halves. In front and on the sides the mouth is surrounded by a tubercular fleshy pad; but in the lower lip there is in the middle a wide interspace between the two halves of this pad. Interiorly both lips are furnished with two rows of small soft warts; the palate and the tongue are also supplied with similar warts placed in more or less regular transverse rows. Moreover there are also three transverse folds on the palate (*Scaphirhynchus Rafinesquii* has four folds in the palate), of which the front one is curved towards the front, and the posterior backwards.

The eyes, which are almost opposite to the front margin of the cavity of the mouth, are exceedingly small, so that their diameter (not exceeding 2 millimetres) is contained not less than fifteen times in the breadth of the interspace between them. In front of them there are the two nasal openings. The upper nasal openings have an oval form, and their diameter is half that of the cleft of the lower. Each of the lower nasal openings is provided from the front side with a tolerably broad skinny flap. The two nasal openings of each side are more approximate to each other with their hinder parts, which are directed obliquely towards the upperside of the head.

The gill-cavity is considerably shorter and the gill-openings are slightly shorter than those of *Scaphirhynchus Rafinesquii*. Each of the gill-covers is composed of two bony pieces: the upper one, which is the larger, reaching almost to the gill-opening, is rather rough, sometimes provided with a longitudinal central ridge; the other (lower) one is smaller and almost completely smooth (comparatively larger than that of *Scaphirhynchus Rafinesquii*). The interspace which divides at the throat the two gill-openings is a little wider than that in the American species, and is not less than one half of the transverse diameter of the mouth.

Two bony laminae (suprascapulary and scapulary) border the upper part of the gill-opening. The former has an irregular square form, and is a little larger than the latter, which is almost triangular. Both of these laminae are rough, but not provided with projecting teeth as in *Scaphirhynchus Rafinesquii*. The two clavicles meet in the central line, and form one broad transverse shield, with two anterior lateral excisions corre-

sponding to the gill-openings, and one central posterior notch of a triangular form. Each of the clavicles is provided with numerous small ridges, of which one, longitudinally passing through the centre of the clavicle, projects beyond the rest.

The body gradually becomes thinner behind; at the same time, in the whole of its length, the vertical diameter remains equal to the transverse diameter. The five rows of scutes which pass along the body render its shape a little angular. The extreme end of the tail, from the dorsal and anal fins, is entirely covered with scutes, but much shorter than in *Scaphirhynchus Rafinesquii*. The trunk of the tail of our Turkestan species (*i. e.* the distance from the end of the anal fin to the base of the caudal) is scarcely one seventh of the distance from the front margin of the clavicle to the base of the caudal, whilst the trunk of the tail of the American species is not less than one fourth of the above-named distance. The distance from the base of the caudal to the anus of the former species is to the distance from the anus to the front margin of the clavicle as 2 : 3, whilst these two distances are almost equal to each other in the other species.

Down the dorsal ridge, from the neck to the base of the dorsal fin, there is a row of saddle-like scutes, numbering from seventeen to eighteen; they are closely set, and each of them is supplied with a projecting longitudinal crest ending behind in a sharp hook. The first scute, immediately adjoining the occipital shield, is the largest of all, and of an irregularly triangular form; the second is smaller and shorter than all the rest following it, which, again, gradually become larger and longer than wide. Likewise also the crests become gradually higher and their terminal hooks longer. The base of each of the scutes is concave.

The lateral rows of scutes commence from the suprascapulary, extend to the base of the caudal fin, and consist of from forty-two to fifty-seven pieces; they are tolerably closely set, and have an irregular obliquely rhomboid form, with a longitudinal projecting crest along the centre. The crests of these scutes, as the crests of the dorsal scutes, terminate in acute spines. At the base of the posterior end of the shoulder-blades there is a small hollow place. The scutes of the side rows, from the first to the fifteenth (approximately), gradually get larger, then for a considerable space they retain almost the same size; and only those approaching the base of the caudal fin again gradually diminish in size; but they do not become so narrow and flat as in *Scaphirhynchus Rafinesquii*.

In each of the abdominal rows there are from seven to nine scutes; but it happens sometimes that in one row (sometimes

the right, and sometimes the left) there are one or two scutes more than in the other; they begin at a little distance behind the pectoral fins, and extend to the base of the ventrals. The scutes are a little like the dorsal; but their crest is somewhat less developed, and appears generally as a ridge without the hook; only in young specimens the crest is comparatively higher and ends in a spine. The anterior are frequently very small and a little removed from the others, which are more or less closely joined together.

The scutes of all the rows, as well as the interspaces between the rows, are more or less covered with a thick soft skin, in which are imbedded bony corpuscles looking like small thorns or longitudinal ribs, in consequence of which the whole of the skin appears rough. Only behind the ventrals scutes begin to appear on the skin, which gradually increase in size and become imbricate, so that the whole of the tail is surrounded by them. The largest of these scutes occupy the space between the anus and the beginning of the anal fin, and are placed in pairs (four or five pairs), with the exception of the last one, which is single, oblong, and directly joins the anal fin. At the front margin of the anus there are no scutes of any kind. Four pairs of thick scutes occupy the space between the end of the anal fin and the beginning of the caudal; towards the centre this space appears to be slightly concave, like a shallow gutter. Four pairs of flat scutes cover the dorsal side of the tail (which is slightly flat) from the posterior end of the dorsal fin to the beginning of the row of fulcra covering the upperside of the thin end of the tail opposite to the caudal. Of these fulcra the three anterior are more or less flat, laminate. The whole of the base of the dorsal fin is surrounded on both sides with narrow, almost lanceolate bony scutes.

The fins, both paired and single, are very much like the corresponding fins of the fishes of this family. The front rays of the fins are simple, and the posterior more or less branched. The first outer ray of the pectorals differs very little in diameter from the others; only it is considerably thicker at the base. The fins themselves are very broad, and their hind margin is round. The ventral fins, which are considerably narrower, are also round at the end. The dorsal fin has a rhomboid form; the anal fin is more rounded, square; and the caudal fin has the shape of a broad triangle. In each of the pectoral fins there are from thirty-six to forty rays, and in each of the ventrals from eighteen to twenty; the dorsal contains from thirty to thirty-four, the anal from nineteen to twenty, and the caudal fin from sixty to seventy rays. The end of the tail ends in a more or less thin filament; and it is necessary

to note that the shorter the snout the longer is the caudal filament.

The colour of the upperside of the fish (judging by the specimens preserved in spirits of wine) is pale brownish grey, light yellow below. All the fins are light grey. There are no dark stripes or spots either on the body or the fins.

The internal parts of *Scaphirhynchus Fedtschenkoi* are exactly like the corresponding parts of *S. Rafinesquii* described by Brutzer; consequently I will notice a few of them only.

The vertebral column, from the occiput to the base of the caudal fin, consists of about fifty-five vertebræ, of which thirty are abdominal and twenty-five caudal.

The supplementary gills, consisting of two parts and placed round the back margin of the gill-covers, are perceptibly less developed than those of *Acipenser*.

The nasal cavities are very spacious and pierced by the olfactory nerve. From the place of its entrance into the cavity there radiate about twenty folds of mucous membrane, of which the lower ones, having almost a vertical direction, are perceptibly longer and thicker than the upper, which are almost horizontal.

A tolerably long intestinal tract makes several convolutions, and is divided into an œsophagus, first stomach, second stomach, small intestine, spiral valve, and rectum. The first stomach is rather long and curved in front, so that it is easy to distinguish in it the receiving and discharging portions; its greatest diameter is nearly in the middle, at the point of the curve; towards the end it becomes narrower. The second stomach is muscular; it forms a loop with the end of the first stomach, and has the shape of a short cone. At the commencement of the small intestine, which passes out of the left side of the muscular stomach, there is an oval slightly spatulate branch, corresponding in all probability to the appendices pyloricæ of other fishes. Further towards the end the small intestine makes a convolution, passing into the part which contains the spiral valve. This last is tolerably thick at the beginning, but gets gradually thinner towards the end; it is perfectly straight, and finally enters into the narrow rectum. The spiral valve has five turns.

In a specimen, the total length of which was 235 millims. and the distance from the mouth to the anus 72 millims., the length of the entire intestine was 109 millims.—that is, to the œsophagus 16 millims., the first stomach 30 millims., the second 11 millims., the small intestine 26 millims., and the spiral valve together with the rectum 26 millims.

The narrow kidneys are situated on the sides of the vertebral

column, and extend almost along the whole length of the abdominal cavity, and are everywhere separated, except at the hinder end, where they coalesce. A small urine-bladder is provided in front with two long spacious horns; in a bladder 5 millims. long the horns are 27 millims. long. The diameter of the roe when nearly mature is about 1.5 millim. (from 1.3 to 1.8 millim.), the roe being of a brownish-yellow colour. In a specimen 230 millims. long I counted in both ovaries about 1500 eggs.

But the most interesting organ of our fish is its swimming-bladder. It is quite rudimentary, a small bag-like appendage to the stomach (in a specimen 235 millims. long the swimming-bladder was 9 millims. long and 4.3 millims. wide), to which it is joined by a short tube. This tube begins at the front end of the bladder, and enters at the commencement of the first stomach from the dorsal side at the distance of 1 millim. from the end of the œsophagus. The position of the bladder between the stomach and the vertebral column is normal; its walls consist of the same membranes as those of the first stomach.

For the cause of such a peculiar development or, rather, malformation of the swimming-bladder in the *Scaphirhynchus Fedtschenkoi* we must search, in all probability, in the mode of life of this fish. There is no doubt (at least I think so) that this fish is obliged to live continually at the bottom of the river, and there burrows in the sand or mud in order to get its food. This is evident from the shape and structure of its snout as well as the smallness of its eyes, which have become almost rudimentary. Indeed I found in the stomach of our fish exclusively the remains of creatures living in mud. It is known that the swimming-bladder is wanting in those fishes only which are in the habit of living at the bottom of the water (viz. rays, soles, lampreys, &c.).

The fish described by us was discovered by M. A. P. Fedchenko in the river Suir-dar. According to his notes the native fishermen do not consider it to be a distinct species, but merely look upon it as the young of the sturgeon of the Aral Sea. Evidently they do so in consequence of its normally small size. Out of the twelve specimens brought by M. Fedchenko the largest were only 8½ inches long (exclusive of the caudal filament); among them there were some females with eggs almost completely matured. This is no doubt the reason why this fish escaped the notice of former travellers who had visited the banks of the river Suir-dar.

XXXVI.—*Note on Scaphirhynchus Fedtschenkoi*.

By Dr. ALBERT GÜNTHER, F.R.S.

ICHTHYOLOGISTS will thankfully acknowledge the service done to them by the Editors of this Journal in having rendered the interesting discovery of a species of *Scaphirhynchus* in Central Asia accessible to them by the foregoing translation. It is true that the original Russian text is accompanied by a plate representing the fish; but more than one ichthyologist would have failed to recognize from it the close affinity of the Asiatic species to the American, as maintained by Prof. Kessler, and would have been rather inclined to regard the new form as the type of a distinct genus. In the figure the rows of scutes are by no means so well marked and so distinctly represented as they are described in the text; and I have still some doubts whether this is an effect produced by the draughtsman or whether they are in reality more deeply imbedded in the general integuments than is the case in the American species.

However, a comparison of Prof. Kessler's description with that of *S. platyrhynchus* by Heckel (which has served as model of the former) shows clearly that both fishes are most closely allied species of the same genus. The most remarkable difference is in the extent of the dorsal and anal fins, which is much greater in *S. Fedtschenkoi*, and combined with a shortening of the tail. But this difference finds a parallel in the species of *Acipenser*.

Prof. Kessler (in a part of the paper not reprinted) compares the importance of this discovery to that of *Ceratodus*. In this I cannot agree with him, and I would rather find an analogous case in the discovery of *Psephurus gladius* in the Yantsekiang. Indeed, after the discovery of this latter species, that of a *Scaphirhynchus* in Asia might have been foreseen, just as I anticipate with confidence the discovery of a Ganoid in Borneo. But nobody, in the present state of knowledge, could have imagined the presence of a Dipnoous form in Australia. The discovery of a living *Ceratodus* opened a new vista into the affinities of recent and extinct fishes, whilst that of *Scaphirhynchus Fedtschenkoi* is only an additional interesting item of the series of instances by which the close affinity of the North-American, North-Asiatic, and European faunas is proved.

XXXVII.—*Additions to the Australian Curculionidæ. Part V.*
By FRANCIS P. PASCOE, F.L.S. &c.

[Continued from p. 239.]

Rhinaria perdis.

R. breviusecula, nigra, cervino-squamosa albo maculata; fronte biverrucosa verrucis infra conjunctis (vel lobo V-formi instructa); rostro in medio longitudinaliter late excavato, infra lobos profunde oblique sulcato; prothorace sat vage punctato, basi quam apice paulo latiore, utrinque rotundato, lateribus albidis; scutello albido, punctiformi; elytris breviusculis, basi prothorace manifeste latioribus, humeris haud prominulis, striato-punctatis, interstitiis convexis, apice rotundatis; corpore infra pedibusque dense albidosquamosis. Long. 4 lin.

Hab. Victoria.

A small robust species, easily known by its white-spotted elytra.

Rhinaria fasciata.

R. oblonga, umbrino-squamosa, albido variegata; fronte verruca cordiformi valde elevata instructa; rostro basi gibboso, in medio haud excavato; clava antennarum, basi excepta, nigra; prothorace latitudine parum longiore, utrinque rotundato, basi quam apice multo latiore, dorso sat confertim granulato, lateribus albidis; scutello albido, apice rotundato; elytris basi prothorace multo latioribus, postice gradatim angustioribus, humeris haud productis, striato-punctatis, interstitiis convexis, seriatim granulatis, fascia irregulari albida paulo ante medium ornatis, apice rotundatis; corpore infra albido; pedibus umbrino variis. Long. 6 lin.

Hab. Australia (interior).

The nearest ally of this species seems to be *R. myrrhata*. Boisduval describes a *Rhinaria variegata* from New Guinea (in the plate it is stated to be from "Port-du-Roi-Georges"), to which, in the Munich Catalogue, *R. maculosa*, Fhs., from Australia, is referred.

Æsiotes leucurus.

Æ. oblongus, fuscus, supra squamulis minutis concoloribus, apice elytrorum excepto, sejunctim vestitus; fronte depressa, supra oculos tuberculis duobus modice elevatis instructa; rostro squamoso, basi et in medio subtransversim excavato, parte intermedia gibbosa, lateribus oblique impresso; antennis parce setulosis; funiculo articulis duobus basalibus breviusculis æqualibus, cæteris transversis, submoniliformibus; clava tomentosa, modice ovata; prothorace latitudine sesquolongiore, supra irregulariter granulato, apice tuberculis duobus mamilliformibus horizontaliter productis;

scutello rotundato, subtiliter fusco-squamoso; elytris postice gradatim angustioribus, seriatim curvato-tuberculatis, interstitiis leviter impresso-punctatis, declivitate dense albo-squamosis, singulis tuberculo conico postice instructis, apicibus obtuse mucronatis; corpore infra pedibusque dense fusco-squamosis, albido variis. Long. $6\frac{1}{2}$ –7 lin.

Hab. Sydney.

Readily known from *Æ. notabilis* by its concolorous dispersed scales, except on the declivity of the elytra, which is densely covered with pure white scales. Mr. Masters informs me that it is "very destructive to introduced conifers."

Æsiotes morosus.

Æ. oblongus, niger, subnudus; fronte ut in præcedente; capite inter oculos rostroque irregulariter lineatim impressis, hoc in medio crista compressa instructo; antennis pallide setosis; funiculo articulis duobus basalibus longiusculis, cæteris subtransversis, haud moniliformibus; clava breviter ovata; prothorace latitudine sesquolongiore, supra tuberculis plerumque magnis, modice elevatis, apice duobus apicalibus cristiformibus, munito; scutello rotundato, squamis piliformibus silaceis dense vestito; elytris postice gradatim angustioribus, seriatim lateribus sulcato-punctatis, punctis inæqualibus, plurimis singulatim seta curvata instructis, interstitiis tertio quinqtoque tuberculato-elevatis, interstitio interiore tuberculo postico majore triangulari, tuberculo apicali elongato, subcylindrico, apicibus obtuse mucronatis; corpore infra pedibusque sparse silaceo-pilosis. Long. 8 lin.

Hab. Victoria.

Mr. French, of Melbourne, to whom I am indebted for this species, says it is found on young saplings of *Eucalyptus viminialis*. Possibly it may be sometimes more scaly than in the example before me; but from the other two species it may be known, *inter alia*, by the narrow crest-shaped protuberance on the middle of the rostrum and the different form of the apex of the prothorax. A renewed examination of the mouth shows that the maxillæ are not covered by the mentum: I have therefore removed the genus from the neighbourhood of *Leptops* to the *Aterpinæ*.

Pachyura vestita.

P. suboblonga, nigra, supra pube suberecta silacea albido griseoque varia, subtus pedibusque albido-pubescentibus; rostro valido, prothorace brevior, apicem versus latior; antennis subtestaceis, pubescentibus, articulo tertio quam primo duplo longiore; prothorace tenuiter granulato-punctato, in medio albo lineato; scutello subscutiformi, albido-pubescente; elytris valde convexis, lateribus subparallelis, apice divaricatis, pone basin utrinque callo

obtuse elevato instructis, in medio albido nebulosis, ad apicem grisescentibus; femoribus dente parvo spiniformi armatis. Long. 5 lin.

Hab. New South Wales (Murrurundi).

Shorter and more convex than *P. australis* and *P. cinerea*; the elytra have two callosities at the base, and their sculpture is hidden by the pubescence. *Pachyura* is perhaps best differentiated from *Isacantha* by its short rostrum, gradually thicker towards the apex (in *Isacantha* it is longer and cylindrical), and not by its toothed femora, as Hope put it. In this case my *P. papulosa* should be placed in *Isacantha*, with which it otherwise agrees. Lacordaire has united the two genera with *Belus*, at the same time intimating that *B. cinereus*, Blanch., should be withdrawn from it; but this is certainly congeneric with *australis*, the type of *Pachyura*. *Belus* itself, having the prothorax and elytra on the same plane, appears to me abundantly distinct from *Isacantha* and *Pachyura*, in which either the base (as in the former) or more or less of the dorsum of the elytra is above the line of the prothorax. I am indebted for this and the two following species to Mr. Masters.

Belus ganglionicus.

B. oblongus, sat robustus, rufo-fuscus, supra confertim granulatus, impunctatus; prothorace vittis tribus, elytrisque maculis elongatis interruptis prope suturam sitis, e pilis albidis condensatis, notatis, his prothorace manifeste latioribus, lateribus parallelis, apice rotundatis, in masculo parum acuminatis; antennis (σ) articulo basali quam tertio brevior, (♀) brevioribus articulis basali tertioque subæqualibus, ultimis crassioribus; corpore infra pilis albidis, medio metasterni et maculis tribus nudis in quoque segmento abdominis exceptis, dense vestito; pedibus parcius pilosis. Long. σ $5\frac{1}{2}$, ♀ 7 lin.

Hab. Willoughby Falls, near Sydney.

A somewhat robust and rather depressed form; in the rounded apex of the elytra (slightly acuminate, however, in the male) it agrees with *B. brunneus*, Guér. It seems to be a very local species.

Isacantha exigua.

I. oblonga, σ cylindrica, subangusta, ♀ postice gradatim latior, ferruginea, supra confertim granulata, pilis griseis sparse, subtus densius, vestita; rostro prothorace vix longiore, in fœmina paulo brevior, basi crebre punctato; antennis subtestaceis, articulo basali longiusculo; prothorace in medio basin versus canaliculato; elytris prothorace paulo latioribus, submaculatim pilosis, apice

rotundatis; femoribus anticis infra denticulatis, dentibusque duobus longioribus versus apicem instructis. Long. $4\frac{1}{4}$ lin.

Hab. Queensland (Gayndah).

A very distinct species, which may be placed near to *I. bimaculata*.

Eurhynchus maculatus.

E. subcylindricus, piceus, squamulis piliformibus albis sejunctim, subtus pedibusque magis dispersis, tectus; capite inter oculos longitudinaliter sulcato; rostro basi subreticulato-punctato, punctis unisquamigeris; clava nigra; prothorace longitudini latitudine æquali, utrinque modice rotundato, confertim granulato-punctato; scutello triangulari; elytris parallelis, haud spinosis, striato-punctatis, interstitiis seriatim piceo-maculatis, apice rotundatis; femoribus leviter incrassatis. Long. 7 lin.

Hab. Swan River.

This species, well differentiated by its cylindrical form, may be placed after *E. lævior*, Kirby. *E. tetracanthus*, Boh., is in the Munich Catalogue a synonym of *E. acanthopterus*, Bois., and Lacordaire's figure (pl. 72. fig. 4) is referred to it; but for me this represents *E. quadrituberculatus*, Boh.

Læmosaccus ocellaris.

L. modice oblongus, ferrugineus, asperse flavescenti-villosus; capite exserto, angusto; oculis peramplis, antice valde approximatis; rostro modice elongato, apicem versus gradatim latiore, leviter inæqualiter punctato; prothorace crebre reticulato-punctato, in medium parum depresso, lateribus ampliatis; scutello triangulari; elytris striato-punctatis, interstitiis granulis distinctis majusculis munitis, regione suturali magis villosis; abdomine segmento secundo breviusculo, suturis secundo tertioque lateraliter valde areuatis; tibiis anticis modice elongatis, parum compressis. Long. 3 lin.

Hab. Champion Bay.

Like *L. pecuarius*; but with a small narrow head and large eyes, only slightly separated in front.

Læmosaccus longiceps.

L. oblongus, fusco-castaneus, squamis piliformibus flavescens maculatim vestitus; antennis pedibusque ferrugineis; capite angusto, exserto; rostro elongato, tenuiter punctato; oculis antice approximatis; prothorace latitudine longiore, antice multo angustiore, crebre punctato; elytris lateraliter parum rotundatis, striato-punctatis, interstitiis subtiliter granulatis, versus latera granulis transversis majoribus instructis; pygidio inæqualiter sed

confertim punctato; tibiis anticis modice elongatis, intus manifeste bisinuatis. Long. 3-3 $\frac{1}{4}$ lin.

Hab. Queensland (Rockhampton).

Like *L. australis*, Boisd., but more elongate, the head narrow, and passing gradually into the rostrum, &c. I have also one example of this species from Aru.

Læmosaccus semiustus.

L. oblongus, rufescens, margine antice prothoracis, vel toto prothorace, apice excepto, scutelloque nigris; antennis pedibusque ferrugineis; rostro brevi, in medio sat abrupte arcuato, crebre punctato; oculis vix approximatis; prothorace transverso, apice angusto, constricto; scutello cordiformi; elytris striato-punctatis, interstitiis transversim granulatis, basi squamis aureis munitis; pygidio nigro, in medio carinulato; femoribus muticis; tibiis anticis modice elongatis, arcuatis, apicem versus angustioribus. Long. 2 $\frac{1}{4}$ lin.

Hab. Champion Bay.

A somewhat narrow form with mutic femora, as in *L. depressilis*, to which it is not otherwise allied. In some species the tooth is small or nearly obsolete; but there are gradations in this and other characters, such as are almost sure to occur in large genera. Notwithstanding, there are few genera in which the species are more readily recognized by the eye once accustomed to the form.

Læmosaccus funereus.

L. oblongus, niger, subnitidus; capite leviter punctato; rostro vix elongato, recto, nitide castaneo, subtiliter vage punctato; oculis antice approximatis; antennis ferrugineis, clava nigricanti; scapo curvato; prothorace creberrime punctato, antice constricto, pone apicem gibboso, gibbo linea longitudinali in medio impresso; scutello valde transverso; elytris striato-punctatis, interstitiis corrugato-granulatis, regione scutellari apicibusque leviter flavescenti-villosis; abdomine segmentis duobus basalibus modice ampliatis, sutura prima obsoleta; pedibus ferrugineis; tibiis anticis brevissimis, valde compressis. Long. 2 lin.

Hab. Queensland (Gayndah).

The straight, moderately long rostrum, and the gibbosity of the prothorax, divided by a longitudinal impression, are the chief diagnostic characters of this species.

Læmosaccus gibbosus.

L. brevisculus; niger, parum nitidus; capite crebre punctato; rostro perbrevis, recto, vix confertim punctato, in medio canaliculato; oculis modice approximatis; antennis fuscis; prothorace confertim punctato, antice constricto, pone apicem abrupte gibboso,

lateribus basi que flavescenti-villosis; scutello depresso; elytris brevibus, lateraliter paulo rotundatis, striato-punctatis, interstitiis transversim corrugatis, regione scutellari apicibusque flavescenti-villosis; tibiis anticis intermediisque brevibus. Long. $1\frac{2}{3}$ lin.

Hab. West Australia (Champion Bay).

A shorter species than the last, and with a more abruptly gibbous prothorax; it has, moreover, a remarkably short rostrum.

Læmosaccus querulus.

L. breviusculus, niger, elytris pedibusque ferrugineis; capite rostroque sat leviter punctatis; hoc perbrevis, recto; antennis ferrugineis; oculis haud approximatis; prothorace transverso, valde convexo, creberrime punctato, vittis tribus indeterminatis flavescenti-villosis decorato; scutello transverso; elytris brevibus, sparse subtiliter villosis, striato-punctatis, interstitiis fere obsolete granulatis, plagis nigricantibus raro subnotatis; tibiis anticis intermediisque brevibus. Long. $1\frac{1}{2}$ lin.

Hab. West Australia; Victoria.

With a short, straight rostrum, as in the last, this species has, *inter alia*, a smaller and less rounded eye, the posterior margin being a little incurved; the villosity is also considerably less condensed. The tooth on the anterior femora is almost obsolete.

Læmosaccus tarsalis.

L. subangustus, nigricans, submaculatim croceo-villosus; capite majusculo, subtransverso; rostro perbrevis, recto, crebre punctato; oculis prominulis, antice haud approximatis; antennis fulvescentibus, clava magna nigricante; prothorace modice convexo, crebre punctato, in medio linea impressa abbreviata; scutello parvo; elytris striato-punctatis, interstitiis subtiliter punctulatis; tibiis apice tarsisque fulvescentibus, tibiis anticis brevibus, compressis; segmento secundo abdominis breviusculo. Long. $1\frac{1}{3}$ lin.

Hab. Champion Bay.

A small, narrowish species, with the head unusually broad.

Læmosaccus magdaloides.

L. angustus, niger, subnitidus; capite transverso; rostro perbrevis, sparse punctulato; oculis vix prominulis, subapproximatis; antennis fulvescentibus, clava minuscula; prothorace parum longiore quam latiore; elytris striato-punctatis, interstitiis paulo convexis, transversim granulatis; femoribus apice, tibiis tarsisque fulvescentibus, tibiis anticis perbrevibus valde compressis; tarsis articulo ultimo unguiculisque minutis; segmento secundo abdominis breviusculo. Long. $1\frac{1}{3}$ lin.

Hab. Champion Bay.

A resemblance to *Magdalis pruni*, which, however, it shares to some extent with the last and following species, has suggested the specific name.

Læmosaccus fulvirostris.

L. angustus, nigricans, subnitidus, rostro, antennis pedibusque fulvis; capite transverso; oculis haud approximatis; rostro breviusculo, cylindrico, tenuato, fere recto; clava sat breviter ovata; prothorace paulo convexo, crebre punctato, utrinque fortiter rotundato; elytris striato-punctatis, interstitiis paulo convexis, transversim granulatis; femoribus muticis, tibiis anticis brevibus, valde compressis; tarsi articulo penultimo apice solo emarginato, articulo ultimo unguiculisque minutis; abdomine segmentis duobus basalibus ampliatis, sutura prima obsoleta. Long. $1\frac{1}{3}$ lin.

Hab. Champion Bay.

With *L. cryptonyx* this and the preceding species form a group distinguished by their very small claw-joints and claws, the former scarcely extending beyond the cleft of the third joint, into which they are inserted.

TENTEGIA.

Rostrum modice robustum, parum arcuatum; *scrobes* præmedianæ, obliquæ, ante oculos desinentes. *Oculi* rotundati, grosse granulati. *Funiculus* articulis duobus basalibus longioribus, æqualibus, cæteris in clavam gradatim continuatis. *Prothorax* transversus, rotundatus, basi truncatus, apice paulo productus. *Scutellum* nullum. *Elytra* ampliata, fere subglobosa, basi prothorace vix latiora. *Rima* pectoralis pone coxas anticæ terminata. *Femora* linearia, mutica; *tibiæ* rectæ, sulcatæ, apice mucronatæ; *tarsi* articulo tertio haud lobato; *unguiculis* liberis. *Processus* intercoxalis latissimus, truncatus. *Abdomen* segmento basali valde ampliato.

An *Acalles*-form, but with linear tarsi, the third joint not being lobed, and with a broad truncated intercoxal process; from *Poropterus* and its allies it is differentiated, *inter alia*, by its semiglobose habit. *Myrtesis*, with a similar habit, has a pectoral canal extending to the abdomen.

Tentegia favosa.

T. nigra, vix nitida, parcius subtiliter setulosa; capite prothoraceque rude reticulato-punctatis, punctis squamositate grisea fundo munitis; rostro punctis in seriebus quatuor notato, interstitiis elevatis; antennis ferrugineis, sparse griseo-pubescentibus, clava angusta, ovali; prothorace antice paulo tubulato, utrinque fortiter rotundato, lobis ocularibus ciliatis; elytris foveato-sulcatis, interstitiis grosse tuberculatis, tuberculis setuligeris, pone humeros calloso-productis, deinde ad apicem fortiter rotundatis; corpore

infra nitide nigro; segmentis abdominis rude confertim foveatis; pedibus ferrugineis, griseo-setigeris. Long. $2\frac{1}{4}$ lin.

Hab. West Australia.

Poropterus prodigus.

P. subellipticus, convexus, niger, omnino umbrino-squamosus; capite inter oculos foveato; rostro basi parce squamoso, dimidio apicali reticulato-punctato; antennis ferrugineis, funiculo articulis duobus basalibus elongatis, æqualibus, clava subglobosa; prothorace haud lato, apice bicristato, postice carinulato et supra scutellum elevato, disco tuberculis quatuor in medio transversim obsito; elytris sat breviter obovatis, seriatim rude punctatis, singulis tuberculis magnis in seriebus tribus digestis, *scil.* serie interiore quatuor, quorum ultimo maximo postice et prope suturam sito, serie secunda tribus, tertiaque uno majore et duobus minuseulis, humeris obsoletis, apicibus tuberculato-productis; pedibus modice elongatis. Long. 7 lin.

Hab. Eclipse Island.

Like *P. Waterhousei* in habit, but with the two basal joints of the funicle of equal length, and nearly as long as the remaining joints together. This species is remarkable for the two large posterior tubercles on the elytra, situated close to the suture, and therefore contiguous at the base (in *P. Waterhousei* there is a considerable interval between them); besides the eight large tubercles on these organs, there are smaller ones, some of which are scarcely more than the slightly elevated interpunctate spaces. Eclipse Island is, according to Keith Johnstone's Atlas, close to King George's Sound, but it seems to have yielded several insects not yet met with on the mainland. The present is the only species of *Poropterus* I have seen from Western Australia.

AXIDES.

Rostrum modice elongatum, arcuatum; *scrobes* postmedianæ, obliquæ. *Funiculus* 7-articulatus, articulis duobus basalibus elongatis, primo crassiore, cæteris transversis, gradatim latioribus; *clava* magna, 4-articulata, quasi ad funiculum adnata. *Oculi* modice ampliati, tenuiter granulati. *Prothorax* subconicus, inæquatus, lobis ocularibus prominulis. *Elytra* subcordata, modice convexa, dorso parum planata. *Rima* pectoralis inter coxas intermedias terminata, apice aperta. *Femora* subtus dentata; *tibiæ* haud compressæ, intus leviter bisinuatæ; *tarsi* articulo ultimo elongato, esquamoso. *Abdomen* articulis duobus basalibus amplis.

This genus has many of the characters of *Chimades*, a curious form with subquadrangular elytra, and apparently having little connexion with the species described below. Both genera, as well as many others, are allied to *Chætéc-*
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tetorus, Schönh., and are numerous represented in Australia; *Mitrastethus*, Redt., is at present the only known exponent of the group in New Zealand.

Axides dorsalis.

A. ovatus, niger, sat dense griseo-albido-squamosus, supra squamis elongatis erectis adspersus; capite inter oculos profunde foveato; rostro piceo, basi capiteque dense squamosis; antennis ferrugineis; prothorace antice tubulato-constricto, ante medium transversim quadri-subfasciculato, basi fusco-nebuloso; scutello elevato, ovato; elytris sulcato-punctatis, interstitiis convexis, singulis postice callosis, apicibus rotundatis, dorso plaga magna fuscescente, in medio nigra et postice bene determinata, ornatis; corpore infra pedibusque dense albido-squamosis, squamis elongatis subdepressis notatis. Long. $2\frac{1}{2}$ lin.

Hab. Sydney; North Australia.

Tychreus sellatus.

T. subovatus, piceus, dense albido-squamosus, prothoracis basi elytris plaga communi fusca ornatis; capite antice convexo; rostro nigro-piceo, tenuiter subvage punctulato; antennis piceis; prothorace subconico, utrinque antice constricto, postice subparallelo, supra tuberculis quatuor, transversim sitis, instructo, apice producto margineque incrassato; scutello invisio; elytris prothorace manifeste latioribus, humeris haud callosis, lateribus subparallelis, apicibus rotundatis, supra fortiter convexis, punctato-sulcatis, interstitiis elevatis et plus minusve tuberculato-fasciculatis, basi utrinque subcallosis; corpore infra pedibusque dense albido-squamosis; femoribus infra dente fere obsoleto instructis. Long. $3\frac{1}{4}$ lin.

Hab. New South Wales (Rope's Creek).

The type of *Tychreus* (*T. camelus*) has two large median tubercles on the elytra, and is of an indefinitely varied greyish colour; it has, therefore, a look quite distinct from the above, with which, however, it appears to be fairly congeneric. The last joint of the funicle, as in the last genus, appears to form part of the club, but the line of separation is sufficiently clear.

XXXVIII.—On *Archædiscus Karreri*, a new Type of Carboniferous Foraminifera. By HENRY B. BRADY, F.L.S., F.G.S.*

[Plate XI.]

IN working out some of the obscure Microzoa of the Carboni-

* Communicated by the Author, having been read in the Biological Section of the British Association, September 1873.

ferous Limestone my attention has been occupied by certain minute discoidal bodies singularly devoid of the sort of external characters which give promise of interest in investigation. The organisms alluded to do not occur in any great numbers; but a few specimens may generally be found amongst other Rhizopoda in the *débris* of fossiliferous limestone beds.

The bodies in question are lenticular disks, seldom more than a twenty-fifth of an inch in diameter, and a fiftieth of an inch in thickness, and never quite symmetrical. They often present an appearance as though of laminated structure, and in this, as in some other features, present a superficial resemblance to very small Nummulites. In the absence of marked external characters the only method of learning their true nature was by means of microscopical sections, which, in bodies so small, were not made without difficulty. The trouble involved, however, was amply repaid; for it unfolded a structure of great interest, especially in its relation to some already well-known types of Foraminifera. I will endeavour, with the help of drawings, to describe this, and to state what I believe to be its significance.

The interior will be best understood by comparing it to a tube coiled upon itself in constantly varying directions, the periphery being determined by the last circlet of the coil. The tube, which represents the cavity occupied during life by the main body of the animal, is never, so far as I have been able to discover, subdivided into chambers. It gradually increases in size with each successive turn—its earlier portion, in one specimen which I have measured, having a transverse diameter of about $\frac{1}{60}$ of an inch, the later portion $\frac{1}{30}$ of an inch; but in most cases the disproportion is scarcely so great as these figures imply.

Its shape also varies considerably:—the transverse section at times representing about three quarters of a circle, the truncate or flattened side facing inwards; at others showing an irregularly crescentic or saddle-shaped contour, the concave surface of which embraces more or less portions of the preceding turn of the coil. The coil terminates externally in the periphery of the disk; and most of the specimens I have examined have an appearance as if a portion of the end of the tube had been broken away (as sometimes observable in *Nummulina*), owing probably to the greater delicacy and tenuity of the newly deposited shell-substance. The mouth of the tube, representing the general aperture of the shell, appears to have been not constricted or otherwise closed in.

A coil, formed as I have endeavoured to describe, would naturally present an irregular surface, were the walls of the

tube of equal thickness throughout ; but in reality the exterior is even and smooth. A transverse section of the fossil (Pl. XI. fig. 4) shows that this is due to a somewhat remarkable thickening of the shell-wall, especially on its lateral surfaces, most observable near the centre of the disk, and usually to a greater extent on one side than on the other. Sometimes the deposit of shell-substance is proportionally so great that the animal has occupied but a small part of the whole test.

The shell-wall throughout is traversed by a multitude of very minute tubuli. In the thinner portions (shown in Pl. XI. fig. 3) these are apparently the ordinary pseudopodial foramina ; in the thicker (fig. 4), though they run in more or less sinuous lines, they are perhaps only the prolongation of the same.

Quite distinct from these, there is a series of tubes of much larger dimensions, best seen near the ends of a transverse section, as in fig. 5. I cannot state what purpose they serve ; but the existence of two distinct systems of tubulation is a noteworthy fact. The same thing may be observed in some other Foraminifera, in *Orbulina* for example ; but as that genus has a thin and uniform shell-wall, the two cases may have nothing in common in respect of structural significance.

I have alluded to the lamination of the shell. In the true Nummulite this is a character of importance ; for it arises from the prolongation of the alæ of the saddle-shaped chambers to the umbilicus of the test, forming with each turn of the spire a fresh and complete investment of the whole. In the new type (*Archædiscus*) a tendency to a similar condition exists, but developed to a much less marked extent, and with no approach to uniformity. A section of the test highly magnified, as in fig. 6, shows the successive layers of shell, due to the prolongation towards the umbilicus of the crescentiform edges of the tube ; but the earlier portions of the tube are nearly circular (transversely), and it is only in the later stages of growth, when it becomes concavo-convex, that it assumes this investing character.

I have been unable to satisfy myself that there is any essential distinction, either in structure or function, between the thin shell-wall and the further deposit which makes up the thicker portion ; in other words, I have not succeeded in determining that there is any distinct primary and secondary skeleton as in the Nummulite. It is nevertheless quite possible at times to trace the thin line of the primary wall, even when no difference in structure is observable between it and the immediately adjacent supplementary layer. In the same way, though I have not been able to identify any part of the structure

as referrible to a true canal-system, there are appearances that continually suggest the possibility of its existence.

Incomplete as the above details may appear, they are sufficient to show that the new organism has many affinities to the Nummulitic type, though less complex in general structure. Its primary and most striking difference consists in its being formed of a coiled non-septate tube instead of a spiral line of chambers, although the tube shows the same tendency as the Nummuline chambers to bifurcate laterally.

The difficulty of determining the structure and organization of so minute a fossil is always great; but in the present case it is much increased by the infiltration with a subcrystalline substance of the same chemical composition as the shell itself. It may be recollected that the true structure of the Nummulite itself, comparatively a large organism, was only made out by the study of non-infiltrated specimens from the sandy Tertiary beds of Hampshire. It is, I fear, too much to hope that a fossil of Carboniferous age may be found in like condition.

I propose the name *Archædiscus* for the genus represented by the fossil I have described; and in suggesting a specific term I am glad of the opportunity of associating with so interesting a type the name of my friend Dr. Felix Karrer, of Vienna, whose researches have added much to the knowledge of Tertiary Foraminifera.

The distribution of *Archædiscus* is, so far as we know, confined to the Lower Carboniferous Limestone. The first specimens which came under my notice were in the collection of Mr. John Young, of Glasgow, who, with characteristic liberality, allowed me to use them in whatever way seemed desirable to elucidate their nature; these were from the Carboniferous-Limestone shale (main limestone) of Brockley, near Lesmahagow, in central Lanarkshire. To Dr. Harvey B. Holl I am similarly indebted for the use of his specimens from Great Ormes Head in Caernarvonshire. Mr. David Robertson's collection has also examples from Brockley; and Mr. R. Etheridge, Jun., of the Geological Survey of Scotland, has kindly supplied me with material both from this locality and from Shiel, near East Kilbride, in the same county.

I have dwelt upon the relationship to *Nummulina* rather than to its allies *Operculina* and *Amphistegina*, either of which the new genus more nearly resembles in degree of complexity of organization, because of the interest which attaches to the geological distribution of the Nummuline type. The view that once prevailed, that the Nummulite made its appearance suddenly at the beginning of the Tertiary epoch and gradually

died out has long been known to be untenable. It has been shown that there is no material distinction, except in size, between the Nummulite of the Eocene period and that now living in southern and tropical seas. On the other hand, Dr. Gümbel of Munich has described a Nummulite (*N. jurassica**) from a Jurassic limestone of the zone of *Ammonites tenuilobatus*. And, referring to a much earlier paper, we find that Rouillier and Vosinsky in 1849 † figured, under the name of *Nummulina antiquior*, an unsymmetrical Foraminifer, one fifth of an inch or more in diameter, from the Carboniferous Limestone of Miatchkovo in Russia. Though not altogether overlooked, this paper seems to have attracted but little attention until very lately; but the figures accompanying it, although deficient in the structural details which we should expect from more modern drawings, leave little doubt that they represent a true Nummulite. Since then Eichwald ‡ has described, under the name of *Orobias æqualis*, what is apparently only a more symmetrical lenticular variety of the same organism, obtained from the same Carboniferous Limestone. It is not without interest, in connexion with the geological distribution of the Nummulinida, that some Carboniferous material collected for me by my friend W. W. Stoddart, F.G.S., of Bristol, from the Clifton rocks, contains an *Amphistegina*, undistinguishable from the *A. vulgaris* of D'Orbigny, though of very small size. I am not aware that any specimen of this genus has hitherto been found earlier than the beginning of the Tertiary epoch.

EXPLANATION OF PLATE XI.

- Figs. 1 a & 2. Archædiscus Karreri*, side views. Magnified 38 diameters.
Fig. 1 b. Periphero-lateral aspect of *1 a*, showing the open end of the tube, forming the general orifice. Magnified 38 diameters.
Fig. 3. Longitudinal section. The shell-wall has scarcely any thickening on the median plane, as shown in the outer circlets of this section. Magnified 38 diameters.
Fig. 4. Transverse section, showing the thickening of the walls on the lateral surfaces, especially near the centre, and the extensive tubulation. Magnified 38 diameters.
Fig. 5. Lower portion of the same section, magnified 230 diameters, showing the two distinct sorts of tubuli, and the indications of a primary shell-wall as distinct from the thickening matter.
Fig. 6. Part of the transverse section of another specimen, magnified 230 diameters, showing successive layers of shell-deposit due to the prolongation of the crescentiform edges of the tubular shelly investment over the lateral surfaces of the test.

* Neues Jahrbuch für Min. &c., Jahrg. 1872, pp. 241–260.

† Bulletin de la Société Impériale des Naturalistes de Moscou (1849), vol. xxii. p. 337, pl. K. figs. 66–78.

‡ Lethæa Rossica (1860), vol. i. p. 353, pl. 22. fig. 16.

XXXIX.—*Descriptions of new Species of Fossorial Hymenoptera in the Collection of the British Museum.* By FREDERICK SMITH, Assistant in the Zoological Department of the British Museum.

[Continued from p. 260.]

Genus CHLORION, Latr.

Chlorion regalis.

Female. Length 15 lines. Black; head, pro- and mesothorax bright light red; the abdomen purple. Mandibles obscure ferruginous, with their tips black; the apical joints of the antennæ slightly fuscous above; the anterior margin of the clypeus with four equidistant, short, angular, acute teeth. Thorax: the metathorax, pectus, sides, coxæ, trochanters, base of the intermediate femora beneath, the posterior legs and intermediate tarsi black; the posterior tibiæ with an obscure ferruginous tinge; wings dark brown, with a violet iridescence; the hind wings have their apical margins clear hyaline; the anterior portion of the prothorax, and the metathorax above, transversely finely striated. Abdomen smooth and shining, its colour changing from bright purple to shades of blue or violet in different lights.

Hab. The Beluchistan district; Afganistan; and Sind.

This beautiful insect was taken by Dr. Leith, and also by Major T. Le Mesurier.

Genus SPHEX, Linn.

Sphex torrida.

Female. Length 13–15 lines. Black, wings bright ferruginous, with broad dark fuscous apical margins. Head: the mandibles falcate, very stout, terminating in an acute point and with a stout acute tooth about the middle of their inner margin; the face silvery and thickly set with erect black hairs. The posterior margin of the prothorax with silvery pubescence; the metathorax with black pubescence; the scutellum with a central impressed line; the postscutellum with two minute tubercles; beyond the enclosed cells the wings are dark fuscous, with a slight violet iridescence. Abdomen smooth and shining, with a somewhat obscure blue tinge.

Hab. Madagascar.

Sphex tuberculata.

Female. Length 13 lines. Black, with the posterior tibiæ and

femora ferruginous. Head densely clothed with golden-coloured pubescence, the cheeks with long hairs of the same colour. Thorax smooth and shining above, the sides and also beneath thinly clothed with long golden-coloured pubescence; it is much more dense on the metathorax, on the sides, and towards the apex; the base of the metathorax transversely striated; the postscutellum bituberculate; wings hyaline, the nervures black, the apical margin of the superior pair faintly clouded; a dark fuscous spot at the apex of the marginal cell; the tibiæ and tarsi very spinose. Abdomen black, with a faint tinge of blue.

Hab. Sierra Leone.

Genus AMPULEX, Jurine.

Ampulex apicalis.

Female. Length 6 lines. Varied with tints of blue and green, the scape of the antennæ and apex of the abdomen ferruginous. Head blue or green, covered with deep confluent punctures; the clypeus and mandibles ferruginous; the clypeus with a sharp carina in the middle, its anterior margin subangular. The pro- and mesothorax with large confluent punctures, the former slightly narrowed towards the head; the metathorax transverse, the posterior lateral angles dentate, the superior surface with a raised margin, a central longitudinal carina that runs from the base a little beyond the middle, where it divides into a fork which runs to the posterior margin, on each side are three oblique carinæ, between the carinæ coarsely striated; wings fuscous, with a hyaline fascia crossing the superior pair at the base of the first submarginal cell; the apex of the wing is subhyaline. Abdomen smooth and shining, delicately and sparingly punctured, the three apical segments ferruginous.

Hab. South Africa (Zulu country).

This species belongs to the section of the genus *Ampulex* which has only two submarginal cells.

Genus DOLICHURUS, Latr.

Dolichurus lævis.

Female. Length 4 lines. Black, smooth and shining, the abdomen brightest. Head very closely and very delicately punctured, with a few irregularly intermixed larger punctures; a tubercle in the middle of the face concave above, with its anterior margin whitish; the palpi, base of the mandibles, and the clypeus yellowish white, the anterior margin

of the latter rounded; the antennæ fulvous beneath. Thorax: the prothorax flattened at the sides, and deeply depressed in the middle above, forming on each side an obtuse tubercle; the mesothorax with two deeply impressed longitudinal lines; the metathorax rugose, with a horseshoe-shaped small enclosed smooth shining space at its base; this shape is again enclosed by a longer but similar-shaped space, which is longitudinally strigose; the apex abruptly truncate, the truncation sharply margined above, finely rugulose, and thinly covered with white pubescence; wings subhyaline and iridescent, the nervures black; the anterior tibiæ, the tarsi, and also the intermediate pair ferruginous. The abdomen smooth and shining; the apical segment, and the margins of the other segments, narrowly rufo-piceous.

Hab. Brazil (Ega and St. Paulo).

The colouring of the legs differs in the two specimens, one being lighter than the other, the extreme tips of the femora being ferruginous.

Family Larridæ.

Genus LARRADA, Smith.

Larrada vestita.

Female. Length $5\frac{1}{2}$ lines. Head and thorax black, the two basal segments of the abdomen and half of the third ferruginous. Head and thorax densely covered with short white pubescence; on the face it is bright and silvery, it is the same on the legs; the apical joints of the tarsi ferruginous; the wings clear hyaline; the tegulæ and nervures ferruginous; the apical margins of the segments of the abdomen with bright silvery fasciæ.

Hab. N. India.

Larrada celestina.

Female. Length 7 lines. Black, head and thorax semi-opaque; abdomen shining. Head closely and finely punctured; the face, as high as the insertion of the antennæ, covered with silvery pile. The thorax closely and finely punctured above; the metathorax obliquely striated, with punctures intermixed; the legs, and the thorax beneath, with a fine changeable silvery pile; the tarsi obscure fusco-ferruginous; the wings dark fuscous and having a purple iridescence, the posterior pair palest. Abdomen pilose at the sides and beneath, the apical margins more or less obscurely rufo-testaceous.

Hab. China (Hong Kong).

Larrada ferox.

Female. Length 8–8½ lines. Head and thorax black, abdomen and legs ferruginous. The head and thorax adorned with short silky glittering pubescence, usually more or less abraded on the disk of the mesothorax, scutellum, and metathorax above; the latter obliquely, finely, and evenly striated; the scape of the antennæ in front and the mandibles ferruginous; the coxæ, trochanters, and the anterior and intermediate femora beneath black; the wings fulvo-hyaline and faintly clouded at their apical margins. Abdomen smooth, shining, and with only a few scattered delicate punctures.

Hab. Africa.

Larrada diabolica.

Female. Length 10½ lines. Black, with the head, and thorax anteriorly, covered with bright golden pubescence. Head: the scape and four or five of the joints of the flagellum, and the mandibles, ferruginous, the tips of the latter black. The anterior femora, tibiæ, and tarsi ferruginous; wings dark brown, with a purple iridescence; the scutellum smooth and shining; the metathorax opaque. Abdomen smooth, shining, and impunctate; the apical segment ferruginous.

Hab. Sierra Leone; Port Natal.

This species is most closely allied to *L. aurulenta*; but its legs are black and its wings darker; it may nevertheless be a climatal variety of that species.

Larrada clypeata.

Female. Length 6¼ lines. Entirely black; the anterior margin of the clypeus emarginate in the middle, the lateral angles forming two blunt tubercles or teeth; the clypeus and sides of the face thinly covered with silvery pile. The mesothorax and scutellum shining, and closely and finely punctured; the metathorax opaque, with a longitudinal central channel, on each side of which it is indistinctly and finely striated obliquely in the middle, but more strongly and irregularly so at the sides; the wings fusco-hyaline, the neuration black. Abdomen smooth, shining, and very finely and closely punctured.

Hab. New Caledonia.

Larrada crassipes.

Female. Length 7 lines. Entirely black; wings fuscous, hyaline towards their base, the nervures black. Head densely covered in front, as high as the ocellus, with bright silvery pile; that on the clypeus has a faint golden tint. The thorax,

from the scutellum forwards, covered with pale golden pile; the metathorax at the sides and behind with a covering of bright silvery pile; the legs stout; the tibiæ and tarsi thickly spinose. The apical margins of the segments of the abdomen with bright silvery fasciæ, the fasciæ widen both in the middle and at the sides; the apical segment with divergent striæ.

Male. About 6 lines long. Body and legs more slender; the head and thorax more pubescent; wings the same as in the other sex; the basal segment of the abdomen covered with silvery pile; the other segments fasciated, the apical one pilose.

Hab. South Australia.

Genus PISON, Spin.

Pison maculipennis.

Female. Length 5 lines. Black, with the thorax, legs, and basal segment of the abdomen ferruginous; wings with two large fuscous maculæ. Head: the scape and four basal joints of the flagellum of the antennæ, the clypeus, and mandibles ferruginous, the latter black at their tips; the head above the clypeus, as high as the insertion of the antennæ, and the orbits of the eyes with glittering pale golden pubescence. Thorax: the posterior margin of the prothorax, of the mesothorax, a line on each side of the postscutellum, and the base of the metathorax adorned with golden pubescence, on the sides of the latter it is inclined to silvery brightness; the sides of the metathorax and the postscutellum black; wings flavo-hyaline, with a dark fuscous macula occupying the externo-median cell, and extending more or less into the posterior wing; another occupying the marginal cell; the nervures surrounding these maculæ black, the rest of the nervures and also the stigma pale testaceous; the apical joints of the intermediate and posterior tarsi fuscous. Abdomen: the apical margins of the two basal segments, and sometimes of the third (much more narrowly), yellowish white; the second segment more or less black at the base.

Hab. Brazil (Ega and Para).

Pison pilosus.

Female. Length 4 lines. Black; the abdomen shining, and covered with a pale golden pile, that on the legs silvery. Head: the cheeks and inner orbits of the eyes with bright silvery pile; the mandibles ferruginous at their apex. Thorax shagreened; the sides of the metathorax with a thin white pubescence; wings hyaline and brilliantly iridescent; the

nervures black; the tegulæ testaceous at their outer margins; the calcaria at the apex of the tibiæ ferruginous. Abdomen: the margins of the segments constricted; the apical margins with bright silvery fasciæ, which, in certain lights, have a golden tinge more or less brilliant.

Hab. Ega.

Family **Bembicidæ.**

Genus **BEMBEX**, Fabr.

Bembex albofasciata.

Male. Length $7\frac{1}{2}$ lines. Black; the abdomen with six white fasciæ, attenuated in the middle, the first slightly interrupted. Head: the clypeus, a line at the inner orbit of the eyes, not extending to their summit, a narrow line behind them, the scape of the antennæ in front, the labrum, and mandibles white, the latter black at their tips; the flagellum pale beneath. Thorax covered with griseous pubescence; the legs white, with a yellow tinge; the coxæ, trochanters, anterior femora behind, and the intermediate and posterior pairs (except at their apex) black; the tibiæ with a black line behind; wings hyaline. Abdomen: the first and second fasciæ are about the middle of the segments, and the following at their basal margins; beneath, each segment has an angular spot at its apical margin laterally; the second segment has a compressed tubercle, its margin curved, its apex truncate; the sixth segment is subtuberculate.

Hab. Zulu country.

Bembex crabroniformis.

Male. Length 6 lines. Black; head, thorax, and base of the abdomen thinly covered with erect white pubescence; the abdomen with six equal yellow fasciæ, all slightly interrupted. Head: the base and apex of the scape of the antennæ in front, the anterior margin of the clypeus, the labrum, mandibles, and a narrow line behind the eyes yellow. Thorax: the posterior margin of the prothorax, a line surrounding the tubercles, and a spot close to the tegulæ yellow; the tips of the femora in front and the tibiæ and tarsi yellow; a black line on the tibiæ behind, but only towards the apex of the posterior pair; wings hyaline. Abdomen: all the fasciæ of nearly equal width, their anterior margins slightly waved; beneath, shining black, with a triangular spot at the side of each segment, at its apical margin a very narrow line emanates from each, but is not continuous to the middle of the segments.

Hab. Port Essington.

Bembex diversipennis.

Female. Length $10\frac{1}{2}$ lines. Head ferruginous; thorax and abdomen black, variegated with yellow; the wings brown, with one third of fore wings at their apex hyaline; the clypeus, labrum, and mandibles yellow, the latter black at their apex; antennæ ferruginous; a quadrate black spot on the vertex. Thorax: the posterior margin of the prothorax, the tubercles, tegulæ, and legs ferruginous; the coxæ, trochanters, and base of the femora black; a transverse curved line on the scutellum, postscutellum, and metathorax, as well as its posterior angles, yellow. Abdomen: the first segment has a large, irregular, somewhat quadrate spot on each side, the second segment a broad oblong yellow macula, which nearly meet in the middle and are deeply incised at their inner margin; the third and fourth segments with large maculæ that are suddenly narrowed and curve inwards and upwards, nearly uniting in the centre of the segment; the fifth segment with a large oblong macula on each side, that nearly meet in the centre of the segment; the sixth ferruginous at the apex; beneath immaculate.

Male. As large as the female; wings hyaline; head and scape of the antennæ yellow, with the flagellum ferruginous, its four apical joints swollen and distorted. Thorax as in the female. Abdomen black beneath and yellow above; the apical margins of the first and three following segments margined with black, the margins produced in the middle into a triangular shape; the first segment with a small semicircular black spot, from which emanates a line, which unites with the black margin; the second segment with two small, oblique, central black spots; the third with two larger spots at its basal margin; the three apical segments margined with ferruginous; a small, acute, compressed spine on the second ventral segment.

Hab. Angola.

Bembex severa.

Female. Length 8 lines. Black, smooth and shining; the thorax with yellow markings, those on the abdomen white. Head: the face and clypeus covered with fine short silvery pubescence, that on the vertex is long and griseous; a narrow yellow line behind the eyes. Thorax: the posterior margin of the prothorax, the tubercles, tegulæ, and a line over them on the mesothorax, an ovate spot on each side of the scutellum, two oblique spots on the postscutellum, which are sometimes united, yellow; occasionally two short yellow lines on the mesothorax anteriorly, or two minute spots, both

frequently obliterated; the anterior femora and the tibiæ in front, as well as the intermediate tibiæ in front, yellow; their tarsi yellow beneath; all the claw-joints yellow; the wings subhyaline, having a fuscous cloud in the middle. Abdomen: the first segment with an angulated spot on each side; the second and third segments with a curved line on each side, which unite in the middle of the segments; the fourth segment with two central minute oblique spots.

The male resembles the female, but has no spots on the thorax, and the posterior tibiæ and apex of the femora are also yellow beneath; the second ventral segment has a compressed obtuse tubercle in the middle, and the fasciæ above are more or less interrupted.

Hab. Australia (Swan River).

Bembex palmata.

Male. Length 8 lines. Yellow beneath and black above, with yellow markings. Head: a quadrate black spot on the vertex, the rest of the head yellow; the scape very stout; the flagellum gradually thickened to the apex of the eighth joint; the following joints much narrowed, and forming a hook-shaped termination; an elongate sulcation on each side of the clypeus and labrum. Thorax: the sides of the mesothorax above, a curved line on the scutellum, a line on the post-scutellum, and a curved transverse one crossing the metathorax yellow; the mesothorax has on its disk two pear-shaped spots, which are united to a narrow line which curves backwards to the base of the scutellum; wings hyaline; the anterior tibiæ expanded at their apex; the first joint of the tarsi dilated into an oblong concavo-convex process, which is fringed behind with black and ferruginous bristles. Abdomen yellow beneath and black above, each segment with a broad yellow fascia, which only leaves a narrow black apical margin; the second ventral segment compressed, forming a short tooth posteriorly.

Hab. N. Australia.

Bembex tridentifera.

Female. Length 7-8 lines. Black; the thorax with yellow markings, the abdomen with white ones. Head: the cheeks, the mandibles, labrum, clypeus, and a tridentate shape above it yellow; the tips of the mandibles and two minute spots at the base of the clypeus black; a line at the side of the scape and the flagellum of the antennæ above black. Thorax: the margin of the prothorax, a line over the tegulæ, which have a spot in front, a spot on each side both of the scutellum and postscutellum yellow; a minute black spot at the apex of the

femora; the thorax at the sides, and also beneath, yellow, with a large quadrate black spot on the clypeus; the legs yellow; the wings hyaline. Abdomen: a triangular spot on each side of the first segment; the three following segments have each a transverse undulating fascia in the middle, the fasciæ are suddenly enlarged laterally into subquadrate maculæ; the fifth segment has an ovate spot on each side; the first four ventral segments have on each side an ovate macula, each in succession smaller, the fourth minute.

Hab. Queensland (Moreton Bay).

Bembex flaviventris.

Female. Length 6-7 lines. Black above and variegated with yellow markings; beneath entirely yellow. Head yellow, with the vertex and upper portion behind black; antennæ yellow, with a black spot at the apex of the scape above; the flagellum above, except the apical joint, black. Thorax: the margin of the prothorax, two abbreviated lines on the mesothorax in front, and two minute spots posteriorly close to the scutellum, which has a line at its lateral margins, a transverse line on the postscutellum, and an oblique one on each side of the metathorax inclining inwardly, yellow; the legs bright yellow, with a narrow black line on the femora and tibiæ; wings hyaline. Abdomen: each segment with a transverse undulating line, which is suddenly widened laterally, and the apical segment yellow.

Male very like the other sex; but with a large, compressed, obtuse tubercle on the second ventral segment.

Hab. Australia (Swan River).

Bembex flavilabris.

Female. Length 6 lines. Black, with the labrum, tibiæ, and tarsi yellow; abdomen with white fasciæ. Head: the clypeus and face with silvery pubescence, the vertex with white pubescence; a line behind the eyes and the scape of the antennæ yellow in front. Thorax: the margin of the prothorax, the tubercles and the tegulæ behind, a spot on the mesothorax close to the tegulæ, a spot on each side of the scutellum, and the postscutellum yellow; the anterior femora in front, and the apex of the intermediate and posterior pairs, yellow; a black line on the anterior and intermediate tibiæ outside. Abdomen: an elongate white spot, pointed inwardly, on the first segment; the three following segments have each an undulating white fascia, the first very slightly interrupted, all widening at the lateral margins; beneath shining black.

Hab. W. Australia.

Bembex multipicta.

Female. Length $7\frac{1}{2}$ lines. Black, variegated with pale yellow markings; the abdomen with curved fasciæ, which are not united in the middle. Head: the mandibles, labrum, a broad line on each side of the face, the clypeus, a triangular spot above it, and two minute spots in front of the ocelli, and with a line behind the eyes, which becomes wider towards the base of the mandibles, yellow; the scape yellow in front; the base of the clypeus with a large bilobed black spot, and the tips of the mandibles black. Thorax: a narrow line on the posterior margin of the prothorax, two minute elongate spots on the disk of the mesothorax, a spot close to the tegulæ, an ovate one on each side of the scutellum, the postscutellum, a curved line across the metathorax, and an ovate spot at its posterior lateral angles yellow; legs yellow, with a black line on the tibiæ and tarsi behind; the wings hyaline. Abdomen: an interrupted broad waved fascia on the first segment; the following segments have on each side a subquadrate spot, from which a line curves backwards in a lunate form; the apical segment black; beneath, each segment has a lateral angular yellow spot.

Hab. Mexico (Oajaca).

A male from Brazil, which has the abdomen marked in the same manner as this species, is in the collection; it only differs in being entirely yellow beneath, a common sexual distinction, and is probably the true male of *B. multipicta*.

Bembex pallidipicta.

Female. Length 8 lines. Black; the head, thorax, and base of the abdomen densely covered with short white pubescence; the abdominal segments with broad glaucous fasciæ. Head: the mandibles, labrum, clypeus, sides of the face, a line behind the eyes, and the scape in front yellowish white; the flagellum fulvous beneath. Thorax: a narrow line on the margin of the prothorax, another over the tegulæ, and also one on the sides and posterior margin of the scutellum, a transverse one on the postscutellum, a curved one across the metathorax and its posterior angles, pale yellowish white; the legs of the same colour, with the femora more or less black behind; wings hyaline. Abdomen: the first fascia much narrowed in the middle, the second broad and suddenly widened laterally, the third slightly incised in the middle posteriorly, and the fourth has its anterior margin waved; beneath, each segment has a lateral triangular pale macula.

Hab. Mexico.

[To be continued.]

XL.—On the Amount of Substance-waste undergone by Insects in the Pupal State; with Remarks on *Papilio Ajax*.
By RAPHAEL MELDOLA, F.C.S.

THE observations herein recorded are preliminary to an experimental inquiry into the law which governs the size of the individual in species undergoing complete metamorphosis. Being unable to continue the investigation until next season, when some species going through its larval and pupal stages within the season will be procurable, I deem it advisable to make known the results of my experiments so far as these are at present conducted.

The ideas that have led to this inquiry are briefly these:—From the period of its emergence from the egg to the assumption of the pupal state the larva of an insect undergoing complete metamorphosis continues to feed and to increase in bulk; in this stage the insect exerts but little activity, so that nutrition is in excess of waste and a considerable surplus is left for growth. With the pupal stage comes a period of quiescence, when the substance-loss due to activity is reduced to a minimum.

The experiments of Newport* have shown that in the pupal state respiration still goes on, though to a diminished extent, so that the carbonic acid and water excreted by the pupa, being uncompensated by food, must be a dead loss of matter to the insect. Several weighings made by Newport prove the truth of this statement. Thus, there being gain of matter in the larval state and loss during the pupal stage, and there being, moreover, undoubted variation in size among the individuals of a species (apart from sexual difference in size), it occurred to me as probable that one of the laws governing individual size was to be derived from the facts above set forth; for from these we might fairly expect that the size of an individual (all disturbing factors being eliminated) would be, *cæteris paribus*, inversely proportional to the ratio of the pupal to the larval period, or directly proportional to the ratio of the larval to the pupal period.

Such being the law arrived at *à priori*, I determined to submit it to experimental investigation when a favourable opportunity presented itself. In the mean time, when searching for recorded facts bearing on the subject, I became acquainted with the interesting experiments of Mr. W. H. Edwards † upon

* Phil. Trans. 1836 & 1837, vols. cxxvi. & cxxvii.

† 'Butterflies of North America,' part ix., Dec. 1871. I am indebted to my friend Mr. A. G. Butler, F.L.S., for the loan of this work and also for specimens of *P. Ajax*.

the breeding of *Papilio Ajax*; and these seemed to furnish data fitted for testing my conclusions.

Papilio Ajax is a polymorphic species inhabiting North America, presenting the three following well-defined forms:—

1. *Papilio Ajax*, var. *Walshii*, Edwards.
2. ———, var. *Telamonides*, Felder.
3. ———, var. *Marcellus*, Boisduval.

These three forms differ in many specific characters, and were long recognized as distinct species. They form a series graduating in size, *Marcellus* being the largest and *Walshii* the smallest. The first to appear on the wing in the year is *Walshii*; this is followed by *Telamonides*, and this in its turn by *Marcellus*. The larvæ of *Walshii* are described by Mr. Edwards as being very uniform in colour and marking; those of *Telamonides* are similar to *Walshii* "up to the second moult, after which there is a wide divergence, some retaining a resemblance to *Walshii*," others presenting several variations. "The larvæ of *Marcellus* combine the variations of *Walshii* and *Telamonides*." The specific identity of the three varieties was proved by rearing them all from one batch of eggs. Mr. Edwards thus sums up the results of his whole series of observations:—" *Walshii* produces *Walshii*, *Telamonides*, and *Marcellus* the same season, and its own type in the spring; *Marcellus* produces successive broods of *Marcellus* the same season, and occasionally *Telamonides* (individual taken in September 1870), and the last brood produces *Walshii* and *Telamonides* in the spring; and whenever any of the chrysalids of either brood of *Marcellus* pass the winter they produce the other two varieties, and probably sometimes their own type (individual taken in April 1867). The chrysalids of *Walshii* that pass the winter of 1871-72 will produce *Walshii* or *Telamonides*." The most important difference between the varieties, so far as our present purpose is concerned, is that in the duration of the larval and pupal periods. The duration of the different stages in the three forms is shown below:—

	Egg.	Larva.	Chrysalis.	Total.
<i>Walshii</i>	7-8 days.	22-29 days.	14 days.	43-51 days.
<i>Telamonides</i>	4-5 "	15-18 "	11-14 "	30-36 "
<i>Marcellus</i>	4-5 "	12-19 "	11-14 "	27-38 "

Here, therefore, is a species presenting varieties differing in size and in the duration of their larval and pupal periods. It is easy to calculate whether any relationship exists between the size of the insect and the ratio of the pupal to the larval period; and on making the calculation I found that there was a relationship, but exactly the reverse of that which would be

anticipated from the conclusions previously set forth. This result is, I think, sufficiently curious to warrant insertion :—

Name of variety.	Ratio of mean pupal to mean larval period.	Ratio of mean larval to mean pupal period.	Mean expanse, ♂.
<i>Walshii</i>	$\frac{14}{25.5} = 0.549$	$\frac{25.5}{14} = 1.821$	inches. 2.70
<i>Telamonides</i> ..	$\frac{12.5}{16.5} = 0.757$	$\frac{16.5}{12.5} = 1.320$	3.00
<i>Marcellus</i>	$\frac{12.5}{15.5} = 0.806$	$\frac{15.5}{12.5} = 1.240$	3.35

It is here seen that the size of the variety is directly instead of inversely proportional to the ratio of the pupal to the larval period and *vice versa*. Whether these results are due to mere coincidence or whether they are related as cause to effect I am quite unable to say. The calculations, however, point to the conclusion either that the pupal waste has no effect upon the size of the imago, or else that it is overbalanced by the action of other causes. The difference of size between *Walshii*, *Telamonides*, and *Marcellus* is therefore most probably correlated with those other differences (such as marking of imago, pattern and colour of larva, duration of egg-stage, &c.) which Mr. Edwards has shown to exist between these three varieties.

Double-brooded species appeared also to present at first sight data fitted for testing the conclusions arrived at; but further reflection convinced me that such facts as are known are so encumbered by factors of unknown value as to render their comparison useless. Thus the species of *Selenia* and *Ephyra* inhabiting this country are double-brooded, the individuals of the spring brood being in both cases larger than those of the autumnal brood. Now the spring brood passes the whole winter in the pupal state, while the autumnal brood passes only a few weeks in the summer in this condition. In this case *temperature* is the unknown disturbing factor. We know not the amount of the total loss either during the summer or winter pupal period; neither do we know the amount of the total gain of the larva during its vernal period of feeding or during its autumnal period of feeding. With *Selenia* also there is some difference of colour and marking between the two broods; so that we have here "seasonal dimorphism," with which, as in *P. Ajax*, the difference of size may be correlated. The European butterfly *Araschnia prorsa* is also double-brooded; but in this case the spring variety is the

smaller. In many species individuals sometimes fail to emerge at their proper period, and then remain in the pupal state until the following season. This commonly happens with *Eriogaster lanestris*, and occasionally with *Bombyx quercus*, var. *callunæ*; I have known it to occur also with *Sphinx ligustri*; and my friend Mr. W. Cole informs me that he has a pupa of *Papilio Machaon* now living (September 12th) which failed to emerge at the proper period. In all cases of this kind we are in complete darkness as to the respiratory activity of such dormant pupæ.

The experiments which I have now to record are extensions of Newport's experiments* upon the loss of weight in pupæ, and were undertaken with a view to ascertain the exact amount of the loss undergone by insects in this condition, and to gain also an insight into the extent of the individual variation in respiratory activity among pupæ of the same species exposed to the same thermal conditions.

The first weighings made were of a specimen of *Bombyx quercus* found in the larval state on Leith Hill on the 2nd of last June. It was nearly full-grown when found, and commenced to spin up a day or two after capture. About a week was allowed to pass before making the first weighing, in order to make sure that the larva had changed, and in order to diminish the risk of error due to the drying-up of the cast-off skin and of the cocoon. The weighings (made throughout in grammes) were repeated at intervals of seven days until the emergence of the imago, which took place on the 14th of July. This pupa was weighed in its cocoon, and the weight of the empty cocoon afterwards subtracted from each of the weighings. The following are the results:—

Table showing loss of weight in pupa of *Bombyx quercus* during periods of seven days.

Date of weighing.	Actual weight.	Loss.	Percentage of loss.
June 12th	1·381	—	—
„ 19th	1·280	0·101	7·31
„ 26th	1·257	0·023	1·79
July 3rd	1·229	0·028	2·22
„ 10th	1·164	0·065	5·28

* This great physiologist proved that pupæ respired, by detecting the excreted carbonic acid; and he estimated the respiratory activity by determining the quantity of this gas. The estimation of the total loss of weight is essential to the present inquiry, because water, whether produced by the oxidation of hydrogen-containing tissues, or whether introduced into the system with the juices of the food-plant, is essentially a product of respiration, and counts, like carbonic acid, for substance-loss.

In the second column of the foregoing table the "actual weight" is the weight of the pupa alone. In the fourth column is calculated the percentage of loss upon the weight of the pupa at the commencement of each of the periods. I estimate that during the whole of its pupal existence this insect lost from 25 to 26 per cent. of its weight.

The next experiments were made upon six specimens of *Liparis dispar* bred from eggs supplied to me in 1872 by my friend Mr. G. W. Bird. These pupæ were, as before, allowed to remain some time before making the first weighing, and were then weighed quite naked, the cocoon and larva-skin being removed, so as to do away with all risk of error due to drying. The weighings were in this case repeated at intervals of four days, with the following results:—

Table showing loss of weight in six pupæ of *Liparis dispar* during periods of four days.

No.	Initial weight.	Serial weighings.											
	July 10.	July 14.			July 18.			July 22.			July 26.		
	Actual weight.	Actual weight.	Loss.	Percent. age of loss.	Actual weight.	Loss.	Percent. age of loss.	Actual weight.	Loss.	Percent. age of loss.	Actual weight.	Loss.	Percent. age of loss.
I. ♀.....	1·031	0·957	0·074	7·18	0·900	0·057	5·95	—	—	—	—	—	—
II. ♀ ...	0·938	0·898	0·040	4·26	0·859	0·039	4·34	—	—	—	—	—	—
III. ♀...	0·998	0·947	0·051	5·11	0·899	0·048	5·07	—	—	—	—	—	—
IV. ♂ ...	0·607	0·577	0·030	4·94	0·548	0·029	5·02	—	—	—	—	—	—
V. ♂ ...	0·429	0·414	0·015	3·52	0·400	0·014	3·38	0·382	0·018	4·50	0·112†	0·270†	70·68†
VI. ♀ ...	1·044	1·012	0·032	3·06	0·873*	0·139*	13·73*	0·690*	0·183*	20·96*	0·500*	0·190*	27·53*

* signifies that the pupa is dead. † signifies that the weight is that of the imago. Where no figure is supplied the imago has emerged.

The expressions "actual weight" and "percentage of loss" have in this table the same meanings as before. Specimen VI. was killed by exposure to ether vapour at the termination of the first period (July 14th), in order to compare the loss of weight due to simple drying up with that due to respiration. For this reason the dead pupa was always weighed on the same days with the living ones; and, as will be seen on reference to the table, it invariably lost more, from the period of its death, than any of the living specimens. All the specimens were kept together in the same apartment, so that they were exposed to the same temperature. Nos. I., II., and III. yielded perfect insects on July 20th; no. IV. emerged on July 22nd, and no. V. on July 26th. This last specimen happening to

emerge on a morning concluding a period, was weighed in the perfect state, and had lost more than seventy per cent. of its weight on July 22nd. This enormous loss is attributable to the increased activity of the imago, to the drying-up of the moist pupa-case, and to the ejection and drying of that red fluid which most Lepidopterous insects emit on their emergence from the pupa. Similarly Newport found that a pupa of *Sphinx ligustri* which weighed 67·4 grains had diminished to 34 grains when weighed 33 days after (the day after the emergence of the imago), having lost 52·1 per cent. of its initial weight. Specimen V. had lost on July 26th nearly seventy-four per cent. of its initial weight; but even this is smaller than the actual loss, because the first weighing was made more than a week after the changing of the larva, during which time the insect had been losing weight.

The next experiments were made upon living specimens of *L. dispar* in the perfect state. Three females and one male were weighed in boxes on July 10th, and then weighed again four days after, with the following results:—

Table showing loss of weight in four specimens of *Liparis dispar* (perfect insects) during a period of four days.

No.	July 10th.	July 14th.		
	Actual weight.	Actual weight.	Loss.	Percentage of loss.
I. ♂	0·118	0·092	0·026	22·03
II. ♀ ..	0·451	0·414	0·037	8·20
III. ♀ ..	0·514	0·460	0·054	10·50
IV. ♀ ..	0·546	0·458	0·088	16·11

This last table shows in a beautiful manner the relation between activity and waste; for the male was very restless and fluttered about in its box, while the females were tolerably quiet. The loss in the male is to the mean loss in the females in the ratio of 22·03 : 11·60, which is very nearly that of 2 : 1. The mean loss in the females is to the mean loss in the four female pupæ in the same period of time in the ratio of 11·60 : 4·99.

Thus do these preliminary experiments prove that there is a loss of substance in the pupal state, that this loss is different in amount in individuals of the same species exposed to the same temperature, and that it is less in amount than that occurring in the same species in the perfect state or in a dead

pupa by desiccation—the comparisons extending in all cases over equal periods of time. They prove also, what is far more important to our present inquiry, that the variation in loss is sufficient in amount to lead us to expect the size, or at least the specific gravity, of the imago to be sensibly influenced by it.

Trusting that other observers may be induced to take up the inquiry next season (for in the multiplicity of observations there is strength), I propose to point out in concluding the various disturbing factors which would interfere with the experimental results. In any species, then, the size of an individual may be influenced by:—

1. *The natural difference in size between the two sexes of many species.* This factor is obviously eliminated by comparing only individuals of the same sex.

2. *The force of heredity—large parents tending to give rise to large individuals and vice versâ.* Eliminated by comparing only the offspring of a single pair.

3. *The varying supply of food to different individual larvæ.* Eliminated by supplying each larva with excess of its food-plant.

4. *The different amount of substance-waste in different individual larvæ due to dissimilar thermal conditions.* Eliminated by keeping the experimental larvæ at the same temperature. The amount of carbonic acid excreted by different individual larvæ of a species exposed to the same temperature is proved by Newport's experiments to vary but little. This factor might, in fact, by itself be neglected altogether, but becomes eliminated when eliminating the next factor.

5. *The different amount of substance-gain in different individual larvæ, due to individual variation in assimilative power.* Eliminated by periodically weighing the experimental larvæ, and comparing only the imagines from those which show a similar proportional increase during the same periods of time.

6. *The different amount of substance-waste in different individual pupæ, due to dissimilar thermal conditions.* Eliminated by keeping the experimental pupæ at the same temperature.

7. *The different amount of substance-waste in different pupæ (kept at the same temperature) due to individual variation in respiratory activity.* Newport's experiments and my own weighings prove that this is a variable factor. Its elimination can therefore only be effected by periodically weighing the experimental pupæ, and comparing only the imagines from those which in given periods of time undergo the same proportional amount of loss.

In these observations an ordinary chemical balance will be found most trustworthy for making the weighings.

XLI.—On the Longicorn Coleoptera of Japan.

By H. W. BATES, F.L.S.

[Continued from p. 201.]

Family Lamiidæ.

Echthistatus gibber, n. sp.

E. spinoso, Pascoe (Journ. Ent. pl. 17. f. 8), forma similis. Brevis, fuscus, tomento vel squamis fulvo-terreis dense vestitus; capite grosse, sparsim punctato; thorace subquadrato, medio paulo dilatato ibique utrinque spina elongata valida armato, supra multituberoso; elytris ad trientem apicalem utrinque fortiter gibbosis, inter gibber et humerum flexuoso-carinatis, apice utrinque productis, mucronatis, supra passim inæqualiter granulatis; antennis ♂ corpore plusquam duplo longioribus, scapo scabroso, articulo secundo apice incrassato. Long. 6–8 lin. ♂ ♀.

Maiyasan and Kawatchi, in September.

I place this extraordinary Longicorn, without hesitation, in the genus *Echthistatus*, although it differs in armature from the type species (*E. spinosus*), and inhabits a far distant country, if the locality "Mexico" for *E. spinosus* be a correct one. In the form of the head (broad front, distant antennæ, and concave vertex), antennæ, legs, and general figure of the body, there is great similarity between the present insect and Pascoe's figure. The elytra, however, are very differently tuberculated; on the disk of each, at rather more than two-thirds the length, is a transverse, slightly elevated ridge, between which and the apex is a straight declivity; from the outer end of the ridge runs an obtuse carina, dipping greatly before it reaches the shoulder; and the sides of the elytra from the carina are vertical. The whole surface of the elytra is studded with granulations, larger and smaller. The species varies greatly in many points, especially in the size and number of the granulations and the length of the apical fork-like mucrones.

The species belongs in all its characters to Lacordaire's Groupe *Dorcadides*, and is closely allied to *Dorcadida*.

Monohammus subfasciatus, n. sp.

M. oblongo-subcylindricus, fuscus, fulvo maculatim tomentosus; elytris medio fascia indefinita, abbreviata, cinerea; scutello fulvotomentoso. Long. 6–8½ lin. ♂ ♀.

Nagasaki; many examples.

A typical *Monohammus*, closely allied to *M. Heinrothii*, Cederj., &c. Smaller, and elytra much less elongated than in *M. sartor*; head and thorax relatively narrower; antenniferous tubercles obtuse; thoracic spine very small. The thorax is

cylindrical, and appears more elongated than in *M. sartor*; the punctuation is much finer and shallower. The elytra are singly rounded at the tip, subconfluent-punctured throughout, and thickly sprinkled with spots of tawny pubescence; in all examples there is a transverse spot a little behind the middle, not reaching the suture or side, of grey pubescence or tomentum; it is ill defined on its edges, and is spotted with darker colour. The antennæ in the male are three times the length of the body; robust towards the base, slender towards the tip, and wholly pitchy black; scape densely and finely rugulose-punctate.

Monohammus tesserula, White.

Monohammus tesserula, White, Proc. Zool. Soc. 1858, p. 408.

Hiogo; many examples. Also Hong-Kong, Amoy, and Northern China.

A true *Monohammus*, allied to the North-American *M. titillator*, F.

Monohammus luxuriosus, n. sp.

M. robustus, modice convexus, postice (♂) angustatus, æneo-fuscus, tomento subtili ochraceo-fusco plagiatis vestitus; elytris fasciis duabus, rectis, vagis, obscurioribus. Long. 13-16 lin.

Several examples. Found also in Northern China.

Differs in many points from the typical *Monohammi*, with which it agrees in the moderately narrow, simple mesosternal process, rounded apex of elytra, &c. The antennal scape varies in form in different individuals—in one male before me being clavate, almost pyriform, and in others elongate obconical, as usual in this group; the cicatrice also is "open" in the clavate form, but "closed" and semicircular in other specimens; the joints 3-10 are a little produced and acute at their inner apical angles. The head and thorax above are rather thickly studded with deep punctures, without trace of the rugæ of the typical species. The elytra are finely granulate, punctate towards the base, and very finely punctulate towards the apex, with traces of two raised lines, limited by a row of punctures, on each. The antennæ are scarcely twice the length of the body in the male, and not much abbreviated in the female; they are clothed generally with very fine grey pubescence, the tips of the joints darker. The anterior legs are very moderately elongated in the male.

Mr. Lewis found the species in Mr. Pascoe's collection standing under the name which I have adopted.

Monohammus fraudator, n. sp.

M. fistulatori similis, at subtilius punctatus, etc. Fuscus, tomento subsericeo subtili ochreo-fulvo dense vestitus; capitis vertice im-

punctato; thorace disco pauciter punctulato; elytris apice singulatim rotundatis, supra subtiliter subseriatim punctulatis; antennis plus minusve rufescentibus, articulis a tertio apice obscurioribus, scapo obconico, cicatrice incompleta. Long. 7-11 lin. ♂ ♀.

♂. Antennis articulis 3^o-5^{um} paulo incrassatis.

Nagasaki and Hiogo, common.

Very similar to *M. fistulator* (Germar); rather less robust, more smoothly clothed with fine tawny-ochreous, rather silky, tomentum, and the punctuation scarcely visible to the naked eye. The male, as in *M. fistulator*, *M. argentatus*, and other allied species, has the 3rd to 5th antennal joints distinctly thickened. As the rim which limits the cicatrice of the scape is much abbreviated, the species would, according to Lacordaire's system, belong to a different subfamily from *Monohammus*; and, in fact, I should consider it to be the *Orsidis sobrius* of Pascoe, if that author had mentioned the thickening of the 3rd to 5th antennal joints in the male. It would violate natural affinities too much, however, to separate it from *M. fistulator* and allies.

Monohammus sejunctus, n. sp.

M. fraudatori quam maxime affinis; differt antennarum scapo tumido, clavato, articulis 3^o-5^{um} (♂) linearibus haud incrassatis; tibiis anticis flexuosis, intermediis tuberculo magis acuto. Long. 6-10 lin. ♂ ♀.

Nagasaki and Hiogo, common.

Very similar in form and clothing to *M. fraudator*; the sculpture is also similar, except that in the female the disk of the thorax is more strongly punctured, and the vertex also marked with similar punctures. In the male the punctuation varies, being sometimes similar to that of the female, and at other times like that of *M. fraudator*. Notwithstanding the many points of structural difference (the simple 3rd to 5th antennal joints, more clavate scape, flexuous anterior tibiae, &c.), I strongly suspect it to be only a variety of *M. fraudator*. The tomentum is more silky, especially on the elytra, where it varies by lighter and darker shades.

This species may possibly be the *Orsidis sobrius* (Pascoe).

Monohammus degener, n. sp.

M. parvus; *M. fistulatori* forma similis, rufo-fuscus, tomento griseo et rufo-fusco variegatus; thorace crebre punctato, fulvo-pubescente, spina laterali brevi, sulco transversali basali unico; scutello fulvo-pubescente; elytris passim punctulatis, apice singulatim subacuminatis; antennis rufo-fuscis, articulis basi pallidis; scapi cicatrice fere obsoleta. Long. 4½-5 lin.

Nagasaki; three examples.

The cicatrice of the scape in this small species is scarcely visible ; it is present, however, and is limited by a curved rim which is a little less closed than in *M. fraudator*. In habit it resembles very much a dwarfed specimen of that species ; but there is a well-marked difference in the punctuation of the thorax, which is rather close and uniform ; the pubescence, too, is rather coarser ; the lateral spines are very short. The elytra are rather produced and sharp at the sutural apex ; and the pubescence is variegated, the ground-colour being reddish tawny and the very irregular patches dull greyish. The 3rd to 5th antennal joints are simple ; the basal halves of all joints from the third are grey.

The base of the thorax has two transverse grooves, neither of them very well marked.

Monohammus (Psacotha) hilaris, Pascoe.

Monohammus (Psacotha) hilaris, Pascoe, Tr. Ent. Soc. vol. iv. 2nd ser. p. 103.

Two examples ; in a timber-yard, Nagasaki. Also N. China and I. of Formosa.

Melanauster chinensis, Forster.

Melanauster chinensis, Forster, Cent. Ins. p. 39.

L. punctator, Fab. Syst. El.

Var. *macularia*, Thoms. Syst. Céramb. p. 553.

Many examples. On *Eleagnus japonicus* ; the larva feeds in the stems.

All the examples belong to what appears to be the var. *macularia*, Thoms., which is rather narrower and less strongly tuberculate at the base of the elytra than the ordinary Chinese form, which is no doubt the true *chinensis*. The var. *macularia* is also abundant in the I. of Formosa.

Melanauster glabripennis, Motschulsky.

Melanauster glabripennis, Motschulsky, Etudes Entom. 1860, p. 19.

Melanauster? ruber, Dalm.

Melanauster? ruber, Dalm., in Schönh. Syn. Ins. iii. App. p. 167.

M. championi, White, Proc. Zool. Soc. 1858, p. 398.

Nagasaki. Common, on firs.

The dense tomentose clothing gives this species a very different facies from the rest of the genus *Melanauster*. The vertex is also narrower, and the antenniferous tubercles more vertical. It has, however, the tuberoso mesosternum and finely granulated eyes of *Melanauster*.

Batocera lineolata, Chevrolat.*Batocera lineolata*, Chevrolat, Rev. et Mag. Zool. 1852, p. 417.*B. chinensis*, Thoms. Arch. Ent. i. p. 170.

Nagasaki; abundant. Found also at Shanghai.

Apriona rugicollis, Chevr.*Apriona rugicollis*, Chevr. Rev. et Mag. Zool. 1852, p. 414.

Many examples. Also at Shanghai, Amoy, and the I. of Formosa.

Uræcha bimaculata, Thoms.*Uræcha bimaculata*, Thoms. Syst. Céramb. p. 84.Common on dead stems of *Cissus*.*Mesosa japonica*, n. sp.

M. myopi proxime affinis, differt colore nigro-fusco, haud griseo, sed tomento fulvo maculatim variegata; elongato-ovata; capite thoraceque confertim granulatis, lineolis fulvis ornatis, thorace lineolis duabus nigris antice et postice ornato, interdum obsoletis; elytris versus basin fortiter granulatis, maculis parvis tenuibus fulvis et nigris conspersis; antennis ♂ apice subhamatis, articulis 3^o-11^{um} basi griseis, scapo grosse scabroso; corpore subtus et pedibus fulvo maculatis. Long. 5½-7 lin. ♂ ♀.

Nagasaki.

Very similar in form to *M. myops*, but decidedly broader or more ovate, and antenniferous tubercles in the male less prominent at the apex. The head and thorax are covered with small, shining, black granulations, and more speckled with bright tawny than in *M. myops*; the four black lineoles much less distinct. The elytra have no trace of the black transverse discoidal spot beyond the middle; they are more densely and largely granulated over their basal half, and are rather evenly sprinkled with wavy specks of bright tawny tomentum, the ground-colour being dark shining brown, with rounded spots of black tomentum.

Mesosa perplexa, Pascoe.*Mesosa perplexa*, Pascoe, Trans. Ent. Soc. ser. 2, vol. iv. p. 243.

Apparently not uncommon. Also N. China and I. of Formosa.

This species differs considerably from the typical *Mesosæ*, having a distinct anterior lateral tubercle to the thorax, and forehead very slightly concave between the antenniferous tubercles. The disk of the thorax, however, is not grossly tuberculate, as in *Coptops*; and the eleventh antennal joint in the male is shorter than the tenth, and quite straight.

Mesosa longipennis, n. sp.

M. elongato-oblonga, griseo-olivacea vel griseo-fusca, nigro maculata, maculis in elytris bifasciatim dispositis; thorace breviter cylindrico, supra æquali sparsissime punctato; elytris versus basin sparsim granulato-punctatis; antennis ♂ corpore multo longioribus, articulo undecimo subrecto, fusco-ferrugineis, articulis (præcipue quarto, sexto et octavo) basi griseis. Long. 7-9½ lin. ♂ ♀.

Hiogo; several examples.

A large, elongated species, unlike *Mesosa* in facies, yet closely allied to *M. nebulosa*. The head is concave, in the same degree, between the antennæ and the thorax, free from tubercles; the antennæ also have the eleventh joint nearly straight. The elytra are greatly elongated in comparison with the head and thorax; they are of a light olivaceous-brown colour, varied with greyish wavy marks, speckled throughout with dark brown, and having a number of black marks—viz. one at the base on each side, others at a third the length, arranged as a broken undulated fascia, and others at two thirds the length, also arranged as a much broken fascia, but with a distinct oblong spot on the suture. The thorax is similarly coloured, and shows distinct traces of black lineoles on the anterior and posterior margins. The dark spots are variable, and sometimes obsolete.

Rhodopis Lewisii, n. sp.

R. facie Monohammi, at minor. Elongata, nigro-fusca, pube brevi ochraceo-fusca plagiatis vestita; capite thoraceque (angustis) sparsim fortiter punctatis, hoc vittis tribus angustis ochraceofuscis, tuberculo laterali brevi, conico; antennis gracilibus, corpore (♂) triplo, (♀) duplo longioribus, articulis 3^o-11^{um} dimidio basali pallidis; scapo pyriformi, ♂ articulo tertio apice fortiter clavato; tibiis basi rufescentibus. Long. 6-7 lin. ♂ ♀.

Hiogo; many examples.

Differs from the only other described species, *R. pubera*, Thoms. (Sylhet), by the pyriform club of the antennal scape; this joint in *R. pubera*, according to Lacordaire's description, being obconical. The lateral tubercle also seems to be more distinct; it is very short, however, and broadly conical. In all other respects it answers well to the generic characters of *Rhodopis*. The club at the apex of the third antennal joint in the male is very similar in size and shape to the scape; and both are dark brown and glossy. The elytra are somewhat evenly punctured throughout; and the light brown macular, tomentose, pubescence is collected here and there into patches,

which form almost fasciæ a little before and after the middle; the apex is very briefly and rather obliquely truncated.

Olenecamptus cretaceus, n. sp.

O. magnus, tomento albo-cretaceo incrustatus; fronte, vitta utrinque laterali, ab oculo usque ad elytrorum apicem, antennis et pedibus fuscis. Long. 11 lin. ♂.

One example.

This fine and distinct species is clothed above and beneath with a white tomentum, so dense and thick that it appears like chalky-white pigment; a lateral stripe, beginning behind the eye and extending along the upper flank of the thorax and the margin of the elytra, remain naked (or nearly so) and of a fine tawny-brown colour; on the elytra the vitta emits a short quadrate branch not far from the base, and a second a little beyond the middle; nearer the apex is a slight projecting angle of the same colour. The forehead is also brown, and coarsely granulate and pubescent. The antennæ are about twice the length of the body, naked, tawny-brown, darker at the base, all the joints (especially towards the base) roughened with sharp tubercles. The legs are tawny brown; the anterior femora are flexuous, nearly as in the typical species; the tibiæ are also bent near the end, and serrate interiorly throughout.

Bumetopia oscitans, Pascoe.

Bumetopia oscitans, Pascoe, Trans. Ent. Soc. 2nd ser. vol. iv. p. 252 (1857).

Yochostyla japonica, Thomson, Physis, ii. p. 151 (1868).

Nagasaki; common in hedges. Also I. of Formosa and Hong-Kong.

The species varies much in size, and also in the relative length and breadth of the thorax; but Japanese specimens are not specifically distinguishable from Chinese.

Ælara furcata, n. sp.

Æ. postice attenuata, ochraceo-albo tomentosa, thorace lateribus inermi, dorso longitudinaliter rugato, medio carinato; elytris basi utrinque crista angusta ochraceo penicillata, apice utrinque sinuato-truncatis, angulis externis longe productis, divaricatis. Long. 8-10 lin.

Hiogo, on bamboo fences; larvæ feed in the interior of the stems. Also I. of Formosa.

Distinguished by the form of its elytra—gradually narrowed and sloping from the basal crests to the apex, with produced divaricate apices. In fresh, unabraded examples the head,

thorax, and sides of the elytra are chalky white, the rest of the elytra being ochreous. The underside and legs are varied with white and ochreous.

Praonetha caudata, n. sp.

P. subcylindrica, robusta; elytris apicem versus fortius angustatis et declivibus, apice ipse utrinque acuminato, ad suturam sinuatim exciso; antennis ♂ corpore triente longioribus, articulis 4^o-11^{um} subæqualibus, filiformibus; corpore supra fortiter punctato: elytris carina centro-basali brevi, alteris duabus discoidalibus post medium elongatis; fuscis, nigro fulvoque conspersis; medio griseis, ante declivitatem posteriorem macula transversa nigra. Long. 6-8 lin. ♂ ♀.

Common everywhere in May.

Belongs to the section with elongate, filiform antennæ—which in the female are equal in length to the body, and in the male a third longer. The antennæ, body, and legs are dark brown; the elytra greyish in the middle, sometimes having a greyish fascia just before the posterior declivity, the fascia bordered behind with black.

Praonetha zonata, n. sp.

P. subcylindrica, robusta; antennis ♂ corpore multo longioribus, ♀ vix brevioribus; nigro-fusca, fulvo paulo variegata; elytris ante declivitatem posteriorem sordide albo fasciatis; crista centro-basali brevi nigro-penicillata, disco bicarinatis, carinis ad fasciæ marginem posticum nigro maculatis; apice intus breviter oblique sinuato-truncatis. Long. 5½-6½ lin. ♂ ♀.

Nagasaki; Yokohama.

Closely allied to *Pr. caudata*; but distinguished at once by the apex of the elytra not produced, and the sides near the apex much less gradually narrowed; the dingy or ochreous-white belt just above the posterior declivity is distinct in all examples; but the part of the elytra behind the belt is of a much lighter brown than the basal portion, and is varied with black and grey spots. The thorax is rather closely punctured. The antennæ have filiform, elongated joints, not abruptly shortened after the fourth; they are reddish and variegated, with the tips of the joints darker. The claws, and sometimes the whole claw-joint, are pale rufous.

Praonetha jugosa, n. sp.

P. oblonga, convexa, nigro-fusca; elytris medio canescentibus, utrinque cristis duabus, prima centro-basali, brevi, subconica, altera posteriore elongata, fortiter compressa; declivitate posteriore abrupta utrinque unituberculata, apice oblique truncato; antennis

♂ corpore paulo longioribus, ♀ multo brevioribus, articulis 5^o-11^{um} abbreviatis. Long. $4\frac{1}{2}$ -5 lin. ♂ ♀.

Hiogo, Nagasaki.

Of shorter form than *Pr. caudata*; the posterior discoidal ridge of the elytra very largely developed, long, high, and compressed, the disk between it and the short, almost conical, basal crests appearing concave; this part is clothed with a whitish-ashy pile, the same colour forming a margin to the scutellum and an indistinct patch on the posterior surface of the thorax; the colour of the rest of the body is blackish brown. The sexual difference in the length of the antennæ is well marked—the male having these organs a third longer than the body, with joints 5-11 long, filiform, and subequal; the female having them three fourths the length of the body, and joints 5-11 much shortened. The antenniferous tubercles are unusually elevated in this species, causing the concavity of the vertex to be deeper and more triangular.

Praonetha Bowringii, Pascoe.

Praonetha Bowringii, Pascoe, Trans. Ent. Soc. 3rd ser. vol. iii. p. 170, note.

Many examples. Also Hong-Kong, China.

Praonetha rigida, n. sp.

P. oblonga, atro-fusca, thoracis lineolis prope basin duabus, maculaque utrinque elytrorum versus apicem triangulari, laterali, albo-ochraceis; antennis brevibus, fusco et griseo annulatis; elytris crista centro-basali et carinis duabus posticis (interiore magis elevata), apice brevissime oblique truncatis. Long. $3\frac{1}{4}$ - $4\frac{1}{2}$ lin.

Hiogo, Nagasaki.

Moderately elongated, convex; dark brown, with numerous lighter-brown spots, besides two distinct longitudinal pale lines on the basal part of the disk of the thorax, and an irregular triangular patch of the same colour on each side of the elytra towards the apex. The antennæ are much shorter than the body in the two examples before me (female?), with joints 5-11 forming only one half of the total length. The thorax is very coarsely punctured. The elytra are very convex and laterally compressed (as in all the allied species), abruptly declivous at the apex, with the apex itself briefly and obliquely truncated. The ridges are not very elevated, the basal one moderately elongated, and the posterior one much longer, with an exterior raised line parallel to it; there is also a third, and shorter, raised line, exterior to the second, and a little nearer the apex.

Praonetha angusta, n. sp.

P. elongata, *angusta*, *fusca*, *nigro*, *fulvo* et *griseo* indistincte variegata, elytris postice macula sublaterali grisea; antennis filiformibus, ♂ corpore paulo longioribus, articulis 4^o-11^{um} basi testaceis; thorace creberrime punctato; elytris postice gradatim declivibus, apice breviter peroblique truncatis, crista centro-basali subconica, nigro penicillata, carinis posticis obsoletis. Long. 3-3½ lin. ♂ ♀.

Wax-trees, Nagasaki.

By its narrow form this species resembles the *Apomecyninae*, particularly the genus *Ropica*; but the simple middle tibiae show that it belongs to the *Niphoninae*; and the elytral crest, thorax, head, and eyes are those of the genus *Praonetha*. The antennae are elongate; the fourth joint shorter than the third, and the fifth to eleventh gradually and slightly decreasing in length. The head and thorax are short compared with the elongate elytra.

Praonetha leiopodina, n. sp.

Leiopodi nebuloso simillima. Elongato-oblonga, modice convexa, fusca, nigro, fulvo et griseo variegata, elytris pone medium fascia griseo-alba; antennis corporis longitudine, filiformibus, articulis basi griseis; thorace crebre punctulato; elytris modice compressis, postice oblique declivibus, apice brevissime obtuse truncatis, carina centro-basali elevata, arcuata, alteris duabus posticis obtusis, omnino (apice excepto) fortiter punctatis. Long. 3-3¼ lin.

On dead branches of wax-tree. Several examples.

Much resembling in form and colour the common European *Leiopus nebulosus*, but a true *Praonetha* in all its generic and group characters; the head and thorax are rather small compared with the elytra, and the latter are less convex than in typical *Praonethae*; the centro-basal ridge is moderately elevated and regularly arcuated.

Apomecyna neglecta, Pascoe.

Apomecyna neglecta, Pascoe, Trans. Ent. Soc. ser. 3, vol. iii. p. 152.

One example.

Mr. Lewis has compared his specimen with the types of *A. neglecta* in Mr. Pascoe's collection.

Apomecyna naevia, n. sp.

A. linearis, *angusta*, pallide fusca; elytris guttis cretaceis late con-
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spersis, lineatim punctatis, apice singulatim triangulariter productis; thorace crebre punctulato. Long. 3-4½ lin.

Abundant on *Cissus*.

Narrow, linear, light brown, thickly clothed with short, adpressed, yellowish, scale-like hairs, the elytra (very distinctly and evenly lineate-punctate) having a number of small, roundish, isolated, cretaceous spots, about 12 in number, on each; the apex is on each side triangularly produced. The thorax is long and narrow, closely punctured, and having four short whitish streaks—one on each side, one in front, and one behind. The antennæ are pitchy red.

Sybra ordinata, n. sp.

S. angusto-elliptica, elongata, fusca, rufescenti-fusco sublineatim variegata; antennis (♂) corpore triente longioribus, rufescentibus, scapo brevi ovato-clavato; thorace grosse subsparsum punctato; elytris omnino striato-punctatis, apice oblique truncatis, angulis exterioribus productis. Long. 4½ lin.

Hiogo; on dead *Cissus*-stems.

An elongated species, tapering a little to both extremities; scarcely convex, with elytra declivous from base to apex. The colour is dingy brown, clothed with laid pubescence, varied with tawny reddish, chiefly in indistinct lines down the flat interstices of the well-marked rows of punctures of the elytra. The thorax is nearly cylindrical, the sides being scarcely rounded. The sides of the breast have a few large punctures.

Sybra cribrella, n. sp.

S. elongato-oblonga, convexa; fusca, griseo-ochreo indistincte variegata; capite et thorace elytris multo angustioribus, fortiter punctatis, hoc breviter cylindrico, linea dorsali interrupta lævi; elytris convexis, postice declivibus, apice brevissime oblique truncatis, crebre sublineatim punctatis, interstitiis nonnullis paulo elevatis. Long. 3½-4 lin.

Moon-temple, Kobé.

Approaches *Praonetha* by its rather convex form and comparatively narrow head and thorax. The notch of the middle tibiæ is placed near the end, and distinct, as in *Apomecyna*. The antennæ are of the length of the body, and dull rufescent. There is a slight elevation in the situation of the centro-basal ridges of the elytra. The colour and markings are very obscure and variable; sometimes there is a trace of a lateral cinerous patch on the elytra. The breast beneath is closely and strongly punctured.

[To be continued.]

XLIII.—*Additional Notes on the Form of the Bones in the Sternum of very young Tortoises, and their Development.*
By Dr. J. E. GRAY, F.R.S. &c.

[Plate XII.]

THE British Museum having received some young tortoises from North America, presented by the Smithsonian Institution, I have been induced to examine the form of the bones of the their sterna—and also the bones of the sterna of other young specimens that are in the Museum, some of which have been received since my former paper.

As many of these specimens were in spirit before they were examined, it is necessary to observe that if the sternum is looked at as it is taken out of spirit, even when perfectly cleaned inside, it appears to be a uniform opaque disk, and the form of the bones cannot be observed even when held up to the light—until it is dried, when the cartilaginous part becomes transparent, showing the opaque bones; and it becomes again opaque when again placed in proof spirit.

I have had great difficulty in obtaining young specimens for the purpose of determining the development of the bones of the sternum, and have thought myself very fortunate when I have obtained one or two of a species; and I thought that this arose from collectors thinking that young specimens would not be so much esteemed by Museum-directors as the others. But Prof. Agassiz, who lives and has collected in the country where tortoises are abundant, observes that the young *Emydes* live almost exclusively in water, much more so than their parents; and though the young are naturally in much larger numbers than the adults, they are still so rarely found that they are almost unknown to zoologists. He observes:—"For example, *Emys insculpta* is so common in the neighbourhood of Lancaster that I have collected more than a hundred specimens in one afternoon, and yet I have never been able to obtain one of the first year, though a whole school of young men were called in to search. Prof. Baird has found the same difficulty in obtaining young *Emys rugosa* for me, and though he offered a high price for them he could not obtain more than a single specimen of the first year; and yet this species is so common that, in the season, hundreds are daily brought to the market of Washington." ('Contributions,' i. p. 294.)

I have also been able to examine the sternum of the very young of two genera of land-tortoises that I had not before been able to examine and therefore to add them to my previous paper.

The bones of the sternum of a specimen of *Homopus signatus* (Pl. XII. fig. 1), which is $1\frac{1}{2}$ inch long, are very little developed. The front pair are very short; the front and hind lateral pairs are separated by a broad space, and form only a margin to the outer side of the front and hinder lobes of the sternum, the hinder pair the smallest; the anal pair very small. The gular plates are very short, band-like, and transverse; the postgular plates are quadrangular, diverging; the pectoral plates triangular.

The sternum of the young *Kinixys erosa* (fig. 2) is like that of the other land-tortoises; but the bones, except the anal pair of a specimen about 2 inches long, are very narrow, only margining the front and hind lobes. The odd bone very small. The anal pair entirely covered both above and below by a hard horny sheath. The front lobe with a narrow, and the sides of the hind lobe with a broader (expanded) margin, the latter covered above and below with the horny sheath of the plates, which is thicker in these parts than usual.

In the younger specimens of Steganopodes (or Freshwater Terrapins) the front pair of bones is distinct, furnished with a lanceolate odd bone on their inner edge. The front lateral pair are more or less expanded, extending more or less across the shell, with a dentated inner edge and more or less straight hinder edge. The hinder lateral pair diverge backwards, and have a more or less dilated lobe on the truncated inner edge; and the hinder pair are smaller, with a lobe on the middle or towards the end of the inner edge, which is dentated on its inner edge, leaving a small oval space on each side of the odd bone; a large oblong or rhombic space between the hinder end of the front lateral and the front edge of the lobes of the hinder lateral bone, and a more or less square cavity between the hinder edge of the lobe of the hinder lateral and the lobe of the hinder pair. These spaces are diminished by the increase of the size of the bones; the central one, between the processes of the front and hinder lateral bones, is closed last.

The sternal bones of the young *Geoemyda spinosa* (fig. 3) 2 inches long form only a ring round the sternum, and they are very like those of *Rhinoclemmys*; but the front lateral bone is broader and larger, more dilated at the upper front end near the odd bone, where it is divided into many narrow lobes, of which a few of the lower are separated from the others by a narrow space, and form a separate group.

The sternal bones of *Geoemyda grandis* (fig. 4) $2\frac{1}{4}$ inches long (although the adult is a much larger species) are very like those of *G. spinosa*: but the front pair are broader; the odd bone is longer and more slender, and the front lateral pair

are furnished on the inner side with a lobe directed towards the centre of the sternum and torn at the end. The hinder lateral pair have a small conical prominence on the middle of the inner side: indeed they are very like those of *Notochelys platynota*; but the lobe on the inner side is much smaller and less marked. The young sternum of this species is intermediate between the form that is found in *Geoemyda spinosa* and that which is common to the species of *Emys*.

The sterna of the young specimens of *Bellia* (fig. 10) and *Damonia* (figs. 11 & 12) are much thicker and more solid than the sterna of the young of *Malaclemmys*, *Pseudemys* (fig. 9), *Chrysemys* (fig. 7), and *Trachemys* (fig. 8) of America, and *Emys* (fig. 6), *Emmenia* (fig. 5), and *Platysternon* (fig. 13) of Europe and Asia. The skin that fills up the vacancies between the bones is much thicker, and so opaque when dried, that the sterna might be regarded as solid; but the cavities leave a sunken space visible on the outside, and they are easily pierced with a pin, showing that there is only a dried cartilaginous skin, though so thick and opaque that it looks like bone.

The development of the bones, and the changes in form which they undergo, in the Freshwater Turtles or Steganopodes may be arranged under four heads.

I. In the more terrestrial animals the bones of the sternum in the young specimens are narrow, and form a marginal ring round the circumference of the sternum, leaving a large oblong central unossified space, which eventually becomes filled up, as in the genera *Cyclemys* in the Cistudinidæ, and *Geoemyda* and *Rhinoclemmys* in the Emydæ.

The sternum of the young *Geoemyda grandis* (fig. 4) has rudimentary lobes diverging from the inner side of the anterior and posterior lateral bones, forming a passage to the next form; but this may be the way in which the central space is filled up, and is only a matter of growth.

II. In the genera which have the second form all the bones of the circumference of the sternum are broader, and the front and hinder lateral pairs and the anal pair have a more or less broad lobe on the inner side, tending towards the central suture, dividing the central space into three parts: the front one is generally the smallest, and divided in the middle by the central odd bone, the middle one the largest and broadest, and the hinder one smaller and generally longer than broad. These processes enlarge, and unite and solidify in the sternum—as in *Notochelys* of the Cistudinidæ, in *Chrysemys* of America, *Emys* and *Emmia* of the Mediterranean region, *Bellia* and *Damonia* (from Asia) of the family Malaclemmydæ, *Pseudemys*

and *Trachemys* of the family Pseudemydæ (which are confined to America), and *Kachuga* of the family Bataguridæ (which are confined to Asia, and have the internal lobes of the sternal bones in the young specimens broader than in any of the preceding genera). In all the above genera the lobe of the internal edge of the anal pair of bones is near the anal end of that bone, except in the genera *Pseudemys* and *Batagur*, where it is much nearer the fore end of the internal edge, leaving a broad vacant space, so that very young specimens appear to have three vacant spaces behind the hinder edge of the front pair of lateral bones.

The bones of the sternum of the young *Platysternon* are intermediate in form between these and the next division; that is to say, the front and hinder lateral bones are dilated into a triangle, dentated on the inner edge, and the anal pair have a broad lobe on the front part of the inner edge, as in *Kachuga* and *Pseudemys*.

III. The third form differs from the second in the lateral pairs of bones and the anal bones of the young specimens being dilated, ovate or triangular, leaving a space on each side of the odd bone, a large, more or less rhombic, space between the front and hinder lateral pairs, and a smaller rhombic space between the hinder edge of the hinder lateral pair and the front edge of the anal pair—as in *Lutremys* and *Cuora* (fig. 14) (both from the Old World) in the Cistudinidæ, and *Malaclemmys* (from North America) in the Malaclemmydæ. The young *Pelomedusa*, the type of the African family Pelomedusidæ, among the Pleuroderes, has the sternum very like that of *Malaclemmys*.

IV. The fourth form, which appears to be peculiar to the family Chelydradæ, has the four pairs of bones of which it is composed more or less dilated, leaving in the very young state an elongate central vacant space, which is generally pervaded in front by a very long slender odd bone; this bone is entirely wanting in the most developed types of the family called the Trap Tortoises, as the genera *Kinosternon* and *Swanka*. Unfortunately I have not been able to examine the sterna of several genera of this group: indeed I have only been able to see the sternum in a small well-developed specimen of *Kinosternon*. A very young specimen of *Swanka* has never occurred to me; and I am not aware that it has ever been seen or described by any American or other zoologist. I have figured the outside of the sternum of a very young *Kinosternon pennsylvanicum* in my former paper ('Annals,' 1873, xi. pl. 5. fig. 6).

EXPLANATION OF PLATE XII.

- Fig. 1.* Homopus signatus.
Fig. 2. Kinixys erosa.
Fig. 3. Geoemyda spinosa.
Fig. 4. Geoemyda grandis.
Fig. 5. Emmenia Grayi.
Fig. 6. Emys Fraseri.
Fig. 7. Chrysemys picta.
Fig. 8. Trachemys Holbrookii.
Fig. 9. Pseudemys concinna.
Fig. 10. Bellia crassicollis.
Fig. 11. Damonia macrocephala.
Fig. 12. Damonia Reevesii.
Fig. 13. Platysternon peguense.
Fig. 14. Cuora amboinensis.

XLIII.—*On Spontaneous Division in the Echinodermata and other Radiata.* By Dr. C. F. LÜTKEN*.

It is only in a few specimens of *Ophiothela isidicola*, sp. n.† (from Formosa), that I have found the six arms equal or nearly so: in most individuals of moderate size the three arms of one side are larger than those of the opposite side; and in this respect we find all possible intermediate stages, from specimens with three arms well developed and three scarcely perceptible, to others in which the difference is insignificant. Moreover we find nearly as many specimens having only three arms and the corresponding half of the disk (as if they had been cut with a knife into two equal parts) as of completely developed individuals with six equal arms. There is no doubt that a division has taken place, at least in the case of those which have only three arms, or three large and three small ones, and that the halves produced by this division have the power of replacing the missing half both of the disk and arms. It is only with regard to the minority which are furnished with six equal arms, and in which the two halves of the disk are equally developed, that there can be any doubt; for although the greater part of the individuals of this species may be destined to undergo division, we must not conclude from this that all are so.

Whether the division is repeated several times in this Ophiurid I cannot decide with certainty; but the series of specimens

* Translated and slightly abridged by W. S. Dallas, F.L.S., from a paper entitled "Ophiuridarum novarum vel minus cognitarum descriptiones nonnullæ," published in the *Oversigt over det K. Dansk. Vid. Selsk. Förhandl.* 1872, pp. 108-158, French summary, pp. 30-54.

† The Latin characters of the new species will be given at the conclusion of this paper.

at my command gives the impression that if the act is not renewed it generally occurs at an early age, and that the lost parts sprout forth as the general growth goes on. Hence the larger the specimens the nearer they approach the normal state (six equal arms, &c.), and the smaller they are (down to a certain limit) the more they approach the divided form with three arms. This rule, however, is by no means without exceptions. Sometimes also the division takes place unequally, so that we meet with specimens with four large and two small arms, or with four small and two large arms; but these cases are rare.

In the case before us the phenomenon would certainly seem to be capable of another interpretation—namely, that these Ophiurids quit the larval state as half individuals, that is to say with three arms (exceptionally four or two) and half (one-third or two-thirds) of the disk, and that the parts deficient are gradually developed; but this interpretation would be immediately rejected as absurd. They might rather, originally, have the whole disk and three arms, so that the new arms might grow in the intervals between the old ones; but although we sometimes meet with six-armed starfishes (*Linckia*) with three short arms and three longer ones alternating with the former, which would seem to support this hypothesis, this mode of development has not been observed in any Asterid or Ophiurid*.

There is yet another question—namely, whether this division is entirely voluntary (*i. e.* a natural spontaneous division) or involuntary (*i. e.* the consequence of exterior violence, of a special lesion so frequent that very few individuals can escape it). The faculty of regeneration is certainly great among the Ophiurids. The disk of an *Ophiura* deprived of all its arms might undoubtedly, under favourable circumstances, regenerate them all; and it is probable that an injury which at the same time removed a small portion of the disk, would be repairable in the same way; at least, I have met with Ophiurids, *e. g.* *Ophioderma virescens*, the disk of which bore indisputable traces of a partial regeneration of this kind after an accidental injury; and I should not be surprised if experiments of artificial division were successful in many cases, especially with young Ophiurids. It would not, however, be right to conclude from this that the phenomenon described in *Ophiothela*

* In connexion with this, *Ophiacantha anomala* and *O. vivipara* are of interest as Ophiurids with more than five arms (six to eight) which originate with all their arms. It is only in some Asterids, in which the number of arms is very great, that new arms continue during growth to sprout forth between the old ones. To this we shall recur hereafter.

isidicola was simply the result of an accidental natural injury. The regularity with which it is manifested proves sufficiently that this is not the case, but that we have to do with a true spontaneous natural division, the object of which is multiplication. The specimens that we possess of the other species of *Ophiothela* are not numerous; but I have ascertained that the four species with which I am best acquainted present an analogous peculiarity; for together with regular individuals with six (exceptionally five) arms, we find others in which the three (or rarely two) pairs of radial plates on one side of the disk are smaller than the others, and the corresponding arms only developed in the same proportion: in the Japanese species the four very small specimens at my disposal were all in this unsymmetrical state of regeneration; in the other species it was comparatively rarer. I believe, however, that this character is sufficiently general to allow us to reckon spontaneous division among the generic characters of *Ophiothela*.

As has already been mentioned by Steenstrup*, Sars†, and myself‡, the same phenomenon is observed in other small six-armed Ophiurids, especially those of the genus *Ophiactis*, which, like the *Ophiothela*, live upon corals and sponges; but I have never found any trace of it in the species of that genus which have normally five arms, whilst, as far as I can judge, it may be observed in all the species with six arms. As a supplement to the brief remarks which I have published upon this subject in connexion with *Ophiactis Mülleri*, *Krebsii*, and *virescens*, I will here communicate the observations which I have made more recently. From a sponge from the Red Sea I extracted 16 specimens of *Ophiactis Savignyi*. Most of them (of average size, with a disk 2–3 millims. in diameter) are regularly furnished with six arms, which present no striking difference in length. In some of them, indeed, two or three arms on one side are shorter than the three or four others; but the difference is so slight that it would hardly be remarked in other Ophiurids, and it might be supposed that these shorter arms had been broken and sprouted afresh. (One specimen has seven arms, one of which is distinctly shorter than the rest.) But it is very clearly seen that a division has taken place in the four larger and smaller specimens. In the smallest of all (with a disk a little more than 1 millim. in diameter) one half of the disk and the three corresponding arms are en-

* Forhandl. ved de Skand. Naturforsk. syvende Møde i Christiania (1857), p. 230.

† Bidrag til Kundskab. om Middelhavets Littoralfauna, i. p. 97.

‡ Additamenta ad historiam Ophiuridarum, ii. pp. 127, 129, and 146, tab. 4. fig. 5d, iii. p. 38.

tirely deficient, but the wound is already closed and cicatrized; a larger specimen has in part regenerated its deficiencies, but the new half of the disk and the new arms are much less developed than the others. This is also the case, although in a somewhat different degree, with the two largest of these four specimens (diameter of disk 3·5–4 millims.; longest arms about 20 millims.); in one the three new arms are half the length and thickness of the others, and in the other they are only 2 millims. long and of proportionate thickness, the new half of the disk presenting a corresponding development. If we may draw any conclusion from this little series of observations, it would be that the division occurs twice in this species—first, in very small individuals, and then in those which are adult or nearly so.

All the specimens of *Ophiactis sexradia*, Gr. (*O. Reinhardtii*, m.), that I have examined have six arms, and in general, especially in the large specimens, there is no striking difference between the arms; it is only in some of the small ones that one of the groups of arms is in course of regeneration. Such is also the case in one of the two small specimens of *Ophiactis virens*, Sars, from the Mediterranean, which I have had the opportunity of seeing. Sars says of this species that all his 23 specimens had six arms, and that in nearly half of them “the three arms situated on one side were much shorter and thinner than the others, and evidently regenerated after a loss or division.” With regard to *O. virescens* of the west coast of America, Mr. Verrill* states that he has always found six arms, but that many young individuals had only three, the three on one side being entirely deficient or very small, as if in course of regeneration. Out of 13 specimens I found 12 with six arms, partly unequal; the thirteenth, which is one of the largest, has five equal arms. I have always found *O. Krebsii* with six arms: a great number of the small individuals show the regeneration; the large specimens always have the arms and the radii of the disk equally developed. Of *O. Mülleri* most of the smaller examples have six unequal arms; but there is a certain number with five equal arms; and most of the adult specimens seem to be in the latter condition.

Except in the above-mentioned genera I only know of a single instance of heteractinism among the Ophiurids—namely, in the young individuals of a certain group of species of the genus *Ophiocoma* (*O. pumila*, *Valencie*). This case is particularly interesting, because it is positively confined to the young individuals, which alone present unequally developed

* Notes on Radiata, No. 2, p. 265.

groups of arms and have more than five arms*. The transformation of the young six-armed individuals into individuals with five arms evidently requires a previous division. They can only lose the sixth arm by regenerating, after the last division, only one or two arms instead of two or three.

It would be very incorrect to conclude from the constant occurrence of heteractinism (and of division if our interpretation of heteractinism is correct) in this tolerably long series of six-armed *Ophioteleæ*, *Ophiactines*, and *Ophiocomæ*, that the same things occur in the other Ophiurids which have normally more than five arms. These, however, are not numerous as far as I know; for, leaving out of consideration the young *Asterophyton* with seven arms described by me (which is as puzzling to me as it was thirteen years ago, and which is still known only from a single specimen) and *Asteromorpha Steenstrupii* (in which the six-armed state is probably only an accidental anomaly), we have in this category only two species of *Ophiocantha*, namely *O. anomala*, Sars, with six, and *O. vivipara*, Lgm., with seven to eight arms; and in neither of these has any thing been observed to indicate a division. The necessary condition for spontaneous division would therefore seem to be that the species (at least when young) should have normally more than five (six) arms, although we must not conclude that it exists from this greater number of arms: in one of the above-mentioned groups (*Ophiocoma*) it is evident that the spontaneous division is confined to the young; and it is not improbable that this is the case also with the others; but this does not at present appear with sufficient clearness from the facts, and the solution of this important question must be left to subsequent researches upon living animals. Its importance consists in the fact that if it is answered in the affirmative the laws of reproduction in these Ophiurids would fall under that of *alternation of generations*, the young individuals then representing the agamic generations, and the adults, after division, the sexual ones.

Perfectly similar phenomena are manifested in certain As-

* All the young individuals, however, or those which have not yet acquired the physiognomy, coloration, &c. characteristic of the species, do not present six arms or the heteractinism which is associated with that number. I have already mentioned (Addit. ii. p. 146) that of 12 specimens, 8 had six arms, two or three of which were generally shorter and thinner than the others. Of 21 specimens now at my disposal (1 of *O. Valenciæ* and the rest *O. punila*) I find that, with one exception, all the individuals below a certain size (4 millims.) have six more or less unequal arms, and all those which measure 5 millims. or more have five arms. The exception is a specimen with six arms rather larger than it should be according to this rule.

terids—namely, in *Asterias problema*, Stp. (*albula*, Stimps.), and *A. tenuispina*, Lamk., and in some forms allied to these two species. In common with the fissiparous Ophiurids they have normally more than five arms; but this furnishes no ground for supposing that other Asterids with six or more than six arms have some tendency to division; indeed we have examples to the contrary in the *Solasteres* with many arms, and in the six-armed *Asterias polaris*, neither of which presents the least traces of this mode of reproduction. What strikes us immediately in looking at a series of *A. tenuispina* and *problema* is, that a great many of them have the arms unequally developed, and that the shorter and weaker arms form on one side a separate group, as if they had been developed after the others, which no doubt is the case. MM. Steenstrup*, Sars†, Häckel‡, and Von Martens§ have already devoted special attention to the former species; but I will, notwithstanding, communicate the result of my own observations. Of 23 specimens 11 (with seven to ten arms) have incontestable traces of a regeneration of three to seven (most frequently four) arms: the smallest of these 11 specimens is $1\frac{1}{4}$ inch in diameter; the largest, if the weaker (younger) side were as much developed as the other, would measure $5\frac{1}{2}$ inches. The smaller the specimens the more clearly in general do we see that a regeneration of this kind (and the previous division?) has taken place: of 15 specimens less than 4 inches in diameter, 9 are in this condition; whilst of 8 which vary in diameter from 4 to 7 inches, there are only 2. In the other 12 specimens (of the 23) the arms are either (approximately) of the same length, or the number of shorter ones does not exceed one or two, and the existence of a single arm shorter than the others indicates nothing more than an accident which is very common in all starfishes, namely that one or more of the arms may have been broken or torn away and regenerated. The series of specimens that I have examined does not indicate that this division and regeneration, perhaps frequently repeated, must result in the number of arms in the larger and more developed individuals being on the average either greater or less than in the young individuals||.

* Forhandl. ved de Skand. Naturforsk. syvende Møde i Christiania (1857), pp. 229 *et seq.*

† Bidrag til Kundskaben om Middelhavets Littoralfauna, ii. p. 108.

‡ Generelle Morphologie (1866), i. p. 350.

§ Archiv für Naturg. xxx. 1, p. 68.

|| See also some remarks by M. R. Greeff on the Asterids of the Canaries, and among others *Asterias tenuispina*. He says it is "worthy of remark that on the rocky shore exposed to the action of the breakers, we scarcely meet with any but small and irregular specimens, whilst far from the

What we observe in *Asterias tenuispina* probably occurs also in the allied species, *A. acutispina*, Stimpson* (Japan), *A. microdiscus*, Stimps.† (Bonin islands), and *A. muricata*, Verr. (New Zealand); but the specimens at my command are too few to enable me to assert that spontaneous division takes place in these species; it is, however, very probable. It is the same with *A. atlantica*, Verr. (Bermudas, Brazil), if it differs from *A. tenuispina*. Mr. Verrill mentions one specimen of it with seven large unequal arms, and one with eight arms, four of which were smaller than the others.

Of *Asterias problema* I have examined several hundred specimens obtained from Greenland by Prof. Steenstrup, and noted the characters of about half of them. It is extremely rare to meet with five-armed specimens of this species. Out of 136 I have only found 7 such (or about 1 in 20); their size is very variable (radius=5-19 millims.): in general the five arms are of the same length, and then it is possible that this number five may be original; less frequently there are two or three a little shorter, probably due either to an irregular division of a six-armed individual forming one with four arms, and another with two arms which has become a five-armed individual by regeneration, or to an individual with three arms having regenerated only two arms instead of three, the third having been aborted. If we carefully examine a specimen which apparently has only five or four arms, we shall frequently find at one of the angles of the arms the germs of two new arms in the form of minute buds; so that the small number of arms is in this case only provisional‡. It is rare, moreover, to find specimens with six or seven arms in which the arms are either equal or approximately equal, without our being able to recognize a fixed law in the slight difference which they present (fig. 1, *e*, p. 330): I have found this only in 12 of the specimens mentioned above; and these equal-armed specimens measured from 5 to 41 millims. in radius. The great majority (fig. 1, *d, f, i*) are furnished with six arms, three of which, on one side, are shorter and in all respects less developed than the others; and this difference between the two

shores, in deep water and in sheltered places, we find much larger and more regular specimens."

* In 4 specimens belonging to this species, Mr. Stimpson found 5+4, 4+4, and 2+5 arms (Proc. Bost. Soc. Nat. Hist. viii. p. 262).

† Sent under this name by the Smithsonian Institution. I do not find it described in Mr. Stimpson's work mentioned above.

‡ The appearance of five arms arises sometimes from the union of two arms; the double ambulacrum explains this apparent reduction of the arms.

groups of arms occurs in all possible degrees: the smaller group may sometimes scarcely differ from the larger; or it may be reduced to 3 (1, 2) scarcely visible buds (fig. 1, *h*). Of the 3 (or 4) regenerated arms the middle one (or 2) generally appears after the two outer ones. Numbers such as 4+2, or

Fig. 1.



Sketches of 9 individuals of *Asterias problema*, all represented of the natural size. In most the madreporic plate is indicated.

2+4, or 3+2, or 2+3 must be regarded as exceptions, as also 4+3 (fig. 1, *b, c*), or 3+4, or 4+4 (fig. 1, *a*), or 4+5, or 5+2, in which the total number of arms exceeds six. Evidently in all cases the smaller group of arms is developed long after the other, and consequently there must have been a period when all these starfishes had only 3 (or exceptionally 2, 4, or 5) arms; in examining a sufficient number of specimens we find several with 3 arms, in which no trace of the deficient arms can be discovered, and among these some (fig. 1, *g*) in which the place where the division probably took place, and where the new arms will be formed, is still open. These specimens with 3 arms (exceptionally with 2) I have found of all sizes, from 3 to 25 millims. or more in radius; moreover, as the specimens

in which one group of arms is less developed present all conditions of size and all possible degrees of development, we must conclude either that the division, supposing it only to occur once, may take place at very different periods in the life of the animals, or else that it is several times repeated, certainly more frequently than in *A. tenuispina*, at least four or five times, perhaps much more frequently. The comparative rarity of the regular individuals with 6 equally developed arms seems to me to furnish a decisive proof of the frequent repetition of the division; but it is only by observations upon the living animals preserved for a long time in aquaria that this question can be settled. It may, perhaps, be supposed that the division ceases when, by the slow growth which accompanies it, the individuals have attained the limit of their development, and acquired the faculty of reproducing in the ordinary manner; but at present this is only an hypothesis. The largest of my specimens (radius 46 millims.) is at any rate far from having attained the point at which all trace of division has disappeared; it has 7 arms, 4 of which (regenerated) are still only 15–28 millims. in length.

If we refuse to admit that these abnormal phenomena, confined, however, within definite limits, may be explained by repeated division and regeneration of the deficient half, it would be necessary to suppose that what occurs is simply an elimination of a certain number of arms effected for some determinate purpose; and the first explanation which would present itself to the mind would be that already indicated by M. Steenstrup—namely, that in this case we have something analogous to the formation of the hectocotyli in the Cephalopoda, a group of arms charged with semen being thrown off to fulfil a special function of reproduction and afterwards regenerated. But there is absolutely nothing in favour of this hypothesis; and it seems to me to have against it the fact that the regeneration of the arms is quite as frequent in the smallest as in the largest specimens. The analogy with the Ophiurida with a supposed spontaneous division, in which this hypothesis would meet with still greater difficulties, is also a powerful motive for rejecting it for the Asterida also*.

* An investigation of the organs of reproduction could not elucidate the phenomena under consideration, unless it be made upon a great number of fresh specimens of all ages and all degrees of development. What is especially necessary to be ascertained is whether *Asterias problema* propagates by ova before the spontaneous division is concluded. I have examined some of my specimens with this question in view, but, as might be expected, without throwing much light upon it. I ascertained that the organs of reproduction were well developed in specimens measuring only 14–16 millims. in radius; on the other hand I found no trace of them

I have found two madreporic plates placed far from each other in the large specimens of *Asterias problema* when the regeneration was so far advanced that the younger group of arms was scarcely behind the older one in development. At the next division, therefore, each half starfish would be furnished with its madreporic plate.

Whether the division always takes place at the same part and in the same line, whether this changes in accordance with definite laws as in the Medusæ, or, finally, whether there is no rule in this matter, I am absolutely unable to say; and I do not think that this question can be cleared up until the species under consideration has been thoroughly investigated in the living state, for which, as it inhabits the north coast of the United States of America, we shall, perhaps, not have long to wait. It is much to be desired that such should be the case, in order that we may know with certainty whether we have to do here merely with a true division, or whether by it some secondary purpose is fulfilled.

Asterias polyplax of New Holland, a species allied to *A. problema*, seems to present the same phenomena; but I have been able to examine only a few specimens of it.

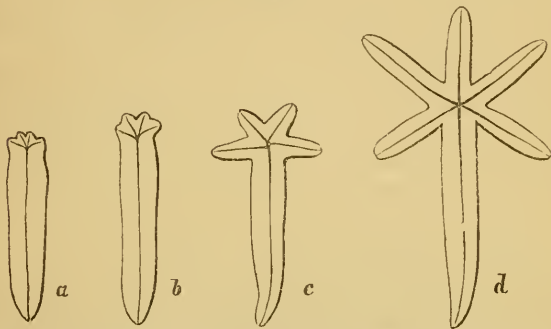
This mode of division is not known with certainty outside the genus *Asterias*, nor even outside certain subdivisions of that genus*. There are, as I have already indicated, a great number of Asterids with multiple arms (*Asterias aster*, *Heliasaster*, *Pycnopodia*, *Solaster*, *Acanthaster*, *Labidiaster*, *Luidia*, &c.) which do not present the least trace of this phenomenon. On the other hand there are certain species of *Ophidiaster* and *Linckia* which seem to be subject to another kind of division; but whether it is perfectly natural, or artificial (in the sense of being provoked by some external violence), I cannot decide.

in other specimens of the same or even larger size (15-18 millims.), and even in a large specimen with six equal arms (43 millims. in radius). Perhaps it may depend in part upon the season whether these organs are or are not developed. In specimens of moderate or pretty large size I have generally found the reproductive organs well developed in the older arms, but wanting in the younger ones; nevertheless in two cases (especially in the specimen represented in fig. 1, *a*) they had attained more or less development in the regenerated arms also. It would seem, therefore, that this starfish is *sexual* (*i. e.* furnished with more or less developed sexual organs) long before spontaneous division has terminated; but it does not follow that it is capable of reproduction before that time.

* The Museum possesses a small specimen of *Cribella sanguinolenta* which so much resembles *Asterias problema* that for a moment I took it for the latter; it has three large and three small arms, exactly like *A. problema*. It was brought up from a depth of 290 fathoms, to the west of Hetland.

This singular phenomenon was briefly mentioned by M. Steenstrup; and MM. Hæckel and Von Martens subsequently published observations made by them upon it in *Linckia multifora*. I have rarely observed it in that species, although I have examined a great number of specimens; but I have frequently seen it in *Linckia ornithopus* and *Ophidiaster cribrarius*. In both species, as in the fissiparous species of *Asterias* above mentioned, there are in general two madreporic plates; and they are more or less frequently provided with more than five arms. In examining a great quantity of specimens of one of these species, we find a very variable number of arms (4, 5, 6, 7); and the proportions of these arms are very different—for example, 3 long alternating with 3 short ones, 4 long and 2 short, or inversely 2 long and 4 short; from time to time also we meet with the “comet-form”—*i. e.* one long and

Fig. 2.



Sketches of 4 individuals of *Ophidiaster cribrarius*, represented of the natural size.

thick arm, and 3, 4, 5, or 6 comparatively short arms. The hypothesis which attributes this form to the production of the small arms after the large one, is confirmed by the circumstance that other specimens in which these little arms are still less occur in various degrees of development; and, lastly, there are specimens in which they are in the state of mere buds—until we find them with a single arm, either closed at its adoral extremity or still presenting traces of the aperture through which it had communicated with the disk of the animal (see the outlines in fig. 2). From this it seems very clear that the regenerative faculty in these animals is so great that an isolated arm, without any portion of the disk, enjoys the power of regenerating a complete set of arms, with the disk, mouth, &c.; and as we cannot suppose that one arm will be more favoured in this respect than the others, it follows

necessarily that when such a *Linckia* or *Ophidiaster* (with 5 or 6 arms) divides, or, what is the same thing, throws off or loses its arms, it will give origin, under favourable circumstances, to as many new Asterids as it possessed arms, perhaps even to one more if the disk is equally endowed with the faculty of regeneration. I have found in the same species such "comets" of small size and also of considerable dimensions. When the disk and the new arms were still but little developed, there was no madreporic plate; in the contrary case I have always found two, one on each side of the principal arm. If we assume that this division is entirely spontaneous, it would be the first known example of a true natural division being more than binary and producing directly and at once a multiplicity of new individuals—the first true example of the "divisio radialis" of Hæckel. That this polymerous divisibility cannot serve to support the singular theory proposed by Duvernoy and taken up by Hæckel and other authors, according to which the Asterida and Ophiurida are compound animals, is quite evident.

It may be further remarked that we may also meet with specimens of other Asterids which at the first glance remind us of the comet-shaped *Linckia* and *Ophidiastres*: I have myself found examples of *Asterias rubens* of this kind with 1 large arm and 4 small ones in course of sprouting; and Sir John Dalyell* represents several of them which he kept alive for some time; but, so far as I can judge from my own experience, this case is not precisely the same as the preceding, as, in fact, in *A. rubens* the disk remains, and it is by this and not by the single arm, as in *Linckia ornithopus* and *Ophidiaster cribrarius*, that the new arms are regenerated. From this it follows that if an *Asterias rubens* lost all its five arms, none of them could continue to live or regenerate the complete animal; how far the disk alone might be capable of doing so, I do not know. I must add, however, that I have met with some very young specimens of *Asterias problema* in the "comet-form," in which the five or six small arms had the appearance of having been regenerated from the extremity of the only arm which had been detached, and consequently I cannot deny that a polymerous division may also take place in that species †.

* It does not appear with equal clearness from all the figures that the disk continues attached to the oldest arm; and, to judge from the manner in which he expresses himself, the author does not seem to regard this as necessary. Similar regenerated specimens are represented by Forbes and Frédo.

† M. Hæckel also has found two specimens of *Asterias tenuispina* with this comet-like form; and at the meeting of naturalists at Christiania in

I do not know that any direct experiments have been made on the divisibility and the faculty of regeneration in the Asterida, although it is easy to prove that they are considerable and general. They are not limited to the long-armed forms, and are manifested in full energy in those which are almost destitute of arms, such as the *Asterinae*. It is sufficient that out of five or six normal rays two are retained, in order that the remainder shall be readily regenerated; but from this we must not deduce an absolute divisibility. Most of the Asterida can, without difficulty, regenerate a lost fragment of an arm from the surface of rupture itself, whilst in the species of the genus *Asterias* (*Asteracanthion*) the disk alone is endowed with this property, as Steenstrup has indicated. The bifurcate (Y-shaped) arms, sometimes met with in various Asterida*, may be attributed to an injury to these arms, just as the double tails of lizards and the corresponding abnormal formations in certain fishes (*Syngnathi*, *Gymnotini*) are due to a lesion of the tail. The species of *Asterias* sometimes present an arm which is bifurcated in a somewhat different manner, a small branch or secondary arm issuing almost at a right angle from near its extremity, with its ambulacrum opening into that of the principal arm; the origin of this anomaly is also undoubtedly a lesion produced at the point where the lateral branch takes its rise†.

1856, M. Esmark indicated, in connexion with M. Steenstrup's communication, that he had likewise observed in Norwegian Asterida (no doubt in *Asterias rubens*) that an arm without disk had regenerated the deficient parts. M. von Martens describes a comet-like specimen of *Echinaster eridanella* (*fallax*) with six arms.

* For example, *Oreaster gigas* and *Astropecten aurantiacus*. When the bifurcation occurs near the origin of the arm, one might almost suppose that the animal had two mouths. I know examples of this kind in a small *Asterina* from the Mauritius and in *Linckia multifora*. When the two points of union of the ambulacra are confounded in one, we have six arms, two of which are united at the base (a *Scytaster pistornis* in the Museum presents this case). See Linck, 'De Stellis marinis,' tab. xiv. fig. 24, and tab. xl. fig. 70; Seba, 'Thesaurus,' iii. tab. viii. fig. 9; and Treviranus, Zeitschr. für Physiol. iv. p. 124.

† Before quitting this subject I may mention a peculiarity of *Asterias helianthus* and some allied species (of the subgenus *Heliaster*). It has already been said that we must not interpret the heteractinism observed in some Asterida and Ophiurida as due simply to the fact that all the arms proper to the species do not make their appearance originally, but only a portion of them, the deficient portion being subsequently developed; and I added that, if such a case occurred among certain Echinoderms with many arms, it would be much more natural to suppose that the new arms (rays) would originate alternately with the old ones than that they should all spring from a single point. From the fact that we find three long and three short arms alternating with each other in a

That the faculty of regeneration is great in the Crinoids is a well-known fact; but as regards division we know no more about these animals than about the Echinida, in which, indeed, it could only occur in the Clypeastridæ (Scutellinæ), which are very flat; for it is possible only when the animal is constructed in such a manner that the deep wound produced by this violent mutilation may cicatrize in a comparatively short time, which also necessarily presupposes that the animal is extremely tenacious of life, and endowed with a strong faculty

single specimen of a species, *e. g.* *Linckia ornithopus*, we cannot, of course, draw any conclusion with respect to this. Now, in *Asterias helianthus*, it seems to me to be beyond doubt that the number of arms is originally small, and increases during the growth of the animal; and as this peculiarity, so far as I know, has not hitherto been ascertained in any Echinoderm, I will here state in detail upon what I found my opinion. The circumstance that the arms in the species in question are often of very unequal length, leads one at once to conclude that some of them may be younger than the others; moreover it is frequently the case that some arms (1, 2, or 3 &c.) are so short that the supposition that they have been subsequently intercalated between the others acquires considerable force; lastly, we sometimes meet with an arm of which the extreme smallness and the awkward position (entirely on the ventral surface, in a slightly dilated brachial angle) can leave no doubt that it is relatively much younger than the rest. If we compare a certain number of specimens of different sizes (I have examined fifteen from 2 to 11 inches in diameter) we acquire a general impression that the smaller they are the fewer arms they possess. This rule, however, can only be taken in the most general sense, and not as if the size and the number of arms constituted two completely parallel progressive series; but it is rarely that several arms in a state of growth are united at the same point. The following Table shows that the smallest number of arms (23) occurs in the smallest specimen, and the largest (41), which is nearly double the preceding, in a specimen which is only half adult:—

Number.	Diameter (approximate) in inches.	Number of arms.
1.	2	23
2.	3	27
3.	3	30
4.	3½	31
5.	3½	32
6.	4½	33
7.	5	34
8.	5½	31
9.	5½	38
10.	5½	41
11.	6	36
12.	6½	33
13.	8½	39
14.	9	33
15.	11	38

From No. 1 to No. 7 the augmentation in the number of the arms goes

of regeneration; but these are not the only conditions of division. It is especially easy in flat animals or in those which are slender and elongated; when the animal is equally developed in the three dimensions, the softness and contractility of the body must be greater. Another condition is that the various sections of the body must not differ too much as regards their importance to the whole; but recent observations, showing that even the head and fore part of the body of the Chætopod Annelides may be regenerated in many cases*, indicate that this condition is not one of the most difficult to fulfil.

[To be continued.]

BIBLIOGRAPHICAL NOTICE.

Jottings during the Cruise of H.M.S. Curaçoa among the South-Sea Islands in 1865. By JULIUS L. BRENCHLEY, M.A., F.R.G.S. With numerous Illustrations and Natural History Notices. Roy. Svo, pp. 487, pls. 50. Longmans, London: 1873.

THERE can be hardly any lover of natural history who has not longed to visit the islands of the Pacific, and none who has not envied the good fortune of Banks, Solander, and the two Forsters—voyagers to whom nearly each plant and animal they saw was new, while they were conscious of its novelty. That golden age is, indeed, rapidly passing away; but the present generation need not sigh in vain for worlds to explore. There are still hundreds of islands, not to say clusters of islands, every one a world in itself, untrodden by any white foot save that of the missionary or the whaler; and it needs no saying that neither the fisher of men nor the fisher of

parallel with that of the diameter; but from the time when the latter has acquired a certain magnitude, we do not see so clearly that there is a connexion between the two quantities. Individuality is manifested by one individual being provided earlier than another with the greater part of its arms, or by its growing more slowly, but devoting its growth to the formation of new arms.

I have at my disposal only three specimens of *A. microbrachia*, of which the diameter varies from 3 to 5 inches, whilst the number of arms at the same time increases from 32 to 38. In four specimens of *A. Kūbinjji* measuring from $1\frac{3}{4}$ to 6 inches, the number of arms varies only from 21 to 24, and there is no parallelism between the number and the diameter; of *A. Cummingii* I only possess a single specimen ($7\frac{1}{4}$ inches, 41 arms). In *A. (Pycnopodia) helianthoides* also it seems that new arms spring between the old ones.

* See Kinberg, "Om Regeneration af bufvudet och de främre segmenterna hos en Annulat" (Öfvers. Vetensk. Akad. Förhandl. 1867), and Ehlers, 'Die Neubildung des Kopfes und des vorderen Körpertheils bei polychäten Anneliden' (1869).

beasts is much given to the promotion of natural history ; while of course that wicked traffic which has of late years sprung up among the isles of this broad ocean, and has excited the righteous indignation of all Christian people throughout the world, is yet less likely to profit the naturalist.

The author of this book enjoyed the opportunity of visiting some of these interesting islands as the guest of Commodore Sir William Wiseman, then commanding Her Majesty's ship 'Curagoa.' Mr. Brenchley was (for we regret to say we have to use the past tense in speaking of him) apparently one of those numerous Englishmen who go every where and do every thing short of writing books of travels. Herein they often show their wisdom ; for the most venturesome of wanderers and explorers are by no means always the best penmen, and Mr. Brenchley seems to have had an instinctive knowledge that this was his case. Though he had crossed the Rocky Mountains long ere the Pacific Railroad was projected, and had lived four years in the Sandwich Islands—though he had slipped down the crater of Pichincha and had coasted along Peru and Chili—though he had descended the Mississippi from its source and had made a "home tour" in such comparatively tame countries as Morocco and Algeria—though he had seen India and Ceylon, China and Mongolia, Japan and Australasia, and had finally returned home by the overland route of the Gobi Desert and Siberia, "he was more interested," we are told, "in collecting material objects, illustrative and commemorative of his varied travels, than in devoting himself to literary descriptions of them ;" and the work now before us "was the result of a promise."

By whom the promise was exacted we know not, nor does it signify. Mr. Brenchley died in its performance. The preface to this book, begun by the author, recounts the death of two of his shipmates, Mr. Foljambe and Mr. Meade, who had helped him in forming, and of two naturalists, Dr. Baird and Mr. George Gray, who had assisted him in determining his collections, and is finished by an unnamed friend. The narrative of the cruise, we must confess, is not very interesting. The "jottings" taken while it lasted must have indeed been very brief ; and the author seems to have been quite unaware of the chief points which deserved his attention, though he was accompanied by men who were at least practical naturalists :—one of the Messrs. Veitch ; Mr. Wall, for many years Curator of the Sydney Museum ; and Mr. Brazier, the shell-collector. Indeed not a small part of the narrative is made up of extracts from very well-known books, those of Erskine, Hood, Mariner, Seemann, and Williams being especially laid under contribution. Of course the dates of arrival at and sailing from the different islands are duly given ; but the original information concerning them and their products is meagre. As an average specimen we subjoin (from Chap. V.) all that is said of the natural history of Vavau, an outlier of the Tonga group.

"The island seemed entirely clothed with vegetation, among which the casuarina, the pandanus, and cocoa-nut trees, were

“ easily distinguishable ; the latter appearing to exist in greater
 “ abundance than I had ever before remarked in any one place. We
 “ saw a building resembling a church, with graves around it, and on
 “ the shore a whale-boat, two things indicative of civilization. There
 “ were also a good many canoes and canoe houses. The Curaçoa
 “ was speedily surrounded by canoes with red-headed men, their
 “ hair cut close to the scalp. These natives, who are of a brightish
 “ brown colour, are very well made, but with faces which, owing to
 “ their extremely flattened noses and very wide nostrils, are by no
 “ means pleasant to look on as compared with the natives of Savage
 “ Island. The greater part of their canoes were small ; I saw one
 “ double one, the ends of which were ornamented with milky cowrie
 “ shells (*Cypræa lactea*). In the afternoon I went on shore
 “ in the dingey. After crossing a reef, where I saw several varieties
 “ of madrepores, I found a convenient landing-place on a jetty of
 “ coral. On reaching the shore there were a few natives, who
 “ treated me with great respect. The country appeared to
 “ me very pleasing, pretty even, with convenient roads [the island is
 “ the seat of a missionary], or rather paths, in all directions, continu-
 “ ously shaded either by the leaves of the cocoa-nut tree, the bread-
 “ fruit tree, or the kukui (*Aleurites*). The temperature was slightly
 “ lower than that of the Samoan group, but the air so much drier
 “ that I found it much more enjoyable than at Pango-Pango or
 “ Apia, where I always felt as if I was in a vapour-bath. I saw
 “ but two species of land-shells, very small and like those of Apia ;
 “ the small birds, also, that I killed were similar to those I had pre-
 “ viously met with. I saw fields of yams, of taro of two kinds, sweet
 “ potatoes, bananas of three varieties, and pine-apples not yet ripe.
 “ A hibiscus covered with large yellow flowers was in abundance
 “ everywhere ; the pawpaw apple, orange tree, pammelo or shad-
 “ dock, the lemon, citron, and other trees grow marvellously well in
 “ the island, and yield, it appears, fine large fruit. No trees that I
 “ saw were at all remarkable for their circumference or height. A
 “ species of ti-tree (*Dracæna*) here and there showed its flowers
 “ and fruits of a fine red. I also saw some plantations of ava, and
 “ frequently came upon patches of land in good condition for re-
 “ ceiving crops. The ferns did not appear to me very numerous ;
 “ those I saw were of the same species I had previously met with
 “ in the Samoan Islands. I passed through several villages, and
 “ met a good many natives ; the women for the most part had their
 “ bosoms covered with a sort of small pinafore, which only reached
 “ to the waist, and all of them had their hair cropped so close as to
 “ make them undistinguishable, as far as their heads were con-
 “ cerned, from the men ; and, by means of lime paste (*chinam*),
 “ they brought the colour of their hair into a kind of harmony with
 “ that of their skin, making their hair of a redder hue than is usual
 “ in Samoa.”

After speaking of some of their industries, and quoting from Erskine
 a description of their chapel, Mr. Brenchley briefly recounts his call
 next day upon the Governor to procure horses with which to visit

the interior. But his "ride did not add much to the sum of our knowledge respecting the island." He goes on:—

"The soil of Vavau is of a dull red, and of so friable a nature that it crumbles in the hand like the ashes of Pompeii. Lava is to be found in many places, and a white stone riddled with holes, which some refer to the coral, but which appears to me to be rather a species of lava, like that formerly thrown out by Vesuvius, and which is still found in the Bay of Naples. This stone is very hard, heavy, and susceptible of a very fine polish. The igneous origin of these countries is, moreover, proved by the little island of Latte, situated some miles to the west, where there is now an active volcano, which I was sorry not to have visited."

Then follows, from Mr. Meade's manuscript journal*, an account of the singular cave with its submarine entrance, originally described by Mariner, and so ingeniously introduced by Byron into his poem of 'The Island,' though the fact was unknown at the time to the writer. Mr. Brenchley concludes:—

"The island possesses no indigenous mammifers, those now found in it being of recent introduction. On the other hand, there is a great quantity and variety of fish and crustacea. The birds, as I have already remarked, present no great variety of species, and resemble those previously met with during our cruise.

"Besides the vegetables I have mentioned, cabbages and onions are cultivated. The principal product of the island is cocoa-nut oil; sugar-cane is grown, but on a very small scale; the same may be said of the cotton-plant."

This is not satisfactory; yet it is a fair if not favourable sample. The author no doubt did do his best to redeem his promise of writing a book about the cruise; but we are forcibly reminded of the old story of 'Eyes and No Eyes.' Yet the worst fault we have to find with the volume is the absence of any connexion between the author's narrative and the "Natural-History Notices" published at the end: nowhere in the former is the slightest reference made to the species figured or described in the latter; so that, if any of them be mentioned in the text, we can only hazard an identification. This is unfortunate; for the plates (especially those by Mr. Ford) are very good. Many new species were brought home by Mr. Brenchley (some of them having been already described in our own pages, while others appear now for the first time); and the names of Mr. George Gray, Dr. Günther, Dr. Baird, Mr. Frederick Smith, and Mr. A. G. Butler, the joint authors of these "Notices," are sufficient to require attention to them. It remains to say that 27 species of Birds are figured, 9 of Reptiles, 12 of Fishes (besides 3 more described), 33 of Shells (besides 1 more described), and 27 of Insects. Mr. Brenchley's collections, we are told, have been divided

* In the preface (p. vi) the author states that a variety of circumstances prevented his making use of the papers of this intelligent and distinguished young officer, whose premature death was a severe loss to the service; but both here and elsewhere Mr. Brenchley's volume contains extracts from them.

between the British Museum and that of Maidstone. There is also a fair map, on which the ship's course during the cruise is traced. This was as follows:—Sydney to Norfolk Island, thence to Niue or Savage Island, the Samoa group, the Friendly group (from Vavau, already mentioned, in the north to Tongataboo in the south), then to the Feejees and across to Anatom, then northward through the New Hebrides and Banks Islands to Santa Cruz, thence to some half dozen of the Solomon group, back again to Eramango in the New Hebrides, and thence by the Loyalty Islands and New Caledonia to Sydney. The book has the great merit of an Index.

MISCELLANEOUS.

On a new Species of Bubaline (Alcelaphus tora) from Abyssinia.

By Dr. J. E. GRAY, F.R.S. &c.

THE British Museum in the early part of the year received a young specimen of a Bubaline from Abyssinia, which bore so much resemblance to the Caama from South Africa that I did not venture to describe it as a distinct species until I should receive more materials. The Museum has just received the skin &c. and the skeletons of adult specimens of both sexes of this animal, which proves to be a most distinct and well-marked species.

These animals were sent to the Museum under the name of "Tora" or "Thora" (for the word is spelt in both ways); I therefore propose to call it *Alcelaphus tora*.

Alcelaphus tora.

Bright pale bay; rump, inside of ears, and hinder side of legs whitish brown; tail with a tuft of black bristles. Horns slender, expanded, and rather recurved at the tip; of the female slender.

Hab. Abyssinia (Dembelas).

The horns are slender compared with the other species of *Alcelaphus*, and have some relation to those of the Sassayby, or *Damalis lunatus*; but it has the long slender skull of *Alcelaphus*. The young specimen, which appears to be a male, has shorter and thicker horns than the two adults more lately received.

The male of the Tora (*Alcelaphus tora*) has a large, round, convex tuft, about the size of a penny piece or larger, of darker hair in front of each eye. This tuft is marked, but not so distinctly, in the head of the young male and adult female. I do not find any such tuft in the head of the male Bubaline in the Museum, which was for many years alive in the Zoological Gardens; but the hair of the sides of the head in front of the eyes is longer than on the rest of the face.

A young specimen of the Caama is figured, from a living specimen in the Earl of Derby's park, in the 'Knowsley Menagerie.'

The species of *Alcelaphus* may be thus tabulated:—

- a. Animal, including the inside of the ears and rump, uniform brown, with a few black hairs on the underside of the tuft of the tail. *A. bubalis* (the Bubale). North Africa.
- b. Animal, including the rump, pale brown above, separated from the pale beneath by a well-defined straight line on the sides; inside of ears white; end of tail black. *A. Lichtensteinii* (the Godonko). Eastern Africa (Peters's 'Mossambique').
- c. Animal brown; inside of ears, rump, and back of legs whitish.
- * Face, dorsal line, and outside of limbs brown, like the rest of the animal; end of tail black. Horns diverging. *A. tora* (the Tora). Abyssinia.
- ** Sides of the head, dorsal line, outside of limbs, and end of tail black. Horns thick, erect. *A. caama* (the Caama). South Africa.

The British Museum has a pair of horns sent by Mr. Fraser from Tunis, which Mr. Blyth has described and figured as *Boselaphus major* (P. Z. S. 1869, p. 53, f. A, 1 & 2); and he says it has black marks above the hoof: but I have never seen this animal in the perfect state; and the horns are very like those of the common Bubale.

On Rhopalorhynchus Kröyeri, a new Genus and Species of Pycnogonida. By JAMES WOOD-MASON, of Queen's College, Oxford.

Much difference of opinion has prevailed with regard to the systematic position of the Pycnogonida, as to whether they should be classed with the Crustacea or with the Arachnida. By one set of naturalists (including Johnston, Milne-Edwards, De Quatrefages, Kröyer, and Dana) they have been placed with the Crustacea; by another, including Latreille, Erichson, Gerstäcker, and Huxley—who separates them, as well as the Tardigrada and Pentastomida, from the typical Arachnida (spiders, mites, and ticks) as an aberrant order—with the Arachnida. Dr. Anton Dohrn*, who has recently studied the embryology of these animals, finds that they are in no way related to the Arachnida, that they resemble the Crustacea in having a naupliiform first developmental stage, but that from this point the course of development ceases to exhibit any thing in common with that of the Crustacea. Under these circumstances I have thought it better to call the *cheliceræ*, *palps*, and *accessory legs* (= mandibles and first and second pairs of maxillæ of Kröyer) of those who range the Pycnogonida with the Arachnida, *the first, second, and third pairs of cephalic appendages* respectively, thus avoiding the use of terms implying affinities and homologies that may not in reality exist.

RHOPALORHYNCHUS †, gen. nov., Wood-Mason.

Corpus lineare, gracillimum, annulis thoracis perdistinctis, cylin-

* Jenaische Zeitschrift, 1869.

† ῥόπαλον, clava; ῥύγχος, rostrum.

dricis, utrinque dilatatis, processibusque lateralibus magnis, obconicis. *Rostrum* uniarticulatum, elongatissimum (corporis longitudinem pæne æquans), clavatum, ore triradiato. *Annulus oculiger* in collum vix coarctatus. *Appendices cephalicæ primi paris* absunt: *appendices cephalicæ secundi paris* tenuissimæ, rostro longiores, novemarticulatæ, articulis secundo tertioque elongatis: *appendices cephalicæ tertii paris* paulo longiores, ex decem confectæ articulis—quorum quartus sextusque sunt elongatissimi, terminalesque quatuor prehensiles ac margine interiore serrati ciliatique—in utroque adsunt sexu; *appendices utriusque paris, secundi ad tertium, tertii ad quartum articulum, sunt geniculatæ. Tuberculus oculiger* in postica annuli parte est situs. *Pedes gracillimi, inermes, æquales, corpore (rostro incluso) duplo longiores, unguibus auxiliaribus armati sunt nullis. Abdomen* uniarticulatum, obtuse conicum, perbreve, vix distinguendum.

Rhopalorhynchus Kröyeri, n. sp.

Body linear, smooth. The rostrum is almost as long as the rest of the body, movably articulated to the middle of the anterior end of the oculigerous somite, slender and filiform nearly to its middle, whence it expands and finally narrows to its obtuse extremity; when examined in profile, the convex upper contour of the expanded portion is seen to carry two minute forwardly directed spines, the one behind the other in the middle line. The mouth is situated at the extremity of the rostrum and has the form of a triradiate slit, the three slits being so disposed that a circle described from the point in which they meet so as to pass through their free extremities would be by them divided into three equal sectors. The ocular tubercle is erect, occupies the posterior half of the segment on which it is placed, and has the form of a short cylinder surmounted by a minute cone, the eyes being situated partly on the cylinder and partly on the cone, at points corresponding, as usual, to the extremities of the arms of a St. Andrew's cross. A very distinct crescentic suture, bounding the base of the ocular tubercle posteriorly and curving forwards and outwards, so that (if produced far enough) it would pass out just in front of the first pair of legs, divides the oculigerous from the first thoracic somite.

The *cephalic appendages of the first pair* are absent. Those of the *second pair* are about once and two thirds as long as the rostrum, with which they lie in the same horizontal line, being articulated one on each side of it to the anterior end of the oculigerous somite, are filiform, excessively slender, and composed of nine joints: the first joint is subglobular, being nearly as broad as long, much broader than any of the succeeding joints; the second greatly elongated and slightly expanded at the apex; the third is very short and slightly curved; the fourth is greatly elongated, but not so much so as the second; the fifth is shorter than either of the four equal terminal joints, which, together with the fifth and the distal half of the fourth, are fringed with short and very delicate cilia. Those of the *third pair* are also extremely slender, are articulated, a little

posteriorly and internally to the second pair, to minute processes springing from the ventral arc of the oculigerous somite and meeting in the middle line: they are composed of ten joints, of which the first is minute, the two next equal and cylindrical; the fourth greatly elongated and just perceptibly expanded at the apical end; the fifth short, scarcely longer than the second of the two basal joints, and curved; the sixth is likewise greatly elongated, but more expanded at the apex and longer than the third; the four terminal joints are short, slightly decrease in length from the first to the last, which comes suddenly to a subacute incurved point forming a sort of claw, are curved, fringed on their inner and concave margins with cilia and minute spinules, and capable of being coiled tightly together so as to form a prehensile organ.

Both pairs of appendages are elbowed at a short joint intercalated between two long ones, viz. the second pair between the second and fourth, the third between the fourth and sixth joints.

In many other species the terminal joints of the third pair of cephalic appendages (*pedes accessori*) will probably be found to be similarly modified as a prehensile organ; an examination of O. F. Müller's faithful figures of *Nymphon grossipes*, Fabr., in the 'Zoologia Danica'* would, in fact, alone suffice to show the existence of such a modification in that species, even if Kröyer† had not described it in his diagnoses of the genera *Nymphon* and *Zetes*, without, however, offering any interpretation of the structure.

The *oculigerous somite* has its anterior margin straight, and is but faintly constricted in front of the eye-tubercle.

The *first thoracic somite*, if its distinctness from the oculigerous somite be admitted, is very short. Of the remaining somites the second and third are subequal, the former being, if any thing, the longer, are as perfectly cylindrical and nearly as long as, but slightly stouter than, the filiform proximal moiety of the rostrum, and are suddenly expanded at their articular ends, each somite presenting the appearance of a cylinder with a greatly truncated cone affixed by its truncated surface to each end. The fourth and last somite is scarce half the length of those that precede it, and is similarly expanded at its anterior end only. From the sides of the expansions at the posterior extremity of the second and third spring two somewhat inflated outwardly directed obconic processes, which might at first sight be mistaken for the first of the basal joints of the legs from their close similarity to these, but which are in reality one with the somite from which they arise; precisely similar processes carry the legs both of the first and of the last somite, in which, however, they diverge like the arms of the letter Y. Wedged in between the roots of these processes of the last somite and the posterior boundary of its ventral arc lies a minute obtusely conical tubercle with a large circular (anal) aperture at its extremity. This is the abdomen, a very evident, though rudimentary, structure in most Pycnogonida, and even biarticulate in one species (in *Zetes hispidus*, Kröyer); but

* *Op. cit.* pl. cxix. figs. 5 & 8.

† *Naturhist. Tidssk.* 1844, pp. 108 & 116.

here so reduced in size as to be quite invisible from above, and only demonstrable with difficulty from below, whence it appears in ordinary positions under the microscope as a convex ovoidal or heart-shaped plate; it, moreover, looks downwards and slightly backwards, instead of upwards and backwards or directly backwards, as it usually does.

The legs are long, slender, simple, equal in length, rather more than twice as long as the body (including the rostrum), and are composed of eight joints, terminated by a weak slightly curved claw. Their three basal joints are as broad as long, equal, and almost globular; the fourth is club-shaped at the distal end; the fifth is all but as long as the fourth, and, with the remaining joints, perfectly filiform; the sixth is shorter and about twice the length of the two last together; these are subequal.

	millims.
Length of the body (including the rostrum)	13
„ „ legs	26
„ „ second pair of cephalic appendages	10
„ „ third „ „ „	12

From the linear form of the body and the slenderness of the legs I conclude that my specimen is a male—a conclusion by no means invalidated by the presence of the third pair of cephalic appendages, which, being apparently invariably developed in both sexes throughout several genera (*Nymphon*, &c.), consequently possesses no value in the determination of questions of sex.

Hab. Dredged by the writer at Port Blair, Andaman Islands, in 25 fathoms of water, at which depth the bottom was clothed with a dense tangle of delicate filamentous algæ so closely resembling the animal in point of colour and form that the latter was with difficulty distinguishable.

In conclusion, I dedicate the first species of Pycnogonida hitherto discovered in these seas to the memory of the illustrious Danish naturalist whose name is so indissolubly connected with the history both of the Pycnogonida and of the lower Crustacea.—*Journal of the Asiatic Society of Bengal*, vol. xlii. part 2 (1873).

On the Development of Distomum nodulosum. By O. von LINSTOW.

The author has ascertained that *Distomum nodulosum* is not produced from the *Cercaria Planorbis carinati* as supposed by De Filippi, but from another form which was not previously known.

To follow the migrations of this worm the author put individuals full of ova into a vase containing freshwater mollusca (*Lymneus*, *Paludina*, *Planorbis*, *Valvata*, &c.). The *Distoma* were soon decomposed and their ova were set free. The first embryos were hatched in two or three days; they swam about rapidly by means of their vibratile covering. It was in the alimentary canal of certain Chætopod Annelids by which they had been swallowed that M. von Linstow was best able to follow the first transformations of these larvæ; they had lost their cilia, and there was clearly to be

distinguished an anterior protuberance, which was already visible in the embryo when free in the water. The examination of the mollusca did not furnish conclusive results. Most of the individuals contained Cercariæ; but these belonged to several species; so that it was impossible to make out which of them were derived from *Distomum nodulosum*. However, by far the most abundant form in *Paludina impura* was a species furnished with an aculeus, and resembling *D. nodulosum* in the form and dimensions of its sucking-disks. This Cercaria is developed in sporocysts, completely destitute of structure, but often presenting a protuberance resembling that seen in the larvæ which penetrated into the interior of the Annelids. The sporocysts increase by transverse division; they never contain more than a few Cercariæ, and sometimes only a single one. In the *Paludina* these Cercariæ become encysted, losing their tails and at the same time their aculeus, which the author saw detach itself. Specimens of *Paludina impura* are found containing only sporocysts and free Cercariæ, others which contain only encysted Cercariæ, and others, again, with all three forms.

The author administered the cysts to four small perch. These fishes were opened two hours afterwards; and in two of them M. von Linstow discovered a certain number of young *Distoma* which proved to be *D. nodulosum*. These experiments therefore seem to prove that the ova of these Trematoda fall into the water, from which the embryos pass into Mollusca, from which they reach the fishes without penetrating into an intermediate host.

A curious fact observed in this species is its presence under a different form in *Acerina cernua*. The author has found on the outer surface of the intestine of this fish delicate cysts which, when ruptured, gave issue to young specimens of *D. nodulosum*, presenting all the characters of the species. Some of them already possessed the vitellogene and the germinogene, the testes and the cirrus-sac. He has also found the same cysts with the same contents, together with free young *D. nodulosa* in the same state of development, in the intestine of *Perca fluviatilis*, which they had evidently reached with an individual of *Acerina cernua*. The walls of the cysts are much more delicate than those occurring in *Paludina impura*; the cysts are also much larger, measuring 0.4 millim. or more instead of 0.07 millim.; moreover the animal contained in them is much further advanced in development.

The author explains in the following manner the presence of the parasite under these exceptional circumstances. There must be two modes of transport of the Cercariæ into fishes. In the first case the fish eats a *Paludina* containing encysted Cercariæ; the Cercariæ are set free by the digestion of the cysts and attain their sexual state in the intestine of the fish. In the second case the *Acerina cernua* eats a mollusk containing free Cercariæ, or else these larvæ pass directly into the fish. They pierce the intestine by means of their aculeus and encyst themselves on the outside of the wall of that organ. During their course through the intestine they increase in size, because they find suitable nourishment there.

Leuckart has laid down the principle that only the encysted *Distoma*

are transferable. M. von Linstow thinks that this opinion is correct if we understand thereby that a state of encystation is always necessary before a *Distomum* can be developed freely in the intestine. If a free *Cercaria* reaches its definitive host, it may continue to live there, but it becomes encysted.—*Archiv für Naturg.* 1873, p. 1; *Bibl. Univ.* August 15, 1873, *Bull. Sci.* p. 328.

Manufactured Glassrope. By Dr. J. E. GRAY, F.R.S. &c.

There have lately been sold at a natural-history sale two or three specimens of the glassrope (*Hyalonema*) from Japan of an extraordinary thickness, made up of a very large number of siliceous fibrous spicules, which at the free end diverge in the most extraordinary manner into a bunch six or seven inches wide. The size, and especially the fibres being separated from each other and twisted in different directions, so that the spiral turns did not match each other, excited my suspicions, which were confirmed by the mass of black pitchy matter with which their base was covered.

The larger specimen was made to appear the most perfect, and was about four inches in circumference about three inches from the base. This part, above the black pitchy substance, is covered with the usual bark for about two or three inches height. When this animal coat or so-called bark was carefully examined, it was found to have no real connexion with the spicules, and to be made up of pieces of bark taken from other specimens and fixed across the bunch of filaments, the grooves between the pieces looking like wrinkles. These specimens are evidently made for sale, probably by the same French taxidermist that made the specimens formerly noticed.

I am sorry to say they found purchasers at prices which the separate glassy filaments of which they are composed would not have fetched. The larger specimens have a usual-sized specimen, partly denuded of its bark, attached by a black pitchy substance to its base.

Note on certain Species of Phasmidæ hitherto referred to the Genus Bacillus. By JAMES WOOD-MASON, of Queen's College, Oxford.

The discovery which I have to announce, viz. that the true males of *Bacillus insignis* and its allies are to be sought in insects of the type of *Lonchodes stilpnus*, Westw., *Lonchodes pseudoporus*, Westw., *Lonchodes Russellii*, Bates, &c., affords another instructive illustration not only of the extreme imperfection of our knowledge of this family of Orthopterous insects, but also of the utter futility of any attempt satisfactorily to distribute the species composing it into genera, until we shall be in possession of the true pairs of many more of the described species.

In 1869 M. Henri de Saussure* proposed, prematurely as it turns out, to divide the genus *Bacillus* into three subgenera—one (*Bacillus*) for the reception of *B. Rossii* and its allies, another (*Ramulus*) for *B. humilis*, Westw., *B. carinulatus*, Sauss., &c., and a third (*Baculum*) for *B. cunicularis*, Westw., *B. ramosus*, Sauss., &c.; and in the first part of my memoir on the *Phasmidæ* †, I provisionally referred to

* Mél. Orth. fasc. ii. pp. 111 & 112.

† Journ. A. S. B. 1873, pt. ii. no. 1.

the last-named subgenus one known and three new species, pointing out that these agreed together in having the last dorsal abdominal segment longitudinally grooved, and mentioning, in the description of each species, the presence, in the posterior border of this segment, of an emargination filled by a well-developed supraanal plate, which is invariably to be found in the females of all species of *Lonchodes*. I have long felt convinced that the insect of which a description is appended was the male of my *Bacillus* (*Baculum*) *insignis*, but have thought it better to wait for evidence confirmatory of the fact. This has at length reached me from Ceylon, thanks to Mr. Hugh Nevill, C.C.C., who has been kind enough to send me, amongst other species of great interest and value, the two sexes of an insect agreeing admirably with M. de Saussure's* description of *L. pseudoporus*, Westw.

The discovery of the male of *B. insignis* will obviously also necessitate the transference of the following species to the genus *Lonchodes*:—*Bacillus cunicularis* et *hyphereon*, West.; *B. patellifer* et *scytale*, Bates; *B. ramosus*, Sauss., *B. Penthesilea* et *furcillatus*, Wood-Mas.: and I strongly suspect that *B. Woodwardi* et *scabriusculus* will eventually have to follow them to the same genus.

Lonchodes insignis.

♀. *Bacillus* (*Baculum*) *insignis*, Wood-Mason, Journ. A. S. B. vol. xlii. 1873, pp. 51 & 52, pl. v. figs. 1 & 2.

♂. Body of excessive tenuity. Antennæ perfectly filiform, 24-jointed, reaching nearly to the apex of the anterior femora. The head is almost a complete miniature of that of the female, and, in the specimen from which the dimensions given below are taken, has two minute tubercles between the eyes, representing the well-developed horns of the opposite sex. Three dark dorsal streaks, one median and two lateral, pass along the whole length of the body from the head to the end of the sixth abdominal segment. Both meso- and meta-thorax are dilated at either end, but especially at the insertion of the legs, and have each a raised median dorsal carina. The six basal abdominal segments are slightly expanded at each end, as in spirit specimens of the female; the seventh and eighth are shorter than the preceding, subequal, and gradually widen, the former from the base to the apex, the latter from the apex to the base; the last is scarcely longer than these, and cleft for rather more than a third of its length, but the sides of the cleft are so closely approximated that no hiatus is visible as in many other species; seen from the side, this segment terminates in an obtuse, scarcely deflexed tip. The legs are devoid of all traces of the foliaceous lobes so conspicuous in the female, but present the same general structure; the intermediate femora are just perceptibly curved; and the four posterior tibiæ have a few inconspicuous spinules towards the apical end.

Total length 4 in. $7\frac{1}{2}$ lin., ant. $15\frac{1}{2}$, head 2, proth. $1\frac{3}{4}$, mesoth. 12, metath. 11, abd. $24 + 6 = 30$ lin., ant. legs $19 + 22 + 6\frac{1}{2} = 4$ in., inter. legs $12 + 12 + 5 = 2$ in. 5 lin., post. legs $15 + 16 + 4\frac{1}{2} = 3$ in.

Hab. Samagooting, Naga Hills, with the female. Collected by Captain Butler.—*Proceedings of the Asiatic Society of Bengal*, July 1873.

* *Op. cit.* pp. 120 & 121.

THE ANNALS

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XLIV.—*On the HEXACTINELLIDÆ and LITHISTIDÆ generally, and particularly on the Aphrocallistidæ, Aulodictyon, and Farreæ, together with Facts elicited from their Deciduous Structures, and Descriptions respectively of Three New Species.* By H. J. CARTER, F.R.S. &c.

[Plates XIII.—XVII.]

THIS paper was commenced with observations on some deciduous specimens of the Hexactinellidæ from the deep sea, in which the influence of an absorbing process (to be mentioned hereafter) had rendered the sexradiate spicules, on which the vitreous fibre had originally been deposited, again recognizable. It was then found necessary to study the Hexactinellidæ and Lithistidæ (that is, Dr. J. E. Gray's *Coralliospongia ex parte*) generally for a better understanding of this process, and particularly the *Aphrocallistidæ*, *Aulodictyon*, and the *Farreæ*, as it was in the deciduous fibre of such sponges that the facts desired were, if possible, to be ascertained. During this study much information hitherto unknown has been obtained, and three new species of vitreous sponges discovered.

I shall first, therefore, give the results of my investigations of Dr. Gray's *Coralliospongia* &c., under the heads respectively of "Hexactinellidæ" and "Lithistidæ"—afterwards an account of the specimens respectively to which I shall have to refer when the spicules of the *Aphrocallistidæ*, *Aulodictyon*, and the *Farreæ* in the *living state* have been described and I come to the identifying of them in the *deciduous* structures—and, lastly, a short summary of what these structures have

revealed, together with a description of a new species of *Farrea* and a new genus of vitreous sponges.

I must here premise that whatever value the contents of this paper may possess is all due to the unceasing exertions of my friend Dr. J. E. Gray to place before me all the opportunities in his power, and afterwards to urge me to publish my observations.

In 1867, Dr. J. E. Gray proposed the term "Coralliospongia" for a certain group of sponges ("Notes on the Arrangement of Sponges," Proc. Zool. Soc. Lond. 1867, p. 505), as follows:—

"Order I. CORALLIOSPONGIA.

"Sponge hard, coral-like. Skeleton entirely formed of siliceous spicules anchylosed together by siliceous matter, forming a netted mass covered with sarcodæ."

Nothing can be more appropriate, both in name and definition, than this diagnosis. Dr. Gray had before him in particular the great, stony, shallow, expanded, stalked, dish-shaped masses of *Dactylocalyx pumiceus*, Stutchbury (P. Z. S. 1841, p. 86), and that of *MacAndrewia azorica* described by himself (P. Z. S. 1859, p. 438, pl. xv.), both in the British Museum, and each more than a foot in diameter.

In 1869, Dr. Bowerbank published his "Monograph of the Siliceous Sponges" (P. Z. S. May and June 1869, parts i. & ii. pls. xxi.—xxv. & pls. iii.—vi.), in which we find details of the same specimens, appearing respectively under the names of "*Dactylocalyx pumiceus*" and "*Dactylocalyx MacAndrewii*."

So far as the term "Coralliospongia" goes, Dr. Gray was right; but the details of Lens Aldous's figures in Dr. Bowerbank's monograph show that *MacAndrewia azorica* might be a family of that order, but could not be a species of *Dactylocalyx*—that is to say, that the elements of *Dactylocalyx pumiceus* are those of a sexradiate sponge, while those of *MacAndrewia azorica* belong to a quadriradiate system. (I call the "quadriradiate system" that in which the shaft of the spicule divides into *three* branches, as in the Geodinidæ, more typically shown in the four-armed spicule of *Pachostrella*, where, the arms being nearly equal in length, that which might be termed the "shaft" is often hardly distinguishable from the rest.) Yet Dr. Bowerbank has changed the name of "*MacAndrewia azorica*" to "*Dactylocalyx MacAndrewii*," thus erring both in grouping and nomenclature.

At the same time Dr. Bowerbank has distinctly shown in his figures, although he has not recognized the fact in his descriptions, that there are two systems, and that while sexra-

diate spicules characterize one, a trifold branching of the shaft or quadriradiate form characterizes the other system.

In 1868, Prof. Wyville Thomson's classification of these sponges appeared under the name of "Vitrea," to which Prof. Thomson added what Dr. Gray had excluded from his *Coraliospongia*, viz. the sarcospiculous Hexactinellidæ (*ex. gr. Hyalonema* &c.)—that is, the Hexactinellidæ which are not vitreous (Annals, vol. i. p. 119, Feb. 1868).

But in his fifth genus Prof. Thomson also includes the two species mentioned under the head of "*Dactylocalyx*," viz. "*Dactylocalyx pumicea* [*pumiceus*?], Stutchbury, and *Dactylocalyx azorica*, Gray," = *MacAndrewia azorica*, Gray. (See also Prof. Wyville Thomson's "genus 4," Phil. Trans. 1869, pt. ii. p. 713.)

At length, in 1870, the results of Schmidt's examination of the deep-sea sponges sent to him from America were published ('Grundzüge einer Spongienfauna des atlantischen Gebietes'), in which the two systems are respectively recognized under the heads of "Hexactinellidæ" and "Lithistidæ"—the former for the sexradiate, and the latter for the triradiate type, our quadriradiate system. The result of this examination shows plainly how much more Schmidt would have done with these systems with more time and more material at his disposal.

I had noticed *this* distinction before seeing Schmidt's work, in my "Fossil Spicules of the Greensand" (Annals, vol. vii. pp. 117, 118, Feb. 1871), where, instead of the term "triradiate," I had proposed "ternate" &c.; but without reference to this in particular, it will be easily seen that if we are to call those sponges *hexactinellid* whose central canal at one point consists of six arms, the other group, whose central canal at one point consists of four arms (viz. that of the shaft and its three branches together), should be termed "*quadriradiate*" to be consistent. The term "triradiate" does not suffice for the latter, which must be either "quadriradiate" or, as I had before proposed, "ternate" or "trifold."

Then, again, if we adopt "ternate" or "trifold," to be consistent we must change "hexactinellid" to "quinate" or "quinquefid;" for in the larger-headed spicules of the Hexactinellidæ the shaft is often so marked that we have to describe it under this term, while the minute sexradiate spicules being for the most part *equiarmed*, no other term can be used for them than "sexradiate."

I have endeavoured to show that in the development of a sponge-spicule which is not equiradiate, the primary form is a straight line, from whose central canal branches are *subsequently* given off to form the rest of the spicule *proper*

(Annals, vol. ix. p. 430, pl. xxii. fig. 16, June 1872). The ornamental parts, such as spines &c., although no doubt in the original design, are not attended by any alteration in the central canal, and therefore do not belong to the "spicule proper." I call the "spicule proper" that fundamental form which is marked out by the central canal and its branches; and these do not run into the ornamental portions.

But whatever may be the terms finally adopted for the spicular systems of the Hexactinellidæ and Lithistidæ respectively, it is perfectly evident that in the grouping of these sponges we cannot include the sarcospiculous Hexactinellidæ, viz. *Hyalonema* &c., under either of the terms "Coralliospongia" or "Vitrea;" while the name "Hexactinellidæ" refers rather to the elements than to the general character of these sponges.

All sponges begin their development from the ovum in the form of a sarcodic embryo; after which come the spicules, and lastly the fibre, which converts the skeleton-spicules into an axis, whether this fibre be vitreous or horny. Hence, as the sarcodic precedes the vitreous state, the latter would rank as a superior development to that of the sarcospiculous Hexactinellidæ, in which the sarcode never passes into either horny or vitreous fibre, but remains simply hardened and amorphous.

So it seems to me desirable that we should discard this "order" altogether, and distribute the groups of the Hexactinellidæ among the divisions of the Spongiadæ in accordance with what I have proposed in the footnote to my paper on the points of distinction between the Spongiadæ and Foraminifera (Annals, vol. xi. pp. 355-356, May 1873).

To understand this suggestion, however, it is necessary to premise that the vitreous fibre of the Hexactinellidæ is merely horny fibre silicified, and that the spicules of the species are imbedded in this, after the same manner respectively as they are imbedded in the fibre of sponges generally. This being the fact, we might expect to find certain Hexactinellidæ with their spicules all confined to the interior of the silicified fibre, as the spicules in the horny fibre of my third division, viz. the "Chalinidæ"—then that the fibre in another group of the Hexactinellidæ is more or less cchinated with spicules in addition to those contained in the interior, as in my fourth division, viz. the "Armatæ"—or the spicules supported by amorphous sarcode alone, as in the fifth division, viz. the "Renierinæ," wherein, too, would come our quadriradiate system, or Schmidt's "Lithistidæ," in which I think the fligreed terminations of the arms interlocking with each other, rather than the presence of vitreous fibre, chiefly bind the

whole structure together; for, indeed, if divested of this filigreed development, as is the case with the surface-spicules of *Dactylocalyx Bowerbankii*, Johnson (which are simply trifid-headed shafts with the shaft projecting internally and the trifid heads horizontally), they would be reduced to the state of similar spicules in the Geodinidæ and in *Pachastrella* (that is, held together only by the amorphous sarcode of the dermis), and would thus form a group in my fifth division.

We shall see by-and-by that, while the glassy skeleton of the Hexactinellidæ is formed by a vitrification of the sarcode or horny fibre, that of the Lithistidæ is formed by a vitrified extension of the spicule.

Assuming this, I shall for the present give lists respectively of the Hexactinellidæ and Lithistidæ which have already been described, grouping them, according to the best of my judgment, as their characters seem to indicate, and following each by a short commentary. After which I shall take the branched tube-net sponges (that is, the Aphrocallistidæ, in which we must include *Farrea* and *Aulodictyon*) for the special subject of this paper, returning to the other groups for more detailed description at a future time when it may be more convenient. I shall also, for the present, use the terms "sex-radiate" for the Hexactinellidæ, and "quadriradiate" for the Lithistidæ.

As the spicule of the Hexactinellidæ and Lithistidæ is, like that of all other sponges, developed from a single point or minute cell, which, by linear extension, becomes the central canal on which the vitreous layers of the spicule are subsequently built, we find that in the Hexactinellidæ the spicules are produced by a more or less uniform *radiation* from the central cell *immediately*; while in the Lithistidæ the spicules are formed by a more or less uniform *triradiation subsequently*, or from one extremity of the primary cell *after* it has undergone linear extension,—that is, that this *half* of the shaft is transformed into three arms, and that, too, probably commencing a little *beyond* the central cell, as an inflation of the shaft, often just below the head, leaving a kind of neck or more constricted portion, would seem to indicate. (See especially the large trifid spicules of the Geodinidæ &c.)

With reference to the Hexactinellidæ, it is also necessary to premise that there are here, as in most of the Spongiadæ, large spicules which are only concerned in the formation of the supporting structure or skeleton, which we shall term "skeleton-spicules," and minute spicules which belong entirely to the sarcode, which will be termed "flesh-spicules"—also that the latter here often afford a valuable character in conjunction with

others for specific distinction; but while the former remain under all circumstances in the dried specimen, the latter, unless accidentally included in the material which binds together the large spicules (a very rare occurrence), will, if the sarcode has passed into dissolution before the specimen is taken up for preservation, inevitably fall through the reticulated structure of the skeleton, as small pebbles through the meshes of a fishing-net. Hence the distinguishing character furnished by the minute or flesh-spicules will be lost or retained as the case may be; while, as some sponges have no minute spicule, its absence then must be determined by the presence of the sarcode, since if the sarcode be preserved the minute spicule will be in it if there be one, and if not the contrary. Thus it should be remembered that a sponge possessing the flesh-spicule in the natural state may not have it in the dried one, and that this remark applies to the Spongiadæ generally.

So far, all the Hexactinellidæ that have been made known possess a minute or flesh-spicule in the form of a "rosette," which may be defined to be an equiarmed, sexradiate spicule, from the ends of whose arms respectively proceed a certain number of rays which, although the same on each arm of the specimen, may vary in form, number, and arrangement with the species, but always project from the ends of the arms, which corresponding to the six sides of a cube, the whole, when the spicule is perfect, forms a more or less spherical rosette.

The term "rosette" first appears in Dr. Bowerbank's 'British Spongiadæ' (vol. ii. p. 189 &c.), as indirectly applied to a globular group of inequianchorate spicules well delineated in his plate xviii. fig. 297 (vol. i., *op. cit.*) as illustrations of an *Esperia* (*Hymeniacidon lingua*, B.). These are also flesh-spicules. Then Prof. Thomson, in describing *Askonema* ('Depths of the Sea,' p. 428), directly applies the term to the flesh-spicules of this sexradiate sponge. I now intend to apply it *generally* to the flesh-spicules of the Hexactinellidæ which possess this form, designating it according to its differences in a way which I hope will be found less oppressive to the memory, and therefore more practicable, than Dr. Bowerbank's "Terminology."

As before stated, we find in most sponges two distinct classes of spicules, viz. those which belong to the skeleton (skeleton-spicules) and those which belong to the sarcode (flesh-spicules). The skeleton-spicules sooner or later are all involved in the formation of this structure, while an enclosure of the latter is an exception so rare that the flesh-spicule may be said never to become united to the skeleton-structure. However remarkable it may be that the flesh-spicules should be inti-

mately mixed up with the skeleton-spicules of the sponge without ever being taken into the structure of the latter, such is the case.

Among the vitreous Hexactinellidæ, however, there is a sexradiate spicule of the skeleton-structure so minute and so plentiful that it might easily pass for a "rosette," were it not for the following differences, viz. that it never goes beyond the *simple* or *first sexradiate* division (that is, where the distinguishing form of the rosette, viz. the rays, commence), and is always more or less involved in or cemented to the vitreous skeleton (Pl. XIII. fig. 1). Thus it often appears in *Aphrocalistes Bocagei* and in the *Farreæ*, as will hereafter be seen, where, although essentially a skeleton-spicule, it is so much smaller than that which formed the basis of the original fibre that I cannot help viewing it as an "afterformation." Be this as it may, it is so mixed up with the rosette in *Farrea infundibuliformis*, one of the "new species" to be described hereafter, that it is desirable to notice the existence of such a spicule in order that it may not be confounded with the rosettes in any sexradiate sponge, besides those mentioned, in which it may be found to occur (Pl. XVII. figs. 2-4).

From this we pass to a consideration of the "rosette" itself (in connexion with our illustrations), which is essentially a flesh-spicule of the kind above mentioned, but of course subject to modifications.

The simplest form appears to be that in which the six arms are *long* and respectively terminated by two divergent pointed rays (Pl. XIII. fig. 2); or the arms may be *short* with dual rays (fig. 3); or the arms short with a variable plurality of the same kind of rays (fig. 4).

(Here it should be noticed that, for the sake of perspicuity, the fifth and sixth arms (fig. 2, *cc*)—that is, the third axis—will not be introduced in the illustrations after fig. 2.)

Then the dual ray may be straight and capitate, when we get the form fig. 5, where the spines of the head are *few* and *long* (fig. 5, *a, b, c*); or the arms, still short, may have straight capitate rays in variable plurality (fig. 6), where the spines of the head are short and *numerous* (fig. 6, *a, b*); or the arms may be *long* with the same kind of rays (fig. 7); or the arms variable in length in different rosettes, and furnished with a multitude of straight capitate rays of unequal length in the same group (figs. 8 & 16):—the pappiform variety. Here the ends of the *arms* also are conically inflated and provided with tubercles, each of which supports a ray.

Or the rays may be sigmoid, capitate, and arranged *en fleur-de-lis* expanded generally (fig. 9); or the same *en fleur-de-*

lis contracted below and only expanded above (fig. 10); or sigmoid, clavate, capitate, and toothed outwardly, with the lower third or inward curve of the ray diminished to almost nothing, arranged *en fleur-de-lis* (fig. 11, *a*, *b*); or sigmoid and without head, subulate, with flexed extremity diminishing to almost nothing in the lower third or inward curve, also arranged *en fleur-de-lis* (figs. 12 & 15):—the pappiform rosette with flexed ray. Here, too, the ends of the *arms* are conically inflated and tubercled for the support of the rays generally, ending on the summit in a straight coarse spine (fig. 15, *c*). The lowest portion of the ray being stouter than that which follows it, is frequently left attached to the end of the arm both here and in the foregoing form, as shown in fig. 15, *d*.

Then there is the rosette with *elongated* axis, shaft-like and straight spines or rays, sometimes pointed, sometimes capitate (figs. 17 & 18), sparsely associated with the globular forms (figs. 6 & 7) which characterize *Aphrocallistes Bocagei*, and which, with fig. 19 from *Aphrocallistes beatrix*, whose spines are also sometimes capitate, appear to be the transitional forms between the globular rosette on the one hand and the large spined shaft (fig. 20) peculiar to *Aphrocallistes beatrix* on the other, the globular form being altogether absent in the latter.

Also the birotulate spicule (fig. 21), consisting of a straight subspined shaft with eight separate recurved blades, which is the flesh-spicule of *Hyalonema* &c., but not unfrequently assumes the sexradiate form (fig. 22), when it becomes a "rosette." There is also a four-armed variety, so that the birotulate spicule may be said to be two-, and occasionally four- or six-headed; while three similar forms occur in *Hyalonema* on which there are no heads, but where the ends (and sometimes the whole surface) are covered with thick short vertical spines. (See Dr. Bowerbank's Brit. Spongiadæ, vol. i. pl. vi. figs. 153-157.)

Lastly, as regards varieties of the "globular rosette," the rays are sometimes once-branched (fig. 13); sometimes the head of the ray is echinated generally with spines (fig. 13, *a*); in others the *arms* alone have become enveloped by a globular vitreous mass (figs. 23 & 24), which seems to be the transitional state to the stellate and siliceous ball of the Geodinidæ &c., also flesh-spicules. There are, again, many slight modifications of the illustrations themselves, but fundamentally no more distinct forms in the Hexactinellidæ that have as yet been brought to notice than those above described and delineated.

As regards size, there is of course not only a difference

between the young and the fully developed rosette in the same species, but the size differs with the form of the rosette and in different specimens. The largest I have met with are in a fragment of *Euplectella aspergillum* dredged up on board H.M.S. 'Porcupine.' Here the form represented in fig. 11 is 26-6000ths inch in diameter, while in the specimens from the Philippine Islands it hardly exceeds 20-6000ths. The pappiform rosette with straight capitate rays (fig. 8) is the smallest form; and this averages in its largest size about 8-6000ths.

Subject to such differences in size, it would of course have been impossible for me to draw all the illustrations which I have given upon the same scale; and therefore, to represent their respective peculiarities, they are for the most part all drawn of the same size.

Let us now proceed to a *list* of the Hexactinellidæ; and as it would be confusing to add to each species the place where it has originally been described and illustrated in the list itself, this will be given in a "footnote," to which the reader may refer if necessary. Also, for the same reason, the short commentary on the species contained in the list will be given subsequently.

Hexactinellidæ*.

General character. Spicules developed upon a sexradiate division of the central canal, held together by silicified fibre or amorphous sarcode, forming a reticulated structure whose interspaces are more or less polyhedral.

SPICULES HELD TOGETHER BY SILICIFIED FIBRE.

Species massive, excavated, shallow.

Rosette or flesh-spicule many-rayed; rays of equal length, straight, capitate, sometimes only pointed (Pl. XIII. figs. 4 & 6).

Dactylocalyx pumiceus, Stutchbury. Barbadoes. (1)

— *pumicea*, Gray. Malacca. (2)

Iphiteon panicea, Valenciennes. Porto Rico. (3)

* *Abbreviations.* P. Z. S., 'Proceedings of the Zoological Society of London.' Annals, 'Annals and Magazine of Natural History.' M. M. J., 'Monthly Microscopic Journal.' B.M., British Museum. Atlantisch. Spongienf., 'Grundzüge einer Spongienfauna des atlantischen Gebietes.'

1. B.M. 1841, P. Z. S. p. 86; and 1869, p. 77, pl. iii. fig. 1, Bk.

2. B.M. 1867, P. Z. S. p. 506, pl. xxvii. fig. 2, = *Iphiteon Ingalli*, Bk., P. Z. S. 1869, p. 331, pl. xxiii. figs. 1-3.

3. Mus. Jardin des Plantes, Paris. P. Z. S. 1869, p. 324, pl. xxii. fig. 1.

Rosette many-rayed : rays of equal length, straight, capitate (figs. 6 & 7), or with multitudinous rays of unequal length, straight, and capitate, "pappiform" (figs. 8 & 16); or occasionally of the first kind once-branched (fig. 13); or occasionally with echinated heads (fig. 13, a).

Dactylocalyx subglobosa, Gray. Malacca. (4)

Rosette many-rayed : rays of equal length, capitate, flexed, and grouped *en fleur-de-lis* (fig. 10); or occasionally with straight and capitate rays.

Myliusia callocyathes, Gray. West Indies. (5)

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4. B.M. 1867, P. Z. S. p. 506, pl. xxvii. fig. 1, = *Iphiteon subglobosa*, Bk. P. Z. S. 1869, p. 329, pl. xxii. figs. 10-12.
 5. B.M. 1859, P. Z. S. p. 439, (Radiata) pl. xvi., = *Iphiteon callocyathes*, Bk. P. Z. S. 1869, p. 333, pl. xxiii. figs. 4-7.
 6. B.M. 1869, P. Z. S. p. 335, pl. xxv. fig. 1.
 7. Trans. Zool. Soc. vol. iii. p. 203, pl. xiii.
 8. B.M. 1858, P. Z. S. p. 114, (Radiata) pl. xi.; Annals, 1868, vol. i. p. 123, Wyville Thomson, = *Iphiteon beatrix*, Bk. P. Z. S. 1869, p. 325, pl. xxi. figs. 2-4.
 9. B.M. Quart. Journ. Microscop. Sc. vol. x. n. s. (No. xxxvii.), p. 4, pl. i. (1870); Schmidt, Atlantisch. Spongienf. 1870, p. 17, pl. ii. figs. 1, 11, 12; Kent, M. M. J. 1870, Nov., p. 248, pl. lxxv. figs. 8-15.
 10. Atlantisch. Spongienf. 1870, p. 13, pl. ii. figs. 1-3; Kent, M. M. J. 1870, Nov., p. 247, pl. lxxv. figs. 2-7.
 11. B.M. M. M. J. 1870, Nov. p. 249, pl. lxxiv. figs. 18-25.
 12. P. Z. S. 1869, p. 339, pl. xxiv. figs. 1-7; Owen, Trans. Linn. Soc. vol. xxii. p. 121, pl. xxi. figs. 8 & 9.
 13. Atlantisch. Spongienf. 1870, p. 16, pl. i. figs. 13-20, & pl. ii. fig. 10.
 14. B.M. 1873. *Vide postea*.
 15. Atlantisch. Spongienf. 1870, p. 15, pl. i. figs. 7-12.
 16. M. M. J. 1870, Nov. p. 245, pl. lxxiv. figs. 1-9; Wyville Thomson, 'Depths of the Sea,' 1873, p. 429.
 17. B.M. Annals, 1872, vol. x. p. 112.
 18. Atlantisch. Spongienf. 1870, p. 14, pl. i. figs. 1-6.
 19. B.M. Annals, 1872, vol. ix. p. 414, pl. xxi.
 20. B.M. Annals, 1872, vol. x. p. 137.
 21. 'Depths of the Sea,' Wyville Thomson, 1873, p. 419.
 22. Quoy et Gaimard, 'Voyage de l'Astrolabe,' 1833, p. 302, Atlas (Zoophytes) pl. xxvi. fig. 3, = *id.* Gray, P. Z. S. 1867, pl. xxviii. fig. 1; Wyville Thomson, Annals, 1868, vol. i. p. 131, pl. iv. fig. 2, &c.
 23. Gray, P. Z. S. 1867, pl. xxviii. fig. 2; Wyville Thomson, Annals, 1868, p. 129, pl. iv. fig. 1.
 24. B.M. P. Z. S. 1835, p. 65, = *H. mirabilis*, 1857, p. 279.
 25. B.M. P. Z. S. 1864, p. 265, pl. xxii.
 26. Phil. Trans. 1869, p. 701, pls. lxxvii.-lxxi.
 27. M. M. J. 1869, June, vol. i. p. 367. American Naturalist, 1871, vol. iv. p. 17.
 28. B.M. M. M. J. 1870, Nov., p. 243, pl. lxxiii. figs. 2-14.
 29. B.M. Annals, 1872, vol. x. p. 110.
 30. B.M. Annals, 1873, vol. xi. p. 275.
 31. Trans. Linn. Soc. 1857, vol. xxii. p. 117, pl. xxi. figs. 1-7.

Rosette many-rayed; rays of equal length, straight, capitate (fig. 6).

Myliusia Grayi, Bowerbank. St. Vincent. (6)

Species tubular, unbranched, closed at the extremity.

Rosette many-rayed: rays of equal length, sigmoid, clavate, and dentate outwards, claw-shaped, flexed and grouped *en fleur-de-lis* (fig. 11, *a, b*); or with rays of equal length, straight and pointed (fig. 4); or occasionally with straight rays, few, and terminated by three or more spines at the free ends laterally (fig. 14).

Provided with long anchoring-spicules of two kinds, viz. smooth and spiniferous; the latter terminating in an inflated head with several recurved spines arranged uniformly all round (Pl. XIV. fig. 5), or on one side of the head only (fig. 4); termination of the smooth spicule unknown.

Euplectella aspergillum, Owen. Philippines. (7)

Species tubular, branched; branches closed at their free extremities; wall thick, formed of polyhedrally reticulated fibre. Possessing a scopuline shaft.

Rosette (*small*) with *elongated* shaft-like axis, many-rayed: rays straight, pointed or capitate, thorn-like, chiefly situated in the middle and at the terminations of the shaft, arranged more or less verticillately (fig. 19); or (*large*) with microspined rays slightly curved and *not* capitate (fig. 20).

Scopuline shaft headed with four rays of equal length, slightly everted, microspined, and terminating in small globular heads (Pl. XV. fig. 2).

Aphrocallistes beatrix, Gray. Malacca. (8)

Rosette many-rayed: rays of equal length, straight, capitate (figs. 6 & 7); or with long shaft-like axis, like that of the "*small*" form in *A. beatrix*, with or without heads (figs. 17 & 18).

Scopuline shaft headed with four rays of equal length, flexed outwards *en fleur-de-lis*, microspined, and each terminating in a large conical end (Pl. XV. fig. 1).

Aphrocallistes Bocagei, Wright. Portugal. (9)

? Equal in the young form to *Lanuginella pupa*, Schmidt. (10)

Species tubular, branched; branches closed (?) at the free extremities; wall thin, formed of a single layer of subrectangular lattice-like fibre. Possessing a spino-capitate or umbrella-like headed shaft.

Rosette many-rayed; rays of equal length, sigmoid, capitate,

slightly flexed outwards, and grouped *en fleur-de-lis* (figs. 9 & 10).

Umbrella-like headed shaft of two kinds, viz. one with large head and many small circumferential spines (Pl. XV. fig. 4), and the other with small head and few long spines; the latter microspined on the inner aspect (fig. 5); each form flatly convex, or umbonate, and both passing into each other by gradational varieties.

Aulodictyon Woodwardii, Kent. Portugal. (11)

Species tubular, branched; branches open and slightly expanded at the free extremities; wall very thin, only one layer thick.

Farrea occa, Bowerbank. Seychelles, &c. (12)

Note. All that is known of this species is that its skeleton is thin, tubular, branched, and composed of subrectangular lattice-like fibre, only one layer thick. Deciduous skeletons alone have as yet been found. (See an account, with illustrations, of what spicules have been discovered in the deciduous fragments, further on.)

The same: possessing both a scopuline and an umbrella-like headed shaft.

Rosette many-rayed: rays of equal length, sigmoid, capitate, flexed *en fleur-de-lis* (Atlantisch. Spongienf. Taf. i. fig. 19).

Scopuline shaft headed with several attenuated pointed rays, slightly divergent, brush-like (*ib.* Taf. i. fig. 18).

Umbrella-like headed spino-capitate spicule consisting of a straight shaft with convex head spined at the circumference (*ib.* Taf. i. fig. 20).

Farrea fecunda, Schmidt. Florida, Cuba. (13)

Species infundibuliform; wall compounded of subrectangular lattice-like, overrun by dendritic, branched, anastomosing fibre. Possessing the rosette only.

Rosette many-rayed; rays of equal length, sigmoid, capitate, expanded and arranged *en fleur-de-lis* (Pl. XIII. fig. 9, & Pl. XVII. fig. 4).

Farrea infundibularis, Carter, n. sp. Caribbean Sea. (14)

Species stalked, dichotomously branching; branches terminating in oviform heads, each with a terminal aperture.

Rosette many-rayed: rays of equal length, straight, capitate

(fig. 6); or rays multitudinous, of unequal length, without heads, flexed outwards and arranged *en fleur-de-lis*; pappiform (figs. 12 & 15).

Sympagella nux, Schmidt. Florida. (15)

SPICULES HELD TOGETHER BY AMORPHOUS SARCODE.

Species sessile, vasiform, deeply excavated, possessing a rosette.

Rosette many-rayed; rays of unequal length, straight, capitate (fig. 6).

Askonema setubalense, Kent. Portugal. (16)

Species stalked, goblet-shaped.

Rosette few- or many-rayed: rays few, of equal length, straight and pointed (fig. 2); or multitudinous, of unequal length, straight and capitate: pappiform (figs. 8 & 16).

Crateromorpha Meyeri, Gray. Cebu, Philippines. (17)

Species sessile, sac-shaped.

Rosette many-rayed; rays multitudinous, of unequal length, straight, and capitate; pappiform (Atlantisch. Spongienf. Taf. i. fig. 6).

Holtenia Pourtalesii, Schmidt. Florida. (18)

Species oblong, excavated, provided with anchoring-spicules.

Rosette few- or many-rayed: rays few, of equal length, straight, and pointed (fig. 3), or spino-capitate (fig. 5); or multitudinous, of unequal length, without heads, flexed outwards and arranged *en fleur-de-lis*; pappiform (figs. 12 & 15): or sometimes many-rayed with rays straight and capitate (fig. 6).

Anchoring-spicules all smooth, stout, and terminating respectively in heads formed of *four* equally stout recurved spines or hooks ('Annals,' 1872, vol. ix. pl. xxi. fig. 7, &c.).

Rossella antarctica, Carter. Antarctic Sea. (19)

— *philippinensis*, Gray. Philippines. (20)

— *velata*, Wy. Thomson. South side of Færoe Islands. (21)

Species tubular, unbranched, closed at the extremity.

Rosette the same as in *Euplectella aspergillum*.

Habrodictyon speciosum, Wy. Thomson. Moluccas. (22)

— *corbicula*, Wy. Thomson. —? (23)

Species solid, not excavated, provided with anchoring-spicules and a flesh-spicule, which is birotulate.

Birotulate spicule consisting of a straight subspined shaft terminated at each end by eight separate recurved blades (fig. 21); or sometimes four- and six-armed, with as many heads, thus assuming the form of a rosette (fig. 22); or without heads, and covered throughout or at the extremities with a number of short vertical spines.

Anchoring-spicules of two kinds, viz. smooth and spiniferous, twisted into the form of a cord which runs through the head. Free terminations of the spicules unknown.

Hyalonema Sieboldii, Gray. Japan. (24)
 — *lusitanicum*, Bocage. Portugal. (25)

Species more or less globular, excavated, provided with anchoring-spicules, and characterized by the birotulate flesh-spicule above mentioned.

Anchoring-spicules of two kinds, viz. smooth and spiniferous, the latter terminating at its free extremity in a recurved double hook; termination of the former unknown.

Holtenia Carpenteri, Wy. Thomson. Sea south of Färoe Islands. (26)

Pheronema Annæ, Leidy. Santa Cruz. (27)

— *Grayi*, Kent. Portugal. (28)

Meyerina claviformis, Gray. Cebu, Philippines. (29)

Species possessing the birotulate flesh-spicule in which the terminations of both kinds of anchoring-spicules are known.

Free termination of spiniferous anchoring-spicule much the same as that above mentioned; termination of the smooth anchoring-spicule consisting of a double hook or arm, opposite, compressed, slightly recurved, and twice the size of the head of the spiniferous form (Pl. XIV. fig. 2).

Labaria hemisphærica, Gray. Cebu, Philippines. (30)

SPICULES HELD TOGETHER IN ONE PART BY VITRIFIED FIBRE AND IN THE OTHER BY AMORPHOUS SARCODE.

Species tubular, unbranched, closed at the extremity.

Body sarcospiculous; lid vitreous. Provided with two kinds of anchoring-spicules and two forms of rosettes, the same as those of *Euplectella aspergillum*.

Euplectella cucumer, Owen. Seychelles. (31)

SHORT COMMENTARY ON THE HEXACTINELLIDÆ.

As considerable difference exists between the older and youngest portions of the vitreous Hexactinellidæ, it is necessary for specific distinction that fragments from both should be examined—first in their natural state, and then after boiling for a few moments in nitric acid or liquor potassæ; while the minute spicules of the sarcode, viz. the rosettes &c., which come off in the boiling, should, with any minute fragments of the skeleton that may remain, be well washed, dried, and mounted in Canada balsam for examination with a higher power.

The chief difference in structure between *Dactylocalyx pumiceus*, Stutchbury, and the following specimen, viz. *D. pumicea*, Gray, is that the latter is charged, especially towards the surface, with long linear spicules (slender, fusiform, slightly inflated and spined for some distance at each end), while there are none to be seen in *D. pumiceus*.

I say "none" advisedly, because I have repeatedly sought for them in the type specimen of *D. pumiceus* without success. Boiling in nitric acid completely frees *D. pumiceus* and *D. pumicea* from the rosette, because the rosette belongs entirely to the sarcode; but the long acerate spicule, although it also appears to be isolated, is retained in the latter by its bent position in the vitreous structure, thus fixing it there by its elasticity; so that, if these spicules had been equally common in *D. pumiceus*, S., each fragment should contain portions of them, as in *D. pumicea*, G. Had not Dr. Bowerbank figured the central (and thus unmeaning) portion of one in his illustrations of the type specimen of *D. pumiceus* (*l. c.*) without the most distant allusion to such spicules in his description, I should not have thought it necessary to write so much about it: as it is, I am compelled to the conclusion not only that such a spicule does not exist in *D. pumiceus*, but that Dr. Bowerbank has, as in other instances, introduced it as part of the illustrations of this species by mistake (to wit, the surface-spicule of *MacAndrewia azorica* with his illustration of *Myliusia callocyathes*, P. Z. S. 1869, pl. xxiii. fig. 6).

Independently, however, of this difference (and the rosette, which, although alike in other respects, is a little more robust in *D. pumicea* than in *D. pumiceus*), I find it so impossible, either in the general form of the specimens of these two sponges or in their reticulated structure respectively, to see the self-evident facts which should determine a specific distinction, that I can hardly consider them varieties, much less different species, as Dr. Bowerbank has made them.

With reference to Dr. Bowerbank's fancied differences, on which he states (P. Z. S. 1869, p. 333) that Dr. Gray "is in error" in identifying *Dactylocalyx pumiceus* with *D. pumicea* = *Iphiteon Ingalli*, Bk., because "none of the singular and beautiful forms of spicula which I have obtained from the type specimen of *D. pumiceus*, and have figured in plate iii., part i., are to be found in the tissues of the type specimen of *I. Ingalli*," it unfortunately happens that figs. 9 & 10 of these "singular and beautiful forms" belong to quite a different order of sponges, viz. to *Pachastrella abyssi*, Sdt.; fig. 11 probably to a sponge of the same kind; fig. 16 to a *Gummina*, Sdt.; and fig. 6, *a* & *b*, to sponges which are certainly not of the sexradiate system. Thus, with the exception of fig. 3, which (as before stated) appears to have been introduced by mistake, we have nothing left here by way of illustration but figures 2, 4, and 5, which are equally common to both *D. pumiceus* and *D. pumicea*.

With *Dactylocalyx subglobosa*, however, it is different; for although two of its rosette-forms are the same as those of *D. pumiceus* and *D. pumicea*, and there is a long acerate spicule present similar to that in the latter species, the large tubercles with flat muricate summits respectively on the joints of the reticulated structure in *D. subglobosa*, together with the third form of rosette (viz. the pappus-like or pappiform, with straight capitate rays), so far only observed in one other species (viz. *Crateromorpha Meyeri*), at once furnish the specific distinctions.

Here we may shortly revert with advantage to the long, linear, acerate, fusiform spicule with spined extremities, which, although not seen in *Dactylocalyx pumiceus*, forms such a prominent feature in *D. pumicea* and *D. subglobosa*, that particular mention of it is desirable. It pierces the reticulated structure of each of the two last-named sponges generally, forming by its free end on their surfaces respectively a fringe which, on account of the superior size of this spicule, is also most noticeable in *D. subglobosa*; but although it is microspined towards the ends and frequently throughout, it presents no circumscribed central inflation, no "cross" on the central canal, nor is it ever included with the rest of the spicules in the vitrified fibre, which it much exceeds in size; so that were it not so interwoven with the skeleton generally, its isolated condition and want of sexradiate character would lead to the conclusion that its presence was accidental. But what is equally worthy of notice is that a similar spicule pervades in a similar manner the structure of at least one of the Lithistidæ (viz. *Azorica Pfeifferæ*, n. sp.), as will be seen hereafter.

At first I thought, from the presence of these long fusiform spicules in great abundance and of large size in *D. subglobosa*, that the latter must be identical with *D. pumicea*; but the general globular cup-like form of *D. subglobosa*, together with the muricated summits of the tubercles on the joints and the pappiform rosette with straight capitate rays, all cause it so far to differ from *D. pumiceus* and *D. pumicea*.

Myliusia callocyathes differs from the foregoing in the thorny appearance of its fibre—that is, in the minute blunt spines which are scattered over the fibre of the foregoing species being much enlarged, elongated, and pointed,—also in the rays of the rosettes in most instances being sigmoid instead of straight, and arranged *en fleur-de-lis*, and in the absence of the linear fusiform spicules. Dr. Bowerbank's figure of its structure would be perfect were it not combined with a surface-spicule of *MacAndrewia azorica*, as before stated (fig. 6, *l. c.*), which of course is an oversight, the latter belonging to quite a different system of sponges, viz. the Lithistidæ.

Myliusia Grayi, both in general form and structure, has many distinguishing characters, especially that which consists in an octahedral lantern-like appearance of the joints, produced by the vitreous fibre stopping short of the joint and proceeding thence directly on from one arm of the sexradiate spicule to the other, so as to leave the centre intact and visible through the interstices. This is best seen in the younger portions of the fibre, as the older ones, by thickening, render the cross in the centre obscure. Schmidt's figure from a fossil species (Taf. ii. fig. 16, *op. cit.*) would illustrate this well, were it not for the absence of the sexradiate cross in the centre, which may have become absorbed in the deciduous specimen previously to fossilization, after the manner to be hereafter explained.

The spicules of *Euplectella aspergillum* are enveloped in ladder-like silicified fibre, such as is seen in some of the horny-fibred sponges; and the characteristic rosette for the most part has its rays arranged *en fleur-de-lis*, while the rays themselves present the peculiarity of being clavate with claw-shaped spines on the outer side of the head. The latter is repeated in *Habrodictyon speciosum* and *H. corbicula*, where the sarcode is not vitrified. It is also present in *Euplectella cucumer*, which appears to be a mixed species in point of structure; that is, while the general structure in the figure looks as if unaccompanied by vitreous fibre, the lid not only appears to be consolidated by it, but in the index to the plate is stated to be "soldered," the only time that this word is used in the whole paper. Thus, a fragment of a *Euplectella* of this nature, presented to the British Museum by "Admiral Sir W. Belcher,"

leads me to the conclusion that it must have belonged to a specimen of *Euplectella cucumer*. That described by Professor Owen and Dr. Farre I have never seen; but no one can have compared the specimens of *Euplectella aspergillum*, which are very common now, with the figures of *Euplectella cucumer* drawn on stone by that accurate artist Mr. G. B. Sowerby (*l. c.*), and those taken from photographs of *Habrodictyon speciosum* and *H. corbicula* obtained by Prof. Wyville Thomson (*l. c.*), without being convinced that *E. aspergillum*, *E. cucumer*, and *Habrodictyon*, if not distinct species, are very different forms of the same type.

Since writing the above I have carefully examined the specimen of *Euplectella cucumer* described by Prof. Owen, still in the possession of Dr. A. Farre, F.R.S., whose kindness on the occasion can only be exceeded by his continued desire for the further elucidation of this beautiful species. I have also examined the figure of *Alcyoncellum speciosum* (*Habrodictyon*, Wy. Thomson) given by Quoy and Gaimard in the Atlas to their Natural History of the Voyage of the 'Astrolabe' in 1826-29 (pl. xxvi. fig. 3, Zoophytes, 1833); and, through the kindness of my friend Dr. J. E. Gray, I am in possession of excellent photographs of this and *A. corbicula*, Val., of the natural size; so that, with specimens of my own of *Euplectella aspergillum*, I am altogether now able to state with certainty the principal differences that exist between these species.

1st. *Euplectella aspergillum* has its spicular basketwork, both of the body and lid, throughout cemented together by an envelope of vitreous ladder-like fibre, which "ladder-like fibre" in a *horny state* is also a peculiarity of some of the kerataceous sponges. The main lines of spicules are longitudinal and transverse, so that, cutting each other at right angles and at nearly equal distances, they leave a number of squarish areas in the intervals, occupied alternately by round holes and matted basketwork. Through this arrangement, the squares with holes and basketwork respectively form diagonal lines again crossing each other, but now obliquely and somewhat spirally round the body; while a number of compressed ridges or frills about a quarter of an inch high, and formed of the same kind of vitreous spicular structure as the rest of the sponge, run along in more or less continuous spiral lines obliquely through the squares of matted basketwork, leaving those with holes free between them, finally terminating above in one which encircles the lid-like end where the latter is joined to the body. The lower end, on the other hand, which is also closed but of a conical form, similar to the

end of a conical sac, is enveloped in a bunch of white horse-hair-like, long, anchoring-spicules, respectively smooth and spiniferous, with hooks at the free extremity of the latter.

2nd. *Euplectella cucumer* has the spicular basketwork of the lid alone cemented together by an envelope of vitreous ladder-like fibre, while all the spicules of the basketwork of the body below are cemented together by sarcode only. The main lines of spicules &c. are the same as in *E. aspergillum*; but there are no ridges or frills, their place being supplied by robust vertical spines one eighth of an inch long, respectively situated in the centre of each square of the matted basketwork, so that the spiral lines of holes are between rows of spines, which thus replace the ridges in *E. aspergillum* (Pl. XIV. fig. 10, *a a a*). Indeed there is a special form of sexradiate spicule produced for this purpose, in which the projecting spine or ray is far more robust than any of the rest, the opposite continuation or internal arm being more or less aborted, and the four horizontal ones extended diagonally along the squares of basketwork to meet the corresponding arms of their neighbours. This spicule is delineated in the original description of the sponge by Prof. Owen (Trans. Linn. Soc. 1857, vol. xxii. pl. xxi. fig. 5), and its position pointed out in the explanation of the plate, but does not appear in the figure of the sponge itself. In other respects *E. cucumer* is generally like *E. aspergillum*, but possesses a number of minor differences, which it is not requisite to mention now.

3rd. *Alcyoncellum speciosum* and *A. corbicula* (*Habrodictyon*, Wy. Thomson) have no vitrified fibre in their composition. The spicules of which their basket-like structure is composed are stated by Prof. Thomson, who examined the specimens, to be cemented together by a "small quantity of mucilaginous sarcode" only ('Annals,' 1868, vol. i. p. 126); and it is evident from the photograph that the main spicules present no regularity in their arrangement like those of *Euplectella aspergillum* and *E. cucumer*—that is, that they do not for the most part cross each other at right angles, in consequence of which neither the holes nor the interspaces are regular either in size or direction, while the interspaces present neither "ridges" nor "spines." Neither does either of these specimens possess any anchoring-spicules; while, as evidence of their sessile growth, *Alcyoncellum speciosum* still retains at its base a portion of the rock to which it was attached. On this difference, however, I do not wish to lay any particular stress, because I have a specimen of *Euplectella aspergillum* (fragment of the base) in the same condition—that is, sessile, on a fragment of *Lophohelia proliifera* dredged up on board H.M.S. 'Porcupine' on this side

of the Atlantic Ocean, probably somewhere between the west coast of Ireland and the Färoe Islands; so that it seems reasonable to infer that when there is a tuft of long anchoring-spicules present it is indicative that the *Euplectella* has grown in mud—and when absent, that it has grown upon some hard object.

Alcyoncellum speciosum and *A. corbicula* appear to me to belong to one and the same species; and when we find Prof. Thomson, who examined them carefully and got photographs made of them, stating respecting their differences, "I am not quite satisfied on this point even now" ('Annals,' l. c. p. 129), one wonders that he made any difference in their designation.

As regards size, *E. aspergillum*, *E. cucumer*, and *Habrodictyon* are almost all equal: hence it cannot be assumed that either is a young form of the other; and while it may reasonably be inferred that the two specimens of *Alcyoncellum* might reproduce each other, it by no means appears likely that either of the three species above differentiated could do this.

Hence, although in general form all three are alike and all possess the characteristic rosettes of *Euplectella* (Pl. XIII. figs. 4 & 11, *a*, *b*), yet between these two extremes there are the differences above mentioned, together with many other minor ones, which indicate that they are three distinct species.

Here I would take the opportunity of mentioning that Mr. Kitton, of Norwich, informs me that he possesses a specimen of *Euplectella aspergillum* in which there is a netted diaphragm—which is so far interesting as it still more nearly allies the structure of this sponge to that of the Aphrocallistidæ, where the diaphragm is a normal and constant occurrence.

As *Aphrocallistes*, *Farrea*, and *Aulodictyon* will be particularly described in the after part of this paper I shall say nothing more of them here.

In *Sympagella nux*, Sdt., there is the same ladder-like vitrified fibre as in *Euplectella*, but not the form of the rosette peculiar to the latter. Of the two forms of rosette, one is the common one (Pl. XIII. fig. 6), and the other the pappus-like or pappiform rosette with flexed rays, no heads, and arranged *en fleur-de-lis* (figs. 12 & 15), noticed in one other genus only, viz. *Rossella*. The ladder-like fibre is well illustrated by Schmidt (Atlantisch. Spongienf. Taf. i. figs. 9–12).

We come now to the *sarcospiculous* Hexactinellidæ, or those whose spicules are held together by unvitrified sarcode, of which the first is *Askonema setubalense*.

Of this sponge, as I have had nothing for examination but a fragment brought from Lisbon to the British Museum by

Mr. S. Kent, I can only state that microscopical observation of portions of it shows that, although *Askonema* possesses small sexradiate spicules, whose arms are covered with short spines, it does not possess that with one arm spined feather-like, which abounds in the *Aphrocallistidæ* &c. ; and thus, as will hereafter appear, I have been able to distinguish the minute young sponge of the former from the latter, which otherwise might have been almost impossible, the rosette being of the same form in both.

In *Askonema* the small sexradiate spicules with short-spined arms (of which the vertical one on one side is often deficient) and found together in groups recall to mind the same kind of spicules (which form a rectangularly reticular network) on the surface of *Crateromorpha Meyeri* and *Rossella velata*. Indeed, so far as this goes, *Askonema* might be considered a sessile, vase-like representative on the coast of Portugal of the cup-like head of *Crateromorpha* found about the Philippines only. While the latter is about $2\frac{3}{4}$ inches high and $3\frac{1}{2}$ inches broad, the specimen of *Askonema* dredged up on board H.M.S. 'Porcupine' on the coast of Portugal, off Cape St. Vincent, was 2 feet high and 3 feet broad at the top ('Depths of the Sea,' Wyville Thomson, p. 428). In short, like most things in the west, if the Hexactinellidæ do not surpass in beauty, they do in size, for the most part, those of the east.

For the further description and illustration of *A. setubalense*, I must refer the reader to Mr. Kent's description and figures of this remarkable sponge in the 'Monthly Microscopical Journal' (*l. c.*), merely adding that the spicules represented in his figures 10 and 11 do not belong to the sexradiate system, but appear to me to have come from a species of *Pachastrella*, viz. *P. abyssi*, Sdt. That this should be the case is not extraordinary, seeing that the *Pachastrellæ* are great wanderers, and seem to grow wherever they can find any thing to rest upon, especially in the deep sea. I possess a portion of coral-detritus from the island of Cuba, which has been burrowed through by a *Cliona*, associated with which, in the burrow, is a *Pachastrella* possessing spicules, as my mounted specimen shows, exactly like those of our British species *Dercitus niger*, Gray, = *Hymeniacidon Bucklandi*, Bk.

The long-stemmed goblet-like form of *Crateromorpha Meyeri* would be sufficient in itself to distinguish this sponge from all other species, had it not also the peculiarity of possessing a complicated, tubuliferous, felt-like structure of the stem, sheathed by a layer of shortish, robust, smooth, fusiform spicules, in the central canal of which the "cross" may always be seen, although there may be no corresponding inflation outside. The cup, too, is covered by a rectangular lattic-like structure or

veil formed of the overlapping arms of a small spiniferous sex-radiate spicule, whose outer vertical arm being undeveloped renders it nail-like by the corresponding one projecting inward like those just mentioned in *Askonema*. It is charged also with rosettes of two kinds, one of which is the pappus-like or pappiform one with straight capitate rays, as yet only noticed in two other species, viz. *Dactylocalyx subglobosa* and *Holtenia Pourtalesii*, Sdt.

The details figured by Schmidt of *Holtenia Pourtalesii* (*l. c.*) seem to me to ally it much more nearly to *Rossella* than to *Holtenia Carpenteri*, the type species of the *Holteniæ*, since the former has not the birotulate spicule which is characteristic of *Holtenia* and its associates. The pappus-like rosette last mentioned is also characteristic of *Holtenia Pourtalesii*; but there is no rosette (at all events of this kind) in *Holtenia Carpenteri*, &c. Again the large nail-like spicule of the surface (*l. c.* Taf. i. fig. 4) is spined like that of *Rossella antarctica*. Lastly, if the pappiform rosette with straight capitate rays be equally characteristic of *Crateromorpha*, the latter also has many points of resemblance in its structure to *Rossella* with the rectangular lattice-like dermal veil &c., well seen in *Rossella velata*, Wy. Thomson.

Then the distinguishing character of *Rossella* is, that all its anchoring-spicules are smooth, and all armed with four robust recurved spines opposite ('Annals,' *l. c.*). It is also covered (that is, *R. velata* and *R. philippinensis*) with the rectangular lattice-like veil mentioned; and besides the common forms of rosette, it is charged with the pappus-like or pappiform one with multitudinous flexed rays of unequal length without heads, and arranged *en fleur-de-lis*, seen only in one other species, viz. *Sympagella nux*.

The arms of the large nail-like spicules of *Rossella antarctica* are covered by a layer of microspines, with here and there large curved spines, inclined outwards ('Annals,' *l. c.*).

Habrodictyon speciosum and *H. corbicula* = *Alcyoncellum speciosum* and *A. corbicula* have been noticed under *Euplectella aspergillum*. They are inserted here on account of their spicular structure being enveloped in amorphous sarcode instead of vitreous fibre. If the glassy fibre be considered of no specific value, then they can be removed back to *Euplectella aspergillum* at any time.

Hyalonema, from its twisted cord-like stem, composed of long anchoring-spicules, passing through the head (*Carteria*, Gray) so as to appear in a conical projection on the summit of the latter, whereby the central portion of the sponge, which thus hangs upon it, is rendered solid (instead of hollow, like

that of the rest of the species characterized by the birotulate spicule before mentioned), thus stands apart from all the other sarcospiculous forms of Hexactinellidæ possessing this spicule.

Here I take the opportunity, in connexion with illustrations, of correcting a mistake which I made respecting the anchoring-spicules of *Hyalonema* ('Annals,' vol. xi. p. 280, 1873), viz. that the specimen "half an inch long," which I took to be *Hyalonema*, I now find to be hollow, and, therefore, that it cannot be one of *Hyalonema*, but is probably one of *Holtenia Carpenteri*. Hence, I still have not yet seen the free termination of either the spiniferous or smooth anchoring-spicule of *Hyalonema*; while those described (*l. c.*) in the young *Holtenia* supposed to be *Hyalonema* show, as illustrated by Prof. Thomson (*l. c.*), that the terminations of its spiniferous anchoring-spicules are of two kinds, viz. one (the common form) in which the flukes are double and opposite, and the other in which they are double or treble and all on one side, somewhat resembling the laterally spined one of *Euplectella* (Pl. XIV. fig. 4).

Then, again (at p. 284, *l. c.*), I might have added what Dr. Gray had sketched for me in a note long ago, viz. that the broken spiral "bracket-like" line round the rough anchoring-spicules of *Hyalonema* was crowned with short spines before the latter became rubbed off (Pl. XIV. fig. 9); while they are of the same nature as the spines on the shafts of the long anchoring-spicules of *Euplectella*, *Holtenia*, and *Meyerina*, in which species, as their spiral continuation disappears, the spines become larger and more isolated.

The spines on the anchoring-spicules of *Hyalonema* are so small and so easily detached (fig. 9, *f*) that we do not wonder at their being for the most part absent on the exposed portions of these spicules; but on examining (this time) an undoubted specimen of *Hyalonema* about $1\frac{1}{2}$ inch long in the body, through which the cord passed, I found the spiral lines on those parts of the spicules which were within the body all fringed with the spines, and immediately mounted some in Canada balsam for more deliberate examination, the result of which went to show that the attenuated end of the spicule in the conical part of the twisted cord which projects above the sponge is smooth and nearly straight—that the spicule then becomes undulated, and upon each bend appears a group of minute points—that these, on descending, soon pass into short spines, and that these become more prominent and supported respectively on the bracket-like processes (Pl. XIV. fig. 9), which, as before stated, form a broken spiral line, here and there more or less continuous round the spicule (fig. 9, *d*)—till at last

the spicule disappears under the parasitic polype (*Palithoa fatua*) which afterwards, for some distance down, covers the cord like a bark. Finally, the spicules again make their appearance, but now with the spines gone and the bracket-like processes alone remaining in the form of a rough more or less continuous spiral line round the spicule, which, together with the free extremities of the smooth anchoring-one, also are always broken off, so that their free terminations are gone: this is the state in which these spicules appear for the most part in the trade specimens.

I have now described the anchoring-spicules of the specimen of *Hyalonema* above mentioned, whose body is about $1\frac{1}{2}$ inch long; and throughout the spicule, all the spines and blunt ends of the bracket-like processes both within and without the body are directed upwards—that is, towards the sponge at the summit of the cord.

Had I not been misled by the observations of others to regard the mounted specimen of the young *Holtenia Carpenteri* “half an inch long” in the first place as a young *Hyalonema*, the mistake to which I have above alluded would not have occurred. But finding it out, and having therefore had to examine more particularly these anchoring-spicules in an undoubted specimen of *Hyalonema*, I am enabled not only to correct the error, but to add more authentic information on the subject than was previously possessed, as well as to point out decisive marks for distinguishing between young *Holtenie* and young *Hyalonemata* another time.

The transition from the sparsely spined anchoring-spicule of *Holtenia Carpenteri* through that of *Meyerina claviformis* to that of *Hyalonema* is represented in Pl. XIV. figs. 7, 8, & 9, where also a comparative view of the heads or free terminations of the anchoring-spicules of *Labaria hemisphærica* (figs. 1 & 2), *Meyerina claviformis* (fig. 3), *Euplectella* (figs. 4 & 5), and *Holtenia Carpenteri* (fig. 6) is also given, to which I have alluded in the “Observations” appended to my description of *Labaria* (‘Annals,’ vol. xi. p. 280, &c., 1873).

Holtenia Carpenteri, *Pheronema Annæ*, *P. Grayi*, and *Meyerina claviformis* all probably possess the same kind of birotulate spicule as *Hyalonema* (Pl. XIII. fig. 21). I say “probably” with reference only to Prof. Leidy’s hasty description of this sponge, in which this spicule appears to have been overlooked. As in *Hyalonema*, so also probably in all the other Hexactinellidæ characterized by the birotulate flesh-spicule, this is not unfrequently found in a sexradiate form, which at once identifies it with the rosette (fig. 22); that is, it may consist of three birotulates joined together in the centre, and thus present six

heads; or it may consist of two birotulates joined together in the form of a cross, and thus present four heads. All the sponges just mentioned, too, possess anchoring-spicules of two kinds, viz. spiniferous and smooth, of which the free or anchoring end of the former terminates in two recurved spines or hooks opposite. But these spicules in all are free, and flow from all parts of the base, not twisted into a compact cord like those of *Hyalonema*, which also traverses the body of the latter, as before stated, in the same form, rendering it solid in the centre, which solidity is replaced, in all the other sponges above mentioned, by a central excavation more or less cylindrical, large, and deep.

In *Pheronema Annæ*, however, this cavity is not wide as in *Holtenia*, but narrow as in *Meyerina claviformis*, and in like manner branches off at the bottom, which is some distance above the base of the sponge. Prof. Leidy describes it as a "canal," whose orifice is only four lines in diameter, descending in the axis of the sponge for "almost half its depth," when it appears to divide into several branches. This is very like the cavity in *Meyerina claviformis*. (For a description and figure of *Pheronema Annæ*, see 'Month. Microscop. Journ.' June 1, 1869, vol. i. p. 36; and 'American Naturalist,' 1871, vol. iv. p. 17.)

Labaria hemisphærica, although possessing the birotulate spicule, is, in addition to the bird's-nest form of its body, distinguished from all the rest by the terminations respectively of its spiniferous and smooth anchoring-spicules, especially the latter (Pl. XIV. figs. 1 & 2). While that of the former consists of a tumid head armed with two round recurved spines opposite like the flukes of an anchor (fig. 1), that of the smooth spicule consists of a compressed head and two compressed spines or arms expanded in the form of a crescent or leather-cutter's knife to double the breadth of the spines on the head of the spiniferous spicule (fig. 2). *Labaria* is the only sponge possessing the two kinds of anchoring-spicules in which I have seen the termination of the smooth form.

Euplectella cucumer, which finishes my list, has already been noticed in connexion with *E. aspergillum* and *Habrodictyon*.

[To be continued.]

XLV.—On three new Species of Birds from Chefoo (North China). By ROBERT SWINHOE, H.B.M. Consul at Chefoo.

1. *Golden-sided Grey Thrush*.

This thrush was shot on the 14th May, on Lighthouse Is-

land, at the entrance to this harbour. I would dedicate it to Mr. Campbell, the keeper of the lighthouse, to whom I am indebted for many good birds during this spring season of migration.

Turdus Campbelli, sp. nov.

All the upper parts dusky slaty ash-colour; quills and rectrices hair-brown on their inner webs. Throat pale yellowish ashy; breast ashy; centre of lower breast, belly, and under tail-coverts white; the side-feathers of the last with their outer webs yellowish alongside the stems, broadly margined with hair-brown. Sides of lower breast and belly, tibial feathers, and axillaries rich yellowish or golden chestnut, the same washing the basal portions of the inner webs of most of the rectrices on their underside.

Length of fresh bird about 9 inches. Wing 4·7; first quill 0·35 shorter than second, which with the third is the longest in the wing; fourth 0·1 shorter; the wing falls 2·15 short of tail-tip. Tail 3·4, of twelve equal pointed or mucronate feathers; under tail-coverts 1·2 short of tail. Bill in front 0·82, from gape 1·05; tarse 1·23; middle toe 0·9, its claw 0·28.

Bill, inside of mouth, and skin round eye orange-yellow; legs and claws the same.

The specimen from which the description was taken proved a male on dissection, with enormous testes, showing that the bird was on the point of breeding. It will be seen that the above diagnosis of this novelty agrees closely with that of Jerdon ('Birds of India,' vol. i. p. 519) of the *Geocichla unicolor*, Blyth, of North India, as to size, and a good deal as to coloration. The main difference consists in the richer rufous on the underparts of our bird being otherwise distributed, and in the markings of the under tail-coverts.

2. *Golden-billed Button-quail*.

In August 1860, during the North-China campaign, on our march from Tientsin to Peking, I came across two French officers shooting in a field of millet. They had knocked over a Button-quail, which seemed to me richer in colour than our South-China species; but I got no specimens myself, and I set it down as the same. Soon after my arrival at this place the Buttons began to come (commencement of May), and for the first week or so all brought to market were females; the males arrived later on. The Chinese here call them "Hwanglan," and prefer the females for their superior size and pugnacious proclivities, and fight them as they do quails. The

male is small and objects to the "noble art." By their brilliant colouring and fruity yellow bills and legs I saw that I had got a species I had not met before. In my "Revised Catalogue of the Birds of China" (P. Z. S. 1871) I noted that I had made a mistake in identifying our South-China bird with *Turnix maculosa*, Temm., and gave it the name *Hemipodius viciarius*. This species I have procured as far north as Shanghai. In Père David's "Catalogue des Oiseaux à Pékin" (Nouv. Arch. du Muséum d'Hist. Nat. de Paris, tome iii. 1867) the Pekin species is marked as *T. maculosa*, Temm. This may be in copy of my first error, or on the belief that it really is the same as Temminck's bird, which was supposed to be from New Holland. I believe the present species to be distinct, and propose to distinguish it as

Hemipodius chrysostomus, sp. nov.

The female in full plumage has the entire face, breast, flanks, and vent yellowish buff, much deeper and strongly tinged with rust-colour on a central patch down the middle of the breast, with black spots more or less hidden on the sides of the breast. Feathers on the top of the head black, bordered with cream- and rust-colour, with a streak of cream-colour down centre of head. Broad half-collar on hind neck fine rust-colour, dotted with light reddish. Back and rump variegated with yellowish-grey, cream-colour, black, and bright rust-colour. Wing-coverts yellowish buff, greyish near bend and edge of wing, with black spots; quills light hair-brown, the first two primaries being edged with yellowish, the rest with brownish, mottled with a deeper brown. Axillaries light brownish buff. Tail-feathers light brown, obscurely mottled with blackish somewhat in the form of bars.

The male in plumage resembles the females not fully developed in having the throat whitish, the underparts less tinged with buff, with no rust-colour on the pectoral median patch, in having the wing-coverts more or less brownish, with only a little buff, and in having only a little of the rich mottling and spots on the upper parts, with but a slight indication of the nuchal half-collar. He differs, however, from them in having smaller and more numerous spots on the sides of the breast.

I took the following note on view of two fresh specimens, which afterwards proved on dissection to be females:—

Length 6·75. Wing 3·8, rounded; first, second, and third quills nearly equal and longest, fourth a little shorter; wing falls 0·35 short of tail, and is 0·4 longer than tertiaries. Tail of eight soft graduated feathers, 1·35 long. Iris cream-white;

bill fine golden yellow; inside of mouth flesh-colour. Bill from forehead 0·55, from gape 0·82; depth at base 0·25. Tarse in front 0·98; middle toe and claw 0·84. Legs, toes, and claws rich honey-yellow. Ovary well developed; trachea with a globular swelling just above where it reaches the bronchi.

Of the fresh male I noted:—Length 5·75. Wing 3·3; quills 0·2 longer than tertiaries, 0·55 short of tail-tip. Tarse in front 0·85; middle toe and claw 0·82. Bill in front 0·45, from gape 0·7. Bill brown on upper mandible, lighter on apical third of lower, rich golden yellow on basal edge of upper and whole of basal two-thirds of lower including rictus. Iris and legs as in female. Testes enormous, evidently on the point of breeding; trachea narrower than in the female and without swelling.

This species differs from *H. viciarius* of South China in having the remiges broader and shorter. Its bill is deeper at the base, and more distinctly marked; its legs are of a richer colour; its plumage above is more richly and definitely marked with black and red. It has a well-marked breast-patch, a nuchal half-collar, and a central streak to the crown of its head.

3. *White-winged Quail Crake.*

In company with Baillon's crake was brought a very charming little species, to me quite unknown, and, I think, new to science. From its feathered *tibia* and short tarse and toes it looks like a diminutive corn-crake; but its speckled upper plumage links it to the *Porzana* crakes, while its rounded wings remove it from both. As it lies on the table it might be taken for a small quail; and I therefore fancy its affinities lie for *Coturnicops noveboracensis* (Gmel.) of Eastern North America, though I have not seen a specimen of that bird, nor have I a good description of it. My single specimen is a female, which I will proceed to describe as

Porzana exquisita, sp. nov.

Size of a small Button-quail. Prevalent colour of head, neck, flanks, and upper parts rich vandyke-brown; on the crown the greater portion of each feather is black, the brown being confined to a narrow margin; on the back of the neck, the back, and the scapulars the centres are black with broad brown margins, thus showing alternate longitudinal lines of broad black and narrower brown; the greater part of the wing-coverts are brown alone. The throat, a broad patch on the shoulder-edge, axillaries, and centre of breast and belly

are white. The eyebrow and face are minutely spotted with white; the upper parts, except the crown, have transverse bands of white extending across the breadth of the black in each feather, the feathers of the hind neck having one band, the dorsals mostly two narrower ones, the scapulars three, and the wing-coverts more scattered ones. The feathers of the hind neck have their margins and a lower hidden band white. The flanks, the tibials, and the under tail-coverts are brown, with a double band of white. The tail is black, each feather with two narrow cross bars of white. The ten primaries of the wing are light hair-brown, the first white on the outer web; the seven secondaries white on their apical two thirds, light brown on basal third, the first of the series having the white mottled with brown.

Bill deep brown, greenish yellow on lower mandible at base and on rictus. Legs and feet light flesh-brown, dark on joints and on claws. Iris brown. Length 5 inches. Wing 3, 0.4 longer than tertiaries, 0.25 short of tail; first quill 0.45 shorter than the second and longest. Bill in front 0.48, from gape 0.55. Tibia bare only just above joint; tarse 0.78; middle toe and claw 1.08. Tail about 1.2, composed of apparently six stiffish feathers, entirely covered by upper and lower coverts, and hard to distinguish.

XLVI.—*On a Collection of Fishes from Chefoo, North China.*
By Dr. ALBERT GÜNTHER, F.R.S.

THE collection of Chinese fishes sent by Mr. Swinhoe to the British Museum, and described in this volume (pp. 239–250), has been supplemented by a second, smaller one, made by the same gentleman at Chefoo. It contains several new forms, beside some others which are worthy of notice.

1. *Sebastes nigromaculatus*, sp. n.

D. 12 | $\frac{1}{12}$. A. $\frac{3}{8}$. L. lat. 75.

The height of the body is a little less than the length of the head, and one third of the total (without caudal). Scales rather irregular. Upper surface of the head scaly, flat, with very low plain ridges, without prominent spines. Superciliary edge not elevated; the width of the interorbital space is one fifth of the length of the head. *Lower margin of the præ-orbital and edge of the præoperculum with acute spines*, thus distinguishing this species from *S. inermis*. The maxillary reaches nearly to the vertical from the hind margin of the

orbit. The fifth, sixth, and seventh (or the fourth, fifth, and sixth) dorsal spines are the longest, longer than those of the anal, and not half as long as the head. A deep notch between the dorsal fins. Brownish or greenish brown, with numerous irregular brownish black spots about as large as the pupil; an oblique brown streak from the lower part of the eye towards the angle of the operculum; fins black.

Two specimens from Chefoo, the larger of which is $7\frac{1}{2}$ inches long.

2. *Sciæna (Corvina) albiflora*.

Corvina? albiflora, Richards. Ichth. Chin. p. 226.

Pagrus macrocephalus, Basil. Nouv. Mém. Nat. Mosc. x. 1855, p. 222, pl. iii. fig. 1.

D. 10 | $\frac{1}{30}$. A. $\frac{2}{3}$. L. lat. ca 80.

The height of the body is equal to the length of the head, and contained thrice and two thirds in the total (without caudal). Snout not obtuse or truncated, but shorter than the orbit. There are nine scales in a transverse series between the first dorsal and the lateral line. Dorsal spines feeble, the third the longest, as long as the postorbital part of the head. The second anal spine strong, striated, three fourths the length of the longest anal ray. Caudal fin rhomboid. Ventrals reaching as far back as the pectorals. Silvery; dorsal parts with many oblique blackish streaks following the series of scales, and composed of more or less confluent spots. The uppermost dorsal series of scales white, this series being accompanied below by a blackish stripe and above by a series of black spots, each dorsal ray having a spot of this colour at the base; the upper part of the dorsal interradiation membrane blackish, separated from the basal series of spots by a whitish band. The other fins whitish.

Two specimens from Chefoo, the larger of which is 10 inches long.

3. *Scomber diego*, Ayres.

4. *Cybiium gracile*, sp. n.

D. 20 | 16 | ix. A. 18 | viii.

Distinguished by its very slender form. The height of the body is one sixth of the total length (the caudal fin not included), the length of the head one fifth; the depth of the head equals its length without snout. Teeth compressed, but rather slender and lanceolate, much narrower and wider apart than in *Cybiium Commersonii*. Lateral line but slightly undulated below the second dorsal fin, without a decided downward curve,

and with a series of pierced scales. The upper half of the fish is uniform blackish; the lower half whitish, with some indistinct small blackish spots arranged in a longitudinal series.

One specimen, 24 inches long, from Chefoo.

5. *Centronotus nebulosus*, Schleg.

6. *Stichæus hexagrammus*, Schleg.

7. *Pseudorhombus Swinhonis*, sp. n.

Allied to *P. brasiliensis* and *P. adspersus*.

D. 69. A. 51. L. lat. ca 110.

The height of the body is contained twice and three fifths in the total length (without caudal), the length of the head thrice and three fourths. Scales ciliated. Snout with the jaws nearly even in front, considerably longer than the eye, the diameter of which is two elevenths of the length of the head; cleft of the mouth wide, the length of the maxillary being contained twice and a third in that of the head; the maxillary extends beyond the vertical from the posterior margin of the eye, and has its extremity covered with minute scales. Upper jaw with three pairs of strong canine teeth anteriorly; lower jaw with eight or ten strong distant teeth on each side. Interorbital space rather flat, scaly posteriorly, not so wide as the vertical diameter of the orbit. The lower eye is scarcely in advance of the upper. Fin-rays scaly. The dorsal fin commences above the front margin of the orbit, and terminates at a distance from the caudal which is equal to three fourths of the depth of the free portion of the tail; its longest rays are in the posterior third of the fin, nearly as long as the pectoral, and contained twice and a third in the length of the head. Caudal fin subtruncated or rounded. Gill-rakers rather widely set, lanceolate, not quite so long as the eye. Brownish grey; head, body, and pectoral fins sprinkled over with brown dots.

Two specimens from Chefoo, the larger of which is 16 inches long.

8. *Cynoglossus semilævis*, sp. n.

D. 123. A. 95. L. lat. 145.

Three lateral lines on the left side; on the level of the end of the abdominal cavity the upper line is separated from the middle by twenty-one rows of scales, and the lower from the middle by twenty-three. Nine series of scales between the dorsal fin and upper lateral line, and eleven between the anal

fin and the lower lateral line. One lateral line on the right side. Scales between the lateral lines perfectly smooth; those between the outer lateral lines and vertical fins, and those on the head, strongly ctenoid; scales of the blind side smooth. Two nostrils—one between the eyes, the other opposite to the lower margin of the lower eye. Eyes extremely small, the upper not in advance of the lower; interorbital space much wider than the orbit. The length of the snout is two fifths of that of the head. Angle of the mouth conspicuously nearer to the end of the snout than to the hind margin of the gill-cover, below the eye. Tail not much elongate. The height of the body is two sevenths of the total length (without caudal), the length of the head one fifth. Left side uniform brown; vertical fins with a white edge. Three distant round blackish spots on the lateral line of the left side may be accidental in this specimen.

One specimen from Chefoo, 18 inches long.

9. *Hemirhamphus Sajori*, Schleg.

10. *Barbus labeo*, Pall.,

= *Gobiobarbus labeo*, Pall., = *Hemibarbus maculatus*, Blkr., and probably = *Hemibarbus dissimilis*, Blkr. (juv.). This species is very closely allied to *Barbus Schlegelii*, Gthr.

11. *Syngnathus acusimilis*, sp. n.

D. 43-45. Osseous rings 20 + 41-43.

The length of the snout equals the distance between the anterior margin of the eye and the middle of the pectoral fin. A low ridge along the median line of the upperside of the snout. Crown, temple, and operculum without ridge. Lateral line and upper caudal edge not continuous. Tail one half longer than the body. Dorsal fin on thirteen rings, two of which belong to the trunk. Caudal fin well developed.

Four specimens, males and females, the longest of which is 8½ inches long; from Chefoo.

XLVII.—On the Longicorn Coleoptera of Japan.

By H. W. BATES, F.L.S.

[Concluded from p. 318.]

Family Lamiidæ.

MICROLERA, nov. gen.

Corpus parvum, gen. *Ptinum simulans*; subcylindricum, convexum,

ad elytrorum basin depressum, crebre punctatum, opacum. *Caput* exsertum, rotundatum, convexum, obtusum, postice crassum, fronte convexa, genis modice elongatis; tuberibus antenniferis vix elevatis, condylo antennarum exserto. *Labrum* parvum. *Palpi* parvi, apice obtusi. *Oculi* vix conspicui, divisi, lobo superiore parvo. *Antennæ* corpore longiores, filiformes, robusti; sparsim longe pubescentes; scapo modice elongato subcylindrico, cæteris articulis regularibus. *Thorax* breviter cylindricus, inermis, convexus, postice depressus. *Elytra* postice paululum ampliata, apice obtuse rotundata. *Pedes* breves; tibiæ intermediæ extus sulcatæ; ungues divergentes, simplices. *Acetabula* antica postice clausa. *Pro- et mesosterna* inter coxas angusta, longitudinaliter convexa. *Acetabula* intermedia extus aperta; sed epimera mesothoracica haud conspicua. *Metathorax* ut in subfam. *Dorcadiinis* brevis.

The affinities of this curious genus are a difficult problem. According to the technical characters employed by Lacordaire, it would belong to the *Apomecyninæ*, except perhaps for the short metathorax. There is much, both in facies and form of the sterna, which reminds one of the Australian genus *Mesolita* in the *Parmeninæ* group; but the claws are not divaricate, the middle tibiæ have a conspicuous exterior groove, and the antennæ are thick to the apex. The sides of the sternum are so thickly punctured that the sutures are invisible; and it is doubtful whether the mesothoracic epimera penetrate to the sockets, which are apparently open.

Microlera ptinoïdes, n. sp.

M. atro-fusca, opaca, toto corpore (abdomine excepto) grosse punctato; elytris basi rufescentibus, vitta utrinque subbasali abbreviata fasciaque pone medium cinereis; antennis piceo-rufis, nitidis; pedibus piceis, cinereo-pubescentibus. Long. $1\frac{1}{2}$ – $1\frac{3}{4}$ lin.

Hiogo; on dead branches of *Ægle sepiaria*.

The body, viewed in profile, has a double convexity, or may be termed biarcuate; the front is a little inclined backwards towards the prosternum, and forms, with the vertex and thorax, a regular convexity; the hind part of the thorax and base of the elytra are depressed, and the rest of the elytra is convex. The elytra at the base are very little broader than the base of the thorax (which is a little constricted); the shoulders form right angles, and there is a short obtuse lateral ridge proceeding from them, causing the sides of the elytra to be nearly vertical almost to the apex.

Atimura japonica, n. sp.

A. fusco-grisea, capite apiceque elytrorum plus minusve fulvis;
Ann. & Mag. N. Hist. Ser. 4. Vol. xii.

thorace angulis posticis lateraliter productis acutis, dorso rugoso punctato, irregulariter tricostato; elytris sublineatim punctatis, costis utrinque acute elevatis quatuor, quarum duabus interioribus multiinterruptis, omnibus apud declivitatem apicalem in tubercula conica desinentibus, apice breviter oblique truncatis, angulo exteriori dentato. Long. $2\frac{1}{2}$ – $3\frac{1}{2}$ lin.

Hiogo; many examples.

Very closely allied to the Bornean *A. bacillina* (Pascoe), which, however, is 5 lines in length.

LASIAPHELES, nov. gen.

Subfam. *Apodasyinini* pertinet, sed acetabulis intermediis extus apertis. Cylindrica, omnino longe hirsuta. Caput exsertum, thorace longius, genis brevissimis. Oculi magni, grossissime granulati, modice sinuati, supra subapproximati. Antennæ corporis longitudine, filiformes, robustæ; scapo modice elongato, obconico, articulis 3° – 11^{um} gradatim perparum decrescentibus. Thorax brevis, fere cylindricus, inermis. Elytra apice rotundata, simplicia. Pedes breves; tibiæ intermediæ extus sulcatæ, sed haud tuberculatæ; ungues divaricati, simplices. Coxæ anticæ exserto-conicæ; prosternum inter coxas angustissimum. Mesosternum inter coxas angustum, simplex.

Lasiapheles obrioides, n. sp.

L. fere cylindrica, fuscescenti-rufa, abdomine excepto toto crebre punctata, longe hirsuta, antennis, tibiis et tarsis nigris. Long. $3\frac{1}{4}$ –4 lin.

Nagasaki; many examples; on a privet-hedge in June.

Has much resemblance to a large *Obrium*, or the forms allied thereto, the head being broader anteriorly than the thorax, and the eyes voluminous and very coarsely faceted, the upper lobes being large, though not so large as the lower. The forehead is convex, and, like the rest of the head, thickly and evenly punctured. The body, although clothed with long grey hairs, is shining.

Pogonocherus seminiveus, n. sp.

P. hispido proxime affinis; paulo major et differt elytrorum dimidio basali (margine basali incluso) albo. Nigro-fuscus, elytris dimidio basali albo, antennis basi fulvis; articulis 4° – 11^{um} basi anguste cinereis; scutello nigro, medio albo-lineato; elytris apice truncatis, angulo exteriori longe spinoso; supra crista subbasali albo-penicillata, alteris duabus vel tribus postmedianis nigro-penicillatis, macula fulva intraapicali. Long. $3\frac{1}{2}$ –4 lin.

Yokohama; Hiogo.

Aulaconotus pachypezoïdes, Thomson.*Aulaconotus pachypezoïdes*, Thomson, Syst. Ceramb. p. 99.Hiogo ; on dead stems of *Cissus*.*Pothyne silacea*, Pascoe.*Pothyne silacea*, Pascoe, Ann. & Mag. Nat. Hist. 1871 (October), p. 278.Nagasaki ; on dead stems of *Cissus*.*Smermus* (?) *bimaculatus*, n. sp.

S. sublinearis, fulvescenti-fuscus, subtiliter incumbenti-pubescentis, elytris utrinque medio macula elongata obliqua atro-fusca ; capite thoraceque angustis, punctulatis ; oculis vix prominulis, tuberculis antenniferis elevatis subparallelis, punctulatis, apice breviter sinuatim truncatis ; antennis longissimis, sparsim ciliatis, rufotestaceis, articulis apice nigro-fuscis, scapo thorace longiore, gradatim clavato. Long. $4\frac{1}{2}$ –6 lin.

Maiyasan ; rare.

Agrees with Lacordaire's definition of *Smermus*, except in the form of the scape, which he defines as "en cône renversé ;" whereas in the present insect it is gradually enlarged into an elongated club. The cheeks, too, are only moderately elongated. I do not venture to institute a new genus on these differences of structure. The thorax is elongated, narrow, and cylindrical, except a slight tumescence of the sides in the middle and at the anterior and posterior extremities. The antennæ are four times as long as the body in some examples, and, as in the type of the genus, the eleventh joint is as long as the ninth and tenth taken together.

Calamobius japonicus, n. sp.

C. linearis vix convexus, fusco-piceus, subtiliter pubescens, crebre punctulatus ; antennis corpore plusquam duplo longioribus, articulis basalibus longe hirsutis, scapo thoracis basin haud attingente ; elytris per suturam depressis, apicem versus haud declivibus, apice obtusissime breviter oblique truncatis ; tibiis rufotestaceis. Long. 3–6 lin.

Nagasaki. Crepuscular or nocturnal in flight.

Similar in size and shape to *Cal. gracilis*, but not agreeing with it in generic characters, according to Lacordaire's definition. This is the case principally in regard to the scape of the antennæ, which is relatively much shorter ; the scape and several basal joints are clothed with long hairs on all sides. The head is similar in shape, the antenniferous tubercles being only moderately elevated, oblique, and rather distant ; but the

front is less oblique and rather shorter. The elytra are depressed along the suture, and have no distinct declivity near the apex.

Acanthocinus griseus, Fab.

Acanthocinus griseus, Fab. Syst. El. ii. p. 277 (et auctor.).

Hiogo; several examples of both sexes, differing in size from $4\frac{1}{2}$ to $7\frac{1}{2}$ lines.

Leiopus guttatus, n. sp.

L. subelongatus, parallelopipedus, fere ut *Acanthocinus griseus*, nullo modo setosus; fuscus; elytris griseis fusco-guttatis, fasciis vagis duabus fuscis, una ante, altera post medium; antennis (♀) corpore plusquam duplo longioribus, haud ciliatis, fere nudis, testaceo-rufis, articulis omnibus apice nigro-piceis; thorace subquadrato, antice gradatim, prope basin citius angustato, post medium tumidulo, ibique spina brevi recta, paulo obliqua armato; dorso grosse, discrete punctato; elytris totis fortiter punctatis, apice breviter obtuse truncatis; pedibus ut in *A. griseo* gracilibus, nigris, femoribus et tibiis dimidio basali testaceo-carneis; tarsis posticis articulo basali cæteris conjunctis multo longiore.

♀ ovipositore vix ultra apicem elytrorum producto; segmento ultimo ventrali haud elongato, truncato. Long. $3\frac{1}{4}$ lin. ♀.

Two examples, Hiogo.

Exocentrus fasciolatus, n. sp.

E. balteato proxime affinis. Atro-fuscus; elytris pube grisea vestitis, fascia dentata post medium denudata, lineatim punctatis, interstitiis setis nigris lineatim ordinatis. Long. $2\frac{1}{2}$ lin.

Many examples.

Similar in form to *E. balteatus* (Serv.). Blackish brown. Head clothed with grey pile. Antennæ setose, as in *E. balteatus*, but the hairs shorter; black, sometimes rufo-piceous; bases of joints grey. Thorax of similar form to that of *E. balteatus*; the base and three short streaks proceeding thence towards the disk griseous pubescent. Elytra punctured in lines, with a row of very distinct and separate rigid black setæ down some of the interstices; the laid ashy pile is in many places interrupted, forming oblong spots; there is an oblique patch at the sides, and beyond the middle an irregular zigzag fascia of the blackish ground-colour.

Exocentrus lineatus, n. sp.

E. balteato forma similis. Piceo-fuscus; elytris sutura et lineis quinque, post medium late interruptis, griseis. Long. $2\frac{3}{4}$ lin.

Many examples.

Similar in form to *E. balteatus*; but the antennæ decidedly thicker and densely clothed with long hairs. Thorax of very similar form. General colour brownish red. The elytra rather densely and irregularly clothed with erect hairs; each elytrôn has the suture and five lines grey; all (except the sutural) interrupted behind the middle by a broad zigzag fascia of the ground-colour, beyond which, near the apex, three short lines only reappear.

Exocentrus tonsus, n. sp.

E. balteato forma similis, at multo minor, haud setosus. Oblongus, testaceo-fuscus, incumbenti-pubescentis; capite thoraceque obscurioribus, subtiliter crebre punctulatis, hoc spina laterali minus obliqua; elytris sublineatim punctulatis, maculis transversis irregulariter sparsim nebulosis; antennis corpore longioribus, gracilibus, haud setosis. Long. $1\frac{1}{4}$ – $1\frac{3}{4}$ lin.

Nagasaki; on ivy.

Exocentrus guttulatus, n. sp.

E. oblongus, convexus, subæneo-niger, griseo-olivaceo pubescens; elytris erecte setosis, pube griseo-olivacea lineatim guttatis et pone medium fasciatis; antennis ciliatis, articulis basi grisco-testaceis. Long. $3\frac{1}{2}$ lin.

One example.

Head and thorax rather smaller and elytra more ample than in *E. balteatus*; thoracic spine broad at the base, oblique and acute. Elytra subseriate-punctulate, with single, erect, black bristles and oblong spots of olive-grey pubescence arranged in lines; a belt of similar colour a little after the middle. The antennæ elongated, as in *E. balteatus*, moderately pubescent, and finely ciliated beneath.

ASAPERDA, nov. gen.

Facies *Saperdarum*, sed unguibus divergentibus, simplicibus. Elongata, linearis. Caput exsertum, postice dilatatum. Oculi fere divisi. Antennæ tenues, filiformes; scapo modice elongato, cylindrico-ovato. Thorax transversus, postice constrictus, tuberculo valido laterali armatus. Elytra apice rotundata, simplicia. Pedes breves; coxæ anticæ extus angulatæ; acetabula intermedia extus aperta; tibiæ intermediæ extus sulcatæ et tuberculatæ; sterna inter coxas simplicia.

This genus does not fall naturally into any of the numerous "groups" into which Lacordaire divides the Lamiadæ with simple antennal scape. It agrees best with the *Apomecyninæ*, and has some resemblance to *Eunidia*, except its longer body and stout thoracic lateral tubercles. I should be inclined to

institute with it a distinct group, to range near the *Agapanthinae*.

Asaperda rufipes, n. sp.

A. atro-fusca, opaca, tenuiter griseo-pubescentis; scutello et sutura griseis; pedibus rufis; antennis rufescentibus, scapo apicibusque articularum nigro-fuscis; corpore supra crebre punctulato. Long. $4\frac{1}{2}$ – $5\frac{1}{2}$ lin.

Hiogo.

Some specimens appear abraded and have no trace of grey suture and scutellum; and the antennæ are sometimes quite black.

Asaperda agapanthina, n. sp.

A. æneo-fusca, tomento olivaceo-griseo nebulosa; pedibus et antennis rufescentibus, harum articulis basi pallidioribus. Long. 5 lin.

Awomori; Yokohama.

This species bears much resemblance to an *Agapanthia*. The olivaceous grey clothing of the elytra is interrupted by numerous roundish spots and by an indistinct fascia across the middle; the thoracic tubercles are large and acute.

Agapanthia pilicornis, Fab.

Agapanthia pilicornis, Fab. Ent. Syst. i. 2, p. 310.

One example, agreeing with others which I obtained from Maack's collection from East Siberia.

Fabricius describes the base of the antennal joints from the third as "subferrugineo." Some examples from East Siberia have yellowish bases to the joints, and others (like the Japanese specimens) grey; I am not sure that they are not distinct species. Motschulsky describes the form with yellowish bases as *A. fasciculosa* (Etudes Entom. 1860, p. 41), evidently considering the other form the true *pilicornis*.

Saperda sanguinolenta, Thomson.

Cagosima sanguinolenta, Thomson, Syst. Ceramb. p. 116.

Hiogo, many examples.

It is not mentioned in the description of the genus *Cagosima*, instituted for this species by M. Thomson, in what it differs from the genus *Saperda*. It appears to be perfectly congeneric with *S. scalaris* &c.

Thyestes Gebleri, Falderm.

Saperda Gebleri, Falderm. Col. ab ill. Bungio in China Bor. &c. p. 434, t. v. f. 6.

Thyestes pubescens, Thomson, Syst. Ceramb. p. 116.

Yokohama; also Manchuria and N. China.

The genus is distinguished from *Saperda* by the groove and notch on the outer edge of the middle tibiæ, and from *Glenea* by the absence of carina from the sides of the elytra.

Glenea Fortunei, Saunders.

Glenea Fortunei, Saunders, Trans. Ent. Soc. ser. 2, ii. p. 112, pl. 4. f. 1.

Common in Japan.

Glenea galathæa, Thomson.

Glenea galathæa, Thomson, Syst. Ceramb. p. 566.

Mr. Lewis's collection does not contain this species.

Glenea ocelota, n. sp.

G. elongata, supra deplanata, pube subtili ochreo-fusca dense vestita; thoracis dorso maculis quatuor; elytris maculis lateralibus utrinque quatuor lineatim ordinatis, humeris et macula subbasali nigris; elytris lateribus acute carinatis, supra versus carinam magis clare coloratis; apice singulatim rotundatis; tibiis intermediis extus longe sinuatis sed haud sulcatis. Long. 7-8 lin. ♂ ♀.

Hiogo, many examples.

Belongs to *Glenea* by the carinated elytra; but the groove of the intermediate tibiæ is obsolete. The claws offer a peculiarity which is not alluded to in any generic description. In the male the inner claw of the four anterior tarsi has a tooth on the outer side of the base, the claws of the hind feet being simple; in the female the claws of the four anterior tarsi are simple, whilst the base of the claws of the hindmost pair has a blunt tooth.

Glenea relictæ, Pascoe.

Glenea relictæ, Pascoe, Trans. Ent. Soc. ser. 2, iv. p. 258.

G. quoad formam G. 9-guttatæ etc. haud dissimilis. Nigra, sparsim erecte pubescens; thorace vitta mediana et scutello ochraceo-albis; elytris rufo-castaneis utrinque guttis quinque ochraceo-albis; pedibus testaceo-flavis; tarsis albis; antennis piceis, ciliatis; corpore subtus sparsim cano pubescente, lateribus plagis cano-tomentosis; capite et thorace supra punctulatis, hoc cylindrico, versus basin paulo angustato; elytris apice utrinque sinuato-truncatis, angulo suturali acuto, producto, exteriore longe spinoso, lateribus bicarinatis, supra fortiter punctatis, prope apicem lævibus ibique colore obscuriore. Long. 5½-6 lin.

Moon-temple, Osaka; Mitsuyama; also N. China.

A true *Glenea*. Intermediate tibiæ grooved and notched, and all claws in both sexes simple.

Phytæcia simulans, n. sp.

Glenea relicta simillima. Nigra, erecte pubescens, verticis vittulis duabus, thoracis vitta mediana scutelloque ochraceo-albis; elytris castaneis, maculis utrinque ochraceo-albis quinque, sutura vittulaque indistincta laterali basali ochraceo-albis; pedibus flavo-testaceis, tarsis albis; antennis nigris, articulo tertio apice griseo; metasterno et abdominis segmentis lateribus cano-tomentosis; corpore supra fortiter punctato; elytris apice obtuse truncatis, lateribus verticalibus, haud vero distincte carinatis. Long. $4\frac{1}{2}$ –6 lin.

Moon-temple, Osaka.

Deceptively similar to *Glenea relicta*, and confounded with it by Mr. Lewis himself; the toothed claws, however, at once show its true character; and the obtuse truncation of the elytra is also a constant and conspicuous means of distinguishing it. The ochreous spots of the elytra are an indistinct one (sometimes absent) on each side of the base, and two, one behind the other, on the disk towards the middle. The tarsal claws are not "bifid," as in the more typical *Phytæcia*, but "appendiculated," almost as in *Oberea*.

Phytæcia ventralis, Chevrolat.

Ph. lineolæ (F.) simillima. Cylindrica, griseo-nigra; thoracis macula discoidali ovali, ventre femoribusque (apice excepto) rufis. Long. 4 lin.

Nagasaki; also I. of Formosa and China.

I have this species in my collection under the above name, but have not succeeded in finding a published description. It is very close to the European *Ph. lineola*, differing chiefly in the yellowish-red abdomen, and in the black of the knees extending halfway along the hind part of the femora; the form and sculpture are the same.

Oberea japonica, n. sp.

O. pupillatæ similis, at major et magis elongata. Testaceo-flava; elytris (basi excepto) griseo-fuscis; vitta laterali, abdominis segmento ultimo, capite et antennis nigris; capite ut in *O. pupillata* regulariter discrete punctato; thorace lateribus paulo rotundato, supra convexo, opaco; elytris lineatim punctatis, apice oblique late truncatis, angulo suturali breviter, exteriore longe spinoso. Long. $8\frac{1}{2}$ –9 lin. ♂ ♀.

Hiogo.

The yellowish or tawny-reddish basal colour of the elytra covers the humeral callus, extending as a short stripe down the side from the shoulder, and forms a squarish patch over and

around the scutellum. The punctuation of the elytra is rather distant, strongly impressed, and arranged in lines. Varieties occur in which the metasternum and the middle of the basal ventral segments are blackish, others in which the sides of the basal ventral segments only are blackish.

Oberea hebescens, n. sp.

O. japonicæ simillima, differt solum thoracis medio magis convexo, elytris apice oblique truncatis, haud spinosis. Longit. 7-8 lin. ♂ ♀.

Among Mr. Lewis's numerous series of *O. japonica* are three examples (♂ ♀) of a form precisely similar in colours, except that the lateral dark stripe of the elytra extends further over the humeral callus; but the apex is simply obliquely truncated, without spine either at the sutural or exterior angle. The thorax also is decidedly more convex on the disk, with a distinct transverse sulcus near the anterior and posterior margins. The punctuation is the same, particularly the regular strong lineate punctures of the elytra, confused and faint only near the apex. The terminal abdominal segment is black, the rest of the under surface, the legs, the thorax, and the base of the elytra (except the humeral callus) testaceous yellow or reddish.

I think it very possible that it is only a variety or aberration of *O. japonica*.

Oberea mixta, n. sp.

O. japonicæ proxime affinis; differt solum punctis elytrorum confusis, nigredineque elytrorum per callum humeralem usque ad basin extensa. Long. 6-8 lin. ♂ ♀.

Simabara, Osaka; four examples.

Deceptively similar to *O. japonica*; rather less elongated, and the punctuation of the elytra not arranged in lines. The head and thorax do not differ in form or colour; but the antennæ are decidedly shorter in both sexes. The testaceous red colour of the base forms only a square patch over and around the scutellum and a narrow streak down the extreme margin below the humerus; the truncation of the elytra is less oblique, and both angles are produced and spiniform, the exterior one much the longer; the base of the apical ventral segment is yellow, the rest black.

Oberea nigriventris, n. sp.

O. valde elongata, angusta, linearis, nigra; capite, thorace, basi elytrorum femoribusque anticis et intermediis castaneo-rufis;

capite sphaerico haud profunde punctato, cum thorace (augusto, cylindrico) opaco; elytris obliquissime sinuato-truncatis, angulis valde productis acutis, supra grosse lineatim punctatis; abdomine lineari, punctulato. Long. 6 lin. ♀.

One example.

Oberea marginella, n. sp.

O. pupillata multo brevior. Flavo-testacea, erecte pubescens; capite antennarumque articulis basalibus duobus nigris nitidis, illo grosse discrete punctato; thorace brevi, opaco, impunctato, antice et postice transversim depresso, disco modice convexo; elytris fortiter deplanatis, gradatim angustatis, apice late suboblique sinuato-truncatis, angulis productis, acutis, supra sericeo-opacis, vitta laterali (basin haud attingente) nigro-fusca, utrinque extus lineatim, intus confuse punctatis; metasterno segmentisque ventris basalibus fusco plagiatis; antennis in utroque sexu corpore paulo longioribus, filiformibus, subtiliter pubescentibus et ciliatis. Long. 5-5½ lin. ♂ ♀.

Osaka, Hiogo; many examples.

Oberea fulveola, n. sp.

O. gracilior, elytris angustatis; rufescenti-fulva, scapo fusco-nigro; capite et thorace opacis vix conspicue punctatis, hoc brevi, lateribus medio rotundatis, antice et postice transversim sulcato, medio dorsi convexo; elytris mox pone humeros angustatis, apice peroblique truncatis, angulo suturali acuto, exteriore late producto, dorso fortiter lineatim punctatis, interstitio quarto paulo elevato. Long. 7 lin.

Kagosima.

Distinguished by its uniform reddish-tawny coloration and the stony-opaque surface of the head as well as the thorax. In some points it agrees with Chevrolat's *O. fuscipennis*; but, so far as the almost unintelligible description goes, the elytra are brown in that species: he says, "elytra . . . apice planis . . . fuscis."

Chreonoma Fortunei, Thomson.

Chreonoma Fortunei, Thomson, Archiv. Entom. i. p. 58.

Many examples. Also Shanghai and Che-kiang in China.

All the Japanese examples differ from the Chinese by the much smaller extent of pale colour at the bases of the antennal joints; in other respects they are precisely similar.

XLVIII.—On Spontaneous Division in the Echinodermata and other Radiata. By Dr. C. F. LÜTKEN.

[Concluded from p. 337.]

DALYELL* and Semper† have investigated the faculty of regeneration in the Holothurida; and the former has established that a voluntary spontaneous division really takes place at least in some species of those Echinoderms. It is to be regretted that with regard to the faculty of regeneration and to artificial division we do not yet possess any methodical observations upon other Echinoderms, especially the Asterida and Ophiurida, in which the frequent cases of regeneration which have been observed lead us to deduce the possibility of artificial division if it were tried. But even if this were the case it would not prevent our interpreting the phenomena already described as a natural or spontaneous binary or radial division, seeing that we are not in a position to discover an exterior influence capable of exerting upon the life of these animals so profound and singular an action, but we can only seek the cause of these natural phenomena of division in an act emanating from the organism itself and having *multiplication* for its object.

Like the authors who have treated before me of heteractinism in the Ophiurida and Asterida, I must therefore hold to the hypothesis that in the cases already specially examined (*Ophiothela*, *Ophiactis* (p. p.), *Ophiocoma* (p. p.), *Asterias* (p. p.), *Linckia* (p. p.), and *Ophidiaster* (p. p.)) it is due to a true *spontaneous* division, no doubt repeated several times. But, as I have already pointed out, however acceptable this explanation may appear, it cannot be regarded as the true one until it has been verified upon animals kept alive for a long time in aquaria. Nevertheless it has so many probabilities in its favour that it is well to call attention to it—especially at a time when “experimental zoology” already possesses a review of its own, and the establishment of zoological stations is being realized on the shores of that very sea which harbours two of the species in which we suppose such a division to occur, namely *Ophiactis virens* and *Asterias tenuispina*. If we could succeed in keeping these species alive for a long time in aquaria, it would no doubt be easy to settle the following points—namely, whether a natural division really takes place, whether it is repeated several times, whether it ceases when the animals attain a certain age or size and when the organs have acquired a certain degree of development, &c. These phenomena possess

* Powers of the Creator, vol. i. pp. 49 *et seqq.*

† Reisen im Archipel der Philippinen, 2ter Theil, Band i. p. 201.

a special interest, because the Holothurida, Asterida, and Ophiurida are the highest organisms in their sphere in which a true spontaneous division has been ascertained or supposed to occur; and as other forms of agamic reproduction, *e. g.* gemmation, are entirely unknown in the class Echinodermata*, there is the less reason here than elsewhere to regard division as a disguised gemmation or something of the kind. Spontaneous division, therefore, is manifested in this class of animals with exceptional purity and independence. If we suppose that it is really a division that takes place here, it is a division pure and simple, and not a mask under which something else is hidden (gemmation or some analogous mode of multiplication).

In fact, although spontaneous division has always been represented as a special category of the various modes of reproduction of the lower animals, especially as a subdivision of agamic reproduction, and although the text-books assign to this mode of reproduction a comparatively wide domain, it is evident that in many cases the spontaneous division is only apparent; in reality it is often something quite different that takes place; and the part ascribed to this mode of reproduction is thus so much reduced that it is easy to understand how doubts may have arisen whether natural spontaneous division ever takes place, with the exception, of course, of the animals placed at the very bottom of the scale (Rhizopoda, Monera), in which the notions of cell and individual are almost confounded, and the individual, with the other properties of the cell, has also inherited its divisibility. Thus, in many Infusoria, a "division in the direction of the length" has been supposed in cases in which there was only a copulation; two individuals have been found half united and half free, and it has been concluded that they were in course of separation, while, on the contrary, they were engaged in the no less astonishing operation of fusing into one †.

* In publishing a very interesting observation upon viviparity in an Echinid (*Anochamus*), M. Grube (Monatsb. Akad. Wiss. Berl. 1868, p. 178) has put forward the hypothesis that it was a case of agamic reproduction by means of germs or internal buds; but in reality there is no sufficient reason for accepting this supposition, nor do I see how the difficulties presented by the history of the reproduction of that Echinid can be diminished by it. M. Grube's hypothesis, moreover, is connected with the theory according to which the formation of the Asterid or Echinid in the *Pluteus*-larva is not a metamorphosis, but a gemmation—an opinion the incorrectness of which I thought zoologists had long since recognized.

† Besides this operation, which is the opposite of a division, there is produced apparently in these animals a true longitudinal division of the various bell-animalcules, which enables them to form colonies, when one of the two newly formed bells does not detach itself. But it remains to be learned whether this division, as in other Infusoria, is not in reality a disguised production of two perfectly new individuals.

The transverse division of the Infusoria also is not a true division. As M. Steenstrup has indicated, it results clearly from the beautiful observations of M. Stein that it is not an individual that divides into two, but two young individuals that are developed in the same mother and become free by absorbing her body. We must also join with those naturalists (Boeck, Steenstrup) who maintain, as resulting clearly from observation, that the act by which the *Scyphistoma* becomes transformed into the *Strobila* (by multiple transverse scission), and the latter breaks up into a series of young *Medusæ*, is only a slightly disguised development of a series of internal germs or buds, accompanied by an absorption of the *Medusa-nurse* (the *Scyphistoma*), exactly as in the Infusoria, with the sole difference that the number of germs is much greater than in the latter.

We may also doubt whether a true spontaneous division ever takes place among the Vermes (at all events those of the highest rank); it would seem that in most cases it is only a disguised gemmation. To discuss this question thoroughly with regard to the fissiparous Chætopoda (*Naiides*, *Syllidea*, *Tubicola*) would carry me far beyond the limits of this memoir, and would nevertheless throw no light upon the subject; it will suffice for me to remind the reader that whilst it seems to result positively from some observations that what takes place here is a gemmation, or a successive development of a series of germs or buds in the posterior extremity of the worm, many observers regard it as beyond doubt that there is a pure division followed by a regeneration of the part separated. These questions being in general surrounded by a certain obscurity, observers have probably in most cases not been fully conscious of the distinction to be established, and consequently have not overcome its difficulties. However, as it cannot be doubted that it is always the same phenomenon that takes place here, *i. e.* either a true division or a true gemmation, the balance in opinion inclines strongly to the latter side. It seems to me that the observations we possess may be readily brought into accordance with the opinion that the so-called scissiparity of the Chætopoda is only a disguised terminal gemmation, precisely as in the *Medusa-nurses*.

That the faculty of regeneration is extremely great in the Vermes is a well-known fact. In certain cases, as O. F. Müller showed a hundred years ago (by very exact experiments, in which spontaneous division with the regeneration resulting from it is most distinctly separated from natural scissiparity or gemmation), it attains such a development that artificial division is produced with great facility. In the present day

we possess interesting observations by Mr. MacIntosh, showing that certain Nemertina (*Borlasia*) when in confinement may break up into a quantity of fragments, all of which possess the power of regeneration so as to become complete individuals. This kind of division, which is neither entirely spontaneous nor entirely artificial, is difficult to range under any definite scientific determination; we find analogous cases among the Actiniæ.

Spontaneous division (schizogony) seems therefore to occur principally in two great groups of the lower animals:—the *Protozoa* (Monera and Rhizopoda), which are reduced to simple cells, and which consequently may be divided artificially and divide themselves; and the *Radiata* (Echinoderms and Cœlenterata), in which the divisibility is partly connected in a perfectly natural manner with the radiate structure. But both in the Echinodermata and in the Cœlenterata spontaneous division is at the same time intimately connected with regeneration, upon which it depends, and from which it cannot be separated: we may regard it as the most perfect expression of its development; and in some Cœlenterata (especially the Actiniæ) it is moreover in intimate connexion with gemmation (blastogony), and passes so insensibly into perfectly characterized phenomena of gemmation, that, at any rate in a great many cases, it seems impossible to trace a boundary between these two modes of reproduction, which seem to be so essentially different. As the experiments made upon this subject have never been considered in their totality, and it would be very desirable that they should be resumed in a methodical manner, I have appended to my communications on spontaneous division in the Echinodermata a short statement of what has been ascertained as to regeneration and artificial and natural division in the Medusæ and Actiniæ. By this means I propose to collect some materials which may assist in answering the following questions:—Of what facts which may throw light upon the spontaneous division of certain Radiata is science in possession? and in what relation does spontaneous division stand on the one hand to artificial division, and on the other to gemmation and other forms of agamic reproduction?

With regard to the Medusæ, I leave on one side the so-called scissiparous division of the *Scyphistoma*, and also pass over in silence the celebrated observations on the spontaneous and artificial division of the freshwater polypes, as likewise the interesting experiments of M. Hæckel on the artificial division of the ova and embryos of the Siphonophora. In fact, in all these cases, as in the researches of Dalyell and Reid on artificial division (both longitudinal and transverse) in the *Scyphi-*

stoma, we have not to do with the division of a true "individual" in the strict acceptation of the term, but with that of a creature which is really very simple, but potentially and *in nuce* is a multiple creature, which would resolve or develop itself into a long series of individuals. I therefore confine myself to references to those cases in which a true artificial or spontaneous division has been observed in the Medusæ—namely, by M. Häckel in the species of the group *Thaumantias*, and by M. Kölliker in young *Mesonemata* (*Stomobrachium*). If, however, Häckel's observations relate to Medusæ of the category which Mr. Allman subsequently termed "Gonochemes" this case would have to be assimilated to those which, for reasons explained above, fall outside the considerations here involved. After mentioning the spontaneous and artificial division of *Protohydra*, a type which is still but little known, and also the artificial division of *Lucernaria* and the spontaneous division of *Schizocladium* (which appear to me to have just as much resemblance to gemmation or sporogony), I take up the examination of the faculty of regeneration and the divisibility of the Actiniæ, commencing with the remarkable investigations of Dique-mare, which are already a century old, and then passing in review the more recent experiments and observations of Gosse, Peach, Bennett, Dalyell, M'Creedy, Mrs. Thynne, Van Beneden, Wright, and Hogg. From these it appears not only that the Actiniæ may be divided longitudinally and transversely, but also that spontaneous division is by no means a rare phenomenon, at least in some species (*A. cereus*, *dianthus*, *cavernosa*); in an Actinid probably produced from the ova of *Caryophyllia Smithii* it was even repeated so frequently that, in the course of two years, two individuals were thus increased to 278. By a similar longitudinal division the frequent appearance of double Actiniæ more or less joined together has also been explained; but their formation may be interpreted in a different way.

Although in the Actiniæ (except, perhaps, *Corynactis*) gemmation cannot be regarded as a normal mode of reproduction, as in the compound Anthozoa, it nevertheless occurs sometimes in them—partly in the same species which are subject to spontaneous longitudinal division, and (as in the supposed *Caryophyllia Smithii*) in conjunction with this latter operation. Consequently these two modes of agamic reproduction, different as they are in form, evidently replace one another, and cannot differ much in their essence; moreover, when the division is a little excentric, and one of the parts is a little smaller than the other, we may ask ourselves whether the division is not really a disguised gemmation. The limit is no less difficult to

trace in those cases in which small portions of the margin of the pedal disk of the Actiniæ spontaneously, accidentally, or artificially detached acquire an independent life and become developed into Actiniæ (*A. lacerata*, *dianthus*). Spontaneous *transverse* scissiparity is known only in *Gonactinia (prolifera)*; and even this has much more the character of a gemmation.

The faculty of regeneration is likewise highly developed in the Fungiæ; and in consequence of injuries it often happens that an individual splits into two or more, or that a larger or smaller number of buds are produced; for in these normally simple Anthozoa gemmation is not a normal phenomenon, and it is not always possible to trace a precise boundary between gemmation and the regeneration which takes place after an injury. What has been described in *Diæseris* as a union of several sectors originally separate is rather a spontaneous or semispontaneous division, followed by phenomena of regeneration and gemmation.

Although an important part has been ascribed to spontaneous division in the compound Madreporaria, and it has even been supposed that this mode of multiplication characterizes certain systematic groups, I have become convinced that its importance in this respect is completely illusory, and that it will be found, by a more careful examination, that in most cases (*e. g.* the *Mæandrinæ*) this supposed division is only a gemmation. As my master, Prof. Steenstrup, pointed out to me many years ago, the new individual always originates as an isolated bud; but as it grows, the boundary between it and its nearest neighbour, which must be regarded as its nurse, is seen gradually to be effaced. This is precisely the opposite of what has been supposed. The individuals (*e. g.* in the *Euphyllie*, the *Mussæ*, and the *Symphyllie*) begin by being isolated, and finish by being more or less completely fused into one another. I think, therefore, that the interpretation of these facts given by Mr. Dana approaches nearer to the truth than that of M. Milne-Edwards; and I must maintain that (leaving out of consideration the intercalicinal gemmation, which it would be very difficult to distinguish from division) no true spontaneous division has yet been ascertained to occur in the compound Madreporaria.

The result of the investigations and considerations which have been set forth here, partly *in extenso* and partly in the form of a summary, is as follows:—

If there are many cases in which spontaneous division is only a more or less disguised gemmation, and in which we are not yet in a position to separate clearly one from the other,

there are nevertheless many other cases in which it by no means presents this character, but, as expressed by the term, is a *division* and nothing else. In some cases (in the Asterida and Ophiurida above mentioned, and perhaps in certain Actiniæ) this division is probably a normal form of increase which replaces gemmation; in others, on the contrary, it appears to be quite accidental. On the one side, therefore, it is related to regeneration, on the other to gemmation. Although it is not always possible to indicate clearly the limit between these phenomena, and division and gemmation often replace each other, this does not prevent our retaining for "schizogony" an independent place in the series of modes of agamic multiplication (monogony), side by side with internal and external gemmation (blastogony), and with multiplication by free germs (sporogony) or by unfecundated ova (parthenogony), especially as it is a deduction from the scientific value and importance of these categories that it seems to be difficult or even impossible to trace a marked line of separation between these modes of multiplication, or between parthenogony and sexual reproduction. But, as I have indicated above, the classification in the category of schizogony of the phenomena of multiplication already described in the Asterida and Ophiurida has precisely the effect of clearly establishing that spontaneous division differs qualitatively from gemmation, which might well have been regarded as doubtful so long as we had exclusively or chiefly in view the phenomena presented by the Coralliaria and Actiniæ.

The general propositions which sum up the present state of our knowledge regarding spontaneous division may therefore, I think, be provisionally enunciated as follows:—

1. The most energetic manifestation of the faculty of regeneration in animals is *divisibility*.

2. In certain forms of Radiata in which the faculty of regeneration is highly developed, *spontaneous division* occurs either alone (Asterida and Ophiurida) or associated with gemmation (Actiniæ).

3. True spontaneous division, or *schizogony*, in the Actiniæ, Medusæ, Asterida, and Ophiurida (which must not be confounded with the disguised gemmation of the Infusoria, of *Scyphistoma*, and of certain Chætopods) must be regarded as a peculiar form of agamic reproduction, side by side with blastogony, sporogony, and parthenogony.

Latin characters of new Species referred to in this Paper.

1. *Ophioderma tongana.*

Granula disci minuta, scutella radialia obtegentia; incisuræ disci scutella dorsalia brachiorum bina vel terna intima amplexæ; scuta oralia latiora quam longa, triangularia, extus rotundata, intus acuminata, angulis lateralibus rotundatis; scutella adoralia granulis obtecta; papillæ orales octonæ, exteriores latæ, obtusæ, interiores acuminatæ, angustæ; scutella ventralia brachiorum octangula, longiora quam lata, lateribus excavatis; dorsalium latitudo longitudinem duplam æquat; spinæ laterales octonæ, depressæ, breves, dense collocatæ, æquales et scutella lateralia dimidia æquantes, infima tantum cæteris major. Diam. disci (speciminis juvenilis) 9 mm.; brachia sextuplo longiora.

Hab. ad insulas Tonganas.

2. *Ophiostigma formosa.*

Discus granulis obtusis, cylindricis infra et sparsius supra obtectus, scutis radialibus tamen nudis, conspicuis; scuta oralia æque longa ac lata, rotundata, intus acuminata; scutella adoralia sat magna, extus latiora, fere transversa, intus et extus sese tangentia, scutello ventrali intimo minutissimo modo sejuncta; papillæ orales quaternæ, externa minuta, rudimentali, cæteræ sat magnæ, æquales, obtusæ. Brachia diametrum disci sextuplum longitudine æquantia, gracilia, apicem versus parum decrescentia, depressa, haud moniliformia; scutella ventralia quadrangula, angulis rotundatis lateribusque excavatis, longiora quam lata, inter se haud sejuncta; spinæ laterales ternæ, breves, acutæ, planiusculæ, latitudinem brachii dimidiam æquantes; papillæ ambulacrales binæ; scutella dorsalia ovalia, latiora quam longa. Diam. disci $3\frac{1}{2}$ mm.

Hab. in freto Formosæ dicto.

3. *Amphipholis Andree.*

Discus planus, margine acuto, supra insertionem brachiorum parum inciso, squamis minutis, numerosis, planis, solidis, æqualibus, imbricatis tectus; squamæ marginales distinctæ, biseriatae, ventrales dorsalibus haud minores; spinæ vel granula nulla; scuta radialia mediocria, contingentia, apicibus modo squamula singula vel squamulis binis minutis sejuncta; conjuncta figuram ovalem, extus latiore, fere æque latam ac longam formant; scuta oralia minuta formam solitam rhomboideam acutam exhibent; adoralia linearia triangularia, extus scutello brachiorum ventrali minutissimo sejuncta; papillæ orales quaternæ, binæ intermediæ maximæ, interdum divisæ. Brachia elongata, gracilia, fortiter decrescentia, filiformia; scutella dorsalia late ovalia, latitudine longitudinem duplam æquante; ventralia pentagona, ad basin brachiorum latiora quam longa, margine aborali recto, lateralibus excavatis; spinæ

laterales ternæ, minutæ, acutæ, articulos spiniferos fere longitudine æquantes; papillæ ambulacrales geminæ. Diam. disci 8 mm.

Hab. ad oras insulæ Javæ.

4. *Amphipholis Kochii.*

Discus planus, margine rotundato, supra insertionem brachiorum in adultis fortiter inciso, squamis minutissimis utrinque tectus, marginalibus nullis; spinæ vel granula nulla; scuta radialia minuta, angusta, introrsum acutiora, parum divergentia, cuneolo squamarum plaue disjuncta; scuta oralia rhomboidea, acuta; papillæ orales ternæ, interna infradentalis, externa maxima; brachia mediocriter elongata, versus apicem decrescientia; scutella dorsalia late ovalia, ventralia pentagona, latiora quam longa, margine aborali recto; spinæ laterales ternæ, validæ, obtusæ, compressæ; papillæ ambulacrales binæ. Diam. disci 6-7 mm.

Hab. ad oras Manschuriæ orientales.

5. *Ophiothela isidicola.*

Discus inter brachiorum sex originem profunde incisus, scutis radialibus 12 maximis fere plane obtectus; zonæ interradales angustissimæ granula sparsa gerunt; tubercula majora pauca, rarius spinæ acutæ breviusculæ in parte centrali disci, in angulis externis interscutellaribus et in lateribus disci inter rimas genitales adsunt; superficies ventralis disci et brachiorum cute molli induta; scuta oralia et adoralia haud conspicua, ventralia brachiorum, nec non papillæ ambulacrales desunt; brachia brevia, sæpe inæqualia, diametrum disci duplum longitudine æquantia, supra granulis rotundatis (in junioribus et in parte externa brachiorum fere evanidis) obtecta, serie media tuberculorum majorum scutellorum dorsalium locum tenente; scutella lateralia fortiter carinata spinas gerunt laterales 5 vel 6, breves, asperas, subtus dentatas vel pectinatas, inferiores breviores et crassiores, medias longiores et graciliores, superiores breviores, apicem versus perpaucas, pluries uncinatas. Diam. disci 5 mm.

Hab. in freto Formosæ dicto in *Pariside laxa* socialis.

6. *Ophiothrix galatææ.*

O. brachiis longissimis, deplanatis, spinisque brachialibus brevibus *O. longipedæ* et *O. nereidincæ* aff., scutis radialibus mediocribus, omnino glabris, disco cæterum supra et infra granulis minutis tecto, distinguenda; granula dorsualia dense collocata, obtusa, ventralia sparsiora, graciliora, acutiora; spinæ brachiales 6-7, inferiores brevissimæ, superiores latitudinem brachiorum parum superantes; scutella dorsualia brachiorum trapeziformia. Diam. disci 14 mm.; brachia 15-20plo longiora.

Hab. ad insulas Nicobaricas.

XLIX.—*Notes on some New-Zealand Fishes.*

By F. W. HUTTON, F.G.S., C.M.Z.S.

Kathetostoma monopterygium.

Two species are, I believe, confused under this name in my 'Catalogue of the Fishes of New Zealand' (1872), which I think can thus be distinguished:—

*Kathetostoma monopterygium.**Uranoscopus maculatus*, J. R. Forster.*Anema monopterygium*, Günther, Cat. Brit. Mus. ii. p. 230.

D. 20. A. 18.

Length $3\frac{3}{4}$ times that of the head, which is 12 times the diameter of the eye; interorbital space $2\frac{3}{4}$ times the diameter of the eye. No filament in the mouth. Brownish olivaceous above, with numerous small, often indistinct, pale spots on the back, which are larger on the sides; pectoral fins not margined with white, and the inside mottled with olivaceous and brown; caudal reddish, marbled with olivaceous brown. Length 16–24 inches.

The granulation of the cranial plates is of quite a different character to that of the next species, and is much more obscure. The pores on the inferior margin of the præoperculum are in proportion much larger; and the villi on the lips, especially the upper, are more developed. The lateral line also is far more difficult to distinguish.

*Kathetostoma maculosa.**Uranoscopus maculosus*, Solander.*U. maculatus*, Richardson, Voy. Ereb. & Terr., Fishes, p. 54, pl. xxxiii.

D. 18. A. 17.

Length $3\frac{1}{4}$ times that of the head, which is 9 times the diameter of the eye; interorbital space twice the diameter of the eye. A filament in the mouth below the tongue. Brown above, with large distinct pale spots on the back and sides; pectoral fins margined with white, and dusky on the inside; caudal whitish, with a broad brown vertical band in the middle, and tipped with reddish. Length 7–11 inches.

The humeral and præorbital spines are sharper and more developed than in the last species, showing that it cannot be the young.

Leptoscopus macropygus, Richardson, *l. c.* p. 55.

This fish has been found in the Greymouth Lagoon.

Leptoscopus angusticeps, sp. nov.

B. 6. D. 33. A. 40. P. 22. L. lat. 104 (52).

Length nearly $4\frac{1}{2}$ times that of the head or $8\frac{1}{4}$ times the height of the body; breadth of the head three fifths of its length; interorbital space less than twice the diameter of the eye; pectorals shorter than the head. Head not cuirassed and without any ridges, covered with skin. Eyes on the upper angles of the head, hardly vertical. Teeth in villiform bands on both jaws, and a few on the palatine bones; vomer apparently smooth. Upper and lower lips with villi. Pale olivaceous grey above, with numerous small dark grey spots which are closer together on the top of the head; below white; a band of silvery from the chin, through the opercles, along the sides below the lateral line to the caudal. Total length 13 inches. Lateral line continuous. No humeral spine.

Hab. Greymouth Lagoon.

In the form of the head and in the position of the eyes this species approaches *Trachinus*, but in other respects it more nearly resembles *Leptoscopus*.

Rhombosolea tapirina, Günther, l. c. iv. p. 459.

The fish that I described under this name in the 'Transactions of the New-Zealand Institute,' v. (1872), p. 268, is evidently a new species, and may be distinguished from *R. tapirina* by the shortness of the cutaneous fold on the upper lip, by the breadth of the interorbital space, by its large and deeply sunken scales, and by its general shape. It may be called *R. retiaria*.

Lately, however, another flat fish has been sent to the Colonial Museum, which answers exactly to Dr. Günther's description of *R. tapirina*, except that the eyes are on the left side instead of on the right. I presume that this is only an individual variation; but the point cannot be settled until other specimens are obtained.

Galaxias grandis, Haast, Trans. N.-Z. Inst. v. p. 278.

I have examined the type of this species sent by Dr. Haast to the Colonial Museum, and can find no character by which it differs from *G. brevipennis*, Günther. This is probably the fish mentioned by Dr. Hector as being "sometimes cast up on the beaches of the great inland lakes of Otago" (Cat. of N.-Z. Fishes, p. 124), and not *Prototroctes oxyrhynchus*, as the latter fish inhabits only rapidly running streams.

L.—*Description of a new Species of Freshwater Crayfish from New Zealand.* By F. W. HUTTON, F.G.S., C.M.Z.S.

Paranephrops setosus, sp. nov.

Carapace with a strong transverse furrow and two longitudinal waved furrows behind it; centre polished, with minute impressed dots; sides thorny, with many short spines projecting forward. Beak reaching beyond the pedicel of the inner antennæ, broad, flattened, and rather hollowed out above, with four teeth on its sides and two teeth at the sides of the base; *a slight median ridge behind, which extends to the anterior of the two spines at the sides of the base of the beak.* Abdominal segments smooth above, the sides obtusely angled. Caudal appendages striate at the ends; middle tail-piece single, the spine one third from the end. Lamellar appendages of the outer antennæ extending slightly beyond the thickened basal joint, and with a strong spine close to their base. The first two joints of the arms with two rows of spines inside; wrists spined all round; hands spined on the sides and below, and a central row of spines outside; *outside covered with distant, long, stiff hairs, the tips of which are often split;* hands longer than the fingers, which are nearly straight and tuberculated inside, slightly curved at the points, and spinous on the outer edge. Legs slender, the claws straight, they and the last joints slightly hairy; order of their length 2, 3, 4, 1.

Olivaceous brown, reddish on the centre of the carapace and first and second abdominal rings; below paler, tinted with green round the base of the legs and on the abdominal rings. Spines and tubercles of the hands and fingers black, with yellow tips; spines on the carapace black. Length 5·4 inches.

Hab. Stream near Invercargill, Province of Otago; and the river Avon, near Christchurch, Canterbury.

LI.—*Descriptions of new Species of Fossorial Hymenoptera in the Collection of the British Museum.* By FREDERICK SMITH, Assistant in the Zoological Department of the British Museum.

[Continued from p. 300.]

Family Nyssonidæ.

Genus LARRA, Klug.

Larra agilis.

Female. Length 4½ lines. Black, with yellow spots and

bands. Head: the labrum, clypeus, a line running halfway up the inner margin of the eyes, and the antennæ beneath yellow; a black line down the middle of the clypeus and a spot at the base of the labrum; the mandibles rufo-piceous at their apex, and the palpi pale testaceous; the clypeus covered with silvery pile. Thorax: a line on the margin of the prothorax, a spot behind the tegulæ, and the postscutellum yellow; the anterior and intermediate tibiæ yellow in front, and the anterior tarsi yellow beneath. Abdomen: the first segment with a transverse yellow band a little before its apical margin; the four following segments with a narrow fascia on their apical margins; these fasciæ are continued beneath.

Var. The band on the basal segment obsolete, and the apical margin yellow.

Hab. Brazil (Ega).

Larra cornuta.

Female. Length 8 lines. Black, with the second, third, and fourth segments of the abdomen ferruginous; wings dark brown, with the base and apex hyaline. Head: the face covered with silvery pile, and with an erect obtuse tubercle above the base of the clypeus. Thorax: the metathorax densely covered with bright silvery pubescence; the legs and base of the abdomen with changeable silvery pile; abdomen black beneath, with the sides of the second and third segments ferruginous.

Hab. Bombay Presidency (India).

This species was collected by Dr. Leith, and presented by him to the national collection.

Larra magnifica, Savigny's Egypt, pl. 16. fig. 15.

Female. Length 17 lines. Head and thorax ferruginous; abdomen yellow above, with the first segment and apical margins of the two following narrowly black; apical margins of the fourth and fifth narrowly ferruginous. Head: the labrum, clypeus, face as high as the ocelli, and a spot in front of the scape of the antennæ yellow. Antennæ and legs ferruginous. Thorax: the metathorax with a dark stain at the base; the wings hyaline, the nervures ferruginous; the prothorax with a narrow yellow margin; both the head and thorax covered with a changeable silvery pile, observable in certain lights. Abdomen: the first segment has at its base a minute central and two lateral ferruginous spots; beneath, the first five segments black, the fifth with two large yellow maculæ, the sixth segment ferruginous.

Hab. Egypt.

St.-Fargeau has described a species of this genus, which he names *Savignyi*; the size given is 9 to 10 lines. He quotes, however, a figure in Savigny's 'Egypt' as being his species; the figure is over 15 lines long, and is certainly the species now described as *L. magnifica*, and has no reference to St.-Fargeau's insect.

Larra flavo-maculata.

Male. Length 8 lines. Black; the abdomen with bright yellow maculæ; wings dark brown, with a violet iridescence. Head: the antennæ, labrum, and mandibles ferruginous; the face with silvery pubescence. Thorax more or less covered with griseous pubescence; the apex of the anterior femora, the tibiæ, and the anterior and intermediate tarsi ferruginous. Abdomen shining; the second, third, and fourth segments with irregular-shaped transverse maculæ in the middle of the segments on each side, those on the second segment smallest; beneath entirely black.

Hab. S. Africa (Burghersdorp).

Genus NYSSON, Latr.

Nysson pilosus.

Female. Length 4 lines. Black, variegated with yellow, and covered with changeable white silky pile. Head strongly punctured, and covered anteriorly with pale golden pile, but not quite as high as the anterior ocellus; the clypeus widely emarginate; the mandibles whitish at their base and ferruginous at their apex. Thorax strongly punctured; the mesothorax with a central longitudinal impressed line; the scutellum rugose, its lateral margins, as well as those of the post-scutellum, raised; the enclosed space at the base of the metathorax with divergent carinæ, and the posterior lateral angles produced into large flattened acute spines that are pale at their apex and covered with dense silvery pubescence; the legs obscurely ferruginous; the wings subhyaline and iridescent; the nervures black. Abdomen: the base strongly punctured; beyond, finely and sparingly so; the apical margins of the segments pale testaceous, and narrowly edged with bright golden pubescence.

The male differs only in having the face covered with bright silvery pubescence, and the legs of a brighter ferruginous.

A variety from St. Paulo has the legs quite black, as well as the apical margins of the segments of the abdomen, except the first segment, which is pale laterally; three specimens from Para agree with the above description.

Hab. Brazil (Para).

Genus SERICOPHORUS, Shuck.

Sericophorus bicolor.

Female. Length $3\frac{1}{4}$ lines. Head and thorax blue; abdomen and legs ferruginous. The head closely and finely punctured; the antennæ, anterior margin of the clypeus, mandibles, and palpi ferruginous; the mandibles abruptly narrowed in the middle, the angle of the broader part produced into a tooth. The thorax finely and closely punctured; the wings flavo-hyaline, the nervures pale ferruginous; a deep channel runs from the base to the apex of the metathorax. The abdomen smooth, shining, and immaculate.

Hab. Australia (Swan River).

Genus MEGALOMMA.

Head transverse; eyes very large, ovate, lateral, and approximating anteriorly, their inner orbits touching the margins of the clypeus; the ocelli in a triangle on the vertex; the clypeus transverse, rounded anteriorly; mandibles arcuate, acute at their apex, and with two minute teeth within; the antennæ inserted above the clypeus, about half the width of the latter above it; the scape short, shorter than the second joint of the funiculus, which is slightly thickened towards the apex. Thorax ovate; the collar transverse; the metathorax narrowed posteriorly, and rounded at its apex, and with a large triangular space at its base, defined by an impressed marginal line; the anterior wings with one marginal and three submarginal cells, the marginal cell narrow, elongate, and pointed at its apex; the first submarginal cell nearly as long as the two following; the second narrowed towards the marginal, and receiving the two recurrent nervures, the first being received about the middle, the second near the apex of the cell; the third cell quadrangular and oblique; the tibiæ and tarsi moderately spinose; the claws simple, with a large pulvillus between their fork. Abdomen: the first segment forming a petiole as long as the second segment, and narrowed towards its base, on each side of which is a minute tooth.

The name of this genus was proposed by Shuckard in Lardner's 'Encyclopædia,' but the genus was never characterized; it is given in the 'Nomenclator Zoologicus' of Agassiz. The insect typical of the genus is in the British Museum, with a manuscript name attached; the name is therefore retained. The species included in the genus form what may be regarded as a section of the genus *Gorytes*, having a petiolated abdomen.

Megalomma politum.

Female. Length 6 lines. Smooth and shining; head and thorax black; legs yellow; abdomen obscure ferruginous. Head: the base of the mandibles yellow, the clypeus obscurely so, as is also the front of the scape; the flagellum fulvous beneath. The sides of the meso- and metathorax with ferruginous stripes; two abbreviated lines on the disk of the mesothorax above ferruginous; the enclosed space at the base of the metathorax with a deep longitudinal central impressed line that runs on to the apex of the metathorax; legs yellow, with ferruginous stripes on the tibiæ and femora within; the wings hyaline and iridescent, the anterior pair yellow along the frontal margin. Abdomen black towards its apex; the apical segment ferruginous, smooth, shining, and carinate at the sides; the second and two following segments with narrow yellow fasciæ on their apical margins; beneath, the fasciæ are much broader, and border the fifth segment also.

Hab. Brazil.

This species is described from an old specimen. The colouring of a recent example would no doubt be much brighter; the ferruginous markings would probably be yellow on the head and thorax.

Megalomma elegans.

Female. Length 6 lines. Yellow, with black markings; abdomen fusco-ferruginous beyond the base of the second segment. Head: the mandibles, labrum, clypeus, and scape of the antennæ yellow; the flagellum ferruginous, more or less fuscous above, and palest at the base; the head in front and behind ferruginous, and yellowish towards the mandibles; the latter rufo-piceous at their apex. Thorax: three black longitudinal stripes on the mesothorax; the sutures of the triangular space at the base of the metathorax black; wings flavo-hyaline and iridescent, the nervures ferruginous; legs yellow, with more or less ferruginous stains. Abdomen: the base of the petiole yellow, its apex ferruginous; the base of the second segment and its lateral margins yellow, the rest of the segment and the base of the third ferruginous—beyond, becoming gradually darker to the apex; beneath, the three basal segments are yellow.

Var.? Abdomen ferruginous; the base of the first and second segments and the apical margins of the following segments yellow; beneath yellow.

Hab. Brazil.

This species was intended by Shuckard for the type; but he never described it; it is possible that the colouring of the abdomen may be more or less suffused, the variety being the natural condition. *Gorytes natalensis*, Smith (Catalogue of Hymenopterous Insects, part iv. p. 365, pl. xi. fig. 3) belongs to this genus.

Megalomma nigriceps.

Female. Length $5\frac{1}{4}$ lines. Yellow, with ferruginous markings; the head black. Head: the mandibles and a spot on the cheeks at their base, the clypeus, and the face a little higher than the insertion of the antennæ, and the scape in front yellow; antennæ ferruginous. Thorax: three longitudinal black lines on the mesothorax; the lateral margins of the triangular space at the base of the metathorax black; the wings flavo-hyaline; the nervures ferruginous, the postcostal nervure black; the legs slightly ferruginous above, with a black line on the posterior femora above at their base. Abdomen ferruginous above; the base of the petiole and a narrow fascia on the apical margins of the three following segments, with the two apical segments, yellow.

Hab. Brazil.

Genus GORYTES, Latr.

Gorytes specialis.

Female. Length 6 lines. Black, and variegated with yellow, smooth and shining. Head: the palpi, labrum, clypeus, sides of the face a little above the insertion of the antennæ, the scape of the antennæ, and an abbreviated line behind the eyes at the base of the mandibles, yellow, the tips of the latter rufo-piceous; the antennæ beneath and the apical joint fulvous. Thorax and legs yellow; the mesothorax black above, with a yellow line at the sides over the tegulæ; the suture between the scutellum and postscutellum, and a central line down the triangular enclosed space at the base of the metathorax black; the pectus and a stripe on the posterior femora above black; wings flavo-hyaline, the nervures rufo-fuscous, with a slight cloud in the marginal cell; the tegulæ and nervures at the base of the wings ferruginous; the stigma pale. Abdomen with a short petiole, which is yellow at the base, and has a minute tooth on each side; the apical margins of the segments narrowly and obscurely rufo-piceous.

Hab. Ega, on the Amazon.

Gorytes vespoides.

Female. Length $5\frac{3}{4}$ lines. Black, clothed with grey scri-

ceous pile; abdomen with yellow bands. Head: the scape yellow beneath, and the first three joints of the funiculus fulvous beneath; on the vertex and on the cheeks the pile has, in certain lights, a pale golden tinge, as it has also on the disk of the thorax. A yellow line on the collar and an orange one on the scutellum; the triangular space at the base of the metathorax longitudinally and divergently striated; wings hyaline, the nervures pale ferruginous; the tibiæ and tarsi spinose; the spines ferruginous; the tibiæ, as well as the apex of the femora, more or less ferruginous within. Abdomen: the apical margin of the second and following segments with yellow fasciæ, which widen laterally; beneath, these segments are yellow.

Hab. Ega.

In general appearance this is the counterpart of the social wasp *Nectarina analis*.

Gorytes triangularis.

Female. Length 7 lines. Black, with the triangular space at the base of the metathorax yellow, smooth, and shining. Head: the base of the mandibles, the labrum, clypeus, face as high as the antennæ, and a broad stripe behind the eyes reddish yellow; the scape of the antennæ of the same colour, and the flagellum fulvous beneath. Thorax: a narrow line on the posterior margin of the prothorax and the postscutellum yellow; the sides of the mesothorax ferruginous; the anterior legs reddish yellow; wings dark brown along the anterior margin of the fore pair, and subhyaline behind. Abdomen velvet-black. The tibiæ and tarsi with pale ferruginous spines.

Hab. Para.

Gorytes facilis.

Male. Length $4\frac{2}{3}$ lines. Black, smooth, and shining; the metathorax and base of the abdomen yellow. Head: the base of the mandibles, the labrum, clypeus, and scape of the antennæ honey-yellow, the latter slightly fuscous behind. Thorax: the margin of the prothorax, the tubercles, a spot beneath the wings, the tegulæ and an epaulet over them, the scutellum, postscutellum, and metathorax honey-yellow; the triangular space at the base of the metathorax black, and with a central impressed line which is continued to the apex of the metathorax; the wings light fuscous, with their apical margins paler; the anterior and intermediate legs yellow; the femora ferruginous above; the posterior legs ferruginous; the third and fourth joints of the tarsi yellow, the claw-joint black;

the apex of the tibiæ and a line on the inside of the femora fuscous. Abdomen: the first segment entirely yellow, and the apical margins of the other segments with a narrow yellow band; the second segment ferruginous above at the base, and entirely ferruginous beneath.

Hab. Para.

Family Philanthidæ.

Genus CERCERIS, Latr.

Cerceris striata.

Female. Length 4 lines. Black, with yellow markings; the mesothorax longitudinally striated. Head: the clypeus slightly elevated and bidentate at its apex; the clypeus, sides of the face, scape in front, and the mandibles yellow, the latter black at their tips; four or five of the joints at the base of the flagellum beneath, and the apical joint entirely, ferruginous. Thorax: the posterior margin of the prothorax transverse, raised, and forming acute lateral angles, yellow, as are also the tubercles, the scutellum, and a line at the sides of the metathorax, which is continuous outside the triangular space at the base of the metathorax; the legs rufo-piceous behind, and yellow in front; wings hyaline and iridescent, with a fuscous stain in the marginal cell which extends to the apex of the wing. Abdomen: the first segment yellow, except its extreme base and apex; the second yellowish at the base; the third with a yellow fascia at its apical margin, the third and fourth with very narrow fasciæ; beneath rufo-testaceous, with the three basal segments more or less yellowish.

Hab. Para.

Cerceris rostrata.

Female. Length 6 lines. Yellow, with black markings; the clypeus elevated and narrowed at half its length to a point. Head: the vertex black, with a black line running to the base of each antenna; two oblique yellow lines converge inwardly from the eyes and meet (or nearly so) at the margin of the vertex; an ovate black spot on each side of the head; the antennæ ferruginous and more or less fuscous above. Thorax: the prothorax black above, with its posterior margin yellow; the mesothorax black above, its lateral margins yellow, and three sides of a square traced in yellow on the disk; a black spot in the middle of the scutellum; the triangular space at the base of the metathorax with a black line in the centre, on each side of it a black line runs halfway down the metathorax; the tibiæ and tarsi with a narrow black line above; wings

fulvo-hyaline. Abdomen black above, with a narrow yellow line on the apical margins of the segments, the first segment ferruginous above.

Hab. Mexico.

Cerceris exsecta.

Female. Length 8 lines. Black, sparingly variegated with bright yellow spots and bands; the clypeus elevated and deeply emarginate anteriorly; a broad oblong spot on each side of the face, the anterior half of the clypeus and a central line running nearly to its base, a minute spot between the antennæ, a narrow longitudinal line on each side of the vertex above the eyes, and the mandibles yellow; antennæ ferruginous and more or less fuscous above. Thorax: an interrupted line on the prothorax, a spot on the tegulæ, another on each side of the scutellum and also of the metathorax posteriorly and the postscutellum, yellow; tibiæ and tarsi variegated with yellow and ferruginous, the posterior pair blackish above; wings fusco-hyaline, the nervures ferruginous. Abdomen: the first, third, and fourth segments with narrow marginal fasciæ.

Male. Smaller than the female; closely resembling it, but differing as follows:—the clypeus not elevated, and entirely yellow, the scape yellow in front; the posterior trochanters yellow, and the apical margins of all the segments, except the second, with narrow yellow fasciæ. Both sexes have a quadrate yellow spot on the underside of the first segment.

Hab. Mexico.

Cerceris graphica.

Female. Length 7 lines. Head and thorax black, spotted with yellow; abdomen ferruginous, with yellow bands. Head: the clypeus, a narrow line running halfway up the inner margin of the eyes, and the mandibles yellow; the latter black at the tips; a narrow line behind the eyes which runs backwards to the margin of the vertex before reaching their summit, the scape of the antennæ, and four or five of the basal joints of the flagellum ferruginous. Thorax: a transverse spot on each side of the prothorax, a spot on the tegulæ and a small one beneath them, two ovate spots on the scutellum, two minute ones on the postscutellum, two central ones on the triangular enclosed space at the base of the metathorax, a line on each side of the metathorax, which widens posteriorly into a large macula; the legs ferruginous, with yellow tarsi; the coxæ, trochanters, and a line beneath the femora black. Abdomen: the sides of the basal segment yellow, and a narrow yellow fascia on the apical margins of the third, fourth, and

fifth segments, their basal margins black; beneath black, with the margins ferruginous. Wings fusco-ferruginous.

Hab. Mexico.

Cerceris multipicta.

Female. Length $9\frac{1}{2}$ lines. Black, variegated with yellow and ferruginous; the abdomen with a large yellow macula on each segment laterally. Head: the clypeus with the anterior margin deeply sinuated and, as well as the sides of the face a little higher than the insertion of the antennæ, and also a large spot behind the eyes, pale yellow; antennæ ferruginous, with the scape yellow in front, and five or six of the apical joints black; the cheeks and mandibles ferruginous, the latter black at their tips. Thorax: the prothorax above, two spots on the postscutellum, the metathorax, and the triangular space in the centre of its base yellow; a longitudinal black line down the centre of the metathorax, and a narrower one down the triangular space; the legs, and a large patch at the sides of the thorax beneath the wings, ferruginous; the anterior tibiæ and the femora spotted with yellow; wings flavo-hyaline, with a dark cloud at their apex, their nervures and tegulæ ferruginous. Abdomen: the basal segment oblong, with the sides, as well as the apical margin, yellow.

Male. This sex is smaller, is similarly coloured, but it has the clypeus rounded anteriorly.

Hab. Angola (Lower Guinea).

Dr. Gerstäcker has described a species of this genus, *Cerceris pictiventris*, in Peters's 'Naturw. Reise nach Mossambique,' a figure of which is given in Taf. xxx. fig. 12 (♂). It resembles the present species—but differs from it in being only 5 lines in length, in having the head and thorax differently coloured, in being smooth and shining, with rather distant punctures, in having the basal segment of the abdomen nearly as broad as long, and in having the triangular space at the base of the metathorax divergently grooved; in the present species it is glassy smooth and shining in both sexes.

Cerceris fervens.

Female. Length 4 lines. Black, strongly and closely punctured, variegated with yellow, and with yellow legs. Head: the mandibles, face, clypeus, and scape of the antennæ yellow. Thorax: an interrupted line on the collar, two on the scutellum, the postscutellum, a large ovate spot on each side of the metathorax, and a spot beneath the wings yellow; the posterior femora and tibiæ fuscous at their apex within; wings subhyaline and iridescent, the anterior pair slightly

clouded at their anterior apical margin. Abdomen: the base of the second segment and the third and fifth segments yellow, with a semicircular black macula at their basal margins; the fourth segment with a lateral yellow spot; beneath yellow, with the apical margins of the segments rufo-piceous.

Male. Length 3-3½ lines. Resembles the female—but is not so brightly coloured, the spots on the scutellum obsolete, and the yellow segments have more black at their base, and it is the third and sixth segments that are coloured; the femora, tibiæ, and posterior tarsi are more or less black; the abdomen beneath is only slightly marked with yellow.

Hab. Northern India.

This species has the aspect of a small form of the European *Cerceris ornata*.

Cerceris albopicta.

Female. Length 4½ lines. Head and thorax black, with white markings; abdomen red at the base, black beyond, with white fasciæ. Head black, and finely and closely punctured; the mandibles, face as high as the insertion of the antennæ, the clypeus, and scape in front white; sometimes a white line behind the eyes. Thorax: the collar, tubercles, two spots on the scutellum, the postscutellum, and legs white; the femora and tibiæ with a fuscous line behind; the antennæ and first two segments of the abdomen ferruginous; the second segment more or less black at its apical margin; the third and fifth segments with white fasciæ on their apical margins, the fasciæ widening laterally.

Male. Length 3-3½ lines. Only differs in having fewer of the white markings, particularly those on the thorax.

Hab. India (Bombay Presidency).

Cerceris fluvialis.

Female. Length 5½ lines. Reddish yellow, closely punctured, the mesothorax and fourth segment of the abdomen most finely so. Head: a curved black band on the vertex between the eyes, widest in the middle, and enclosing the ocelli; the clypeus truncate in front, the upper margin of the truncation subtuberculate in the middle; tips of the mandibles black; a sharp carina between the antennæ. Thorax beneath, the mesothorax above, and hinder portion of the metathorax black; the wings towards their base flavo-hyaline, the nervures ferruginous; the apex of the wings fuscous, with a darker cloud in the marginal cell. The fourth segment of the abdomen black.

Hab. Swan River, Australia.

Cerceris varipes.

Female. Length 7 lines. Black, with the second and fifth segments orange-yellow. Head: the base of the mandibles, the clypeus, the face (as high as the insertion of the antennæ), and a minute ovate spot behind the eyes yellowish white; a spot on the scape, and the second and four following joints of the antennæ fulvous beneath. Thorax: the triangular space at the base of the metathorax with fine divergent striæ; wings subhyaline, with a dark fuscous cloud occupying the marginal cell and passing on to the apex of the wing; the nervures rufo-fuscous; the tegulæ rufo-testaceous, with a yellow spot in front; the apex of the femora and the tibiæ ferruginous; the anterior and intermediate tarsi white, slightly stained with ferruginous at the apex of the joints, the posterior tarsi fuscous, with their base and the claw-joint ferruginous, the posterior trochanters white beneath. Abdomen black beneath.

Hab. Adelaide.

Cerceris venusta.

Female. Length $4\frac{1}{2}$ lines. Variegated with black and yellow; the head wider than the thorax. The mandibles, clypeus, face higher than the insertion of the antennæ, a line between them (which terminates in a round spot), the scape in front, a line behind the eyes, and two oblique spots on the vertex yellow; the flagellum fulvous and slightly fuscous above. Thorax black, with a broad fascia on the prothorax, the tegulæ, scutellum, postscutellum, and a large ovate oblique spot on each side of the metathorax yellow; the legs ferruginous, with yellow stains; beneath, the trochanters and some spots on the coxæ white; a black line on the posterior femora and tibiæ; wings subhyaline, with a fuscous cloud occupying the marginal cell and passing beyond to the apex of the wing. Abdomen: the base of the first, second, and fourth, and the third segment entirely black; a small ovate yellow spot on each side of the third segment; otherwise yellow; a central ferruginous stain on the first and second segments; beneath ferruginous, with the margins of the segments narrowly black; the fourth and fifth segments with a yellow spot on each side.

Hab. Queensland.

Cerceris opposita.

Female. Length $4\frac{1}{2}$ lines. Black; the clypeus elevated, and with three yellow fasciæ on the abdomen; the insect covered with rather fine confluent punctures. Head: the mandibles, clypeus, sides of the face as high as the insertion of the antennæ, a narrow line between them, and a minute spot behind the eyes

yellow ; tips of the mandibles black ; the flagellum of the antennæ fulvous beneath. Thorax : a narrow line on each side of the posterior margin of the prothorax, and another on each side of the postscutellum, yellow ; wings subhyaline, with a faint cloud beyond the stigma ; nervures fuscous ; tegulæ yellow ; the tips of the femora, the tibiæ, and tarsi ferruginous, the anterior and intermediate tarsi have the first joint white, the posterior pair are slightly fuscous above.

Hab. Australia (Lower Plenty, Victoria).

Cerceris sæva.

Female. Length $3\frac{1}{2}$ – $4\frac{1}{2}$ lines. Black, very closely and strongly punctured ; variegated with yellow and ferruginous spots and fasciæ. Head : clypeus elevated and truncate ; the mandibles, clypeus, sides of the face as high as the insertion of the antennæ, a narrow carina between them, and sometimes a minute dot behind the eyes, yellow. Thorax : two spots on the collar, two on the postscutellum (these are frequently obsolete), and the tegulæ yellow ; wings subhyaline ; a fuscous stain in the marginal cell, which extends to the apex of the wing ; tips of the femora, the tibiæ, and tarsi ferruginous ; the basal joint of the anterior and intermediate tarsi whitish. Abdomen : the second segment black at the base and more or less so down the centre, at the sides ferruginous, and with a yellow spot ; the fourth and fifth segments with a narrow yellow fascia on the apical margin.

Hab. Victoria (Lower Plenty, &c.).

This is a variable species : sometimes the apex of the first segment of the abdomen is ferruginous ; occasionally the apical segment is entirely so ; the third segment rarely more or less ferruginous ; the scape of the antennæ usually yellow in front, and the flagellum fulvous beneath. The male varies principally in the colouring of the abdomen ; it is sometimes yellow at the base and ferruginous beyond, with a black spot in the middle, or it is half yellow and half black ; the thorax black, with two minute yellow spots on the collar.

Cerceris aurantiaca.

Female. Length 5 lines. Pale orange-coloured ; the fourth segment of the abdomen, the mesothorax, and a macula on the vertex black ; closely punctured. Head : a short carina between the antennæ ; the clypeus oblong, curved, and elevated ; a black macula on the vertex encloses the ocelli, and extends to the insertion of the antennæ, it is somewhat heart-shaped, and unites with a black broad line at the summit of the eyes,

from which a narrow curved line runs to the margin of the vertex, where it is more or less interrupted; the tips of the mandibles also black; the head and thorax black beneath; wings subhyaline, with a fuscous stain running from the base of the marginal cell to the apex of the wing. The fourth segment of the abdomen above, and the fourth and fifth beneath, black.

Hab. South Australia.

Genus PHILANTHUS, Fabr.

Philanthus niloticus.

Female. Length 4 lines. Black, and variegated with bright yellow spots and fasciæ. Head: the mandibles, clypeus, sides of the face as high as the insertion of the antennæ, a lunate spot above the clypeus, a large transverse semicircular spot in front of the anterior ocellus, a transverse line above the ocelli, and a broad line behind the eyes yellow. Thorax: the prothorax, two abbreviated lines on the disk of the mesothorax, the tegulæ, the scutellum and postscutellum, an ovate spot on each side of the metathorax, the tubercles, two irregular-shaped spots beneath them, and the legs yellow; the posterior femora only yellow at their apex; the wings hyaline and iridescent. Abdomen: the second segment, a broad band on the first and fourth segments, a narrow band on the two following, and the apical segment yellow.

Hab. White Nile.

Philanthus elegans.

Female. Length $4\frac{1}{2}$ lines. Variegated with white, black, and ferruginous. Head white in front and pale yellow behind; the vertex black, with a transverse white line between the eyes above the ocelli, and a white tridentate spot in front of them; the flagellum ferruginous. Thorax very pale yellow, nearly white; a black spot on the prothorax; and the mesothorax black, with four longitudinal white lines, the lateral ones close to the tegulæ, the two central lines running backwards a little beyond the disk; a large triangular black spot at the base of the metathorax above, and a central one behind uniting with it; wings hyaline, the nervures pale ferruginous; the thorax beneath and the legs pale yellow, with ferruginous stains on the femora above. Abdomen pale yellow beneath, with two black ovate spots on the second segment; above, ferruginous at the base and black beyond; each segment with a large transverse yellowish-white macula on each side and nearly uniting in the middle; the apical segment pale.

Hab. Northern India.

LII.—Notes on the Rats; with the Description of some new Species from Panama and the Aru Islands. By Dr. J. E. GRAY, F.R.S. &c.

THE species of Rats are exceedingly difficult to distinguish; and from many species having the habit of going on board ships, and of being carried about in goods, the same species becomes spread over different parts of the world, rendering it very unsafe to distinguish them by their geographical distribution. The skulls afford one of the best characters to separate the species into groups; and therefore I have arranged the various skulls in the British Museum thus, and described three species which I did not find recorded in the catalogues in such a manner that I could recognize them.

The British Museum has lately procured from Paris a rat from Panama, which I do not find described, and am therefore inclined to think is new. It is well distinguished from all other rats by the form of the skull, and especially of the cavity on the side of the nose in front of the orbit.

NEOMYS.

Head short, rather conical. Whiskers long, smooth, black. Eyes moderate. Ears rounded, naked. Fur very soft, close, with very slender, rather stiffer, black hairs. Feet covered with very short close hair. Toes quite free, four in front, five behind, with short curved claws, which are partly covered with white hairs at the base. Tail elongate, naked, slender, covered with close, regular, thin, square scales placed in rings; black, the terminal third being white.

Skull broad, depressed, nearly twice as long as wide, flat above, with a thin edge above the eyebrow, which is continued on and expanded out, forming a wide sharp keel on the sides of the temples. The aperture in front of the orbit narrow, linear, erect, with a sharp, nearly straight, slightly arched hinder edge, and a large concavity in front, which is not so long as high and has a slanting ridge in front, so that it is much narrower at the lower part than the hinder one, and has an arched lower edge; there is a tubercle in the middle of the front edge. Teeth $\frac{3.3}{3.3}$, as in *Mus*.

This genus is at once known from the true genus *Mus* by the softness and slenderness of the longer hair and the general softness of the fur. The skull is at once distinguished from that of the genus *Mus* by its very flat broad crown, which has a rather broad expanded edge over the eyes and the upper part of the temporal muscles, and in the form of the aperture in front

of the orbit, and the concavity on the side of the nose before it. The concavity on the side of the nose in front of the eye is broad and deep, and is suddenly narrowed on the lower side, so as to leave a narrow erect opening on the lower part of the side of the nose, which has a rather raised front edge on its lower part, as in *Mus decumanus*.

Fig. 1.

Skull of *Neomys panamensis*.*Neomys panamensis*. (Fig. 1.)

Mouse-coloured; back blackish-washed, with longer hairs; sides of the head and body rather paler; throat, chest, under-side of body, and inside of legs white; feet brownish, with white hairs over the claws; tail slender, naked, glossy black, white at the end. Size of a common rat (*Mus decumanus*).

Hab. Panama (*Boucard*).

NESOKIA.

Skull short, broad, broader than half the length ($1\frac{3}{4}$ to 1). The nose short, slender, and compressed. Slit before the orbit narrow, expanded and oval above, thickened on the front edge.

Nesokia kok. *N. hydrophorus*.

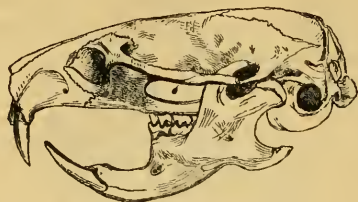
HELIOMYS.

The skull rather broad, flat above, about once and two thirds as long as wide at the back of the orbits. Orbits wide. Forehead between the eyes narrow, with a ridge on each side, and the sides parallel. The cavity before the eyes triangular, deep, not so long as high, above with a straight, scarcely lamellar, hinder edge, and a thickened, shelving, convex front edge. Palatine groove elongate. Nose rather broad.

I do not know the animal belonging to this skull, which we received from Professor Jeude from the Utrecht Museum; but it is exceedingly different from the skulls of all the rats which I had previously seen, by its breadth, the spreading of the zygomatic arch, the narrow forehead between the eyes, and the peculiar form of the aperture in front of the orbit, and also by the thickening of the central part of the substance of the central

lobe of the lower jaw, and by the very great length of the upper and lower lobes of its hinder edge.

Fig. 2.

Skull of *Heliomys Jeudei*.

Heliomys Jeudei. (Fig. 2.)

Hab. Unknown.

BANDICOTA.

Skull elongate, about twice as long as wide at the hinder part of the orbits. Nose elongate. Slit before the orbit short, with a thick callous front edge, oval and expanded above. Palatine slits elongate.

Bandicota gigantea.

The British Museum received two specimens of a male and female rat, which Dr. A. B. Meyer obtained at Aru Island in April 1870, and at Buntimunang, in the south-west part of Celebes, in November. It is intermediate in size and the harshness of the fur between the Bandicote and the Norway rat (*Mus decumanus*).

UROMYS, Peters.

Skull elongate, about twice as long as broad at the hinder part of the orbit. Nose arched down. Slit before the orbits short; front edge simple, with a conical projection contracting the slit and expanding into an oval form above. The palatine slits rather short.

Dr. Peters established this genus upon a rat which I had described under the name of *Mus macropus* (P. Z. S. 1866, p. 221)—calling it *Uromys macropus* (Peters, Monatsber. 1867, p. 3, t.), and giving a very good figure of the animal, with details of its skull; but *macropus* is a larger species than *U. aruensis*, the skull is not so arched and bent down in front, and the tail is nearly two thirds white and the basal third dark. The palatine slits are equally short in both species.

Uromys aruensis.

Reddish brown: back, especially in the middle, varied with

black-brown stiffer hairs; whiskers very long, black; upper lip, lower side of head, throat, chest, underside of body, and inner side of limbs pure white; ears rather large, naked; tail elongate, rather longer than body and head, rather thick at the base, tapering, black, terminal quarter white; feet covered with very short hair; claws strong, naked.

Skull elongate, $2\frac{1}{3}$ inches long, and $1\frac{1}{6}$ inch broad at the zygomatic arch. Nearly the same size as the skull of *Bandicota gigantea*; but the forehead is much more curved down, the cavity in front of the orbit is smaller, and the front edge of the cavity is not thickened on the front margin, and is furnished with an acute, subcentral, conical projection, contracting on the upper part of the perpendicular cleft. Teeth bright yellow and much incurved. Palatine slits rather short, not more than two thirds the length of the slits in *B. gigantea*, nor nearly so long as they are in the much smaller *Mus decumanus*.

Mus.

Skull elongate, twice as long as broad at the hinder edge of the orbit. The slit in front of the orbit narrow, elongate, extended above into an oval cavity. Slit in the front of the palate elongate.

Mus decumanus, *M. rattus*, *M. indicus*, *M. piloides*, *M. cervinipes*, *Holochilus brasiliensis*, *H. cephalotes*, and *Mus alexandrinus*, which has the slit in front of the nostrils shorter and wider than the rest, as is also the case with *Laggada platythrinx*, *L. boodunga*, *Golunda barbara*, and *G. meltada*: these have the front teeth smooth; *G. Ellioti* has the front teeth with a central longitudinal groove.

BIBLIOGRAPHICAL NOTICES.

The Sea and its Living Wonders; a Popular Account of the Marvels of the Deep, and of the Progress of Maritime Discovery from the earliest ages to the present time. By Dr. G. HARTWIG. 4th edition. 8vo. Longmans: London, 1873.

ON the appearance of the first edition of this book we gave a notice of its contents in this journal; and it is with pleasure that we now announce the publication of a fourth edition. Dr. Hartwig's volume is undoubtedly one of the best of the tolerably numerous class to which it belongs; and it is rather to be wondered that it has not secured even a wider sale than would seem to be indicated by the number of editions which it has reached.

In the new edition the general treatment of the subject is the same as in former issues; but the author has made many important addi-

tions and alterations. The book opens with a short treatise on the physical geography of the sea, in which we have a picturesque general description of the sea, its waves, tides, and currents, and their causes, and of the "aerial and terrestrial migrations of the waters," the latter including an account of the winds and of the circulation of the water evaporated from the ocean through the atmosphere to the surface of the land and back again to its source. To this section of the book the author has added two new chapters, containing descriptions of some marine caves and of certain marine constructions, chiefly lighthouses.

It is to the second part of his work, which treats of the inhabitants of the sea, that the author has evidently devoted his chief attention; and he has succeeded in giving a good popular account of the principal forms of marine animals and plants. In comparing this section of Dr. Hartwig's book with that in the first edition, we find that, without making it very technical, he has put it in such a form as to convey a very fair general notion of the modern classification of animals and of the peculiarities characteristic of the chief types belonging to each great group which is represented among the population of the sea; the chapter on the Crustacea has been reconstructed and made much fuller, especially with respect to the metamorphoses which most of those animals undergo; a brief account of some marine Rotifera has been appended to the chapter on marine worms; the description of the Mollusca has been considerably added to and improved; and the account of the Cœlenterata has been entirely rewritten on quite a new plan. We notice also that the Diatoms have been removed from their former position among the Infusoria and placed with the marine plants. In the chapter on the geographical distribution of marine life, Dr. Hartwig has availed himself of the results obtained by recent researches in the abyssal waters of the Atlantic.

The third and concluding part of the book is devoted to a brief sketch of the history of maritime discovery, with which we have nothing to do here, but which will doubtless enhance its value in the eyes of those young readers for whose delectation it is particularly designed. On the whole we are not acquainted with any better gift-book than Dr. Hartwig's volume, almost the only defect of which consists in the miserably small size and generally poor execution of many of its numerous natural-history illustrations. We notice, however, as a sign of better things, that most of the new woodcuts are on a larger scale and fairly executed; so that we may hope in course of time, as more editions are called for, the paltry little old blocks will be gradually eliminated.

Outlines of Natural History for Beginners, being Descriptions of a Progressive Series of Zoological Types. By H. ALLEYNE NICHOLSON, M.D. &c. 12mo. Blackwood: Edinburgh and London, 1873.

DR. NICHOLSON has added one more to his already long list of educational works; but we do not think that his 'Outlines of

Natural History' will fulfil the object with which the book has been produced. Its *raison d'être* is stated by the author, in his preface, as follows:—"It has been recently asserted," he says, "that zoology is not a subject which can be profitably taught in schools. . . . ; and the present work is an attempt to solve, upon a new basis, the problem how the facts of natural history can be imparted to the previously uninstructed beginner in such a manner that he may obtain some real knowledge of the subject, and not a mere parrot-like acquaintance with a greater or less number of technical names." With this purpose in view, Dr. Nicholson has selected a series of types representing the classes adopted in his former manuals: he describes the structure of these in popular language, and points out at the end of each description what characters of the type are common to the rest of the class to which it belongs. It is evident that the amount of zoological knowledge thus conveyed is very limited; and as the very essence of such knowledge consists in a more or less exact and extended acquaintance with the various forms which the same type of structure can put on in its different living manifestations, it is clear that the zoological ideas to be acquired by the learner from this book will be of a peculiarly imperfect kind.

The value of such a work as Dr. Nicholson's must depend greatly on the selection of the types; and among the lower classes of the animal kingdom, at all events, it is almost impossible to select types which shall really be good general representatives of their classes. In the book before us, *Amœba* serves as the type of the Rhizopoda, *Hydra* of the Hydrozoa, a rotifer of the Scolecida, and the leech of the Annelida.

It seems to us that what is needed in order to popularize the study of zoology among the young is a treatment of the subject in a rather more picturesque style, a recognition that the creatures treated of are living beings with most interesting habits and functional peculiarities to be studied, and not mere agglomerations of organs to be anatomized. This purpose Dr. Nicholson's new manual does not fulfil; and for teaching junior classes we should greatly prefer his little 'Introductory Text-book of Zoology.'

Endomycici Recitati. A Catalogue of the Endomycici, &c., with Descriptions of New Species and Notes. With a Plate by E. W. Robinson. By HENRY STEPHEN GORHAM, Vicar of Shipley, Sussex. Williams and Norgate.

UNDER the above singular title Mr. Gorham has given us a useful catalogue of the Coleopterous family Endomychidæ. The number of species belonging to it is not large, with the new species here described amounting to 302, arranged under 46 genera. The author names the Endomychidæ a "group," here called Endomycici; and its sub-families he elevates to the rank of families, with the addition of one bearing the very awkward name of Paussidoidæ. No reason for these alterations is given; so we suppose we must attribute them to the illusive eccentricity of inexperience; but they are to be regretted both as unnecessary and as tending to give a low idea of the logical

capacity of the author's mind. Mr. Gorham, however, is well known among the London entomologists as an acute and highly promising Coleopterist; and we hope he will work up other comparatively neglected families with the same ability he has shown in the *brochure* before us. We regret to see that in the preface the author complains of difficulties thrown in his way by the authorities of the British Museum. There must have been some misapprehension; Dr. Gray, we believe, is as ready now as formerly to assist any one studying the collections under his charge.

MISCELLANEOUS.

On the Respiratory Organs of the Araneida.

By Dr. P. BERTKAU.

THE old division of the Arachnida into pulmonary and trachean, established by Latreille, lost all its value when Léon Dufour, Dugès, and, after them, Menge and Siebold discovered that the Araneida possessed tracheæ besides their lungs.

One might be surprised at first to see two different aërial respiratory apparatus existing together in the same animal; but Leuckart soon showed that the so-called lungs ought to be considered a formation homologous with that of the tracheæ, and he gives them, in consequence, the name of pulmonary tracheæ (*Lungentracheen*). This interpretation has been generally accepted; and the new observations of M. Bertkau go also to confirm it.

The author describes the structure of the lungs, for which he proposes on his part the name of laminar tracheæ (*Fächertracheen*) and that of the tracheæ properly so called. From these investigations, which have been directed to a great number of genera and species, he deduces a grouping of Araneida based on the modifications that these animals present in their respiratory organs. We shall not follow him in the description that he gives of the lungs, because it contains nothing but well-known facts. We may recall only that the two stigmata which admit the air into these organs are situated on the lower surface of the abdomen, immediately behind the peduncle which unites that region to the cephalothorax. In some genera there is behind these pulmonary stigmata, and quite close to them, another pair of stigmata. It is only in the Mygalidæ that these orifices lead, like the anterior ones, to a second pair of lungs. In *Dysdera*, *Segestria*, and *Argyroneta* they give access to a trachean system. A very short canal, starting from each of them, leads to a wide, compressed, principal trunk, of which the wall is strengthened by chitinous rods, which are either irregularly placed (*Dysdera*) or united into a spiral thread exactly as in the tracheæ of insects (*Segestria* and *Argyroneta*). The greater portion of the trachean trunk inclines forward; a little bursiform appendage is directed backward. In *Dysdera* and *Argyroneta* each of the two anterior or

cephalothoracic trunks passes into the cephalothorax, where it terminates in a little rounded swelling, from which issue a considerable number of small unramified tubes with thin walls. In *Segestria* the trunks remain in the abdomen and do not become inflated; but they also send forth little tubes of the same nature, which, uniting in two strong bundles, penetrate in great part into the cephalothorax. Each posterior or abdominal trunk gives origin throughout its length to a great number of little tubes going to the organs of the abdomen. These tubes, starting from the trachean trunks, proceed in bundles to the extremities of the appendages, gradually diminishing in size, but without ramifying or presenting anastomoses. No trace of a spiral thread can be detected in them, even under the strongest magnifying-powers. In all the other Araneida there are in front only the two anterior stigmata leading to the lungs. On the other hand, we find at the posterior extremity of the body, and immediately before the spinnerets, a transverse slit formed by the coalescence of a pair of stigmata, and leading to two symmetrically constructed tracheæ. The trachean system, which is connected with these stigmata, presents great differences, according to genera. In *Dyctina*, Sund., it presents the greatest resemblance to that of *Dysdera*, *Segestria*, and *Argyroneta*, and only differs in the smaller number of the tubules. In *Erigone*, Sav., and *Micryphantès*, Koch, the trachean system is less developed. The air-sac, which is small, first gives origin on each side to a simple tube, which terminates in a fine point. Beyond the point of origin of these two tubes the sac is divided into two short, wide, and flattened trunks. From the middle of their length these trunks send forth some tubules, of which some remain in the abdomen, while the others pass into the cephalothorax, where they are distributed even into the extremities.

The genera of the family of the Attidæ have a trachean system constructed on a very uniform plan. It commences by two trunks but little ramified, and sends forth at intervals a great number of bundles of tubules. In the wall of the tubules there are seen transverse lines which seem to indicate the appearance of a spiral thread.

The Thomisidæ have all the trachean apparatus more simplified and less extended. A narrow fissure leads into a small respiratory cavity, from which four branches start. The two lateral branches are smaller than the intermediate ones; but they all send forth along the whole length of their course, which is limited to the abdomen, branches which ramify in their turn, or terminate in a filiform point without being ramified. The trachean system of the other Araneida presents a still less degree of development. A narrow fissure, situated before the spinnerets, leads into a depressed air-cavity, at the anterior extremity of which issue four simple tubes, flattened in the form of ribbons, having no trace of a spiral thread, but, at most, some fine granulations irregularly disseminated in their membrane. Such, at least, is the general arrangement; it presents some variations in the different genera. In certain cases we see the two tubes of each side, which were originally united, bifurcate further on; or the two median tubes, at first united, separate beyond the origin of the lateral

tubes. In general the external tubes are more slender, but longer than the internal ones.

M. Bertkau has in vain sought for these simple tracheæ at the extremity of the abdomen in *Oletera*, *Dysdera*, and *Segestria*.

Thus it is established that the Araneida have four stigmata, of which the two anterior are situated at the anterior part of the abdomen. The two others are placed either immediately behind these or further back, at the extremity of the abdomen. In this latter case they unite to form a fissure in the median line. The first pair of stigmata always leads to "lungs;" the second to lungs (*Mygalidæ*) or, more frequently, to tracheæ. When the second pair of stigmata is anterior, the tracheæ to which it corresponds always present two principal trunks—one directed forward, furnishing trachean tubes to the cephalothorax (*Dysdera* and *Segestria*), whilst the other passes backward and supplies the abdomen. When the second pair of stigmata is situated at the extremity of the abdomen, and the two trunks must necessarily go forward, it is the external one which corresponds to the posterior trunk of *Dysdera* and *Segestria*.

The modifications which are observed in the respiratory apparatus of the Araneida are in correlation with those which are manifested in the rest of the organization and which have served to establish the principal groups. There are, however, some points on which a division having for base the organization of the respiratory apparatus does not exactly coincide with the classification adopted now. This is observed, for example, in the family of the Thomisidæ, in which the genera *Thomisus*, *Xysticus*, *Artamus*, and *Philodromus* have ramified trachean tubes, while they are not so in *Sparassus* and *Thanatus*. But it must be remarked at the same time that the forms belonging to these two genera differ by their facies, by the claw of their first jaws, and by the claws of the feet. M. Bertkau has therefore established a family of Sparassidæ which forms a transition from the Thomisidæ to the Lycosidæ. *Scytodes* includes the only known representatives of a new family, that of the Scytodidæ; and *Dictyna*, *Erigone*, and *Micryphantes* constitute the family of the Micryphantidæ, in which, perhaps, we ought to place *Argyroneta*, a genus of which the place is yet uncertain.

The author proposes the following grouping of the Araneida:—

- I. Two pairs of laminar tracheæ. *Mygalidæ* (Tetrapucumones).
- II. A single pair of laminar tracheæ.
 - A. A pair of tubular tracheæ in tufts.
 - a. Stigmata distinct. *Dysdera*, *Argyroneta*.
 - b. Stigmatary aperture common. *Micryphantæ*, *Attidæ*.
 - B. A pair of ramified tubular tracheæ with a common orifice. *Thomisidæ*.
 - C. Four simple tubes with a common orifice. *Scytodidæ*, *Drassidæ*, *Agelenidæ* (excl. *Argyroneta*), *Epeiridæ*, *Therididæ* (in great part), *Sparassidæ*, *Lycosidæ*.

—*Archiv für Naturg.* vol. xxxviii. (1872) p. 208; *Bibl. Univ.* April 15, 1873, *Bull. Sci.* p. 355.

Migrations of *Danais Archippus*.

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

Altona, October 15, 1873.

GENTLEMEN,—In the June and August numbers of the 'Annals' are two letters from Professor F. M'Coy regarding the sudden appearance of *Danais Archippus* in Australia. I beg to state that I have just published, in the fourth part of the 'Journal des Museum Godeffroy' (Hamburg, L. Friederichsen & Co.), all the facts known to me on the wandering of this American butterfly over the islands of the Pacific Ocean, and the continent of Australia, to Gorontalo on North Celebes, where Dr. A. B. Meyer captured four specimens of *Danais Archippus*—three of which are at the Berlin Museum, and one in my collection.

GEORG SEMPER.

On the Change of Form of the Lachrymal Pit during Growth in the Skulls of the Bush-boks (Cephalophus) and Muntjacs (Cervulus).
By Dr. J. E. GRAY, F.R.S.

The lachrymal pit is large, rounded, deep, and well developed in the adult bush-boks; and the characters afforded by these parts have generally been considered important for the separation of the genera and species of the bush-boks and other antelopes; but care should be taken to compare skulls (at least of the species of bush-boks) of nearly the same age. The lachrymal pit of *Cephalophus rufilatus*, *C. badius*, and *C. coronatus* is large and deep in the adult skull; but in the younger skulls it is smaller and shallower, being least marked of all in the young specimens. It is very slightly marked in the skull of *C. Whitfieldii* and *C. bicolor*, which are only known from very young specimens, and of which we do not know the adult; but the skull will very probably be like that of the adult of other bush-boks.

I think we may conclude, from these facts, that the tear-pit in this genus is small and shallow in the young, and increases in size, form, and depth as the animal approaches the adult age. The variation is so great that it is only safe to compare the skulls of different species of the same or nearly the same age.

The size of the intermaxillary bone appears to be generally a good character, and not influenced by age; but sometimes it varies in extent in different specimens of the same species. In three specimens of *Cephalophus Ogilbyi*, for example, the intermaxillary bone does not reach the edge of the nasal; but in one specimen the intermaxillary bone is very large, and is margined above by the nasal (Hand-list of Ruminants, t. xxxiii. f. 2). The size of the orbit seems to be pretty permanent in the skulls of the different species.

I have not had the opportunity of observing this change in the skulls of the other genera of antelopes and the allied animals. Perhaps it is not so great as in this group.

An alteration in the size of the tear-pit is observable in the old and young of *Cervulus Sclateri* from China, in which the adult has the tear-pit very like that of *Cervulus Reevesii*, but larger, more circular, and deeper; but in the young of this species the pit is distinct, but more oblong, and comparatively shallow, especially in the upper part. It may at the same time be remarked that the bones of the face greatly develop themselves during growth both in length and breadth. In the skull of the fawn the nose is slender, conical, and two thirds the length from the front of the orbit to the occiput, whereas in the adult the nose is much broader and, as in *Cervulus Reevesii*, the same length from the front of the orbit to the end of the nose and the occiput.

New Species of Shells. By F. P. MARRAT.

Marginella quadrifasciata, Marrat. (Mus. Keen.)

M. testa minima, obtuse ovata, pellucida, nitente, fasciis quatuor rufis distantibus cingulata, spira obtuse conica; apertura angusta; columella callosa, quadriplicata, labro incrassato, intus denticulato. Long. 3 mill.

Hab. Kabenda, 30 miles north of the Congo, Africa, in 10 fathoms.

This small, pellucid, distinctly banded shell cannot be mistaken for any other allied species.

Nassa nodulosa, Marrat.

N. testa ovato-globosa, lutea; anfractibus regulariter nodoso-plicatis, superne concavo-indentatis; costis subdistantibus, tenuiter transversim punctato-sulcata; apertura suborbiculari, labio cum callo mediocri; columella lævi; labro extus marginato, intus plicato. Size $\frac{1}{2}$ inch long.

Hab. ———?

Nassa æthiopica, Marrat.

N. testa parvula, ovato-conica, rufo-aurantiaca, valde longitudinaliter plicata, striis elevatis transversis; apertura ovata; columella plicata, labro extus marginato, intus lirato. Long. 7 mill.

Hab. Kabenda, 30 miles north of the Congo, Africa, in 10 fathoms.

100 Edge Lane, Liverpool.

On the Wood-Deer of Brazil (*Blastocerus sylvestris*).

By Dr. J. E. GRAY, F.R.S.

The Rev. G. T. Hudson presented to the Museum last year the imperfect skull, consisting only of the brain-case and horns, of what he called a "wood-deer" from Brazil. This skull and horns show

that it is a small species of *Blastocerus*; but it differs from both the Guazu pucú (*B. paludosus*) and the Guazuti (*B. campestris*) in the form of the horns; and its size and the name, the "wood-deer," show that its habits are different from the *B. campestris* or *B. paludosus*; and I therefore propose to call it *B. sylvestris*. The species may be thus described:—

Blastocerus sylvestris. (The Wood-Deer.)

Horns short, slender, smoothish, forked above; the front snag elongate, projecting forwards, and suddenly rather angularly bent upwards, with a slight tubercle on the middle of the lower edge, and a small snag rather below it on the inner side of the upper edge.

The skull shows all the signs of full age; but the sutures between the bones are very well marked, and very much dentated and interlocked.

Hab. Brazil (Rev. G. T. Hudson.)

This deer has nothing to do with the "Cariacou deer" (*Cervus nemoralis*) figured by Colonel Hamilton Smith in the 'Animal Kingdom,' iv. p. 137, t., which has horns different from those of any other animal that has occurred to me. I am inclined to think they are deformed.

Dolphins from the Cape of Good Hope.

By Dr. J. E. GRAY, F.R.S. &c.

M. van Beneden, in the 'Bulletin Acad. Roy. de Belgique' for July 1873, has described and figured two drawings of Cetacea from the Cape of Good Hope, which he observed in the album of the Comte de Castelnau. He calls one *Orca capensis*, Gray, ♀, and the other *Lagenorhynchus de Castelnau*. The drawing of the *Orca* was named *Delphinus Heavisidii* by Castelnau, which M. van Beneden considers a synonym of *Orca capensis*; but I believe this to be a mistake. They are two most distinct animals; and M. van Beneden has misunderstood the Comte de Castelnau's note about the teeth, regarding the number on one side, $\frac{23}{24}$, as meaning the number on the two sides; and the *Orca capensis*, Van Beneden (Bull. Acad. Roy. Belgique, t. xxxvi. f. 1) is *Eutopia Heavisidii*, Gray, Suppl. Cat. Seals and Whales, p. 75.

There is no account of the bones and teeth of *Lagenorhynchus de Castelnau*; but I should consider, from the figure, that it is a species of the restricted genus *Delphinus*.

M. van Beneden observes, "Les Lagénorhynques du Dr. Gray établis d'après des crânes du British Museum, sont d'origine inconnue," overlooking the fact that the animal of *Lagenorhynchus albirostris* and *L. leucopleurus* have been figured, and are known to inhabit the North Sea.

Delphinus Castelnaui is distinct from *D. Morei* and *D. Walkeri*, from the S. Atlantic, as it has a black, and they have a white, forehead at the base of the beak.

Experiments on the Scolex of Tænia mediocanellata.

By M. SAINT-CYR.

Three Cestoid worms live as parasites in the human intestine, namely:—*Tænia solium*, derived from the *Cysticercus cellulosæ* of the pig; *Bothriocephalus latus*, the scolex of which, according to Bertolus and Knoch, lives in fishes of the genus *Salmo*; and *Tænia mediocanellata*, which was long confounded with *T. solium*, from which it was distinguished in 1853 by Küchenmeister, its chief difference being in its unarmed head.

The history of this last worm is much less complete than that of *Tænia solium*. We only know that Leuckart having administered ova of *T. mediocanellata* to calves, obtained an abundant development of *Cysticerci* in their muscles, and that these *Cysticerci* encysted in the calves had all the characters of *T. mediocanellata*.

M. Saint-Cyr has repeated Leuckart's experiments, with the following results. He administered four proglottides of *T. mediocanellata* to a healthy young heifer six weeks old, which was still nourished exclusively by its mother's milk. There were soon formed under the tongue two small hard tumours, exactly like those observed in the same region in pigs affected with measles. The heifer was not killed until 224 days after the ingestion of the proglottides; cysticercal tumours were found, but the worms were all dead.

On the 2nd of April M. Saint-Cyr had an opportunity of repeating his experiments. He administered forty proglottides of *T. mediocanellata* to a sucking calf four weeks old. On the 21st of April a granulation was observed on the lower surface of the tongue; and this increased a little until the 26th of May, when the calf was killed, 54 days after the ingestion of the proglottides. Twenty *Cysticerci* were found scattered here and there in the conjunctive tissues, two under the mucous membrane of the tongue, six along the œsophagus, and the rest in the subperitoneal conjunctive tissue.

The author describes the parasite as dwelling in a cyst about the size of a cherry, having thick and strong walls. After the removal of the cyst the *Cysticercus* is of about the size of a pea, and of a spherical form. Its membrane is very delicate and transparent, and filled with a limpid fluid; at one point there is a small white spot, pierced by a very small aperture, indicating the place where the head is invaginated. The head is tetragonal, truncated at its anterior part, quite destitute of rostellum and hooks, but furnished with four round, thick, and nearly terminal suckers. The greatest dimension of the head is 1.20 millim.; and the diameter of the vesicle is 3 millims.—*Comptes Rendus*, August 25, 1873, p. 536.

On a new Genus and Species of the Family Trochilidæ.

By JOHN GOULD, F.R.S. &c.

I must confess that, after the many years I have been studying this family of birds, I was not prepared for the acquisition of the very remarkable species hereinafter described. It is most nearly allied to the members of the genus *Thalurania*, but is sufficiently distinct in its form to warrant its being constituted the type of a new genus, for which I propose the name of *Hylonympha*, with the following characters:—

Bill stout, somewhat curved, a little longer than the head. *Wings* rather long and falciform. *Feet* and *toes* moderately strong; *tarsi* clothed. *Tail* ample, deeply forked, and larger in comparison with the size of the body than that of any other member of the family.

Were it not for its large, long, swinging tail, it would very much remind us of *Thalurania glaucopis*.

Hylonympha macrocerca.

Crown of the head glittering blue, with a reflection of green towards the edges; throat glittering green, passing into dull green on the flanks; abdomen black, glossed with green; feathers clothing the tarsi dark brown on the outer side and white on the inner; under tail-coverts black; all the ten feathers of the tail, the outer ones of which are very broad, a uniform steel-black.

Total length $8\frac{1}{2}$ inches; bill 1, wing $2\frac{3}{4}$, tail 6, tarsi $\frac{1}{4}$.

Habitat uncertain. I obtained this bird from Mr. Whitely, who stated he received it in a collection of skins which had been formed in Brazil.

On the Zoological Position and Function of the Parasitic Acarina called Hypopus. By M. MÉGNIN.

In a recent note I announced:—1, that under my eyes an octopod nymph of *Tyroglyphus rostro-serratus* had been transformed into a *Hypopus* easily recognizable as *H. feroniarum*, L. Dufour; and, 2, that I had seen the same *Hypopus* under different conditions resume the form of *Tyroglyphus*. From these facts I concluded that the *Hypopodes*, and their analogues the *Homopodes* and *Trichodactyli*, were merely transitory asexual states of the *Tyroglyphi* and perhaps of other Acarina. I have now to announce further observations, which fully confirm the previous ones.

In a large undescribed *Tyroglyphus*, which also lives upon fungi, but feeds chiefly on the stalk (whilst *T. rostro-serratus* particularly affects the hood and the lamellæ), I have also seen the asexual nymph become transformed into a *Hypopus*. This *Hypopus*, which is much larger than the former one, appears to be the *Acarus spinitarsus*, Herm.; it is of the same size (0.33 by 0.12 millim.) and of the same orbicular oval form. Its legs are robust, furnished with claws without suckers, and provided with numerous rigid setæ, especially posteriorly; it is cuirassed like the other *Hypopodes*, is of a rose colour, with a pair of vesicles filled with a bright green liquid,

and bears beneath the abdomen an adherent apparatus composed of five pairs of suckers. By placing it in suitable conditions we have seen this *Hypopus* also resume its original form of *Tyroglyphus*.

These observations completely solve the problem of the dissemination of the detriticolous Acarina. Every one who studies the animals which live in decomposing substances must have often asked himself how those legions of Acarina which swarm and appear in myriads in them in so short a time get there, and what becomes of them when their work of destruction is completed, and the material in which they swarmed, being reduced to the state of a dry powder, no longer offers them any nourishment. These little creatures have not the aid of wings to enable them to fly from places desolated by famine; nor have they the activity of the ants, which enables those insects to migrate and make long journeys. They have soft integuments, which afford them but little protection against external influences and the voracity of their numerous enemies; exposure to the sun kills them; and the woodlice destroy them in great quantities; their eggs, which are comparatively large, are not to be met with in the dust of the air in company with the germs of moulds and Infusoria; and, lastly, they do not enjoy the faculty of reviving after desiccation, like the *Anguillulæ*, Rotifera, and bear-animalcules. One can easily understand how they came to furnish a principal argument in favour of the theory of spontaneous generation. Now this is what takes place in a colony of *Tyroglyphi* when the privation of food seems to devote it to certain destruction. All the adult and old individuals, as well as the young hexapod larvæ, die and strew the soil with their bodies; but the adolescent individuals (the octopod nymphs) are preserved: they change their form, acquire a cuirass, a true travelling garb, which acts as a complete disguise, but which at the same time protects them from external influences; moreover they acquire an adhesive apparatus, by means of which they can attach themselves firmly to any creatures that come within their reach—flies, spiders, myriopods, insects of all kinds, and even quadrupeds, which, like regular omnibuses, transport them where they could not go themselves. If the place where the vehicle stops is suitable, if it is by a fresh fungus or a mass of rubbish in decomposition, the little mite quits the animal that bears it, as well as its *Hypopus*-form, and becomes a *Tyroglyphus*, such as it was before. Under the influence of abundant food it grows rapidly, becomes adult and sexual, copulates, and in less than forty-eight hours the colony is founded afresh. That is the function of the *Hypopus*.

The conclusion to be drawn from my observations is that the genera *Hypopus*, *Homopus*, and *Trichodactylus*, and the numerous species which have been established as subdivisions of those genera, must be struck out of our zoological nomenclature. The word *Hypopus* may be retained, but only as a common name serving to designate the curious cuirassed, heteromorphous, and adventitious nymph of the *Tyroglyphi*, whose office is the preservation and dissemination of the species to which it belongs.—*Comptes Rendus*, August 18, 1873, p. 492.

THE ANNALS

AND

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[FOURTH SERIES.]

No. 72. DECEMBER 1873.

LIII.—*On the Protection of Pollen from Premature Dislodgment or Moisture.* By M. A. KERNER.*

THE works of Darwin, Delpino, Hildebrandt, &c., on the part played by insects in the fecundation of phanerogamous plants have lately attracted attention to this subject, and led to numerous observations on the peculiarities of the organization of flowers. The investigation just published by M. Kerner relates to a point which had scarcely been touched previously, but the importance of which can hardly be doubted—namely, the precautions taken to keep the pollen intact until the moment when it is gathered by insects, and especially to preserve it from premature dispersion by means of the wind, or from irremediable injury by water.

There is a large category of plants which escape the dangers just referred to, and the whole organization of which is directed to utilize the action of the wind for the dispersion of pollen. These are the *anemophilous* plants of Delpino, the dry and pulverulent pollen of which escapes in clouds at the least shake. Various peculiarities of organization all accord with the final object to be attained. Thus the flowers, in order to give free access to the wind, are never concealed under leaves, but always suspended at the extremity of slender branches (amentaceous trees), or at the summit of an elevated stalk (grasses, Cyperaceæ, &c.). Moreover, as they have not to

* Translated by W. S. Dallas, F.L.S., from the Abstract in the *Bibliothèque Universelle*, August 15, 1873, tome xlvii. p. 302.

attract insects, they are generally not remarkable either for colour or perfume; their perianth is generally yellowish or greenish and often scaly; the stamens, instead of being hidden at the bottom of a corolla, are attached to movable catkins, or they push themselves (as in the grasses) above the floral envelope.

In every way a considerable quantity of pollen is lost; it falls to the earth without reaching the stigma, or it is damaged by moisture. All the plants of this category obviate this inconvenience by producing enormous quantities of pollen (*e. g.* the positive clouds of yellow powder which frequently surround the Conifers at the moment of flowering).

But in still more numerous cases the pollen must be conveyed to the stigma by insects; and from this flows a multitude of consequences which greatly influence the form and appearance of the flowers. Thus the perianth will always be more or less coloured or odoriferous, to attract insects; the grains of pollen are not dry and free as in the previous cases, but always more or less adherent to each other, being retained by a product of the degenerescence of the mother cell, which M. Kerner regards (wrongly we think) as *bassorine*. The degree of cohesion is extremely variable, from the solid pollen-masses of the Orchideæ and Asclepiadæ to the pollen of a great number of plants which presents little conglomerations easily dispersed.

In these plants the pollen is produced in quantities infinitely smaller than in the anemophilous plants. Moreover there is a more or less considerable lapse of time between the opening of the anthers and the moment when the fecundating dust is carried away by insects; and it is absolutely necessary that during this time it should be protected from the deleterious influences of wind and moisture. The most various parts of the flower may be charged with this function; and it is the examination of the different cases which he has had the opportunity of observing that forms the greater part of M. Kerner's memoir.

The reproductive organs themselves are often charged with the protection of the pollen. Thus, in the iris the stigmata are developed into broad petaloid plates bent outwards and meeting the lobes of the perigonium; they thus completely envelope the anthers in a sort of narrow channel, through which insects must of necessity pass when going to collect the nectar, but into which neither wind nor rain can penetrate. In the genus *Aspidistra* the corolla takes on the form of a widely open cup, at the bottom of which are the extremely short stamens; the stigma is developed into a broad disk

placed about halfway up the corolla and closing it completely, so as to shelter the stamens and leave only a narrow passage for insects. In the periwinkles, oleanders, &c. the anthers bear at their summits a sort of spoon-shaped prolongation, and the style is surrounded by a collar of long stiff hairs; the junction of these two organs forms a perfect roof above the pollen. In the Compositæ the tube formed by the union of the anthers, in the interior of which is the pollen, shelters it until the moment when insects come to collect it.

Frequently the protective shelter comes from the *perianth*. A great number of plants have a portion of the corolla developed into the form of a regular roof placed over the anthers. This peculiarity of organization is characteristic of some very important families (such as the Labiatae, Scrophulariaceae, Orobanchae, Gesneriaceae, Utriculariae, Polygaleae, Violaceae, many Papilionaceae, and some Ranunculaceae).

In other cases the upper part of the lobes of the corolla remains united during the first portion of the flowering, thus protecting the stamens and the style (*Phyteuma*); or, as in *Trollius*, the petals, which are strongly concave within, join at the top of the flower. In other cases, again, the tube of the corolla which encloses the anthers is so narrow that water cannot penetrate into it, the air finding no means of exit and remaining enclosed in the form of a bubble, which keeps the pollen dry (*Androsace*, *Verbena*); or, what is still more frequent, the entrance of the tube is closed by hairs, scales, &c.

The *spathe* in many Aroïdeae, the *bracts* of certain Musaceae, and the *leaves* of the lime tree extend over the flower or the inflorescence like an umbrella.

When no part of the flower is constructed so as to be able to shelter the stamens from the weather, the desired result is obtained either by periodical movements of the perianth or by curvatures of the axis.

In the first category we find, in the first place, all the so-called ephemeral flowers, the opening of which lasts only one day (*Villarsia*, *Tradescantia*, *Convolvulus tricolor*, *Tigridia pavonia*, and many others). The anthers open and allow the pollen to escape in the bud, which on its part opens only during the hottest part of the day, when the sun is shining, and the insects, buzzing about everywhere, are ready to effect fecundation. Those flowers which present a similar structure, but of which the anthesis lasts several days, are governed by similar laws; they close during the cooler hours, when the dew might injure the pollen, and also during rainy weather and when little life is about. Some of them particularly affect twilight and evening; they only open a little after the setting

of the sun, and close in the course of the evening. Their usual visitors are of course the crepuscular insects; and to attract these some are clothed in brilliant colours (nightshade and several *Enotheræ*), whilst others have very dull colours but exhale a penetrating perfume, which is insensible during the day (*Pelargonium triste*, *Hesperis tristis*, *Nyctanthes arbor-tristis*). But these cases are quite exceptional, and the great majority of flowers with periodical movements open during the brightest hours of the day; the petals, in closing again, resume the position they occupied in the bud, and thus completely protect the stamens and the style.

Where it is by means of curvatures of the floral axis that fecundation is ensured, the perianth must be brought into such a position as to form a protective roof for the reproductive organs. Its form, and also the degree of curvature, depend of course greatly upon the length of the stamens: where, as in the lily of the valley, these are quite short, a slightly developed perianth and a simple lateral inclination suffice to attain the desired object; but where, as in the fuchsia, the anthers are borne upon long filaments, the perianth is much broader and spread out like a wheel, and the flower becomes completely pendent.

All degrees of curvature are met with in nature: sometimes the phenomenon is already perceptible in the bud (*Soldanella*); in other cases it is manifested only at the moment of flowering. When once fecundation is effected the young fruit usually becomes erected, at least if it is not of a fleshy nature, and consequently too heavy to be carried up by the tension of the tissues of the peduncle (*Fuchsia*, many *Solana*).

It is sometimes the case that the curvature of the axis, like the closing of the perianth, is periodical. Thus the flower of *Oxalis acetosella*, which is completely erect during the day, describes an arc of more than 100 degrees at the moment when the sun sets, and finally has its opening directed towards the ground. The periodical changes in the tension of the tissues of the peduncle required by this movement occur in many other plants under the influence of exterior excitements, repeated shocks, &c.; and many flowers which are usually erect become recurved towards the earth, and thus protect their stamens when they are shaken by the wind or disturbed by the repeated shocks of drops of rain (many *Compositæ*, tulips, anemones, *Ranunculus*, poppies).

Lastly, in those compound inflorescences of which the axis is twisted, as in the *Boragineæ* and some other families, development brings the flowers successively into all sorts of

positions with regard to the horizon; they then most frequently open in such a manner that at the moment when the pollen would be exposed to inclement weather the opening of the corolla looks towards the ground, and thus the rain may pour upon them without injury.

Such are the different peculiarities of organization, the special object of which is to facilitate fecundation by protecting the pollen from accidents which might injure it, without, however, presenting any obstacle to the free access of insects whose business it is to cooperate in the accomplishment of that function. Of course these different means are often combined: for example, if a flower in closing at night leaves an aperture at the apex of the corolla, it will be borne upon a more or less curved peduncle.

In a general way we may say that the pollen is more completely protected in proportion as it is less abundant and more coherent, and in proportion as the fecundation is more absolutely subjected to the intervention of insects, the time of anthesis short, and the climate less favourable.

Thus the Orchideæ perhaps present the most complete combination of all the means of protection, which is in perfect accordance with the nature of their pollen and the small number of their flowers. In the Pomaceæ and Amygdaleæ, on the other hand, the stamens are very numerous, and the flowers are so abundant that if only half of them developed fruit the tree could never bear its load. Hence the means of protection employed are very rudimentary.

Even a superficial glance over the flora of a country will generally show an intimate relation between the climatal conditions and the structure of the most wide-spread families. A cold and humid region (where fecundation will always be difficult and where the flowers must sometimes wait for several days for a ray of the sun to favour the issue of insects) cannot fail to exert a marked influence upon the character of its flora. It is thus that in the Alps, where the dews are very heavy and where persistent clouds often cover the summits for whole days, the dominant genera (*Gentiana*, *Primula*, *Andromeda*, *Soldanella*, *Pedicularis*, *Campanula*, *Euphrasia*, *Veronica*, &c.) all possess complete means of sheltering their pollen. No plants with ephemeral flowers occur there; and in none do the stamens rise much above the corolla. If, on the other hand, we take as a point of comparison the flora of the south of Australia, a region where during the season when plants flower not a drop of water falls, we find that the *Mimosæ*, *Myrtaceæ*, and *Proteaceæ* (which are so abundant there) all have rigid flowers with very

short perianths and very long stamens—in a word, flowers in which the pollen is completely exposed.

Some plants which seem at the first glance to form an exception to the general rules above laid down, when attentively examined really serve to confirm them. The *Ericæ*, for example, present the anomalous combination of a pulverulent pollen with a coloured perianth producing nectar.* But here, just as in plants with coherent pollen, fecundation is impossible without the intervention of insects. In fact the anthers only open by two pores placed laterally at the apex of each cell; at the moment of flowering they are applied to each other by their lateral surfaces so as to close all issue for the pollen. To enable the latter to issue it is necessary that an insect entering the flower should produce a shock upon one stamen, which separates from its neighbours, lets fall a few grains of pollen upon the visitor, and then resumes its place. Some little appendages which are developed at the base of the anthers, and bar the passage of the insect, are exactly destined to produce the required movement.

Analogous peculiarities occur in some Boragineæ of the genera *Cerithe* and *Onosma*.

Certain *Salices*, of which the pollen, although more or less coherent, is not at all protected, remedy this by producing an enormous quantity of pollen, and by prolonging their flowering for a very long time (a circumstance which recurs with the same signification in many Umbelliferæ, Cruciferæ, and Saxifragaceæ). Sometimes, also, parts of the inflorescence which are already withered become a protection for those which are about to open.

We may remark also among heterostylous plants, such as the *Primulæ*, *Pulmonariæ*, &c., a marked tendency to dimorphism of the perianth. It is more amply developed in the form with long exserted anthers, where the protection of the pollen is more difficult.

M. Kerner concludes his interesting memoir by some considerations on the probable origin of the species with coherent pollen, in which we shall not follow him: they do not appear to us to be necessarily connected with the preceding; and the ideas of the author merit a discussion of which space will not permit the introduction here. These pages suffice to show the object and utility of the infinite variety of form of the floral organs.

LIV.—On the HEXACTINELLIDÆ and LITHISTIDÆ generally, and particularly on the Aphrocallistidæ, Aulodictyon, and Farreæ, together with Facts elicited from their Deciduous Structures, and Descriptions respectively of Three New Species. By H. J. CARTER, F.R.S. &c.

[Concluded from p. 373.]

LET us now turn our attention to the Lithistidæ, of which the following is a similar list of those also that have been brought to notice.

Lithistidæ*.

General character. Spicules developed upon a quadri-
radiate division of the central canal, held together by amorphous
sarcode and an interlocking of their filigreed arms, forming
a reticulated glassy structure, whose interspaces are more or
less irregular and curvilinear. Composed of two kinds of
“skeleton-spicules,” viz. those which form a layer on the
surface and are accompanied by minute or “flesh-spicules”
characterizing the species, and those forming the body, which
are more or less alike in all the species and accompanied by
fewer flesh-spicules. The skeleton-spicules of the surface,
which, for the most part, are provided with a smooth, pointed,
vertical shaft, directed inwards, and a horizontal head of dif-
ferent shapes according to the species, will be termed “surface-;”
and the spicules of the body, which interlock with their neigh-
bours through a filigreed development of all the arms, will be
termed “body-spicules.”

*Species in which the surface-spicule consists of a shaft and three
straight bifurcated arms all smooth and pointed.*

Minute spicules of two kinds, viz. one acerate, fusiform,
slightly curved and microspined; the other subspiral, sinuous,
tuberculo-spined.

<i>Dactylocalyx Bowerbankii</i> , Johnson.	Azores.	(1)
— <i>Masoni</i> , Bowerbank.	Madeira.	(2)
<i>Corallistes typus</i> , Schmidt.	Florida.	(3)

* Abbreviations the same as in footnote, p. 357.

1. B.M. P. Z. S. 1863, p. 259, = P. Z. S. 1869, p. 94, pl. vi. figs. 6, 7, & 8,
= *MacAndrewia azorica*, Gray, P. Z. S. 1867, p. 507.

2. P. Z. S. 1869, p. 91, pl. vi. figs. 1-4.

3. Atlantisch. Spongienf. pl. iii. f. 3.

4. B.M. P. Z. S. 1868, p. 565, fig. 1.

5. P. Z. S. 1869, p. 89, pl. v. figs. 6-11.

Species in which the surface-spicule consists of a shaft and three sinuous arms branched.

Minute spicules of two kinds, viz. one long, fusiform, sub-spinulate, smooth; the other short, more or less bent or horse-shoe-shaped and microspined.

Theonella Swinhoei, Gray. Formosa. (4)
Dactylocalyx Prattii, Bk. East Indies. (5)

Species in which the surface-spicule consists of a shaft and three sinuous arms compressed vertically; branched and dentate or curvilinear on the margins.

Minute spicule acerate, fusiform, curved, microspined.

MacAndrewia azorica, Gray. Azores. (6)
 = *Corallistes clavatella*, Schmidt. Florida. (7)
Kaliapsis cidaris, Bowerbank. South Seas. (8)

Species in which the surface-spicule consists of a short shaft and subcircular discoid head, deeply and irregularly fissured.

Minute spicule acerate, fusiform, curved, blunt-pointed, microspined.

Corallistes polydiscus, Schmidt. Portugal, Florida, Cuba. (9)

Species in which the surface-spicule consists of a short shaft and subcircular discoid head.

Minute spicule acerate, fusiform, curved, microspined.

Dactylocalyx polydiscus, Bowerbank. St. Vincent, Portugal. (10)

6. B.M. P. Z. S. 1859, p. 438, pl. xv. *Dactylocalyx McAndrewii*, Bk. P. Z. S. 1869, p. 86, pl. iv. fig. 5.

7. Atlantisch. Spongienf. pl. iii. f. 7.

8. P. Z. S. 1869, p. 338, pl. xxv. figs. 2 & 5.

9. Atlantisch. Spongienf. 1870, p. 24, pl. iii. figs. 8 & 9.

10. B.M. P. Z. S. 1869, p. 96, pl. vi. figs. 10-14. *Discodermia polydiscus*, Bocage, 1869, Journ. des Sc. Math. Phys. et Nat. Lisbonne, No. iv. pl. xi. fig. 1, &c.

11. B.M. See p. 442.

12. See p. 443.

13. Atlantisch. Spongienf. p. 23, pl. iii. fig. 6, &c.

14. *Ib.* p. 23, pl. iii. fig. 4.

15. *Ib.* p. 23, pl. iii. fig. 5.

16. *Ib.* p. 22, pl. iii. fig. 1.

17. *Ib.* p. 21, pl. iii. fig. 2.

18. See p. 443.

Species in which the surface-spicule consists of a shaft and three arms. Arms sinuous, branched, curvilinear, tubercled on the upper or outer aspect, and filigreed at the extremities; shaft filigreed also at its extremity.

Minute spicule long, slender, fusiform, subspinulate, smooth, most numerous on the margin, where it forms a fringe.

Azorica Pfeifferæ, Carter. Azores. (11)

Species in which the surface-spicule is much the same as the last, but with others like those of Dactylocalyx Bowerbankii and D. polydiscus among the body-spicules.

No minute spicule observed.

Corallistes borealis, Carter. Færoe Islands. (12)

Species in which the surface-spicule consists of a long shaft and three arms, bifurcated and more or less tubercled on the outer or upper aspect.

Minute spicule (in the slide at the British Museum) straight or slightly curved, smooth, fusiform, acerate.

Corallistes noli tangere, Schmidt. Portugal, St. Jago. (13)

Species in which the surface-spicule (according to the slide in the British Museum) is like that of Dactylocalyx Masoni, with the branches of the body-spicules in like manner glomerato-tubercled.

Minute spicules in the slide of two kinds, viz. one acerate, fusiform, curved, smooth; and the other with sinuous shaft, spirally covered with fine spines like that of *D. Masoni*.

Corallistes microtuberculatus, Schmidt. St. Jago, Cape-Verde Isl. (14)

Species in which the surface-spicule (according to the slide in the British Museum) is like that of Dactylocalyx Bowerbankii; the rest with large filigreed head and long sinuous shaft filigreed at the extremity, as in the figure (Atlantisch. Spongienf. Taf. iii. f. 5).

Corallistes elegantior, Schmidt. Portugal. (15)

Species with curly filigreed spicules (according to the slide).

Leiodermatium ramosum, Schmidt. Florida. (16)

— *lynceus*, Schmidt. Portugal. (17)

Fossil species in which the surface-spicule is not known, but in which the body-spicule has the common branched filigreed form.

Minute spicule not observed.

Lithospongitis Kittonii, Carter. Carrow, hamlet adjoining Norwich. (18)

SHORT COMMENTARY ON THE LITHISTIDÆ.

The remarks regarding the microscopical examination of the Hexactinellidæ (see p. 363) apply to the Lithistidæ; but while the two large specimens respectively of *Dactylocalyx pumiceus*, Stutchbury, and *MacAndrewia azorica*, Gray, in the British Museum, are very much alike in their dish-shaped, wide, circular heads, each of which is supported by a thick short stem, and their minute structure has the same vitrified glassy appearance, it should be remembered that they form representatives of two totally different systems of sponges, the former being built upon a sexradiate division of the spicule, and the latter upon a quadriradiate one; that is, while the Hexactinellidæ have six ends to their spicule, the Lithistidæ have only four, and the lowest system of spicules in which the linear form prevails, of course, only two. Hence the spicule of the Hexactinellidæ has, as it were, three shafts joined together in the centre, thus giving six ends; the next, or quadriradiate system, has, as it were, two shafts joined together in the form of a cross, thus presenting four ends; while the simplest system of all has only one shaft, and consequently only two ends. Thus modified, forms of all the three systems may be found in the Hexactinellidæ; but only those of the third system with the Lithistidæ—that is, no sexradiate spicules. Of course I allude to the staple spicules here, and not to the monstrosities which may occur in either system; and perhaps, too, I should restrict these observations to the spicules of the skeleton-system, or skeleton-spicules, since, when we come to the minute or flesh-spicules, we find the multifid form of the sexradiate spicule, viz. that of the rosettes, passing, as before stated, into the stellates and globular siliceous balls of the Geodinidæ &c., and of course *vice versâ*.

But, be this as it may, there seems to be very little doubt that the system of the Lithistidæ is that of *Pachastrella*, *Geodia*, and *Stelletta*, and never that of the Hexactinellidæ: that is, a sexradiate spicule, as just stated, is never found in the Lithistidæ.

In *Dactylocalyx Bowerbankii* and *D. Masoni* the surface-spicules are nail-like, having the spike or shaft directed inwards and the three arms of the head bifurcated and spread out horizontally, so as to meet those of the other surface-spicules, while the interspaces are occupied by the sarcodæ charged with the flesh-spicules, in the midst of which are the pores; and thus the dermal aspect is completed. In *D. Masoni* the subspiral shaft of the minute or flesh-spicule is covered

with fine, pointed, long spines, while in *D. Bowerbankii* they are short, blunt, and slightly inflated at the ends; again, the acerate spicule in the former is not figured (Bk. Monogr.), while the fine-spined subspiral spicule of *D. Masoni* seems to be only a variety of the more coarsely formed one in *D. Bowerbankii*; and the acerate spicule, being also very sparse in the latter, may have been entirely overlooked in the former. Thus, at the utmost, *D. Masoni* can only be considered a variety of *D. Bowerbankii*. The secondarily furcate extremities of the arms of the surface-spicule in Dr. Bowerbank's fig. 7 of *D. Bowerbankii* (*l. c.*) at once allies it to similar forms of the spicule in *Pachastrella abyssi*, Sdt., and points out the commencement of the filigree which becomes so elaborately developed as the surface-spicules gradually sink into the general structure of the body. Schmidt's *Corallistes typus* would, therefore, come in here.

In *Theonella Swinhoei* and *Dactylocalyx Prattii*, the arms of the surface-spicules are not straight but sinuous, and, thus overlapping each other, leave circular interspaces which are filled up with sarcode charged with the flesh-spicules, in the midst of which are the pores. The minute, cylindrical, microspined spicule varies much in form, from an elongated ellipse to that of a horseshoe-shaped, cylindrical, linear spicule, being also sometimes contracted in the centre and enlarged towards the extremities.

In *MacAndrewia azorica* and *Kaliapsis cidaris* the arms of the surface-spicule, besides being sinuously branched, are also flattened, and possess a dentate curvilinear margin on both sides, while the branches overlapping each other, as before stated, leave interspaces that are filled with sarcode charged with the rough, microspined, acerate spicule mentioned, in the midst of which are the pores. These minute linear spicules, often slightly inflated in the centre, are arranged around the pores in a radiated manner, so that the pore can be opened or closed by their being raised or the reverse. The structure is well represented by Schmidt in *Corallistes clavatella* (*op. cit.* pl. iii. fig. 7, *b*), which appears to be equal to *MacAndrewia azorica*. I possess fragment-specimens of *MacAndrewia azorica* which were dredged up on board H. M. S. 'Porcupine' between the Færoe Islands and the north coast of Scotland. Unfortunately the specimen of *Kaliapsis cidaris* which Dr. Bowerbank found on a portion of *Oculina rosea* from the South Seas was so small that it was "all" absorbed in the mounting and examination.

In *Corallistes polydiscus*—better designated "*asteroides*" by Schmidt on the slide which he sent to the British Museum,

seeing that this, as well as his figure (*op. cit.* pl. iii. fig. 8), has a discoidal head so deeply fissured as to merit the term mentioned—we seem to have in the surface-spicule a transitional form from the three- flat armed head of that in *MacAndrewia azorica* to that of the subcircular form in the following species, viz. *Dactylocalyx polydiscus*, where the discoid head is so little fissured as to merit this designation. How far these forms may run into each other in the same species I am ignorant, as I have only examined *D. polydiscus*, in which *all* the heads are subcircular.

Here I should notice that, in a small rolled fragment of *Corallistes borealis* which I sent to Mr. F. Kitton, of Norwich, to compare with the fossil species to be presently mentioned, he detected some spicules with subcircular discoid heads, like those of *Dactylocalyx polydiscus*, which he kindly mounted and sent to me; and on them I observe two or three of the minute flesh-spicules common to *D. polydiscus*, but reduced by the process of absorption which takes place in the deciduous vitreous structures of sponges, to be described hereafter, to irregular stick-like forms. Now it so happens that with Schmidt's fig. 8 of the surface-spicule of *Corallistes polydiscus* there are also two of these irregular stick-like forms represented, which I never could understand until Mr. Kitton sent me the mounted specimen mentioned. Hence it seems to me, from their imperfect form, that Schmidt's minute or flesh-spicules at least belonged to a deciduous skeleton.

As just stated, the heads of the surface-spicules in *Dactylocalyx polydiscus* are discoid and subcircular. The shaft is short, smooth, and pointed; and where it joins the disk a tri-radiate line is seen, which results from the division of the central canal of the shaft into three branches. The discoid heads as usual overlap each other; and the dermal sarcode is charged with the minute flesh-spicule already mentioned; while in the interspaces between the heads are the pores. The triradiate line is often seen in this kind of spicule in the Lithistidæ, where also the minute, acerate, fusiform, microspined flesh-spicule is also very common.

In *Azorica Pfeifferæ*, n. sp. (two specimens, called after Madame Ida Pfeiffer, who obtained them at Madeira and presented them to the British Museum), the surface-spicule is like that of the interior, viz. with the sinuously branched arms and shaft all terminating in filigreed structure, that of the shaft interlocking with that of the heads of the next layer inside it. There is no very minute flesh-spicule, but a great number of long, subspinulated, fusiform, linear ones, which abound

especially upon the growing edge or margins of the specimen. The specimens are covered with dried sarcode, evidencing that they were taken alive and may so far be considered perfect. Hence there is no doubt about their possessing no characteristic surface-spicule; for I searched for this in many parts. Still I think it just possible that this may be explained by assuming that the surface-spicule had passed into the form of the body-spicule before the new layer of surface-spicules had been developed.

Be this as it may, the specimens are magnificent and magnificently perfect; not, perhaps, from any particular care having been bestowed on their preservation, but because, contrary to what one would infer from their glassy structure, they are so tough that it is difficult to get a piece off them. One is 14 inches in diameter and 11 inches high, and the other not quite so large. They are flattish, cabbage-like, infoliated, with branched sinuous laminae $\frac{2}{12}$ to $\frac{3}{12}$ inch thick, vertical, widely separated, and proliferous. The vents are a little raised on papillary eminences, and scattered over the *inner* aspect of the fronds or laminae; while the pores are *outside*, as in *MacAndrewia azorica*, to which it bears a strong general resemblance. My reason for stating all these characters is because these specimens have hitherto not been described.

Corallistes borealis is the name which I have given to deciduous fragments of a Lithistid dredged up on board H.M.S. 'Porcupine' between the Färoe Islands and the north coast of Scotland. They have no characteristic surface-spicule; and in their body-structure are confusedly mingled both the simple form of surface-spicule characterizing *Dactylocalyx Bowerbankii* and that of *D. polydiscus* respectively. Various other sponges have built their structures upon them, among which is that possessing the snake-like form of large acerate spicule figured by Schmidt in connexion with his representation of *Corallistes typus* (*op. cit.* pl. iii. fig. 3 c), which of course is also parasitic. How to account for the surface-spicules before mentioned occurring among the body-structure of *Corallistes borealis* I know not.

For the structure and form of the remaining Lithistidæ and their spicules, I must refer the reader to Schmidt's work on the Atlantic sponge-fauna, already mentioned, where they are respectively described and figured.

I would, however, for a moment more here revert to the fossil species *Lithospongitis Kittonii*, which Mr. F. Kitton, of Norwich, found in a flint of the Upper Greensand taken from an artesian well at Carrow, close to Norwich, to observe

that we have here *en masse* what my illustrations of the fossil spicules of the same geological formation on Haldon Hill, near Exeter, show in individual spicules (Annals, 1871, vol. vii. pls. vii. & viii.). Thus the existence of such sponges in the Upper Greensand had been predetermined.

OBSERVATIONS.

The above arrangements of the Hexactinellidæ and Lithistidæ, together with the short commentaries which follow them respectively, must be regarded only as preliminary to more detailed descriptions which I hope to offer on some future occasion. They are chiefly intended as an introduction to what will hereafter be stated of the *Aphrocallistidæ*, *Farrea*, and *Aulodictyon*, concerning which I had, as before stated, gathered many facts for publication hitherto unnoticed, when I found it necessary to make myself acquainted with all the Hexactinellidæ and Lithistidæ that had been made known before I could satisfactorily acquit myself of the task.

This involved much time and much research, combined with opportunities which may not readily occur again. Hence I thought it desirable to record at once the most important part of my observations, although this is not the place to give the whole, which would entail long descriptions.

OBJECT.

We now come to the primary object of this paper, which was to show that the tubular lines which appear in the vitreous fibre of the Hexactinellidæ arise from the absorption of the spicules on which it was originally deposited—that if this has not gone too far, the exact forms of these spicules can be recognized; so that, although nothing else but the deciduous fibre remains, the species of the sponge to which it belonged can thus be determined if previously known in the living state—and if not previously known in the living state, then also the kind of spicules it must have possessed in this condition. The deciduous specimens of Hexactinellidæ which will come before us for this purpose belong to *Aphrocallistes Bocagei* and *Farrea occa*, of which the living state of the former is well known, but the deciduous skeleton *only* of the latter. Meanwhile, for the sake of reference, it will be necessary to premise a short account of each of the specimens from which my observations have been derived; then a description of each of the spicules of the species of Hexactinellidæ with which we are now chiefly concerned that have been found in a living state, viz. the *Aphrocallistidæ*, *Aulodictyon*, and the *Farrea*; and,

lastly, a description of the deciduous skeleton of *Farrea occa*, and the destructive changes which take place in the sponge-spicule generally, followed by the absorbing process in the vitreous fibre of the deciduous Hexactinellidæ to which I have often above alluded.

SHORT DESCRIPTIONS OF SPECIMENS THAT WILL PRESENTLY COME UNDER REFERENCE.

The first of the specimens that came under my observation in this respect was one of the so-called *Farrea occa*, which, having grown upon a branched coral (*Lophohelia prolifera*), subsequently became overgrown, both sponge and coral, by a *Gummina* (*Corticium abyssi*), so as to form a solid mass, through whose smooth surface here and there projected portions of both sponge and coral. This specimen, I learn from the label on the glass jar containing it, was dredged up on board H.M.S. 'Porcupine,' in lat. 43° 31' N., and long. 10° 3' W. (that is, in the so-called "chops" of the English Channel), in 500 fathoms. It is now an oblong portion, in size about $2\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{4}$ inch, which originally must have been larger, as there are many fragments of it in the same jar. The specimen is figured in the 'Annals' for July 1873, pl. i. figs. 1 & 2, of the natural size; and to this specimen or figure I shall often have to allude as "No. 3 a," which heads the label on the jar. All this may seem unnecessarily particular; but as the specimens of Spongiadæ dredged up on board H.M.S. 'Porcupine' have been handed over to me by Prof. Wyville Thomson for description, every thing that tends to point out their history should be recorded.

By the term "so-called *Farrea occa*," I mean that this name was given to a simple fragment of vitrified network, found in great abundance in the detrital mass on which Dr. Farre's specimen of *Euplectella cucumer* had grown. "Simple," because the fragments are those of dead sponges, and therefore without sarcode, while the minute spicules which accompanied them, and are figured by Dr. Bowerbank as the "retentive spicules" of *Farrea occa* (*l. c.*), are not those of a sexradiate sponge, which the fragments are, but of an undescribed species of *Gummina*. How far the form and structure of this sponge, to which the fragment figured by Dr. Bowerbank (fig. 7, *l. c.*) belonged, has been subsequently discovered, the sequel of this paper will show. Suffice it now to state that we shall take as the characteristic feature of Dr. Bowerbank's *Farrea occa* the rectangular latticed "harrow-like" structure of his illustrations (*l. c.* pl. xxiv. fig. 7, 1869), first represented by Prof. Owen in connexion with *Euplectella cucumer* (Trans. Linn. Soc. 1857,

vol. xxii. pl. xxi. fig. 9 & 9 a), and not Dr. Bowerbank's figure 1, which we shall hereafter find to belong to another species of *Farrea*, also illustrated by Prof. Owen (*op. cit.* fig. 8). In short, a cursory inspection of the two figures in Dr. Bowerbank's plate will show that they belong to two different structures, one of which (*viz.* fig. 7) has smooth, and the other (fig. 1) spiniferous fibre. The former we shall call "*Farrea occa*," and the latter "*Farrea densa*."

At the time Dr. Bowerbank described *Farrea occa* (P. Z. S. p. 339, 1869), the only thing known of it was the fragment mentioned; hence it is not surprising that his description should, to say the least of it, be very different from reality. We now know that this smooth rectangular fibre belonged to a branched, tubular skeleton, only one layer thick, and the branches patulous at the ends, which, up to this time, appears to have been found only in a deciduous state; so that we do not know even now what were the forms of the spicules on which the fibre was originally deposited, except through the means already stated, *viz.* the absorption of these spicules, which takes place only in the deciduous skeleton, reducing their forms to mere moulds, which, however, represent their true forms inside the fibre. Can we find, then, sufficient of these forms enveloped in the deciduous fibre to tell us what the living species possessed? will be the question by-and-by, when we come to consider *Farrea occa* more particularly.

The next specimen which I have had for observation is that of a dead *Aphrocallistes Bocagei* in a jar without label; but finding only one place where this sponge is mentioned in the "Preliminary Report of H.M.S. 'Porcupine,'" published in the Royal Society's 'Proceedings' (No. 121, p. 424, 1869), where it is stated that a "tolerably perfect though dead specimen of *Aphrocallistes Bocagei* had been dredged up at Station 36 in 725 fathoms with a bottom of muddy sand," I presume that it is the one in question, which consists of a hollow cylindrical tube, composed of vitreous network, closed at the free end by the same structure in a convex form, and terminated at the other by a flat disk, which adhered to the object on which it grew, covered with buds or shorter tubes of a like kind, whose cavities respectively are continuous with that of the main tube or stem, the whole specimen being about two inches long and one in diameter. This "Station," I see by the table, was in lat. 48° 50' N., and long. 11° 9' W.; so that it was dredged up close to the specimen of *Farrea occa* just mentioned. We will designate it by the "Station," *viz.* "No. 36."

From the deep-sea specimens of H.M.S. 'Porcupine,' let us go to those in the British Museum dredged up on board

Mr. Marshall Hall's yacht 'Norna' in 1870, on the N.W. coast of Spain and Portugal, by Mr. Saville Kent; and here we shall find a dead specimen of *Aphrocallistes Bocagei* now broken into pieces, but when entire a little larger and of the same kind as that last described,—also a dead specimen of *Farrea occa*, consisting of a bunch of short tubes slightly trumpet-shaped, and open at their free ends, branching off from a main axis (Month. Microscop. Journ., Nov. 1870, pl. lxiv. fig. 12), both dredged up from a muddy bottom, and both filled with the mud.

Further, on a bunch of dead *Lophohelia prolifera*, there is another small but living specimen of *Aphrocallistes Bocagei*, together with several young or embryonic specimens here and there on the branches of the former, some of which are not more than $\frac{1}{4}$ of an inch in diameter, which, on microscopical examination, present the spicules of *Aphrocallistes Bocagei*, that at the same time are identical with those figured by Schmidt (*l. c.*) as illustrative of his *Lanuginella pupa*, which, as may be observed by his figure of *Aphrocallistes Bocagei* (*op. cit.* pl. ii. fig. 1), grew in great numbers on this specimen.

Lastly, on one of the branches of the same bunch of *Lophohelia prolifera* may be observed the unique specimen of *Aulodictyon Woodwardii*, discovered, described, and figured by Mr. Kent (*op. et l. cit.*). It also, like *Farrea occa*, is a tubular structure of rectangular lattice-like vitreous fibre, but otherwise appears to have been branched and closed at the extremities like *Aphrocallistes Bocagei*; still the specimen is so small, being not more than half an inch long, and the ends of the branches are so broken off, that, with the exception of its growing from a branch of the *Lophohelia* like *Farrea occa* (that is, spread out and not attached by a disk-like end like *Aphrocallistes Bocagei*), nothing more can be said of its general form.

Lastly, I have to notice a deciduous specimen of *Farrea occa*, about the same size and form as that last-mentioned, which was dredged up from the Caribbean Sea in about "lat. 14° 2' N., and long. 77° 42' W., in 1500 fathoms," and submitted by Mr. Gassiot (to whom the vessel belonged whose captain obtained it) to Dr. Gray, and by the latter to myself for examination. It is also much broken, but measures an inch long by about the same in transverse diameter. Also, from the same locality, a little stick-like fragment about $1\frac{1}{2}$ inch long and $\frac{1}{4}$ inch broad, composed of vitreous fibre like that of *Farrea*, but solid, bleached, and rounded in its contour, which is rendered very irregular by a dissolving action that has been going on in the fibre both inside and out for some time; and three specimens of a new species of *Farrea*, which was funnel-

shaped, to the solid stem of which stick-like fragment the foregoing specimen appears to have considerable resemblance.

As the latter constitutes the type of a new species of *Farrea*, some specimens of which were taken in the living as well as in the deciduous state, it is necessary, for future reference, to give a particular description of it at once, which will now follow under the designation of "*infundibuliformis*."

Farrea infundibuliformis, Carter, n. sp. Pl. XVII. figs. 1-4.

Vitreo-hexactinellid. Infundibuliform, consisting of a head (fig. 1, *a*) and stem (fig. 1, *b*). Stem subround, solid, composed of interlacing, branched, mixed with rectangular lattice-like fibre. Head funnel-shaped, formed of an expansion of the stem composed of a layer of rectangular lattice-like fibre in the centre (fig. 2, *b b*), covered on each side by one of branched vitreous fibre, whose branches diminish in size as they increase in number towards the circumference (fig. 1, *c*, 2, *a a*); reticulated and anastomosing obliquely throughout. Rectangular fibre strongly spined and formed of an extension of vitrified sarcode over a regular rectangular arrangement of large sexradiate spicules. Branched fibre minutely spined (fig. 2, *c c*), and more or less charged with minute sexradiate spicules, smooth and pointed or spined along the arms and at the ends, confusedly arranged (fig. 1, *d d*, & fig. 3), some of which are only partially enveloped, and others only cemented by one end (fig. 3, *a*) to the fibre. Interstices lined with sarcode charged with rosettes. Rosette many-rayed; rays sigmoid, capitate, expanded and arranged *en fleur-de-lis* (fig. 4); head of ray convex, spined round the margin. *Size*: diameter of funnel-shaped head about an inch, depth about $\frac{1}{4}$ inch; thickness of wall at the margin, which is broken, $\frac{1}{8}$ inch; length of the portion of stem remaining $\frac{1}{2}$ inch; diameter of the same close below the head $\frac{3}{4}$ inch.

Hab. Marine.

Loc. Caribbean Sea.

Obs. There are three specimens of the vitreous skeleton of this sponge in the British Museum, all about the same size and shape, but all more or less imperfect on the margin of the funnel-shaped expansion, which, being very thin, has no doubt been broken away by the dredge or "tangle" in which the specimens were taken. The stem in each also appears to have been broken off at the end, where it was just branching into three or more divisions, as if these divisions had terminated in the roots by which the sponge had been attached to some submarine object, and from which the specimens respectively had been broken off by the dredge or tangle.

Besides the specimens mentioned, there are two other thin flat portions, each of which is about an inch square and $\frac{1}{24}$ inch thick, which, presenting no visible curvature, may have belonged to infundibuliform heads of much larger dimensions than those above given. It is not improbable too, from the extreme thinness of the margin of the expansion of the more perfect specimens, that, if the heads in them respectively had been entire, their diameter would also have been greater. The flat portions must have been broken off from living specimens, as they are covered with dry sarcode abundantly charged with the form of rosette above mentioned.

This differs from *Farrea occa*:—1st, in the addition to the single lattice-like layer of which *Farrea occa* is composed, of a much larger, obliquely anastomosing, branched, vitreous fibre, apparently originating, both outside and in, from the bottom of the funnel-shaped expansion where it is thickest; 2nd, in this fibre being charged with the minute sexradiate spicules of the species, *confusedly* imbedded, entirely or partially (that is, in various degrees), within its substance; 3rd, in these sexradiates being much smaller than those singly and *regularly* arranged in what appears to be the basework or original lattice-like fibre of a *Farrea occa*. In short, the branched anastomosing fibre charged with the minute sexradiate spicules appears to be a secondary formation, which has run over a rectangular fibre vertically, so that it cuts the transverse bars of the latter, although amalgamating with them here and there at right angles.

SPICULES OF THE *APHROCALLISTIDÆ*, *AULODICTYON*, AND *FARREA FACUNDA*.

We now come to the description of the spicules respectively of the *Aphrocallistidæ* and *Aulodictyon Woodwardii* in their living state, together with a species of *Farrea* described by Schmidt as *F. facunda* (*fecunda*?), with all of which it will be found necessary that we should become acquainted before we can make out any thing of those in the deciduous skeletons.

Aphrocallistidæ.

Aphrocallistes beatrix, Gray, and *A. Bocagei*, Wright.

These two sponges have been excellently described and illustrated by the naturalists respectively who named and brought them into notice. But only generally. The detail of their spicules has not been sufficiently given; and as it is necessary that this should be minutely done, in connexion with illustrations, before their histories respectively can be considered

complete, as well as for the purpose of identification just mentioned, we will direct our attention for a few moments to this part of the subject.

Aphrocallistes Bocagei.

Taking *Aphrocallistes Bocagei* first, as this is the simplest form, it will be found that, besides the common large sexradiate spicule on which the vitreous structure is based, there are seven other kinds attendant upon it, all of which are more or less free and unimplicated in the vitreous sarcode, viz. :—

1. The staple, *linear*, fusiform spicule with inflated centre and extremities, in which the former presents 2–4 tubercles more or less developed opposite corresponding branches of the sexradiate central canal; extremities more or less pointed and spined.

2. A more delicate, *linear*, fusiform spicule, spined throughout. The spines long and slender, supported on projections of the shaft resembling the bracket-steps of a flagstaff; more or less closely inclined towards the shaft, and *all* in the *same direction*—that is, not half one way and half the other, beginning from the centre of the shaft and proceeding in opposite directions, but from one end towards the other throughout. As this is a very common form in the Hexactinellidæ, and the other kind also exists occasionally, viz. that in which the spines are inclined towards either point beginning from the centre, it is necessary to note the difference and give particular attention to the form chiefly under consideration (Pl. XV. fig. 8).

3. A sexradiate spicule whose arms are more or less unequal in length—five being smooth at the commencement and conically inflated and spined at the termination, and the sixth spined, feather-like all round, the spines increasing in length from the fixed to the free end. Sometimes, in an abnormal state, more than one of the arms is thus spined (fig. 9).

4. A scopuline spicule, consisting of a long shaft and four rays. The rays more or less divergent, arising from a corresponding number of tubercles at the end of the shaft, and terminating in conical heads surrounded with recurved spines. The rays are microspined and the end of the shaft also. Frequently the shaft presents a quadriform inflation just below the giving off of the rays; and sometimes the little tubercle in the centre of the four rays, which is the end of the shaft, is prolonged into a fifth ray (figs. 1 & 1 *d*).

5. A rosette with five-rayed arms, each ray straight or slightly sigmoid, and all divergent and capitate, except the central one, which is in a line with the arm; head of the ray convex and spined round the margin more or less deeply

(fig. 11, *d*). An abnormal form of the rosette is to have the arms continued respectively into one large ray.

6. The same, but with the axis stretched out linearly, shaft-like, and the rays arranged round it more or less spirally; rays long, spine-like, capitate, most numerous at the ends, where they are more or less divergent (Pl. XIII. fig. 17).

7. The same, with the rays of the shaft more confined to its centre, and all simple (that is, *not* capitate, but pointed).

N.B. The last two forms are not near so abundant as the globular rosette (Pl. XV. fig. 11, *d*).

Aphrocallistes beatrix.

We now come to *Aphrocallistes beatrix*, in which it will be also found that, besides the common large sexradiate spicule on which the vitreous structure is based, there are six other kinds, viz. :—

1. Similar to no. 1 of *A. Bocagei*, but a shorter, coarser, and more robust form, spined throughout.

2. The same as no. 2 in *A. Bocagei*.

3. A sexradiate spicule whose pointed arms are sparsely and irregularly covered throughout with smooth spines curved outwards, and longest about the union of the middle with the inner third, diminishing towards the extremities of the arms (Pl. XV. fig. 10). This appears to be the analogue of no. 3 in *A. Bocagei*, since I have never seen the sexradiate spicule with feather-like spined arm in *A. beatrix*, nor has Mr. Kent, who also states this, and that the one figured in his illustration of this sponge is taken from Dr. Bowerbank's (P. Z. S. 1869, pl. xxii. fig. 3). If, however, Dr. Bowerbank has been more fortunate in this respect, his figure shows, by the abortive condition of the spines on the feathered arm of this spicule in *A. beatrix* compared with that in *A. Bocagei*, that this spicule is very poorly, and therefore perhaps very sparsely, represented in *A. beatrix*.

4. A scopuline spicule, consisting of a long shaft and four rays; the rays quadrangularly based on a hand-like expansion of the end of the shaft; for the most part proceeding for some distance almost parallel to each other, when they end by becoming slightly divergent, terminating respectively in small, smooth, round heads, surrounded by recurved spines. The rays and the end of the shaft also microspined throughout (Pl. XV. fig. 2).

5. A straight large shaft more or less beset with long, thorn-like spines, most numerous towards the centre, where they are vertical, and at the extremities, where they are divergent; each slightly curved and microspined (Pl. XIII. fig. 20).

6. A smaller kind, in which the rays are straight, smooth, and capitate (Pl. XIII. fig. 19). This, which has also been figured by Mr. Kent (Month. Microscop. Journ. 1870, no. 33, pl. lxx. fig. 20), is analogous to no. 6 in *A. Bocagei*, and thus becomes a transitional form of the rosette in the latter to the large, spined shaft no. 5 (just described) peculiar to *A. beatrix*, in which sponge there is no rosette; that is, the globular rosette in *A. Bocagei* first presents itself in that sponge with elongated shaft-like axis and pointed or capitate spines, which form is again found, *without* the globular rosette, in *A. beatrix* apparently leading to the large spined shaft that is as characteristic of this species as the globular rosette is of *A. Bocagei*.

Obs. About the bunch of dead *Lophohelia prolifera* dredged up by Mr. Kent there are, as before stated, in addition to the larger specimens of *Aphrocallistes Bocagei* and *Aulodictyon Woodwardii*, several embryo sponges; and two of these (viz. one $\frac{1}{4}$ and the other about $\frac{2}{12}$ of an inch in diameter) I mounted in Canada balsam, when it was observed that they both belonged to *Aphrocallistes Bocagei*; but while the vitrified fibre had not begun to appear in the former, it had in the latter, where several sexradiate and linear spicules had become cemented together, involving also some of the sexradiates of *Aphrocallistes Bocagei* with feather-like spined arm (Pl. XV. figs. 9 & 11, *a, b, c*). At first I took these embryos for *Askonema*; but the sexradiate spicule with feather-like spined arm, together with the vitrification (both of which are absent in *Askonema*), decided this point. Then I remembered that the feather-like spined arm-spicule abounded also in *Sympagella nux*; but the ladder-like forms of the vitreous fibre here, together with the presence of the pappiform rosette with flexed rays, presented a decided difference. Lastly, it was observed that their spicules accorded with those of *Lanuginella pupa*, Schmidt. But when it is remembered that Schmidt's specimen of *Aphrocallistes Bocagei* bore on its surface many specimens of his *Lanuginella* in an embryo state, that their spicules are identical with those of the embryos of *Aphrocallistes Bocagei* on the specimen of *Lophohelia* mentioned, in company also with a fully developed living specimen of *A. Bocagei*, there seems to be very good reason for assuming that *Lanuginella pupa* is neither more nor less than *A. Bocagei* in an embryonic condition.

Aulodictyon Woodwardii, Kent.

In the tube net of *Aulodictyon*, like that of *Aphrocallistes*, there are several other spicules besides the staple sexradiate which forms the basis of the vitreous fibre; and these are also more or less enclosed together with the sexradiates. According

to Mr. Kent (who, as before stated, has the merit of having discovered, described, and illustrated this unique specimen), confirmed by my own observations, they amount to seven, viz. :—

1 and 2. The same as in *Aphrocallistes Bocagei*.

3. An umbrella-like spino-capitate shaft of two forms, one of which has a *large*, flat, convex head, plain or umbonate, with a fringe of minute spines (Pl. XV. fig. 4), and the other a *small* convex head, also plain or umbonate, with a few long recurved spines, microspined on the inner aspect (fig. 5); while between these two extremes this spicule assumes several intermediate forms, in all of which the shaft is pointed, more or less microspined, and of whip-like fineness towards the free extremity.

N.B. This spicule, which appears to be analogous to the scopuline form in the Aphrocallistidæ and that of Schmidt's *Farrea facunda*, from lying parallel with the arms of the large sexradiate skeleton-spicule, often becomes enveloped with them in the vitreous fibre (Pl. XV. figs. 6 & 7).

4. A rosette whose arms are five-rayed; the rays sigmoid, capitate, and somewhat expanded or divergent *en fleur-de-lis*, with the head of the ray round and spined on the margin (like fig. 10, Pl. XIII.).

5. A sexradiate spicule with one arm smooth and inflated, the rest smooth, and terminated respectively by spiniferous points (see Mr. Kent's figure 23, Month. Microscop. Journ. 1870, pl. lxiv.).

6. A sexradiate spicule with one arm spined feather-like, and the rest terminated respectively by spiniferous points (like fig. 9, Pl. XV.).

Nos. 5 and 6 appear to be alternating forms of each other, and analogous to the sexradiate spicule with one arm spined feather-like in *Aphrocallistes Bocagei* &c., but apparently more sparse and less fully developed.

7. A simple minute sexradiate, whose arms may be smooth or spined, attached by one arm to, or more or less enveloped in, the vitrified fibre, as in Pl. XIII. fig. 1.

Obs. These spicules all appear to be analogous to those in *Aphrocallistes Bocagei*; while the umbrella-like ones, lying parallel and close to the arms of the large sexradiate (which forms the basis of the vitrified skeleton), are often, as before stated, enveloped with it (Pl. XV. figs. 6 & 7, *b*). In short, as the sexradiate spicule with feather-like spined arm is seen in the embryo *Aphrocallistes Bocagei* to be becoming enclosed in the vitreous fibre of that species, so the umbrella-like spicules of *Aulodictyon Woodwardii* may be observed on

their way to become enclosed in its vitreous fibre (fig. 7, *b*). Hence may we not infer that the unique specimen of the latter (which is only half an inch in length) is a very young specimen also?

Farrea facunda, Schmidt (*fecunda*?).

For a more detailed description of this species, with illustrations, I must refer the reader to Schmidt's 'Atlantisch. Spongienfauna' (1870), merely observing here, for the sake of comparison, that his figure 10, pl. ii., which represents the skeleton of *Farrea facunda* of its natural size, is almost identical in size and form with that figured by Mr. Kent as *Farrea occa* (*l. c.*), with that in my possession from the dredgings of the 'Porcupine' (No. 3*a*, *antèa*), and with that which was obtained by Mr. Gassiot from the Caribbean Sea, which I examined microscopically and of which I made an accurate drawing. The detail of the skeleton in *F. facunda*, represented in Schmidt's pl. i. figs. 13-17, also corresponds with that of the specimens mentioned; while the scopuline form (fig. 18) is often found modified in *Aphrocallistes Bocagei* (see our Pl. XV. fig. 3); and his rosette (fig. 19), with the exception of its arms and rays being microspined, together with the spino-capitate spicule (fig. 20), have their analogues in the rosette and umbrella-like spicules respectively of *Aulodictyon Woodwardii*.

Farrea occa, Bowerbank. Pl. XVI. fig. 4.

We now come to *Farrea occa*, which, as before stated, was so called from a fragment of lattice-like vitreous fibre that Prof. Owen found among the detrital mass on which Dr. A. Farre's specimen of *Euplectella cucumer* (obtained from the Seychelles) had grown. The structure of this fragment Prof. Owen figured (Trans. Linn. Soc. 1857, p. 121), and likened to a "harrow." Subsequently Dr. Bowerbank took a portion from the same detrital mass, and, having subjected it to a higher magnifying-power, thought that he had discovered in it a new kind of vitreous fibre, which was designated "fistulose siliceous," applying the name of "*Farrea*" to the sponge from which it was supposed to have come (Phil. Trans. 1862, p. 758, pl. xxviii. fig. 11). This was repeated in his 'British Spongiadæ,' where it was called "simple fistulose siliceous fibre spinulated, from *Farrea occa*" (vol. i. p. 274, 1864): *occa*, a harrow. Finally, in 1869 (P. Z. S. pl. xxiv. fig. 1) a different representation was given, in addition to the foregoing spinulated form, which was also now accompanied by certain minute spicules termed "attenuate stellate retentive spicula" of *Farrea occa* (*op. cit.* p. 341). These two representations,

viz. figs. 1 & 7, we shall find by-and-by to belong to two different species of *Farrea*, both figured previously and separately by Prof. Owen (*op. et loc. cit.* figs. 8 & 9 respectively); while Dr. Bowerbank's figure 7 alone represents *Farrea occa*, and the "retentive spicula" belong to quite another and very different system of sponges.

Now, considering that Dr. Bowerbank viewed fig. 7 as the "harrow-like tissue of the dermis" of some unknown sponge (instead of a part of the skeleton itself, which we now know to be the case)—that is, a portion of the wall itself of the tube of which *Farrea occa* is formed—considering that the term "fistulose" for the fibre, as being analogous to "simple keratose fibre" (B. S. vol. i. p. 80), ex. gr. *Luffaria*, is misapplied, inasmuch as it will presently be shown that the fistulous appearance in the siliceous fibre arises from the presence of sexradiate spicules, while in the keratose fibre it is a *bonâ fide* continuous canal—and considering that the "attenuate stellate retentive spicula" are not of the sexradiate type, but probably belong to an undescribed species of *Gummina* (see 'Annals,' 1873, vol. xii. p. 22), we have absolutely nothing left but the fragment of rectangular, vitreous, lattice-like fibre of this sponge, first represented by Prof. Owen's figures 9 & 9 a (*op. cit.*), and repeated in Dr. Bowerbank's figure 7 (P. Z. S. *l. c.*).

That, however, this rectangular lattice-like vitreous fibre has been identified with that forming the skeleton of a sponge to which Mr. Kent has applied the name of *Farrea occa* in his figures (*l. c.*), confirmed by my own observation, his delineations will show, and the specimen itself (now, Mr. Kent informs me, in the British Museum) will demonstrate. But there was nothing but the skeleton left, which, as before stated, was dredged up on the coast of Portugal filled with mud. Mr. Gassiot's specimen, of which I made an accurate drawing and microscopical examination, was in the same condition, and the specimen in "No. 3 a," dredged up on board H.M.S. 'Porcupine,' also the same; while Schmidt's figure of the specimen from Florida, which he examined (*op. et loc. cit.*), does not differ from either, and appears to have been also nothing but a deciduous skeleton, although it was accompanied by the spicules mentioned, and Schmidt has made a new species of it under the name of "*Farrea facunda*."

Since the above was written, I have (as before stated) examined Dr. A. Farre's specimen of *Euplectella cucumer*, entangled in the beard-like mass of which at the base (viz. the long anchoring-spicules) are many large fragments of *Farrea occa* (Pl. XVI. fig. 4), among which is a small portion of the

tubular general form, quite sufficient to identify with the specimens just mentioned,—also large fragments of the other or spiniferous species, represented by Dr. Bowerbank in his figure 1 (P. Z. S. l. c.), which will be described under the name of "*Farrea densa*" by-and-by.

Up to the present time, then, this is all we know of *Farrea occa*; but as there have been several specimens of its deciduous skeleton brought to notice, as well as many of *Aphrocallistes Bocagei*, with the so-called "fistulose" character in the fibre of all, it was not safe to state that all did not belong to the same genus, viz. *Farrea*. Under these circumstances there would be no hope of solving the problem, had it not been found that, although in the fresh and living state of the sponge hardly any trace of the spicules in the vitreous fibre can be seen, yet after death a process of absorption takes place in the interior of the fibre, whereby, if it has not gone too far, the whole of the forms of these spicules may be recognized. Hence, if any peculiarly characteristic spicules should happen to be present in this fibre, the species of the sponge to which it belonged can be determined, as in the case of the Aphrocallistidæ; while in *Farrea occa*, where we have never had any thing but the bare deciduous skeleton, the spicules which it possessed in the *living state* might, under the same circumstances, be also discovered. It is to this process of absorption and its effects in the sponge-spicule as well as the vitreous fibre that we shall now more particularly direct our attention.

Taking first the siliceous sponge-spicule by itself, we find that it is subject to two kinds of wasting or decay, viz. one which takes place in the interior or wall of the central canal, and the other on the surface—the former frequently occurring in the living sponge, and the latter in the substance of the spicule after death.

The wasting which takes place in the wall of the central canal is recognized by its increasing size, which in some cases goes on until the spicule is reduced to a mere shell; or it may take place only at the ends of the spicule, when the central canal at these points presents a funnel-shaped cavity diminishing inwards or towards the centre of the spicule. In either case the cause is not apparent. As this occurs in the living state it is just possible that the central canal of the spicule, which begins in a simple cell, may sometimes become so dilated as to assume the form of a full-grown spicule, with little if any vitrification, and thus appear as the mere shell. To this may be added a general absorption of the proper spicule, which frequently takes place within the horny fibre of

the keratose sponges to such an extent as often to render it very difficult to determine what was its original form.

On the other hand, the destruction which takes place on the surface of the spicule and extends into its substance presents itself under three different phases (Pl. XVI. fig. 8): viz., first, it consists of a simple superficial circular concavity, which may increase in size and depth (fig. 8, *a*); second, of a simple, straight, uniform blind tube extended vertically into the substance of the spicule (fig. 8, *b*); and, third, of a smaller tube of the same kind ending in a globular dilatation (fig. 8, *c*). In each instance it seems to be produced by the eroding action of an organized cell; that is, in specimens of the two latter, mounted in Canada balsam, a graniferous cell may be observed to occupy the inner extremities respectively (fig. 9, *a*, *b*, *c*), recalling strongly to mind the appearance of the saprolegneous cell *Pythium* when working its way through the cell-wall of *Spirogyra*. Kölliker gives good figures of the first and second forms of this, merely observing that it is a "peculiar degeneration" ('Icones Histologicæ,' der feinere Bau, p. 83, pl. viii. fig. 10).

It is the dimpled superficial kind of this destruction which, attacking the deciduous spicule, seems not only to destroy the ornamental parts but in many instances to reduce the spicule to a mere ragged stick-like state, in which its original form is no longer recognizable: hence the condition of a great number of the fossil spicules in the Upper Greensand deposit of Haldon Hill near Exeter (Annals, 1871, vol. vii. p. 113, pls. vii., viii., & ix.).

I may here also notice that the calcareous sponge-spicules are also subject to two kinds of destruction, viz.:—one which takes place in the living sponge, where the extremities of the acerate long spicules are rendered funnel-shaped, as before mentioned in the siliceous ones; and the other, in which there is a general breakdown of the whole fabric, which gradually becomes resolved into a group of aqueous-looking globules of different sizes, among which there is not a trace of the original structure to be seen. Were this change confined to those calcareous spicules which I have mounted in Canada balsam, I should have inferred that it was caused by the balsam; but I find that the same change accompanies these spicules where they may have been taken in by the kerataceous sponges to form an axis for their horny fibre; and it is worthy of remark that the spicules of the Echinodermata, which may lie side by side with them, do not appear to be similarly affected. Of what nature the origin of this disorganization may be I am ignorant; it is a chemical question; but the destruction takes

place so rapidly in many instances that I have for some time past ceased to mount any more calcareous spicules, and now preserve a record of them by immediate sketches.

Lastly, we come to the peculiar kind of destruction to which I have so often before alluded, which takes place in the centre of the vitrified fibre of the Hexactinellidæ apparently *only* after the death of the sponge. This also, as before stated, consists in an absorption of the spicules over which the vitreous fibre was originally deposited, together with a certain amount of the fibre itself, leaving nothing but their moulds, which, if the absorption has not gone too far, will present exact representations of the spicules respectively. It is analogous to that which takes place in the spicules of the keratose sponges above mentioned.

We have here then an explanation of Dr. Bowerbank's "fistulose siliceous fibre," also a proof that the siliceous fibre of the Hexactinellidæ is based upon the spicules of the sponge, and, finally, means of detecting what the isolated spicules of the sponge were, although nothing may be left but the vitreous fibre in a deciduous state. It is thus that specimens of *Aphrocallistes Bocagei* have been identified, and some of those possessed by *Farrea occa* in its living condition recognized—facts which first drew my attention to the subject, originated this contribution, and will now be severally described.

The first specimen that attracted my notice in this way was the bunch of *Aphrocallistes* in the British Museum, already stated to have been dredged up by Mr. Kent on the coast of Portugal; but possessing the feature which had led Dr. Bowerbank to the idea that there existed "fistulose siliceous fibre" as well as "fistulose kerataceous fibre," and that this was an especial characteristic of his *Farrea occa*, I at once concluded that this was not an *Aphrocallistes*, but a *Farrea* (Pl. XVI. fig. 1).

Soon, however, it became evident that this "fistulose" appearance arose from the presence of sexradiate spicules originally enveloped in the vitrified fibre (fig. 1, *bb*); and chancing to meet with a fragment in which the characteristic scopuline shaft of *Aphrocallistes Bocagei* was present (fig. 2, *b*), the origin of the fistulose appearance was explained, and the specimen, which otherwise bore the character of *Aphrocallistes*, shown to be not *Farrea*, but *Aphrocallistes Bocagei* with the same fistulose appearance as the fibre of *Farrea* (fig. 4). Hence the necessity, to which I have alluded, of a minute and accurate description of all the spicules of these sponges.

Subsequently the specimen dredged up on board H.M.S. 'Porcupine' at station "No. 36" (*vide antea*) came before

me; and being exactly like Mr. Kent's, there was no difficulty in recognizing its specific nature; but on boiling a portion of it in *liquor potassæ*, it was also found to possess the characteristic scopuline shaft (Pl. XV. fig. 1) together with a rosette (fig. 11, *d*), both in great abundance in the mud with which the tubular branches of the sponge were still filled, especially towards their free closed extremities. It was then observed in the mounted specimen that there were also a few rosettes with elongated shaft-like axes, on which the rays were sometimes capitate and sometimes pointed, the latter bearing a strong resemblance to the spined shafts peculiar to *Aphrocallistes beatrix* (Pl. XIII. figs. 17 & 18). The presence of the rosette in these two forms being new to me, I turned to the examination of the type specimen of *Aphrocallistes Bocagei* in the British Museum, described and figured by Dr. Wright (*l. c.*), and found that it also contained the same kind of rosettes. Lastly, I examined *Aphrocallistes beatrix* in the British Museum, described and figured by Dr. Gray (*l. c.*), and found that, although this did not contain the globular rosette with *short* axis so abundant in *A. Bocagei*, it contained that form with elongated shaft-like axis in which the rays are occasionally capitate (Pl. XIII. fig. 19), thus so far retaining this character of *Aphrocallistes Bocagei*. Hence, again, the necessity of studying minutely all the spicules of these sponges, which led me to write the descriptions of them above given. It will now be observed that, in order to arrive at an accurate knowledge of the Spongiadæ structurally, they must be studied elementarily in this way, and upon the amount of this knowledge will depend the accuracy of our classification.

I next took some minute portions from the fragment which Mr. Kent sent me of his *Farrea occa*, and also from Mr. Gassiot's before mentioned, but was not correspondingly fortunate here. However, on returning to the deep-sea specimen dredged up on board H.M.S. 'Porcupine' (No. 3 *a*), which had grown on a *Lophohelia* and had subsequently been enveloped in a *Gummina* (*Corticium abyssi*), I found in one fragment, as the illustration will show (Pl. XVI. fig. 5), a spicule of the form no. 2 (Pl. XV. fig. 8) previously described under *Aphrocallistes Bocagei*. This spicule, as I have before stated, is not confined to *A. Bocagei*, but is found in *Aulodictyon Woodwardii*, *Hyalonema*, and all the sarcospiculous Hexactinellidæ possessing the "birotulate spicule." Possibly it might be considered an accidental instance, and therefore might not originally have belonged to *Farrea occa*; but in three or four instances it was found thus imbedded.

In each of two other fragments from this specimen of

Farrea occa a scopuline spicule with pointed rays was found, like that figured by Schmidt in his *Farrea facunda* (l. c.). These specimens were also mounted in Canada balsam and delineated, as the illustrations will show (Pl. XVI. figs. 6, b, & 7, b).

Lastly, in many instances in the fibre of *Farrea occa* the capitate end of a largish spicule was observed (fig. 7, c), which I see appears in one of Schmidt's fossil illustrations (op. cit. pl. ii. fig. 18) as an arm of a sexradiate spicule. Of this form I can state, as I know, nothing further.

I had hoped, by finding this specimen of *Farrea* enveloped in the Gummina, that I might also find some of its isolated spicules within the tube; but, with the exception of four sexradiates of the form no. 3 under *Aphrocallistes Bocagei*, viz. that with the feather-like spined arm (Pl. XV. fig. 9), I could not, even after repeated searching, see any thing of the kind.

Whether or not these spicules did belong to *Farrea occa* I am unable to state, since together with the *Farrea* were included in the Gummina some fragments of *Aphrocallistes Bocagei*, one of which, as will be seen by the illustration, bears a mould of the sexradiate spicule with feather-like arm just mentioned. That such spicules are involved in the vitreous skeleton of this sponge has been already shown by the embryonic specimen mentioned at p. 452.

In the "stick-like" fragment among Mr. Gassiot's specimens, also above noticed, which looks like the solid stem of *Farrea infundibuliformis*, the absorbing process has gone on to such an extent internally as to destroy all forms of the sexradiate spicules on which the vitreous fibre of which it is composed was built, and externally to such a degree as to round off and diminish in size every spine and original projection of this fibre; so that it now presents the white appearance and form of a substance that is disappearing under the dissolving influence of water. Such is another instance of the way in which the fibre of the hexactinellid sponges may pass into dissolution.

We learn from the foregoing, then:—

1st. That the vitreous structure of the Hexactinellidæ is built upon a network of their spicules, as proved by the examination of the embryonic forms of *Aphrocallistes Bocagei*, in one of which (viz. that $\frac{1}{24}$ of an inch in diameter) the process of vitrification has not commenced, while in the other ($\frac{2}{17}$ of an inch in diameter), although incomplete, it has already made considerable progress; that after the spicules have become enveloped in the vitrification their forms disappear; and that,

finally, after the fully developed fibre has become deciduous, their forms reappear in the state of moulds caused by a process of absorption of the spicule not yet explained.

2nd. That by the reappearance of the forms of the spicules we are enabled to determine the species if previously known in a living state, although nothing but the bare deciduous vitrified structure may remain; and therefore, where no living specimen of the species has been found, to determine what kind of spicules it originally possessed.

3rd. That there are no grounds for stating that a hexactinellid sponge exists in which the fibre is fistulous—that is, pervaded by a continuous central canal, as in the keratose sponge *Luffaria* (D. et M.); but, on the contrary, that the vitreous fibre is always based on an axis of sexradiate spicules.

With the deciduous specimens of *Aphrocallistes Bocagei* there has been no difficulty in determination, because we know what the characteristic spicules of this sponge are in its living state.

But the case is not so satisfactory with *Farrea occa*, of which nothing but deciduous specimens have yet been found. However, here it is evident that, besides the common sexradiate spicules of the skeleton (Pl. XVI. fig. 4, *bbb*), there was the spined one described as no. 2 under *Aphrocallistes Bocagei* (fig. 5, *b*), and the scopuline shaft like that figured by Schmidt in his *Farrea occa* (figs. 6, *b* & 7, *b*), to which I have before alluded.

Lastly, it might be stated respecting *Farrea occa* that, although we know that, in addition to the common sexradiates, it possessed the spined spicule no. 2 of *Aphrocallistes Bocagei* and another like the scopuline spicule of *Farrea facunda*, while the latter spicule is by no means identical with that figured by Schmidt (neither have we seen the spino-capitate spicule nor the rosette which are also figured by the same author as characteristic of *F. facunda*), yet the field from which we have obtained the facts above mentioned respecting *F. occa* is very limited; so that by-and-by, if a living specimen is not found of *F. occa*, but still more deciduous ones, more of the spicules it originally possessed may be made known after a like manner. At the same time, it should be remembered that the *general* figure (Taf. ii. fig. 10), as well as the detail of its skeleton which Schmidt has given of his *F. facunda*, are so identical with Mr. Kent's, Mr. Gassiot's, and the deep-sea ones of *F. occa* before mentioned that without a certain knowledge of all the isolated spicules of the latter it would be very hazardous to state that *F. occa* and *F. facunda* were not one

and the same species. Should this turn out to be the case, which name is to be suppressed?

That Schmidt's specimen of *F. facunda* was a deciduous one is proved (if I am right in considering that the re-appearance of the sexradiate spicules (Pl. XVII. fig. 4) *only* takes place after death) by his description and delineations, wherein he both states and shows that the vitreous fibre was built upon sexradiate spicules, and also shows that the specimen which was submitted to him for examination was accompanied by the isolated forms of spicules peculiar to the species, which he has also represented; so was the deciduous specimen of *Aphrocallistes Bocagei* "No. 36" dredged up on board H.M.S. 'Porcupine,' although not that dredged up on board the 'Norna' by Mr. Kent, of which nothing was left but the vitreous structure.

It will be remembered that at p. 446 I have stated that Dr. Bowerbank had confounded two species of *Farrea* in his illustrations of *F. occa* (P. Z. S. 1869, pl. xxiv. figs. 1 & 7); also that both had been previously noticed and illustrated by Prof. Owen in 1857 (Trans. Linn. Soc. *l. c.*); further that the "retentive spicules" figured by Dr. Bowerbank as characteristic of *Farrea occa* do not belong to the sexradiate system of sponges, but probably to some undescribed species of *Gummina*.

In order that I might fully satisfy myself of these points I (at the kind suggestion of Dr. Farre) took for deliberate examination fragments of these two species of *Farrea*, which abound, in a deciduous state, in the mass of detrital material in which the anchoring-spicules of his specimen of *Euplectella cucumer* are imbedded. These, which altogether would not fill a cubic space of $\frac{2}{15}$ inch, were boiled in nitric acid; and the larger fragments having been taken out, the rest was well washed, dried, and mounted in Canada balsam. To a short description of the latter I shall return presently; in the mean time let us turn our attention to the specimens of the two *Farreæ*; and as already *F. occa* has been described, we have now only left the new species which stands in Prof. Owen's and Dr. Bowerbank's illustrations respectively under the figures "8" and "1." To this species I intend to apply the term "*densa*," on account of its massive reticular structure, which is just the opposite to that of *Farrea occa*, whose general form is tubular, branched, and only one layer thick. While, however, nothing remains of this sponge also but its deciduous skeleton, still the general character of this and the peculiar character of the fibre of which it is composed appear to me, although necessitating a very short de-

scription, to be quite sufficient to show that it is a distinct species.

Farrea densa, n. sp. (Pl. XVII. figs. 5 & 6.)

Skeleton composed of lattice-like, subrectangular, thickly spined, vitreous fibre, varying in size with its age, anastomosing freely in all directions, so as to form a densely reticulate massive structure. Fibre originally based on sexradiate spicules, whose forms have become more or less recognizable by the process of absorption above mentioned; thickly spiniferous, each spine conical and divided at the summit into several spinules, which are expanded (fig. 6, *b b b*).

Hab. Marine.

Loc. Seychelles.

Obs. There are many large detrital fragments of the deciduous skeleton of this sponge mixed up with those of *Farrea occa*, and a host of other matters, all entangled in the tuft of anchoring-spicules at the base of Dr. A. Farre's specimen of *Euplectella cucumer*; but none appear to indicate the general form of the sponge to which they belonged, while they are accompanied by such a variety of minute spicules of all kinds that it is impossible to state which, if any of them, formed part of their original structure.

Among the spicules boiled off from these minute fragments and mounted in balsam, as before stated, may be observed:— a new form of equianchorate, very large, with both ends of the shaft winged or spread out laterally by a thin expansion like that on the shaft of the anchorate in the deep-sea sponge called by the late Dr. M. Sars "*Cladorhiza abyssicola*" ('Remarkable Forms of Animal Life from the Great Deeps on the Norwegian Coast,' by the late Dr. M. Sars, edited by his son, p. 65, pl. vi. f. 32: Christiana, 1872); several kinds of bihamate spicules, among which is one sparsely spined on the body and measuring 23 1800ths of an inch long by one 1800th of an inch in its thickest part (this is the largest known, being more than twice the size of that in the deep-sea sponge just mentioned, viz. *Cladorhiza abyssicola*, which with another similar sponge, viz. *Chondrocladia virgata*, Wy. Thomson, were abundantly dredged up on board H.M.S. 'Porcupine'); three distinct forms of siliceous globules, indicating as many species of *Geodia*; one discoid from *Stelletta mammillaris*, Sdt. (?); the scopuline shaft of *Aphrocallistes beatrix* in great abundance; spicules of undescribed species of Gummineæ, especially that figured by Dr. Bowerbank (P. Z. S. 1869, pl. iii. figs. 6 *a* & 16) as belonging to "*Dactylocalyx pumiceus*, Stutchbury"! the surface-spicule of two different kinds of Lithistidæ, and frag-

ments of a new species which I am about to describe under the name of *Arabescula parasitica*, together with exquisite skeletons of many Polycystinæ and circular frustules of Diatomaceæ, &c. In short, I should think that a careful examination of this mass of detritus, after the manner mentioned, would, if furnishing an amount of deciduous remains proportional in number and variety to that which came from the minute fragments of the *Farrea* that I boiled in nitric acid, yield sufficient not only to copiously illustrate a book with most exquisite figures, but to afford no mean catalogue of the sponge-fauna, Polycystinæ, and marine Diatomaceæ of that part of the Seychelles from which this specimen of *Euplectella cucumer* was obtained.

Lastly, I have to describe the structure of a new genus of sponges, apparently allied to the Lithistidæ, which was first observed on some fragments of the deciduous skeletons of *Aphrocallistes Bocagei* and *Farrea occa* respectively, from the specimen No. 3 *a* dredged up by H.M.S. 'Porcupine,' and subsequently seen among the minute spicules &c. just mentioned which were boiled off the fragments of the two *Farree* from the root-mass of *Euplectella cucumer*. The resemblance of this structure, which lies flat and parasitic on the deciduous glassy fibre mentioned, to that kind of sculptured "open work" used by the Mohammedans for their architectural windows before glass was made for this purpose, suggests the generic name of "*Arabescula*"—and the manner in which it has grown over the deciduous fibre mentioned, the specific "*parasitica*;" under which appellation it will now, so far as the bare skeleton permits, be described:—

ARABESCULA, nov. gen., Carter.

Arabescula parasitica, n. sp., Carter. (Pl. XVII. figs. 7–9.)

Skeleton corticiform, vitreous, thin, spreading, composed of frond-like spicules, each of which is formed of a sinuous, vermicular body, tortuously branched in all directions on the same plane (fig. 8, *a*); branches ending in filigreed terminations, which, interlocking with those of adjoining fronds, constitute a membrane-like expansion (fig. 7, *b*). Body smooth externally, provided with sparsely scattered, short, truncated cylindrical projections (fig. 8, *b*) on the inner side, which, being situated on the body and larger branches, rested on the vitreous fibre over which the sponge might be growing.

Hab. Marine, growing over deciduous fibre of *Aphrocallistes Bocagei* and *Farrea occa*.

Loc. Western entrance of the English Channel; and the sea about the Seychelles.

Obs. This exquisite little arabesque structure (Pl. XVII. fig. 7, *b*), from its vitreous appearance, and from not dissolving when boiled in nitric acid, together with the form of its frond-like branched and fligreed spicules (fig. 8, *aa*), seems to belong to the Lithistidæ; but, like the preceding species of *Farrea densa* as well as *F. occa*, it has yet to be found in a living state for this identification, and for the remaining part of its description. While some portions are found on the vitreous fibre of the sponge mentioned, others are observed to be separated from it (fig. 9), as if the extent to which the structure had grown round the spicule and had formed by union a continuous sheath had determined this. It appears to be the product of a creeping sarcode, like that of the Spongiadæ; and therefore I assume for the present that it is the structure of a sponge.

EXPLANATION OF THE PLATES.

PLATE XIII.

HEXACTINELLIDÆ.

Skeleton-spicule.

Fig. 1. Three small skeleton-spicules, showing the way in which they are united to the main fibre and to each other to form the skeleton-structure: *a*, fragment of main fibre; *b*, small skeleton-spicule united by one arm to the fibre; *cc*, skeleton-spicules united by one arm to the spicule *b*. From *Aphrocallistes Boscagei*.

Flesh-spicules.

Fig. 2. Rosette with long arms and short, straight, pointed, dual rays: *a a a a a a*, arms; *b b b b b b*, rays. From *Crateromorpha Meyeri*, Gray.

N.B. After this the fifth and sixth arms (*cc*), or third axis, will, for the sake of perspicuity, be omitted.

Fig. 3. Rosette with short arms and long, straight, pointed rays. *Euplectella aspergillum*.

Fig. 4. Rosette with three-rayed arm. *Euplectellidæ*.

Fig. 5. Rosette with two-rayed arm; rays straight, capitate, few- and long-spined: *a*, caput or head; *b*, head, more magnified, to show spines, end view; *c*, the same, lateral view. *Rossella velata*, Wy. Thomson.

Fig. 6. Rosette with short arms and many straight capitate rays: *a*, many-spined head, end view; *b*, the same, lateral view. *Dactylocalyx subglobosa*, Gray.

N.B. This is the usual form of head, although the spines may not always be distinguishable except with a very high power.

Fig. 7. Rosette with long arms and many straight capitate rays. *Dactylocalyx subglobosa*, Gray.

Fig. 8. Rosette with multitudinous straight rays of unequal length, capitate. *Crateromorpha Meyeri*.

This is the rosette to which I have applied the term "pappiform," with straight capitate rays.

Fig. 9. Rosette with many sigmoid capitate rays arranged *en fleur-de-lis*, expanded. *Farrea infundibuliformis*.

Fig. 10. Rosette with many sigmoid capitate rays arranged *en fleur-de-lis*, contracted below only. *Myliusia callocyathes*.

Fig. 11. Rosette with many sigmoid capitate rays arranged *en fleur-de-lis*. Ray clavate; head expanded laterally and dentate outwardly, claw-shaped; diminished to extreme fineness just before it terminates in the lower fourth, which again becoming thicker joins the end of the arm of the rosette: *a*, upper portion of ray, more magnified, dorsal view; *b*, the same, lateral view. *Euplectellide*.

Fig. 12. Rosette with multitudinous sigmoid rays of unequal length, without heads, arranged *en fleur-de-lis*. Ray linear, subulate; upper portion thick and bent downwards and outwards at the end; diminishing below into extreme fineness just before it terminates in the lower fourth, which again becoming thicker joins the end of the arm of the rosette. *Rossella velata*, Wy. Thomson.

N.B. The extreme fineness to which the ray is reduced at the point mentioned often leads to its being broken off in the two rosettes last described, whereby it is seen lying about the "field" in the forms of 11 *b* and 15 *a* respectively, while the lower extremities still remain attached to the arm of the rosette, as at 15 *d*.

Fig. 13. Rosette with rays once branched, capitate. An occasional form. *Dactylocalyx subglobosa*. *a*, echinated head of ray; an occasional form of the head in fig. 6, from the same sponge.

Fig. 14. Rosette with straight capitate rays spined laterally. *Euplectella aspergillum* (fragment dredged up by H.M.S. 'Porcupine').

Fig. 15. Rosette; more magnified view of one arm of fig. 12: *a*, detached ray, broken off at the fine portion; *b*, conically inflated and tubercled end of arm; *c*, apical straight spine of the same; *d*, end of arm, showing the way in which the lower extremities of the rays still remain attached to the tubercles on the inflation after the upper portions (*a*) have been broken off.

Fig. 16. Rosette; more magnified view of one arm of fig. 8: *a*, rays, of unequal length; *b*, conically inflated and tubercled end of arm; *c*, end of arm, showing the way in which the straight rays are respectively based on a tubercle.

Fig. 17. Rosette with elongated shaft-like axis and straight capitate rays. *Aphrocallistes Bocagei*.

Fig. 18. Rosette with elongated axis and pointed rays. *Aphrocallistes Bocagei*.

N.B. The last two forms are rather sparsely mixed up with the globular forms figs. 6 & 7 in *Aphrocallistes Bocagei*.

Fig. 19. Rosette with elongated axis and straight pointed rays, often capitate. *Aphrocallistes beatrix*.

Fig. 20. Long-spined shaft peculiar to *Aphrocallistes beatrix*.

This and the foregoing form are mixed up together in *A. beatrix* without the forms 6 & 7, which are only found in *A. Bocagei*. They bear the relation in size represented in the figures (19 & 20); but 20 is much more plentiful than 19. Thus, while the forms 6 & 7 appear to pass into 17 & 18 in *A. Bocagei*,

fig. 19 (which is identical with the latter) appears to be a transitional form to fig. 20, which is the long-spined spicule peculiar to *A. beatrix*.

N.B. The dotted lines indicate that the spines themselves are microspined. Figs. 18-20 are all on the scale of 1-12th to 1-6000th of an inch.

Flesh-spicules of Hyalonema, &c.

Fig. 21. Birotulate, consisting of a sparsely spined straight shaft, terminated at each end by eight separate blades, which are recurved, dome-shaped towards the centre. *Hyalonema Sieboldii*, Gray, &c.

Fig. 22. Birotulate in a sexradiate form, showing its analogy to the "rosette." *Hyalonema Sieboldii*. Sparse.

N.B. The birotulate may have two, four, or six heads, according with the development of the elementary cell of the spicule into two, four, or six arms—that is, a simple shaft, a cross, or sexradiate.

In like manner, the rotulate heads may be absent, and the shafts thickened and covered with short, conical, vertical spines either at the extremities only or throughout (see Bowerbank's Brit. Spong. vol. i. pl. vi. figs. 153-157).

Fig. 23. Rosette with straight pointed rays, in which the arms have become enveloped by vitrified sarcodæ so as to form a spherical centre. *Euplectella cucumer*.

Fig. 24. Rosette with straight capitate rays, in which the same thing has taken place, but the vitrified mass has gone beyond the arms of the rosette: *a*, main fibre; *b*, portion uniting rosette to main fibre. *Dactylocalyx puniceus*.

N.B. The last two forms point out the transition of the rosette to the siliceous globules and stellates (which are also "flesh-spicules") in the Geodinidæ, &c.; while the junction of this rosette with the main fibre is the *only* instance in which I have met with a flesh-spicule involved in the skeleton-structure.

PLATE XIV.

Anchoring-spicules.

Fig. 1. Spiniferous anchoring-spicule of *Labaria hemisphærica*, Gray, showing form of head or free end: *a*, head; *b*, undulating line on head, which has its projecting curves prolonged into spines in *Euplectella* (see figs. 4 & 5); *c*, portion of shaft, whose upper or fixed end is smooth and attenuated; *d*, spines on shaft; *e*, position of cross on central canal.

Fig. 2. Smooth anchoring-spicule of *Labaria hemisphærica*, showing form of head or free end: *a*, position of cross; *b*, usual inflation of shaft just before expansion into head (here there is no undulating line on the head, which is more or less compressed); *c*, portion of the smooth shaft.

N.B. These two forms in *Labaria* are relatively magnified and taken from the larger specimens of their kind. The upper or fixed end of the shaft is not figured, neither is the intervening portion between it and that given; but the former is the same in all the anchoring-spicules, viz. smooth, attenuated, and firmly fixed in the sarcodæ of the body; while the latter or intervening

portion is spiniferous in the spined and smooth in the smooth anchoring-spicules.

- Fig. 3.* Spiniferous anchoring-spicule of *Meyerina claviformis*, Gray, showing form of head or free end: *a*, position of the cross; *b*, undulating line.

The only difference between this and the spiniferous anchoring-spicule of *Labaria* consists in the prominence and number of the undulations of the line on the head, too slight for specific distinction, although showing still more strongly that these undulations are prolonged into spines in *Euplectella*. Figs. 1-3 are all on the scale of 1-24th to 1-1800th of an inch.

- Fig. 4.* Spiniferous anchoring-spicule of *Euplectella aspergillum*, showing form of head or free end, where the spines or arms are lateral and much recurved: *a*, undulating line; *b*, end of central canal terminating in a lash of branches; *c*, position of the cross on central canal.

- Fig. 5.* The same, in which there are eight spines or arms uniformly arranged round the head, and based respectively upon the projections of *a*, the undulating line; *b*, position of the cross on the central canal.

Figs. 4 and 5 are on the scale of 1-12th to 1-1800th of an inch.

- Fig. 6.* Spiniferous anchoring-spicule of *Holtenia Carpenteri*, showing form of head or free end: *a*, position of the cross on the central canal. Here there is no undulating line, on account of the thinness of the head. Scale 1-24th to 1-1800th of an inch.

- Fig. 7.* Portion of the shaft of a spiniferous anchoring-spicule of *Holtenia Carpenteri*, showing the distant but still spiral arrangement of the spines: *a*, proximal end; *b*, spines; *c c c*, spines, made a little lighter to represent their being on the opposite side of the shaft.

- Fig. 8.* Portion of the shaft of a spiniferous anchoring-spicule of *Meyerina claviformis*, showing a more crowded, but still spiral, arrangement of the spines: *a*, proximal end; *b*, spines; *c c c*, spines on the opposite side of the shaft.

- Fig. 9.* Portion of the shaft of a spiniferous anchoring-spicule of *Hyalonema Sieboldii*, Gray, showing a still more crowded condition of the spines, which are here grouped into lines arranged round the shaft more or less in a continuous spire; also that they are supported on bracket-like projections of the shaft: *a*, proximal end; *b*, spines; *c c c c*, spines on the opposite side of the shaft; *d*, groups in continuous spiral; *e*, minute tubercles or aborted spines; *f*, spines broken off.

N.B. The specimen of *Hyalonema* from which this drawing was made was dredged up on board H.M.S. 'Porcupine' in the Atlantic Ocean, somewhere off the coasts of Great Britain and Ireland. The body is just $1\frac{1}{2}$ inch long, and the thickness of the spicule of course very small compared with that of an adult form, which, if relatively magnified, would exceed the whole width of the plate. Moreover the portion selected for mounting and drawing was taken out of the body and not from the stem, where the spines soon get rubbed off, although they may be afterwards frequently found lying on the shaft, as at *f*. The minute tubercles *e*, often accompanying the groups of spines, are the remains of such as never went beyond this stage of development, as the whole group of spines and tubercles commences in this way in the upper part of the anchoring-spicule

(viz. that enclosed within the body), diminishing upwards into nothing, and gradually passing into fully developed spines below.

Figs. 7-9 are on the scale of 1-12th to 1-1800th of an inch.

- Fig. 10.* Fragment of *Euplectella cucumer*, to show robust vertical spine of sexradiate spicule in the intervals between the circular openings: *a a a*, spines; *b b*, circular openings; *c*, lines of main spicules crossing each other. Diagrammatic.

PLATE XV.

Sub-skeleton spicules of the Aphrocallistidæ and Aulodictyon. (By "sub-skeleton" are meant the subordinate, not the staple, skeleton-spicules.)

- Fig. 1.* Scopuline spicule of *Aphrocallistes Bocagei*: *a*, head; *b*, shaft; *c*, sexradiate tubercle-inflation of neck; *d*, variety in which the shaft is somewhat extended beyond the inflation.

Fig. 2. Scopuline spicule of *Aphrocallistes beatrix*.

- Fig. 3.* Scopuline spicule of *Aphrocallistes Bocagei*. Occasional variety. Like the one in Schmidt's *Farrea fucunda* (*l. c.*).

N.B. The dotted lines indicate that the parts are microspined. Such is the case also with the ends of the shafts, which are here represented with smooth lines.

- Fig. 4.* Spino-capitate shaft or spicule of *Aulodictyon Woodwardii*; head umbonate, many- and small-spined. *a*, the same, with head plano-convex or plain, not umbonate.

- Fig. 5.* Spino-capitate shaft or spicule of *Aulodictyon Woodwardii*; head umbonate, spines few, and microspined on the inner aspect. *a*, the same, with plano-convex head.

N.B. These two forms appear to be the extremes of the same spicule, which are united by a variety of transitional ones. Figs. 1-5 are on the scale of 1-12th to 1-6000th of an inch.

- Fig. 6.* Nail-like skeleton-spicule of *Aulodictyon Woodwardii*, to show the way in which the four arms are accompanied by the spino-capitate spicules, with which they become included in the vitreous fibre (as shown in the following figure): *a*, shaft of nail-like spicule; *b*, arms; *c*, spino-capitate spicules. Diagrammatic.

- Fig. 7.* Portion of the vitrified fibre of *Aulodictyon Woodwardii*, showing that the spino-capitate spicules are included with the arms of the nail-like spicules in the vitrified skeleton: *a*, vitrified fibre; *b*, head of spino-capitate spicule, whose shaft is enclosed in the fibre; *c*, end of arm of nail-like spicule not enclosed. Scale 1-12th to 1-6000th of an inch.

- Fig. 8.* Fusiform spiniferous spicule, in which all the spines incline the same way. Common to the Aphrocallistidæ, *Aulodictyon*, and *Farrea occa* (see Pl. XVI. fig. 5); also to all the Hexactinellidæ possessing the birotulate spicule.

- Fig. 9.* Sexradiate spicule with one arm spined, feather-like. Common to the Aphrocallistidæ, *Aulodictyon*, *Sympagella nux*, and the Hexactinellidæ which possess the birotulate spicule. Scale 1-24th to 1-6000th of an inch.

- Fig. 10.* Sexradiate spicule in which each arm is more or less uniformly beset with long curved spines. *Aphrocallistes beatrix*, *Euplectellidæ*, and the Hexactinellidæ possessing the birotulate spicule.

The figure represents an unusually perfect form, as regards the

uniformity of spines, from *Aphrocallistes beatrix*. Scale 1-24th to 1-6000th of an inch. In general, it is a very ragged-looking half-developed spicule.

- Fig. 11. Portion of the commencing vitrification of the skeleton in a young *Aphrocallistes Bocagei*, not more than two twelfths of an inch in diameter, showing the enclosure of the sexradiate with spined feather-like arm among the other spicules; also the characteristic rosette: *a a*, spicules with feather-like arm; *b b*, other spicules; *c c*, vitrified sarcode spreading over the same; *d*, form of rosette. Scale 1-24th to 1-6000th of an inch.

N.B. This appears to be Schmidt's *Lanuginella pupa*. It is found growing on a branch of *Lophohelia prolifera* close to a living *Aphrocallistes Bocagei*, just as Schmidt has represented it growing in abundance on *Aphrocallistes Bocagei* itself (Atlantisch. Spongienf. pl. ii. fig. 1). It can only be confounded with the structure of *Sympagella nuc.*, Sdt., whose characteristic ladder-like vitreous fibre and the pappiform rosette, however, point out the distinction.

PLATE XVI.

Deciduous vitrified fibre.

- Fig. 1. *Aphrocallistes Bocagei*. Fragment of dead specimen dredged up from muddy bottom at the western entrance to the English Channel, in 725 fathoms, by H.M.S. 'Porcupine,' showing that the fibre is based on sexradiate spicules whose presence is rendered evident, after the fibre has become deciduous, by a process of absorption which, if not gone too far, leaves a perfect mould of the imbedded spicule. *a a*, spiniferous vitreous fibre; *b b*, moulds of spicules; *c c*, puncta indicating spines on the surface of the fibre.

This specimen, or the portions which were still filled with mud having been boiled in liquor potassæ, yielded an abundance of the rosette and scopuline spicule peculiar to *Aphrocallistes Bocagei*.

- Fig. 2. *Aphrocallistes Bocagei*. Fragment of dead specimen dredged up from muddy bottom on the north-west coast of Spain, on board the yacht 'Norma' (depth not mentioned), showing an enclosure of the scopuline spicule in the vitreous skeleton (Pl. XV. fig. 1): *a*, spiniferous vitreous fibre or skeleton; *b*, scopuline spicule.

Although this specimen was treated with liquor potassæ in the way above mentioned, it yielded neither rosette nor scopuline spicule. Thus, but for the presence of the latter involved in the skeleton, there might have been (and indeed was) a doubt as to the species. Figs. 1 and 2 are on the scale of 1-12th to 1-1800th of an inch. The difference in size is owing to the difference in the size of the fibre in the two specimens figured.

- Fig. 3. *Aphrocallistes Bocagei*. Fragment involved in the Gummina (*Corticium abyssi*) enveloping *Farrea occa*, which had grown on a dead *Lophohelia prolifera* dredged up from muddy bottom at the western entrance of the English Channel, on board H.M.S. 'Porcupine,' in 500 fathoms (see sketches of specimen, 'Annals,' 1873, vol. xii. pl. i. figs. 1 & 2), showing an enclosure of the sexradiate spicule with feather-like arm in the vitreous skeleton (Pl. XV. fig. 9): *a a*, spiniferous vitrified skeleton; *b*, sexradiate spicule with feather-like arm. Scale 1-12th to 1-1800th of an inch.

Fig. 4. Farrea occa. Fragment of deciduous skeleton from the last-named specimen showing that the smooth, lattice-like, subrectangular fibre is based on sexradiate spicules, as above mentioned: *a a a a*, lattice-like fibre, smooth; *b b b*, moulds of sexradiate spicules; *c c c*, short conical spiniferous extensions of the fibre, corresponding to the two arms of the sexradiate spicule, which projected vertically both inside and outside of the lattice-like structure. Scale 1-24th to 1-1800th of an inch.

Fig. 5. Farrea occa, fragment of, from the same specimen, showing an enclosure of part of a fusiform spined spicule in the vitreous fibre (Pl. XV. fig. 8): *a a*, smooth vitrified fibre; *b*, unimbedded half of fusiform spined spicule; *c*, imbedded half of the same. Scale 1-24th to 1-1800th of an inch.

This spicule is common in the Aphrocallistidæ, *Aulodictyon*, &c.

Fig. 6. Farrea occa, fragment of, from the same specimen, showing the enclosure of a scopuline spicule with pointed rays, like that figured by Schmidt as occurring in his *F. facunda*: *a a*, smooth vitrified fibre; *b*, mould of scopuline spicule (see a similar form found occasionally in *Aphrocallistes Bocagei*, Pl. XV. fig. 3).

Fig. 7. Farrea occa, fragment of, from the same specimen, showing the enclosure of another form of scopuline spicule with pointed rays; also a capitate spicule of a larger kind, often observed: *a*, smooth vitrified fibre; *b*, scopuline spicule; *c*, capitate spicule, in which the head seems in some instances to be flattened; the latter is introduced by Schmidt as an arm of a fossilized sexradiate spicule (tab. ii. f. 18, *op. cit.*).

Figs. 6 and 7 are on the scale of 1-24th to 1-6000th of an inch.

Fig. 8. Fragment of a large deciduous linear spicule (from *Geodia?*), to show the different forms caused by some eroding organism: *a*, simple circular depression; *b*, straight tubular form; *c*, the same, expanding into a globular termination in the substance of the spicule. Diagrammatic.

Fig. 9. The same, more magnified, to show that each of the forms is attended by a granuliferous cell something like the saprolegneous one (*Pythium entophyllum*) which bores its way through the cell-wall of *Spirogyra*, &c. *a a a*, granuliferous cell.

Appears to be of general occurrence, as I have specimens from the Agulhas Shoal at the Cape of Good Hope, dredged up by Dr. Wallich, from the dredgings of H.M.S. 'Porcupine' off the north coast of Scotland, and from the Seychelles, among the detrital mass of the specimen of *Euplectella cucumer* in the possession of Dr. A. Farre, &c. &c.

PLATE XVII.

New Species of Hexactinellidæ, &c.

Fig. 1. Farrea infundibuliformis, sp. n. *a*, funnel-shaped expansion; *b*, stem; *c*, reticulating lines of large, branching, vitreous fibre imbedding minute sexradiate spicules confusedly, fibre microspined; *d*, distinct or accessory portion of small vitreous fibre imbedding the same regularly; *e*, dotted line indicative of original expansion. Natural size.

Fig. 2. The same, portion of inner surface of funnel-shaped expansion,

- more magnified, to show:—*a a a*, reticulating lines of large vitreous fibre imbedding *minute* sexradiates confusedly, running over and covering in part *b b*, spinous lattice-like fibre imbedding *large* sexradiates regularly; *c c*, puncta indicating microspines on large vitreous fibre; *d d*, minute sexradiates. Diagrammatic.
- Fig. 3.* The same, minute sexradiate, more magnified, showing that one end is united to the vitreous fibre: *a*, minute sexradiate; *b*, vitreous fibre.
- Fig. 4.* The same. Rosette or flesh-spicule, also more magnified. Figs. 3 and 4 are upon the scale of 1-48th to 1-6000th of an inch.
- Fig. 5.* *Farrea densa*, sp. n. Fragment magnified on scale of 1-48th to 1-1800th of an inch. From deciduous portions, upwards of an inch in diameter, in the detrital mass enveloped by the anchoring-spicules of *Euplectella cucumer* from the Seychelles.
- Fig. 6.* The same. Portion of vitreous fibre of, more magnified, to show that the summit of the spines is mucronate: *a a*, fibre; *b b b*, mucronate spines; *c c*, mould of sexradiate spicule. Scale 1-12th to 1-6000th of an inch.
- Fig. 7.* *Arabescula parasitica*, sp. n., parasitic on vitreous fibre of *Aphrocallistes Bocagei*: *a a*, fibre; *b*, portion of *Arabescula*. From the specimen dredged up on board H.M.S. 'Porcupine' in 500 fathoms, above mentioned; also from the detrital mass of *Euplectella cucumer* on the fibre of the foregoing species. Scale about 1-32nd to 1-6000th of an inch.
- Fig. 8.* The same. *Internal* view, showing that there are distinct fronds, *a a*, with projections, *b*, on the body and main branches here and there, which appear to have been based upon the fibre on which the *Arabescula* was parasitic.
- Fig. 9.* The same. Portion much less magnified, which appears to have become separated from the fibre on which it had been parasitic. Natural size about 1-18th of an inch long by 1-180th of an inch in widest part.

LV.—*Descriptions of New Genera and Species of Heteromera, chiefly from New Zealand and New Caledonia, together with a Revision of the Genus Hypaulax and a Description of an allied New Genus from Colombia.* By FREDERICK BATES.

As there is considerable activity just now displayed in the publication of papers descriptive of the coleopterous fauna of New Zealand, I have thought it might be acceptable to give descriptions of all the species of New-Zealand *Heteromera* contained in my collection that appear to be new to science.

I have therewith incorporated a revision, together with descriptions of new species, of my genus *Hypaulax* and another, allied, new genus (*Astathmetus*) from Colombia.

Of the genus *Cilibe* (peculiar to New Zealand) I have established twelve species (ten of which are new, the *phosphugoides*, White, = *elongata*, Brême) and two supposed varieties.

The *Titæna Erichsoni*, White, proving upon examination to be generically distinct from *Titæna*, has caused me to notice the species of that genus (which are peculiar to Australia), and to describe some that are new; the New-Zealand group of three species forms a new genus (*Artystona*), the characters of which are fully stated in the body of the paper. I have also thought it interesting to describe the cognate group of species found in New Caledonia which constitute my genus *Callismilax*, some of the species of which have already been described by Montrouzier as belonging to the genus *Strongylium*.

The *Opatrinus convexus*, Fairmaire, described from examples coming from Wallis Island, occurs also in New Zealand; it will form the type of a new genus, totally removed from *Opatrinus*, and must be placed not far from *Scotoderus*, Perroud*.

The *Opatrum tuberculicostatatum*, White, evidently does not belong to that genus; as M. Miedel, of Liège, is at present engaged upon a monograph of the *Opatrides*, I leave this in his hands.

I have not as yet been able to consult the work by Blanchard containing the description of his *Bolitophagus angulifer* (from New Zealand); I, however, strongly suspect it to be identical with a species I have in my collection, and which I refer to the genus *Bradymerus*, Perroud: this genus is placed by its author with the *Bolitophagides*; to me it seems more natural to place it with the true *Tenebrionides*.

I have received from Mr. Pascoe examples of the *Selenopalpus cyaneus*, Fab.; these appear to me to be specifically identical with the type specimens (in my possession) of *S. chalybeus*, White. The characters of this genus lie rather in the form of the hind femora and tibiæ in the male (of which

* The description of *Scotoderus cancellatus*, Perroud, very accurately applies to examples of *Iphthimus cancellatus*, Montrouz., obtained from the collection of Doué. *Dechius*, Pascoe, is but another name for *Scotoderus*; and Perroud's, having priority, must stand. The mesocoxal cavities being widely open externally, revealing the trochantins, at once removes this genus from the position where Perroud has placed it, viz. in the vicinity of *Antimachus* (a genus of *Ulomides*); as I have previously stated (Trans. Ent. Soc. 1868, p. 265), its true position appears to me to be near to *Bius*. The *Scotoderus cancellatus* is very near to *aphodioides* (*Dechius*), Pascoe, but may at once be separated from the latter by its smaller size, more finely punctured prothorax, the more distinctly crenated striæ of the elytra (especially those by the suture), with the intervals distinctly punctulate. *Scissicollis* (*Dechius*), mihi, may instantly be distinguished from both by its sparsely punctured and not at all rugose head, the very strong (and punctured) groove down the middle of its prothorax, the remainder of the surface of this part being almost impunctate.

the former are strongly incrassated and somewhat arched, and the latter much thickened and strongly and acutely produced at the apex (within) than in the form of the last joint of the maxillary palpi (in the same sex), as we find in some male examples of the *Dryops* (*Ananca?*) *strigipennis*, White, a precisely similar form of palpus as in *Selenopalpus cyaneus*—i. e. the last joint strongly expanded, flattened, and with a deep semicircular excision at the outer edge.

The *Zolodinus zelandicus*, Blanch., has the very exceptional character of having the hind margins of the third and fourth ventral segments corneous*.

The *Mimopeus amaroides*, Pascoe, judging from description, will be the same as the *Cilibe elongata*, Brême.

The genus *Rygmodus*, White, has been shown by Mr. C. O. Waterhouse (Journ. of Entom. v. p. 194) to belong to the *Hydrobiidae*.

The number of the now described New-Zealand *Heteromera* amounts to but 40 species, distributed in 22 genera; there are doubtless many more to come.

Cilibe opacula, n. sp.

Somewhat broadly oval, but little convex; brownish black, the clytra usually with a tinge of dark chocolate- (or purplish) brown; subopaque. Head and prothorax finely and very closely punctured, the interstices (except on the epistoma and disk of prothorax) a little elevated and reticulate; epistoma broadly truncated in front, the angles rounded, the suture strongly marked at each side: prothorax deeply arcuately (sometimes slightly sinuously) emarginate in front; front angles prominent, subacute, slightly convergent; base more or less strongly bisinuate-emarginate; the hind angles more or less produced, acute, directed behind or sometimes a little outwardly, reposing on the shoulders of the elytra; sides gradually narrowing in a slight curve from base to apex, sometimes (♀?) subparallel from the base to a little beyond the middle, thence rapidly curvedly narrowed to the apex; usually they are very slightly sinuous in front of the hind angles; disk very moderately convex, lateral margins rather broadly expanded, a little reflexed or concave, and unequally thickened at the edges; base and apex more or less distinctly margined or thickened at each side, sometimes throughout at the apex; a more or less distinct, transverse, angulate impression at each side of

* It is the same in the genus *Calcar* and in another, allied but undescribed, South-American genus; these somewhat militate against the value of this as a great divisional character, as laid down by Drs. Le Conte and Horn.

the middle, close to the basal margin; scutellum transversely curvilinearly triangular, closely punctured: elytra more or less sinuate-truncate (and a little wider than base of prothorax) at the base; a space, more or less open, between the base of the elytra and base of prothorax; sides very slightly rounded, more or less gradually narrowed from the middle to the apex; expanded lateral margins wide, reflexed or concave, transversely and somewhat reticulately rugose-punctate, and studded with small granules; disk closely, finely, and rather uniformly punctured, the interstices (especially at the sides) a little elevated and reticulate and studded with indistinct minute granules; a series of narrow longitudinal costæ more or less indicated, and an irregular row of rugged foveæ, just within the expanded margin, not extending to the apex: underside brownish black, shining, finely punctured; flanks of prothorax more or less strongly (especially basally) longitudinally rugose, the underside of the expanded lateral margins being transversely rugose: legs dark brown, shining; femora finely and not closely punctured; tibiæ closely submuricately punctured, the anterior obliquely truncated at the outer side at apex; hind tibiæ quite straight; tarsi and antennæ reddish brown; joint 8 of the latter subpyriform, 9 and 10 a little transverse, subturbinate, 11 large, broadly rounded at apex.

Length $8\frac{1}{2}$ –9 lines; width of elytra $4\frac{1}{3}$ – $4\frac{3}{4}$ lines.

Hab. New Zealand.

There is a very great amount of individual variation in the species of this genus in the form of the prothorax (especially) and elytra, and in the amount and intensity of the punctuation &c. of their surface.

In one of the three examples of the present species before me (possibly a female, as similar differences exist in individuals of the other species whereof a series has been obtained), the form is more expanded or more broadly oval, the head and prothorax are broader in proportion to their length, the sides of the latter, instead of gradually narrowing in a slight curve from base to apex, are subparallel to a little beyond the middle, thence rapidly curvedly narrowed to the apex; besides the two ordinary foveæ at each side of the middle, at the basal margin, there is also a broad transverse line or depression, feebly arched, subparallel and near to the basal margin; the elytra are broader and less narrowed behind, and the base is squarely truncated; and the punctuation on the prothorax and elytra (especially on their disks) is more open.

Altogether the largest, most expanded and opaque, and least convex form in the genus.

Cilibe nitidula, n. sp.

Very near to the preceding, and of the same form, but smaller; the colour black; the entire upper surface much smoother, and shining; the punctuation finer and more open, the interstices less distinctly elevated and reticulate: the elytra do not present the shagreened appearance seen in the preceding; they are more, and very distinctly, convex behind the middle, and consequently more abruptly declivous behind; on the underside the punctuation and the rugosities on the flanks of the prothorax and on the abdomen are similar but stronger; the hind tibiæ are feebly but perceptibly sinuous; antennæ &c. as in *C. opacula*.

In the single example of this species before me, the head is distinctly impressed on the crown; the prothorax is gradually and slightly curvedly narrowed from base to apex; the apex is strongly arcuately (and feebly sinuously) emarginate, the front angles prominent, subacute, and directed forwards; the base is strongly bisinuate, the hind angles prominent, acute, and slightly outwardly directed; the lateral margins are expanded (but less broadly so than in the preceding) and slightly reflexed or concave, the edges irregularly thickened, and the base and apex margined at each side only. There is a large, distinct, outwardly curved impression at each side the disk, extending from near the middle to the basal margin; the scutellum is transversely curvilinearly triangular and closely punctured; the elytra are distinctly convex behind the middle, and are consequently more abruptly declivous behind than in *C. opacula*; the base is feebly sinuately truncated, and between it and the base of the prothorax (and the hind angles of the latter, which repose on the shoulders) there is a decided open space, as in *C. opacula*; the lateral margins are expanded (but less broadly so than in the preceding species) and concave, and there is the row of rugged foveæ just within this margin, as in *C. opacula*; the disks of the elytra also present traces of numerous narrow longitudinal costæ; the underside and legs are of a deep brownish black, shining; the antennæ, tarsi, and palpi are reddish brown.

Length $7\frac{1}{2}$ lines; elytra, width $3\frac{5}{8}$ lines.

Hab. New Zealand.

Cilibe otagensis, n. sp.

Very close to *C. opacula*, and difficult intelligibly to define in what it differs from that species; it is, however, distinctly narrower or oblong-oval, usually smaller, paler, more convex, the base of the prothorax more closely applied to the base of

the elytra, distinctly more shining, the punctuation &c. on the elytra coarser, more confluent and confused, somewhat ruggedly so at the sides; the sides of the prothorax more rounded, more incurved at the base, the median basal lobe more prominent; the base, consequently, has not that appearance of being bisinuate-emarginate as is the case in *C. opacula*.

Head closely punctured, the punctures coarsest and somewhat confluent on the front, between the eyes, where there are also usually two more or less marked, foveate depressions: prothorax more or less strongly transverse; sides more or less regularly rounded, more narrowed in front than behind, always distinctly and more or less sinuously incurved before the hind angles; apex deeply arcuate-emarginate, the angles prominent, subacute, and usually directed forwards; base bisinuate, the angles more or less prominent and acute, reposing on the shoulders of the elytra, and directed backwards; disk moderately convex, very closely (save on the centre) punctured, the interstices a little elevated, and more or less reticulate, at the sides; a transverse depression subparallel and near to the base, and an angulate fovea at each side, close to the basal margin (as in ♀? of *C. opacula*); sides moderately expanded, the edges unequally (not uniformly) thickened; scutellum as in *C. opacula*: elytra oblong-oval, base sinuate-truncated; disk moderately convex, closely and more or less confluent punctured; the interstices (especially at the sides) elevated, minutely granulose, reticulately confluent, sometimes assuming the form of irregular nodules, at others of small umbilicated tubercles; the ordinary series of narrow costæ and the row of foveæ within the side-margins more or less apparent; sides rather strongly expanded, concave, transversely reticulately rugose-punctate and granulous: underside, legs, antennæ, &c. as in *C. opacula*.

Length $7\frac{1}{4}$ – $8\frac{1}{4}$ lines; width of elytra $3\frac{3}{5}$ –4 lines.

Hab. Otago, New Zealand. Four examples.

Var. ? grandis.

Larger (length 9 lines; width of elytra $4\frac{1}{5}$ lines); the elytra less convex, distinctly more gradually declivous behind; the punctuation &c. (on the elytra especially) coarser, the punctures larger, the interstices still more elevated and more uniformly reticulate; the apical emargination of the prothorax distinctly sinuous; the tibiæ (especially the anterior) distinctly less closely punctured, and the entire upper surface of a browner colour.

Hab. New Zealand. One example.

Cilibe elongata, Brême, and *C. phosphugoides*, White.

Examples of *C. elongata* obtained from the collections of Reiche and Doué (presumably authentic exponents of the species) do not differ from *C. phosphugoides* except in the form of the prothorax, which in the former has the sides more obliquely narrowed anteriorly, and the elytra, which are more acuminate behind. Experience has shown us that these differences possess no true specific value in this genus: *C. phosphugoides* must consequently be sunk under *C. elongata*.

This species is much smaller than any of those preceding; the form is more or less elongate-oval; prothorax shining black; the expanded lateral margins paler; the elytra are of a more or less deep purplish or chocolate-brown. Head convex between the eyes, trapezoidal in front, with the borders usually dark ferruginous, more or less strongly, closely, and sometimes rugosely punctured; epistoma convex, more or less distinctly arcuate-emarginate in front, the sutural impression more or less distinct: the form and punctuation of the prothorax is variable; it is always of a shining black, convex, a depression on the middle near the base, another smaller at each side at the basal margin; usually very finely and not closely punctured on the disk, the punctures more crowded at the sides and finely rugulose, more or less distinctly granulous on the intervals; lateral margins moderately expanded and concave, the edges finely and uniformly thickened; apex deeply emarginate, front angles more or less acute, and usually a little convergent, sometimes directed forwards; base closely applied to the base of the elytra, bisinuate, hind angles prominent, reposing on the shoulders of the elytra, acute, usually a little outwardly directed; ordinarily the sides are a little sinuously contracted posteriorly, but sometimes they are subparallel (in this latter case the base is as wide as the base of the elytra); anteriorly they are always more strongly contracted, sometimes very gradually (obliquely) from behind the middle, at others more abruptly (curvedly) from the middle or even before the middle; scutellum transversely triangular, punctured: elytra oval, more or less acuminate behind, convex, subopaque, of a dark purplish brown; frequently the base (narrowly), the suture, the expanded margins, and the scutellum are of a reddish tinge; base sinuous, and generally a little wider than base of prothorax; expanded lateral margins narrow, concave, not distinctly reaching the apex; disk with numerous more or less distinct longitudinal costæ, irregularly punctured, finely rugose (most strongly at the sides), and

studded with very distinct, shining, black granules: underside shining black, finely punctured; flanks of prothorax longitudinally wrinkled, the lateral margins transversely wrinkled; abdomen finely longitudinally rugose; epipleural fold and legs dark reddish brown, sometimes ferruginous; antennæ, palpi, and labrum (sometimes) ferruginous.

Length 6-6½ lines; width of elytra across the middle 2¾-3¼ lines.

Hab. New Zealand. Six examples.

It is doubtless in error that De Brême has reported this species as from "New Guinea."

Var. granulipennis.

A little smaller (5½ lines); head and prothorax (at the sides) less closely punctured, the punctuation nowhere rugosely confluent; prothorax gradually curvedly narrowed from the hind to the front angles, median basal lobe less prominent, the base consequently appears bisinuate emarginate; the interstices (between the punctures) not perceptibly granulose; scutellum a little shorter, less distinctly pointed behind; elytra scarcely sinuous at the base, the punctuation less varied, the punctures distinctly larger and rounder.

Hab. New Zealand. One example.

Cilibe Pascoei, n. sp.

Near to *C. elongata*; more broadly oval. Head closely punctured, somewhat reticulately so between the eyes, the interstices being also finely punctulate; epistomial suture well marked throughout: prothorax moderately convex, black, subopaque; sides subangulately rounded, more strongly (and somewhat obliquely) narrowed in front than behind, distinctly and very feebly sinuously narrowed from behind the middle to the hind angles, which are directed backwards; base bisinuate, closely applied to the base of the elytra; apex deeply subangularly emarginate, front angles produced, acute, directed forwards; disk not closely punctured, the interstices not granulose, but sparsely finely punctulate, basal impressions as in *C. elongata*; lateral expanded margins wide, a little concave, and (together with the sides of the disk) rather strongly reticulately rugose-punctate, the edges unequally (not uniformly) thickened: scutellum strongly transversely triangular, punctured: elytra convex, very dark purplish brown, the suture and narrowly at the base inclined to reddish; base subtruncate; disk finely irregularly punctured, the costæ but little evident except at the base, and, together with the suture, smoother than the intervals; indistinctly, except at the apex,

minutely granulose; intervals between the costæ irregularly impressed with much larger punctures, and feebly reticulately rugose, most distinctly so at the sides; lateral expanded margins wide, distinctly extending to the apex, concave, faintly punctured: underside shining black; legs and antennæ dark reddish brown.

Length $6\frac{1}{4}$ lines; width of elytra across the middle $3\frac{1}{4}$ lines.

Hab. Pitt's Island. A single example.

Easily separable from *C. elongata* by the relatively broader form, the subangulately rounded sides of prothorax, the peculiar punctuation of the head &c., the much broader expanded lateral margins, which in the elytra are distinctly broadly continuous to the apex.

Cilibe humeralis, n. sp.

Oblong or oblong-oval; black; elytra sometimes with a slight purplish-brown tinge, slightly shining, moderately convex. Head moderately punctured, the punctures not crowded, the interstices sometimes sparsely minutely punctulate: prothorax distinctly less transverse than in any preceding species, sides more or less strongly and obliquely narrowed from behind the middle, slightly sinuously narrowed behind; hind angles acute, slightly outwardly directed; disk finely punctured, the punctures more crowded at the sides, the interstices not perceptibly granulose, sparsely minutely punctulate; a transverse, slightly bowed, impressed line at each side the middle near the basal margin, and sometimes a rounded fovea at each side the median line near the middle of the thorax; lateral margins moderately expanded, a little concave, rugosely punctured, finely and somewhat uniformly thickened at the edges; apex deeply emarginate, front angles prominent, acute, directed forwards: elytra slightly emarginate at the middle of the base, obliquely and slightly arcuately truncated at each side; humeral angle very prominent, slightly rounded, reflexed, and deeply concave within the angle; disk finely rugulose, studded with small granules, rather closely and finely but irregularly punctured, the punctures largest and most crowded (and frequently, especially at the base, more or less run together, forming indistinct irregular foveæ) between the costæ; these very indistinct; expanded lateral margins rather broad at the base, gradually narrowing behind and scarcely extending to the apex, concave in their basal portion: underside shining, pitchy black; legs and epipleural fold with a reddish tinge; flanks of prothorax and sterna more or less strongly reticulately rugose and granulose; antennæ, palpi, and labrum (sometimes) ferruginous; anterior border of epistoma rufescent.

Length $5\frac{1}{2}$ –6 lines; width of elytra across the middle $2\frac{2}{3}$ –3 lines.

Hab. New Zealand. Four examples.

In the ♀? the form is slightly more expanded, the prothorax slightly more transverse, the sides less strongly narrowed anteriorly, and the punctuation of the elytra a little more open.

The three species last described are very near to each other; but I think there is ample justification, at present at least, in holding them distinct. The species last described is of a more oblong form (especially in the ♂?) than the others; the prothorax has not the same glossy blackness as in *elongata*; and the elytra are less opaquely roughened, more closely punctured, and much less distinctly granulose; the humeral angle is much more prominent, the lateral expanded margins broader and strongly concave within the humeral angle. From *Pascoei* it may be known by its narrower and more oblong form, finer and closer punctuation, and more narrowly expanded lateral margins.

Cilibe thoracica, n. sp.

In this species the prothorax is still more decidedly elongated (but is yet wider than long) than in the preceding. Form elongate-oval; entirely of a dark brownish black, subopaque. Head and prothorax (save on the middle of the disk) closely punctured, the punctures rounded, a little more crowded at the sides of the latter, the interstices distinctly punctulate; sides of prothorax gradually and but slightly curvedly narrowed from near the hind angles to the apex, distinctly incurved at the hind angles, which are more produced than in *humeralis*, and slightly convergent or directed inwardly; apex deeply emarginate, front angles subacute, slightly convergent; expanded lateral margins moderately wide, scarcely concave, the edges finely and almost uniformly thickened; a rather slight sublunate impression at each side of the middle, close to the basal margin, and another, still less distinct, rounded fovea above and in front of them: scutellum transversely triangular, punctured: base of elytra as in *C. humeralis*, the humeral angle still more produced (but not strongly concave within the angle), sides with a very distinct sinus behind the humeral angle; disk slightly roughened or rugulose, indistinctly (except at apex) granulose, moderately punctured, obscurely foveate-punctured between the costæ (when viewed obliquely); costæ very feeble; expanded lateral margins wide (and concave) at the base, gradually narrowed behind; underside &c. as in *C. humeralis*.

Length $5\frac{1}{4}$ lines; width of elytra across the middle $2\frac{2}{3}$ lines.

Hab. New Zealand. One example.

The punctuation on the head and on the sides of the prothorax is more crowded, and the interstices more closely and distinctly punctulate than in *C. humeralis*; the sides of the thorax are distinctly incurved at the hind angles; the punctuation on the elytra is less defined; and the form is elongate-oval.

Cilibe brevipennis, n. sp.

Smaller, and of a more briefly oval form, than any other species in the genus. Black, usually most nitid on the prothorax, the elytra frequently of an obscure purplish-brown hue; sometimes the entire upper surface is of a decided reddish-brown colour. Head and prothorax finely and closely punctured, the punctuation very dense (and frequently finely reticulately rugose) on the former and on the sides of the latter; the interstices more or less distinctly minutely punctulate: prothorax transverse, apex deeply emarginate; front angles prominent, more or less acute, usually directed forwards, sometimes slightly convergent; sides anteriorly very gradually narrowed from the middle (sometimes from behind the middle), posteriorly subparallel, or slightly incurved (in one example they are distinctly excurved at the hind angles, which are consequently somewhat outwardly directed), hind angles more or less produced, acute, directed backwards; lateral margins moderately expanded, more or less concave; three more or less distinct impressions at the base, and sometimes two indistinct foveate impressions on the middle, at each side of the median line: elytra short, moderately convex, base feebly sinuous; humeral angle not distinctly prominent as in *C. humeralis* and *thoracica*; sides subparallel or slightly rounded, not sinuous behind the humeral angle; expanded lateral margins rather broad at the base, narrowed behind, more or less distinctly extending to the apex, strongly concave at the base (especially within the humeral angle) as in *C. humeralis*; punctuation &c. almost as in *C. thoracica*, but (especially at the sides and apex) the surface is slightly more roughened, more distinctly granulose, and the punctuation a little finer and closer: underside, &c. as in *C. humeralis*.

Length $4\frac{1}{2}$ – $5\frac{1}{2}$ lines; width of elytra $2\frac{1}{3}$ – $2\frac{3}{4}$ lines.

Hab. New Zealand. Five examples.

Cilibe granulosa, De Brême.

Easily recognizable by its usually squalid aspect, and coarsely sculptured and closely granulose surface. The humeral angle is more or less strongly prominent; the expanded lateral margins of the elytra broad and concave; and there is at the sides a more or less distinct sinus behind the humeral angle; the costæ on the elytra are more conspicuous (especially at

the base) than in any of those preceding. In some examples we can perceive on the elytra a very minute pubescence.

Length $5\frac{1}{4}$ – $6\frac{3}{4}$ lines; width of elytra $2\frac{1}{2}$ – $3\frac{1}{2}$ lines.

Hab. New Zealand. Six examples.

Cilibe rugosa, n. sp.

Near *C. granulosa*, but distinctly narrower; the expanded lateral margins of the elytra very narrow, not concave, except slightly at the base; the surface of the elytra distinctly punctured, reticulately rugose, not granulose, or granulose-punctate, and with three distinctly prominent costæ on each; humeral angles not prominent, the sides not sinuous behind them; and the anterior tibiæ have the outer apical angle strongly dentiform.

From the following (*C. tibialis*, the only other species having the outer apical angle of the anterior tibiæ dentiform) it may be known by its different form, somewhat squalid, opaque surface, the elytra distinctly rugose, costate, and pubescent; the prothorax more deeply emarginate at apex, the front angles more prominent, the hind angles not acutely produced, &c.

Brown, slightly squalid; head (except the epistoma) and prothorax coarsely punctured, the interstices narrow, appearing a little elevated, and a good deal broken up on the front of the head and the base of the prothorax, allowing the punctures to run confusedly together. Head trapezoidal in front; sides of epistoma almost completely continuous with the antennary orbits, the angles slightly rounded: prothorax arcuate-emarginate in front, the angles a little produced, subacute, directed forwards; sides regularly but moderately rounded, more narrowed anteriorly than behind, a little sinuous in front of the hind angles, these latter not acutely produced, slightly divergent; the three impressions by the base as ordinary, the two outer strongly marked, and another rounded depression on the middle, at each side of the median line: elytra rather strongly narrowed behind, humeral angles not prominent; sides slightly rounded from the humeral angles, not at all sinuous behind them; the surface somewhat coarsely punctured, very distinctly reticulate-rugose, and very thinly clothed with a short, minute, rigid, pale golden pubescence, on each elytron three very distinct costæ, with a much fainter one between them; these send out irregular, lateral, elevated branches, which cause the reticulate-rugose appearance before mentioned, the interstices being somewhat squalid; the punctuation, costæ, &c. obsolete at the apex; lateral expanded margins very narrow, and concave only at the base: underside brown, closely and somewhat coarsely punctured, much more distinctly pubescent (especially on the

abdomen) than on the upperside ; flanks of prothorax sparsely, pronotum closely and coarsely, rugose-tuberculate : legs rather long, reddish brown ; hind tibiæ a little sinuous, front tibiæ with the outer apical angle strongly dentiform ; tarsi elongate ; antennæ and palpi ferruginous.

Length $5\frac{1}{3}$ lines ; width of elytra $2\frac{1}{3}$ lines.

Hab. New Zealand. One example.

Cilibe tibialis, n. sp.

Oblong or (rarely) oblong-oval, convex, entirely dark brown, slightly shining, anterior border of the head more or less rufescent ; epistoma broadly emarginate in front, the sides distinct from the antennary orbits, the angles broadly rounded : head and prothorax rather coarsely and closely punctured, the interstices on the middle of the former, and on the sides of the latter, appearing a little elevated and somewhat reticulate : prothorax strongly transverse, rather broadly and feebly, and usually a little sinuously, emarginate at apex ; front angles not at all prominent, convergent ; sides more or less rounded (ordinarily they are well rounded), more or less strongly incurved anteriorly from the middle, less strongly and a little sinuously posteriorly ; hind angles acutely produced, divergent ; lateral margins not distinctly expanded, the edges very finely and almost uniformly thickened ; the three impressions by the basal border always obscure, sometimes obsolete : elytra oblong, or oblong-oval, the punctuation finer than on the prothorax and with a disposition to run together between the costæ ; costæ more or less distinct ; the intervals, or interstices, more or less distinctly reticulate-rugose at the base, sides, and apex ; lateral margins narrowly expanded, usually not distinctly extending to the apex, strongly reflexed at the base, rather coarsely transversely rugose-punctate : flanks (save the lateral margins) of prothorax and sides of abdomen longitudinally wrinkled ; flanks of meso- and metasterna coarsely punctured ; abdomen finely punctured ; underside shining black ; epipleural fold and legs reddish brown, or piceous ; antennæ elongate, and, together with the palpi, ferruginous ; outer apical angle of the anterior tibiæ strongly dentiform.

Length $6-7\frac{1}{2}$ lines ; width of elytra $2\frac{1}{3}-3\frac{3}{4}$ lines.

Hab. New Zealand. Seven examples.

The apical emargination of the prothorax is distinctly more feeble in this species than in any of the others, and the front angles least prominent ; it is also the most convex, and, ordinarily, the most oblong, form.

Cilibe impressifrons, n. sp.

Oblong- or elongate-oval; ordinarily black, the elytra sometimes dark brown, the entire insect sometimes reddish brown; most nitid on the prothorax; rather convex: head rather long, rather finely and closely punctured; a distinct, transverse, slightly bowed impression across the front between the eyes: epistoma broadly truncated in front, the suture rather strongly marked and angulate at the sides; prothorax very finely and, on the middle, remotely punctured; a strong angulate impression at each side close to the basal margin, and sometimes an obscure transverse impression between them; apex moderately emarginate; anterior angles subacute, directed forwards; sides more or less regularly rounded, more contracted anteriorly than posteriorly, occasionally a little sinuous before the front angles; hind angles more or less (sometimes almost imperceptibly) outwardly produced, acute; lateral margins very slightly expanded, a little concave, the edges moderately and almost uniformly thickened: elytra oblong-oval, feebly sinuous at the base; shoulders more or less distinctly rounded; punctuation, &c. almost as in *C. tibialis*, but the interstices, especially at the sides, are more distinctly rugulose; expanded lateral margins narrow, almost obsolete (or strongly narrowed) at the base, scarcely perceptibly continued to the apex, a little concave, the edges sometimes slightly reflexed at the base: markings on the underside similar, but much feebler, to those in *C. tibialis*; legs, antennæ, and epipleural fold reddish piceous; anterior tibiæ acute (but not at all dentiform) at the outer apical angle.

Length $6\frac{1}{2}$ –8 lines; width of elytra $2\frac{4}{5}$ – $3\frac{2}{5}$ lines.

Hab. New Zealand. Five examples.

The oblong or elongate-oval form, the transverse impression between the eyes, the almost smooth prothorax in contrast with the somewhat coarsely sculptured elytra, the scarcely expanded sides of the prothorax, and the lateral expanded margins of the elytra obsolete at the base, will serve to distinguish this species.

[To be continued.]

LVI.—On the Great Northern Falcons.

By ALFRED NEWTON, M.A., F.R.S., &c.

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

GENTLEMEN,

The much-debated matter of the Great Northern Falcons has so confessedly received its chief elucidation from papers

in your Journal and its predecessor, that I beg the favour of making a few observations on Mr. Sharpe's recently published remarks (Proc. Zool. Soc. 1873, pp. 414-419), in which he has reopened the question thought by the best-informed ornithologists to have been settled nineteen years ago by Mr. John Hancock (Ann. & Mag. N. H. ser. 2, xiii. pp. 110-112). Such of your readers as take any interest in the subject are aware that, in 1833, Mr. Hoy (Mag. N. H. vi. pp. 107-110) pointed out the distinctness of the Norwegian form, to which the name of Gyrfalcon properly applies; and that, in 1838, Mr. Hancock (Ann. N. H. ii. pp. 241-250) established the difference of the two birds which mainly have their respective homes in Iceland and Greenland, being, however, accidentally led into a pardonable error, which he afterwards (*loc. secundò cit.*) corrected. This error was one prevalent at the time, and even subsequently, among those who had had but few opportunities of observing (or of knowing from those who had observed it) the fact that these Falcons assume their mature plumage at the first moult. This fact has been proved by repeated and continuous observations, carried on not only in this country but abroad, and not only in zoological gardens, where inattention to the requirements of the captives might not impossibly affect the due course of nature, but in falconers' mews, where the birds are kept in the very highest state of health and condition. It is, however, denied by Mr. Sharpe, who falls back on the old and, I may say, exploded belief that these Falcons continue to change the character of their plumage as they advance in age. I have read his paper carefully, and he has obligingly allowed me to examine minutely the score of specimens in the British Museum on which he partly rests his theory; but I am unable to find the slightest ground for doubting the truth of Mr. Hancock's statement published, as before mentioned, in this Journal in 1854—a statement, I must add, which is strictly in accordance with the traditions of falconers, than whom, in such a matter as this, there can scarcely be better authorities. Furthermore, I have first and last examined some hundreds of specimens with the same result; for the subject is one in which I have long taken great interest; and I therefore desire to protest against the retrograde opinion now resuscitated by Mr. Sharpe.

I am unwilling to trespass too much on your space, or I would comment on some others of Mr. Sharpe's *dicta* in the same paper. I will content myself with two remarks. "No one," he says, "therefore, can hope to say positively what Holböll's *Falco arcticus* really was." Now this supposed species was long ago perfectly well known; for specimens

received immediately from him, and bearing that name on their labels, existed and perhaps even still exist, though unfortunately not in the British Museum. Several of such specimens I, in former years, have examined (a good many more, indeed, than Mr. Sharpe has ever seen); and I can confirm the suggestion made more than ten years since (Ibis, 1862, p. 50, note) that Holböll's *F. arcticus* was founded upon the adults of the Greenland and of the Iceland form, under the mistaken idea that the latter were the young of the former. That Mr. Sharpe's "new species" is "as distinct from the true Iceland Jer Falcon as is the Jer Falcon of Norway," can, I think, be hardly likely; for I have not been able to detect any proportional difference in the Greenland form (*F. candicans*) and the Icelander (*F. islandus*), while the "new species" is obviously intermediate between them. On the other hand, the difference in proportion between the Icelander and the real Gyrfalcon (*F. gyrfalco*) is, as I have elsewhere shown (Yarrell's Brit. Birds, edit. 4, i. pp. 47, 48), very considerable.

I am, &c.,

ALFRED NEWTON.

Magdalene College, Cambridge,
November 20, 1873.

LVII.—*Descriptions of three new Species of Asiatic Birds.*

By ARTHUR, Viscount WALDEN, P.Z.S., F.R.S., &c.

Alcedo rufigastra, n. sp.

Chin and throat creamy white, washed faintly with rufous; remainder of under surface, the under tail-coverts, and wing-coverts deep bright rufous; spot before the eye rufous, paler in some than in others; feathers of the head black, with a penultimate bright blue band, those of the cheeks all bright blue; back and upper tail-coverts bright blue; wing-coverts black, washed with blue, each feather tipped with bright blue; scapulars and rectrices black, washed with blue.

Wing 2.5 inches, tail 1.62, bill from nostril 1.37.

Described from three male examples obtained in the island of South Andaman by Lieutenant R. Wardlaw Ramsay.

This is a well-marked form, intermediate between *A. moluccensis* and *A. asiatica*. Above it nearly resembles the first; underneath it is undistinguishable from the last.

Pomatorhinus ochraceiceps, n. sp.

Lores black; ear-coverts brown, washed with ochreous;

supercilium (commencing at the base of the maxilla and reaching to the sides of the neck), chin, cheeks, throat, breast, and shoulder-edge pure unsullied white; crown and nape bright ochreous ferruginous; back and upper tail-coverts ochreous olive; wings when closed ochreous brown; middle rectrices brown, washed with ochreous, remainder with outer webs coloured like the middle pair; inner webs pure brown; the terminal portion of all the rectrices hardly tinged with ochreous; abdomen, flanks, thigh, and under tail-coverts ochreous brown, the ventral region exhibiting a brighter ferruginous tint; bill yellow, probably red in the fresh skin.

Wing 3·62 inches, tail 4·87, tarsus 1·25, bill, from nostril (in a straight line) 1·00.

Hab. Kareen Hills, Burma.

Munia fumigata, n. sp.

Above dark brown, deeper on the head; rump white; quills above and externally deep brown, on the borders of the inner webs pale tawny rufous, most developed on the secondaries and tertiaries; tail jet-black, the middle pair of rectrices being slightly elongated; chin, throat, and cheeks concolorous with the head; ear-coverts brown, with pale edgings; breast, abdomen, and flanks dingy white, the breast-feathers with brown spots; thigh and under tail-coverts brown, with rusty margins.

Wing 2·00 inches, tail 1·75, tarsus 0·50.

Described from examples obtained by Lieutenant R. W. Ramsay in the island of South Andaman. Nearly allied to *M. acuticauda*, Hodgs., but to be readily distinguished by the absence of pale shafts to the dorsal plumage.

LVIII.—*Reply to Dr. J. E. Gray's Observations on certain Species of Sponges described in the 'Proceedings of the Zoological Society' for 1873.* By Dr. J. S. BOWERBANK, F.R.S. &c.

DR. GRAY has made so many inaccurate assertions in his observations on my descriptions of some sponges in the 'Proc. Zool. Soc.' for 1873, that I must request space to correct his misapprehensions on these subjects. Had he confined himself to legitimate criticisms on the subject, I should not have thought it necessary to controvert his hastily formed opinions. In these explanations I shall follow the order in which Dr. Gray has treated these matters in the 'Annals and Magazine of Natural History' for September 1873.

Leuconia glomerosa, Dr. Gray says, "is the same as the species I long ago described and figured under the name of *Aphroceras alcornis* (P. Z. S. 1858, p. 113, t. x)." I can only say that I have carefully examined at the British Museum the specimen presented by Dr. Harland, and its structure is specifically distinct from my *L. glomerosa*. In truth, any one looking at the figures of the two would at once come to the conclusion that they were different species.

Ciocalypta Tyleri.—I am certainly astonished that Mr. Carter and Dr. Gray cannot see the remarkable anatomical differences in structure of the genera *Halichondria* and *Ciocalypta*. I can only refer them to the 'Philosophical Transactions' for 1862 (for *Ciocalypta*, page 1195, tab. xxiii. figs. 4 & 5, and for *Halichondria* to page 1113, tab. xxxiii. figs. 1 & 5) to disabuse them of their very hasty and inaccurate conclusions.

As I have given my reasons, in the third volume of the 'Monograph of British Spongiadæ,' for disagreeing with my friend Mr. Norman in not adopting his genus *Oceanapia*, I shall not trouble Dr. Gray on that subject.

Dr. Gray writes in page 267 as follows:—"Mr. Carter informs me that the *Haliphysema tubulatum* (P. Z. S. 1873, p. 29, t. vii.) is a massive form of his *Dictyocylindrus* of the British coast." In this short sentence there are two errors. In the first place, the skeleton-structure of *Haliphysema tubulatum* is a series of hollow membranous tubes, and the structure of *Dictyocylindrus* is essentially that of a solid cylinder composed of closely compacted spicula. In the next place, the genus *Dictyocylindrus* was established by me, not by Mr. Carter (see 'Philosophical Transactions of the Royal Society' for 1862, p. 1108). Mr. Carter can scarcely be obliged to Dr. Gray for such palpable misstatements.

Spongionella Holdsworthii.—Dr. Gray's style of treating his brethren in the study of natural history is very off-handed and magisterial. In treating of this sponge (p. 266) he writes:—"This sponge has been formed into a genus under the name of *Phyllospongia*. It has very little affinity and quite a different structure to *Spongionella pulchra*, which is considered the type of the genus." Here, again, Dr. Gray is, as usual, very inaccurate. In the first place, there is no such species as *Spongionella pulchra* as the type of the genus: the type specimen of the genus is in my possession, and its specific name is not *pulchra* but *pulchella*; and its structural peculiarities and the mode of the arrangement of its skeleton are in perfect accordance with the corresponding organs of *S. Holdsworthii*, as any one may perceive by comparing the skeleton figure of

S. pulchella, represented in plate lxxiv. fig. 10, 'Philosophical Transactions of the Royal Society' for 1862, with the corresponding representation of the skeleton-structure of *S. Holdsworthii* (Proc. Zool. Soc. 1873, pl. vi. fig. 7). There is a slight difference in the size of the fibres in the two species, but not in the mode of their arrangement.

If it will be any satisfaction to Dr. Gray, I will explain to him my reasons for designating the Ceylon sponge *Spongionella Holdsworthii*. Esper, and most of the old writers on natural history, had but one genus for the whole of the Spongiadæ—that of *Spongia*; and their determinations of species were based on external characters only. The consequence has been such an inextricable confusion, that a satisfactory determination or recognition of their species can scarcely ever be arrived at.

In the first place, the Ceylon sponge is not a *Spongia*, but a *Spongionella*. Esper's *Spongia papyracea* tab. lxxv. and *Spongia papyracea* tab. lxxv. A have every appearance of being separate species, as far as we can judge by the form and texture represented; and independent of the variations in form, substance, and external characters in these two, there are several British species, and a very considerable number of African and Australian ones, in my possession that, regarding only form and substance, would quite as readily serve as the types of Esper's figures as those brought home by Mr. Holdsworth. Esper's figures exhibit no structural characters by which a species can be satisfactorily determined. I thought therefore that it was most for the interests of science that Mr. Holdsworth's sponge should stand upon its own merits, and that not only the best type of its average external form, but also its anatomical structure should be accurately represented and described, so as to avoid future misconceptions on the subject.

An equal degree of careless error pervades his criticism of the sponge I have described in the same report on Mr. Holdsworth's Ceylon sponges as *Isodictya Donnani*. No one who really knows the structure of the genus *Isodictya* can fail to recognize it in figure 3, pl. vi. Proc. Zool. Soc. Nor can the veriest tyro in sponge-anatomy for a moment imagine it to be a *Dictyocylindrus*. I really cannot imagine that Mr. Carter has justified such wild statements on that subject as Dr. Gray has attributed to him.

Dr. Gray has for the third time, in the 'Annals and Magazine of Natural History' for September last, ventilated his remarkably visionary scheme of arranging the Spongiadæ by the forms of their spicula. As I have criticised his very im-

practicable scheme in my paper in the 'Proceedings of the Zoological Society' for 1868 (p. 118), entitled "Observations on Dr. Gray's 'Notes on the arrangement of Sponges, with the description of some new Genera,'" I should not have taken any notice of his paper had he not repeated himself for the second or third time in endeavouring to enhance himself in his own and others' esteem by very considerably deploring my shortcomings in anatomy and physiology:—"as Dr. Bowerbank had no preliminary study of anatomy, many of his ideas are most crude and not consistent with physiological knowledge." It is a well-known legal instruction to counsel, that "if you find that you really have no case, then abuse plaintiff's attorney." A similar course seems to be that adopted by Dr. Gray. It is very true that I did not attend the lectures at which Dr. Gray attained his knowledge of anatomy and physiology in his youth, and that I studied those sciences in my own way, and that the results of our respective modes of attaining knowledge have led to very opposite conclusions,—Dr. Gray's to his publishing (Gray's 'British Plants,' vol. i. p. 362) all the British sponges then known as British plants, and to his describing the *siliceous* spicula of *Tethea pilosa* as *hairs*; while my course of studies led me to the conclusion that sponges were animals.

Dr. Gray's mode of concocting a new arrangement of the Spongiadæ by means of the forms of their spicula is a very facile one—far easier than examining more than a thousand specimens to gain a knowledge of their various forms and their positions *in situ*. Dr. Gray asked me to give him a copy of my works on sponges, which I did with pleasure; and he then cut up the plates and arranged the figures according to his own fancy, and in doing so he succeeded in making four new genera and four new species out of the spicula of two sponges, never having at that time seen a scrap or a spiculum of either of them (see Proc. Zool. Soc. 1868, p. 129). This mode of proceeding is quite after the old adage of "making your hay with other people's grass."

BIBLIOGRAPHICAL NOTICES.

Andrew Garrett's '*Fische der Südsee*,' beschrieben und redigirt von ALBERT C. L. G. GÜNTHER. Heft I. 4to. Hamburg: L. Friedrichsen & Co., 1873.

WE are accustomed in this country to see merchants and others engaged in various departments of trade or in professions devoting

their leisure to scientific investigations, and often with results of the greatest value. In fact nothing can exceed the *naïve* surprise with which foreign *savants* usually receive the information that some of our most distinguished naturalists hold no Professorship or other recognized scientific position, but that they are simply private individuals. In some cases, however, those of our more wealthy countrymen whose tastes lead them to cultivate some particular department of science not only occupy themselves personally with such studies, but also adopt another course, which is perhaps rather more comprehensible to the minds of our neighbours across the channel: they contribute freely from the wealth which their regular avocations bring them to assist and encourage poorer workers in the same field, or to bring forth the results of investigations which would otherwise be prevented from appearing on account of the cost of publication.

But although much has been done in this way, individually and collectively, in England, we cannot point in this country to any such munificent patrons of science as Cesar Godeffroy, of Hamburg. This gentleman, belonging to a firm of great merchants and shipowners, trading to the far east, and especially to the islands scattered over the Pacific Ocean, some years ago conceived the notion of making the extended commerce of his firm a means of founding a museum of natural history in his native city; and having begun by accumulating such specimens as were brought home by the officers in command of their ships, he soon enlarged the plan by sending out competent collectors to various places, and intrusting the care of the valuable specimens thus obtained to naturalists of high attainments.

As an outcome from these researches, this gentleman commenced in the year 1871 the publication of a journal in large quarto, intended to contain communications relating to the geography, ethnography, and general natural history of the countries visited by the Godeffroy collectors; and of this journal, which is most liberally illustrated, the work of which the title stands at the head of this article forms the third part.

From the preliminary statement given by the author, Dr. Günther of the British Museum, it appears that towards the end of last year Hr. C. Godeffroy received a collection of about 470 figures of fishes, coloured from the life by Mr. Andrew Garrett during a residence of several years as a natural-history collector in the Sandwich and Society Islands and in other parts of Polynesia. These drawings (which confirm the account given by Cook in the history of his last voyage of the magnificence of the fishes observed about the coral-reefs of Palmerston Island), and the colours of the fishes especially, are reproduced with the greatest patience and truthfulness—Dr. Günther, when asked to undertake the determination of the species, having ascertained, by the comparison of many of them with other figures also taken from the life, that Mr. Garrett's drawings were perfectly trustworthy in this respect. As regards the structural characters of the objects represented, and especially the number and direction of the rows of scales, the drawings were hardly so satisfactory; and these details had to be corrected by comparison with pre-

served specimens. Convinced by these comparisons of the great scientific value of the materials in his hands, Hr. Godeffroy resolved to spare neither trouble nor expense in rendering it generally serviceable to ichthyologists; and accordingly Dr. Günther undertook to determine the species and edit the work, whilst the services of Mr. Ford were secured to reproduce the drawings.

Like many other undertakings of the same kind, this also took a wider scope as it advanced. It was found that Mr. Garrett's series of drawings included so large a proportion of the known fishes of the South Sea, and that the specimens from the same region accumulated in the British Museum and the Museum Godeffroy furnished such abundant materials for the task, that the temptation became irresistible to a naturalist like Dr. Günther to render his work a complete account of all the species belonging to the fauna which he was called upon to illustrate. Accordingly he decided to give an enumeration with descriptions of all the known fishes of the South Sea, including under that denomination the sea containing the Polynesian and Micronesian groups of islands, but excluding the Fiji Islands and the whole of Melanesia, where an Australian fauna is distinctly recognizable.

That we have dwelt so long on the origin and history of this valuable work is due to two causes. In the first place its general scope and bearing are best indicated by means of a recapitulation of the circumstances which led to its production; and, secondly, a purely descriptive book of this kind gives but little opening either for laudation or criticism. When completed it will form a faunistic contribution of the greatest value, equalling or perhaps exceeding in importance the author's previous labours of the same nature—his 'Reptiles of British India' and his 'Fishes of Zanzibar.'

The part now before us (the first of ten) includes notices of about forty-five species of Serranidæ, five of which are described as new. Five others—namely, a *Serranus*, a *Mesoprion*, an *Ambassis*, and two species of *Apogon* (the last described from Godeffroyian specimens)—appear to be peculiar to the Polynesian region; of the rest, the majority have a very wide distribution, many of them stretching from the Red Sea to Polynesia; and some of these are also taken on the coast of Australia, but none appear to be specially Australian forms. On the other hand, eleven species (four of which belong to *Apogon*) are inhabitants of the Indian archipelago and the seas to the east of Asia. The most curious case of distant isolated distribution is that of *Aprion virescens*, which has the Seychelles as its sole recorded western habitat, but occurs also in the Society and Sandwich Islands and at the Fijis.

The only important change in a systematic point of view made by Dr. Günther in the present part is the establishment of a new main section of *Acanthopterygii Serraniformes* by the division of his old group *Acanth. Perciformes*. He states that in the Serraniformes the vertebral column consists of only about twenty-four vertebræ, of which ten usually belong to the trunk, and fourteen to the tail. The number of vertebræ is much greater in the true Perciformes

To us it seems that the desirability of this change is very questionable. To make up for this, Dr. Günther reunites his *Pristipomatidæ* with the *Serranidæ*.

Before taking leave of this book we must say a few words as to the illustrations. Mr. Ford's power of representing fishes is so well known that it is almost a work of supererogation to say that these figures of South-Sea fishes are beautifully drawn; and, in fact, the structural details are represented with a delicacy and accuracy which leave nothing to be desired. But in most cases the plates are worked in colours; and these have generally been most admirably managed, the brilliant and delicate tints of the beautiful Basses and Apogons coming out wonderfully, and rendering the mere contemplation of the plates a real gratification. We look forward with pleasure to the continuation and completion of this most valuable work, which will form a worthy monument at once to the talents and industry of the author and artist and to the liberality of the founder and supporter of the Museum Godeffroy.

The Recent and Fossil Foraminifera of Belgium. By MM. H. J. MILLER and E. VANDEN BROECK. (*Les Foraminifères, &c.*) 8vo. pp. 34 and Tables. Brussels, 1873.

This memoir, reprinted from the 'Annals' of the Malacological Society of Belgium, is the first part of an intended monograph of the Foraminifera of Belgium. It consists partly of an Introduction, treating of the gradual progress made by naturalists in the study of these Rhizopods, and more particularly of what is known of the presence of fossil Foraminifera in the several Belgian formations from the Lias to the Pliocene inclusive. Thus, in the Lias (Lower) there are 11 species known; in the Aachenian stage of the Cretaceous system, 0; in the Hervian, 11; Nervian, 1; Senonian, 92; Maestrichtian, 76. In the Tertiary Montian and Heersian, 0; Landenian, 6; Ypresian, 11; Paniselian, 1; Bruxellian, 3; Laekennian, 9; Tongrian, 1; Rupelian, 4; Bolderian, 0; Diestian, 70; and in the Scaldisian, 8.

Part I., on the existing Foraminifera of Belgium, follows, commencing with a list of littoral species collected at Sluys-Kill, Ostend, and Nieuport. The first-named place is a little beyond the frontier, on a shallow sea-creek full of animal and vegetable life, and swarming with Foraminifera, the different groups of which at different depths and localities can be reached by wading, and collected separately. Our authors have detected many fossil specimens, derived from neighbouring Diestian and Scaldisian strata, among the recent fauna; and they have given a list of them (p. 27), in which they have had the aid of Messrs. Jones and Parker. Sluys-Kill typifies the muddy littoral zone; whilst the sandy zone is to be studied at Nieuport, Ostend, Blankenberg, Heyst, and along the coast generally. On the sand zone strong shells of *Polystomella crispa*, *Rotalia Beccarii*, *Triloculina oblonga*, *Quinqueloculina bicornis*, &c. are common; whilst the delicate *Lagena laevis*, *L. sulcata*, *Poly-*

morphina oblonga, *Polystomella striato-punctata*, and *Nonionina depressula* abound on the mud zone of Sluys-Kill. A large synoptical table is appended, showing the localities and relative abundance or rarity of the 86 recent species MM. Miller and Vanden Broeck have collected. They treat of the difficulty of determining specific types among this low class of creatures (pp. 31 &c.), and explain that they give preference to the plan of nomenclature established by the English rhizopodists, Williamson, Carpenter, Parker, and Jones.

MISCELLANEOUS.

MR. ALBANY HANCOCK.

ALBANY HANCOCK died, after a long illness, on the 24th of October. He was born at Newcastle-on-Tyne in 1806, and was one of a band of naturalists gradually passing from our midst, who have made this district famous in scientific circles, especially for British zoology. He was one of the founders of the Natural-History Society of that town, and also of the Tyneside Natural-History Field-Club, and a constant contributor to their 'Transactions,' and for many years an active member of the Committee of the Literary and Philosophical Society of Newcastle, in which he has always taken a lively interest.

The number of this band of naturalists has gradually dwindled by the loss of Adamson, Hutton, Alder, Fryer, and others; but we have with us Hewitson, John Hancock, Embleton, King, Norman, Howse, and others, who are still working in their vocation.

Mr. Albany Hancock, in conjunction with his brother John, mainly by their efforts in the local committee, greatly contributed to gathering together the splendid collection of art and science that was exhibited in the Central Exchange during the meeting of the British Association in 1863.

Mr. Hancock's contributions were not confined to the 'Transactions' of his district, but many valuable papers emanating from his pen are in the 'Transactions' of the Royal, and the 'Transactions' and 'Journals' of the Linnean, the Zoological, and the Geological Societies, and in the 'Annals and Magazine of Natural History.' He was a most accurate anatomical examiner and describer; and his great abilities as a draughtsman enabled him to accompany his papers with beautiful plates. His most celebrated work, prepared and written in conjunction with his friend Joshua Alder, and published by the Ray Society, is that on the British Nudibranchiate Mollusca, which was completed in 1855. It will be in the recollection of our readers that Mr. Alder died in 1867, and that he had been engaged in conjunction with Mr. Albany Hancock in the preparation of a work on the British Tunicata, to be published by the Ray Society. Subsequently to his colleague's death Mr. Hancock

devoted himself with great assiduity to the study of the anatomy and physiology of this interesting class of the Molluscoïda, and, when compelled by increasing weakness to relinquish the use of the microscope, had nearly, if not quite, completed his investigation of the Ascidiadæ. Both manuscript and plates of this work are, we are led to hope, in such an advanced state that there is still a prospect of the work being published. During the last three years, when unable from ill-health to pursue his microscopic dissections of the Tunicata, he turned his attention to the investigation and description of the fossils of the Coal-measures; and to this we owe the valuable series of papers published by him, in conjunction with Mr. Atthey and Mr. Howse, on some of the rarer specimens in the remarkably fine collection of the former of these two geologists. In 1858 the Royal Society awarded Mr. Hancock the Royal Medal, in recognition of his scientific labours in general, and with especial reference to his exhaustive paper "On the Organization of the Brachiopoda" (Phil. Trans. 1858, p. 791). He was a Fellow of the Linnean Society, and also a Corresponding Member of the Zoological Society. In 1866 the Imperial Royal Botanical and Zoological Society of Vienna conferred upon him and upon his friend Mr. Alder the diploma of Honorary Fellow. In the list of scientific papers published by the Royal Society there are thirty-one papers published in his own name, in conjunction with Mr. Alder sixteen, with Dr. Embleton five, and with Mr. Norman one; and he has published several papers in the 'Annals' and other works since this list was printed. His papers on the fossils of the Carboniferous strata consist of twelve written in conjunction with Mr. Atthey, and four with Mr. Howse.—J. E. GRAY.

On a Variety of Chersina angulata.

By Dr. J. E. GRAY, F.R.S. &c.

The British Museum has just received an adult male specimen of this tortoise, which was formerly in the possession of Mr. Arthur Adams, who obtained it at the Cape of Good Hope. It is peculiar for having the hinder marginal plate on the side of the caudal plate shorter than usual, so that the suture between it and the plate before it is on the same line as the suture between the hinder edge of the fourth costal plate and the lateral edge of the fifth vertebral plate. I am inclined to regard this as an accidental variation; for in another large specimen of the same sex in the same collection, and in ten other specimens in the British Museum, the suture between the hinder and penultimate marginal shields is always before the suture between the hinder costal and last vertebral shield; but I do not believe that this difference is specific as one zoologist seemed inclined to consider it, because the width of the last marginal plate varies in different specimens, and in one specimen they differ on the two sides. I therefore only regard it as an accidental variety, which also has the upper margin of the caudal plate much narrower than usual; but the shape of this plate varies in the male specimens in the Museum.

Fertilization of Pedicularis canadensis. By Mr. THOMAS MEEHAN.

The author drew attention to the structure of the flower of *Pedicularis canadensis*, in which it was evident self-impregnation was impossible, and there seemed to be no special arrangements for fertilization by insect agency, as there were in so many allied plants. In this case the stamens were included in the closely compressed arch of the corolla, and, with the anthers, were directed retrorsely to the pistil, which at an early age, and long before the maturity of the pollen, was protruded beyond the corolla, rendering self-fertilization almost impossible in this flower. But the flowers were always abundantly fertile; and though the arrangements were such as seemingly to afford no chance even for insects to aid in the fertilization, it was also probable that in some way it was accomplished by them. Both last season and this he had devoted some time to watching the plant, but failed to find any clue to the process. A species of *Bombus* seemed to have the plant especially under its charge, visiting the flowers in great numbers; but they bored through the corolla on the outside of the tube for the saccharine matter, and the anthers or pollen did not seem to be in the least disturbed by this. Still it was so highly probable that in some way some insect aided in the cross-fertilization of these flowers, that it might serve a useful purpose to direct attention to it, as others with time and opportunity might discover what he had failed to find.—*Proc. Acad. Nat. Sci. Philad.* June 1873.

Fertilization of Pedicularis canadensis. By Mr. GENTRY.

At the last meeting of the Academy, Mr. Meehan made some observations upon the peculiar structure of the flowers of *Pedicularis canadensis*, observing that he had vainly watched them during two seasons with the view of determining the manner in which they were fertilized. He further said that he had noticed that they received the attention of a species of bumble-bee, for the sake of their honey, which, in order to accomplish its purpose, always bored a hole into the side of the tube.

On Wednesday morning last I visited a spot where the plants were growing luxuriantly, affording an interesting field for observation. It was not long before I observed a *Bombus terrestris* to alight upon the outer side of the tube of a flower, at a distance of three feet from me. At this distance it did seem as if the bee, in order to obtain the honey which the flower secretes, produced a slit into the tube, as Mr. Meehan observed. But the movements of the bee being so quick, and the distance too great to judge accurately, I approached the insect by degrees, until I was within three inches of it, when the whole process became apparent. The bee, however, was so intent upon its labours, as not to take any notice of me.

The flower is composed of an erect tube, with a natural cleft running along its lateral walls from above, through one third its entire length, presenting outwardly apparently a mere crease, from

the manner in which the compressed margins of the upper lip fit into the rolled-in edges of the lateral lobes of the under lip. The upper lip is compressed, arched, and beaked, presenting an aperture at the apex, through which passes a curved pistil; the lower lip is reflexed, consisting of three lobes, one median and two lateral, assuming a platform arrangement. Enclosed within the upper lip are four stamens, didynamous, with their anthers turning backwards, facing each other ventrally. When ripe these anthers split upon the inner side, thus giving a fancied resemblance to an oval snuff-box, thrown backwards upon its hinges. Each cell is filled with white pollen-grains.

Now, when the bee alights upon the tube, by means of its trunk it opens the natural cleft above alluded to, and having thus gained a partial entrance, it would defeat its intention did not the length of the flower's tube when contrasted with that of the bee's trunk necessitate the admission of the entire head also. In this operation the lips of the flower are pressed apart, the margins of the upper lip are separated to receive the head, and the pollen-grains, already ripe, by the considerable motion to which they are subjected, become dislodged from their cells, and fall down in a dense shower upon the bee's back and head. Having obtained the coveted sweet, it flies to another flower upon a different stalk, as I observed in a score of cases during two days; but before renewing the preceding operations, it stations itself awhile upon the lower lip, its head coming in contact with the stigma of the pistil. Then, by means of the hairs that line the inner side of the tarsus of each anterior leg, and the constant rubbing together of the parts composing its trophi or instrumenta cibaria, the attached pollen-grains are sent flying in every direction, sure to adhere to the stigma.

Whilst observing the above process, I also noticed that after the lips had been pressed apart and were permitted to regain their position, the upper lip, being somewhat elastic, sprung back to its place with considerable force, sending through the aperture, through which passes the pistil, a complete cloud of pollen, enveloping the stigma upon every side.

This operation can be performed artificially, by taking hold of the under lip with the left thumb and fore finger, and pulling the upper lip backward by the right, and then releasing the hold of the latter: the upper lip springs to its place, spiriting the pollen through the aperture upon the left hand. From the above it is to be seen that the plant has two chances of being fertilized—one by its own pollen, and the other by that of another. Although the flower seeds abundantly, yet I am disposed to think that it is mainly through the pollen of another that the seeds become perfect. I incline to this opinion because, in an examination of many pods, I noticed that a few seeds were found in a rudimentary condition, apparently manifesting a tendency to abort, while the majority were in a vigorous condition—the former, doubtless, being the effects of self-fertilization in part, which, as is well known, is a degenerating process.—*Proc. Acad. Nat. Sci. Philad.* June 1873.

Bos brachyceros, the West-African Buffalo, and the Dwarf Buffalo of Pennant. By Dr. J. E. GRAY, F.R.S. &c.

Sir Victor Brooke, in the P. Z. S. 1873, p. 474, has given a very good account, illustrated with some admirable figures, of the head and skulls of a species of buffalo, *Bos brachyceros*, and has changed the name to that of *Bos pumilus* because he thinks it is the dwarf animal described by Belon as coming from Morocco. Should it prove to be the Morocco animal, which I greatly doubt, I wonder it has not occurred to Sir V. Brooke that *B. pumilus* is a very inappropriate name for a buffalo as large or larger than the Cape buffalo; and I may observe that his synonyma, compiled with such appearance of care, are really very untrustworthy, as I have found them on several other occasions.

Belon, in his 'Voyage,' pp. 119 & 120, mentions and very roughly figures an animal under the name of "un moult beau plus petit bœuf d'Afrique," which he saw at Cairo, but which was said to have been brought from Assaimie on the coast of Morocco.

Linnæus, in the 12th edition of the 'Systema Naturæ,' vol. i. p. 99, refers to this account, and considers it a variety of his *Bos indicus*, quoting it under the name of *Bubalus africanus*, observing that he believes it to be the same species as *B. indicus*. The account of the animal gives no means of determining to what it belonged; but it may be, from its habitat, *Bos dante* or the African zebu.

Pennant, in his 'Synopsis of Quadrupeds,' p. 9, finds a species, under the name of the dwarf ox, entirely on Belon's description, adding that he thinks a pair of horns in the Museum of the Royal Society, noticed by Grew, belonged to this species. He also says that perhaps the lant or dant described by Leo Africanus may belong to this kind. In his next edition, called the 'History of Quadrupeds,' p. 31, and in the 3rd edition, p. 36, he leaves out all reference to these horns under the dwarf ox; but in the 1st edition of the 'History' he repeats the plate that was in the 'Synopsis,' but in the account of the plates he refers to the figure as that of the young Cape buffalo; and in the 3rd edition he leaves out the figures of these horns. In the text of both editions he refers to the horns under the account of the Cape buffalo, saying that he believes they belong to that species.

Turton, in 'A General System of Nature,' published in 1806, which is chiefly a translation of Gmelin, has a species which he calls *Bos pumilus*, from what seems to be Pennant's description of the dwarf ox; but he does not give any reference to that author, whose name he uses, and he refers to the lant of Pennant as *Bos taurus*, var. *h*, called the African ox. *Bos pumilus* of Turton entirely reposes on the dwarf ox of Pennant, which is founded on the "*petit bœuf*" of Belon; and this neither in the account of the animal, the size, nor the habitat agrees with the West-African Buffalo, which has any thing but a shining coat or horns like Belon's figure.

Grew, in his account of the "Rarities in the Museum of the Royal Society," p. 26, mentions the horns of a wild bull called *Bubalus sive Buffalus*, brought from Africa.

Pennant, in his 'Synopsis of Quadrupeds,' p. 97, refers to and

figures this pair of horns (t. viii. f. 3), which is evidently that of a very young animal, and thinks it belongs to the dwarf ox, p. 9; but in the 'History of Quadrupeds,' p. 28, under the Cape ox, he observes, "The horns (t. iii. f. 9) of my former edition, which I attributed to the next species (the dwarf ox) most probably are those of the young of this kind;" this account is repeated and the figure left out in the 3rd edition of the 'History,' p. 33; so that we have Pennant's own authority for saying that these horns were not those of his dwarf ox, on which the name *Bos pumilus* of Turton was founded, and therefore that the change of name made by Sir V. Brooke, like many other of his synonyma, is entirely founded on a mistake, or, in fact, on the want of sufficient research.

The pair of horns in Grew is in the British Museum, is figured in our 'Catalogue of Ruminants,' was described by Blyth under the name of *Bubalus reclinis*; and I believe that we have no authority for their being considered the young of *Bos brachyceros*, or at least that Sir V. Brooke has as yet shown no reason for regarding *Bos reclinis* and *B. planiceros*, Blyth, as the young of *Bos brachyceros*, and therefore that the first of the two conclusions that Sir Victor Brooke arrives at, viz. "the identity of *pumilus* of Turton with *brachyceros*, Gray," is entirely erroneous; and as to the second, we have no means of knowing, not having specimens to refer to.

I make these remarks because compilers will be misled by the apparent care and speciality with which the synonyms are quoted; and it is to be observed that synonyms so compiled are very apt to mislead, and thus be injurious to the progress of science.

To show the little reliance that can be placed on Sir Victor Brooke's statement of his pretended history of the dwarf ox (in the Proc. Zool. Soc. 1873, p. 476), I may observe:—First, he states that Pennant's dwarf bull was established on the horns in the Museum of the Royal Society, whereas it was entirely founded on Belon's account of the "petit bœuf d'Afrique" from Morocco. Pennant, in his 'Synopsis,' p. 9, thinks that the horns mentioned by Grew might belong to it; but in his 'History,' published ten years afterwards, he says they are "most probably those of a young Cape ox," observing that "Grew improperly thinks them the horns of the common buffalo" (p. 28). Secondly, he states that Turton gives the name of *B. pumilus* to "the same" (that is Grew's) specimen. Turton merely gives an abridgment of Pennant's account of the dwarf ox from Belon, and makes no reference to the horns described by Grew, nor even to the figure of them. This is a very fair specimen of the accuracy of Sir Victor Brooke's observations and conclusions therefrom. I can scarcely allow it to pass without a protest against his remark, "the very slight interest which Dr. Baikie appears to have taken in natural history" (p. 478), because his specimens in the Museum are without special habitats. All who knew Dr. Baikie, and any body who has seen his numerous specimens in the British Museum, must feel the falseness of this accusation. Dr. Baikie died on the Niger, a sacrifice to his scientific zeal; and his specimens were received in the Museum some time after his death, after they had passed through two hands at least, and their history was lost.

On the Vascular System of the Ascidia. By Prof. C. HELLER.

It is well known that the heart in the Tunicata contracts sometimes in one and sometimes in the other direction, and that its contents are driven sometimes into the dorsal and sometimes into the ventral vessel; but hitherto no close investigation has been made of the intimate structure of this organ, or of the nature of the vessels springing from it in the Ascidia.

In the Ascidia the heart forms a cylindrical, elongated, more or less curved tube, generally placed at the hinder margin of the stomach, and more rarely further forward, near the latter. It is always enclosed by a special, thinly membranous pericardium, with which it is connected towards the dorsal side. The wall of the heart consists of a layer of thin, delicate muscular fibres, which show distinct transverse striation. These muscular fibres are not placed parallel to each other, but form an elegant network, uniting with each other here and there and then again separating, so as to leave small interspaces between them.

The two large vascular trunks which originate directly from the heart, and of which one runs forward along the dorsal part of the branchial sac above the endostyle, and the other on the ventral part of the branchial sac below the œsophageal channel, also exhibit a similar structure of wall; in them also the network formed by delicate transversely striated muscular fibres may be observed. These two vascular trunks therefore appear to be direct continuations of the heart, from which they cannot be distinguished by their structure; and they contract like the true heart, although in a less degree.

As regards the other vessels, those which are distributed in the wall of the branchial sac and in the external envelope are provided with proper walls; but the course of the blood in the inner mantle seems to be lacunar. The branchial vessels are all furnished with an endothelium consisting of small elongated cells. In the walls of the large transverse vascular trunks of the branchial net smooth muscular fibres are distinctly observed; they run in a crooked course and forming meshes with their neighbours towards the projecting longitudinal partition.

The vessels which, in the simple Ascidia, run to the outer tunic and then ramify, are also remarkable in their form and structure. They are always double vessels, which only communicate with each other at the extremity of the last ramifications. The blood flows outwards in one vessel and inwards in the other. The largest trunks exhibit in their walls a distinct layer of smooth muscular fibres, both longitudinal and annular. The latter are by far the more numerous and lie close together, whereas the longitudinal fibres are more scanty. In the further course of these vessels the annular muscular fibres also become rarer; and in the finer terminal ramifications the muscular elements are entirely wanting, and the wall consists of a thin membrane composed of roundish cells. The vessels are not connected with the external envelope, but lie quite loose in lacunæ.

The blood circulating in the vessels is frequently coloured; and its colour is due to that of the blood-corpuscles. Thus *Ascidia fumigata* is distinguished by the greenish-yellow colour of its blood, and *Ascidia mentula* and *mamillata* by a more brownish colour, whilst in some species, e. g. *A. intestinalis*, the blood appears quite colourless.—*Anzeiger der Akad. der Wiss. in Wien*, October 16, 1873.

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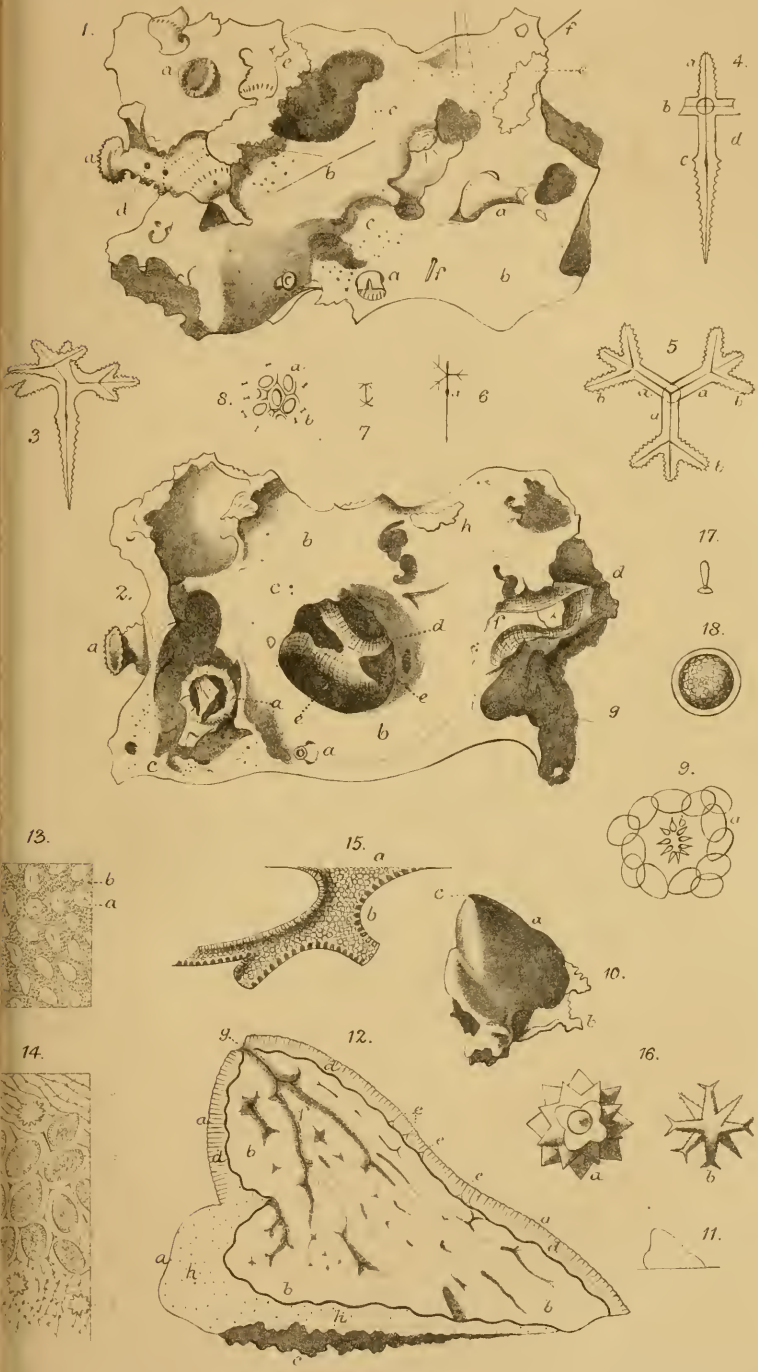
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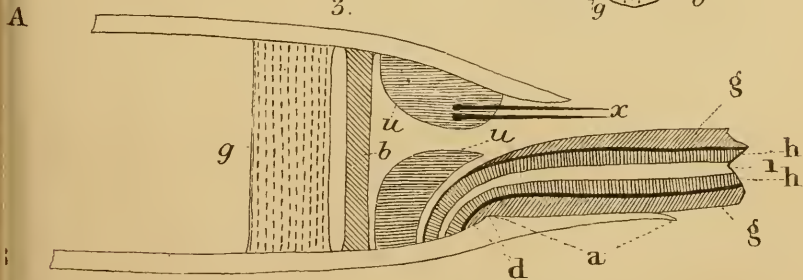
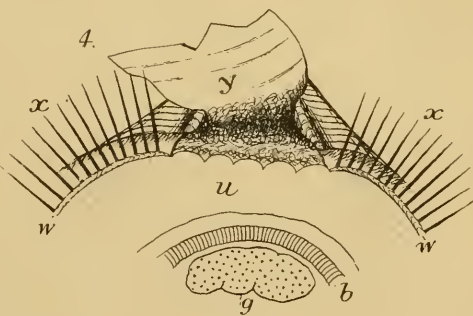
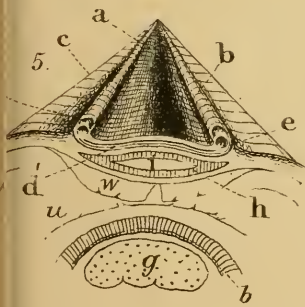
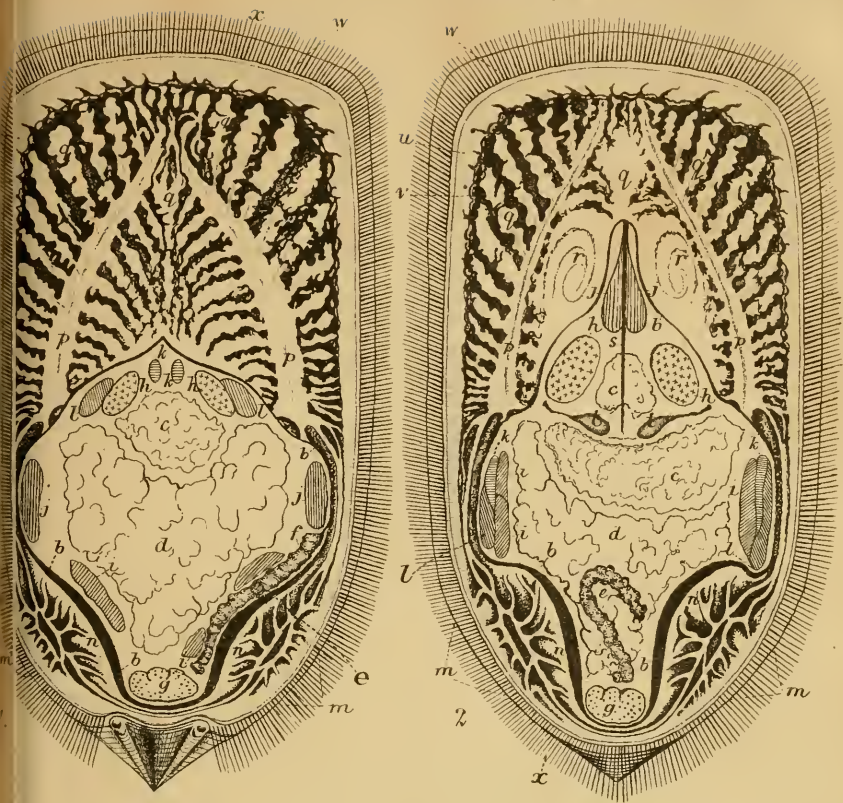
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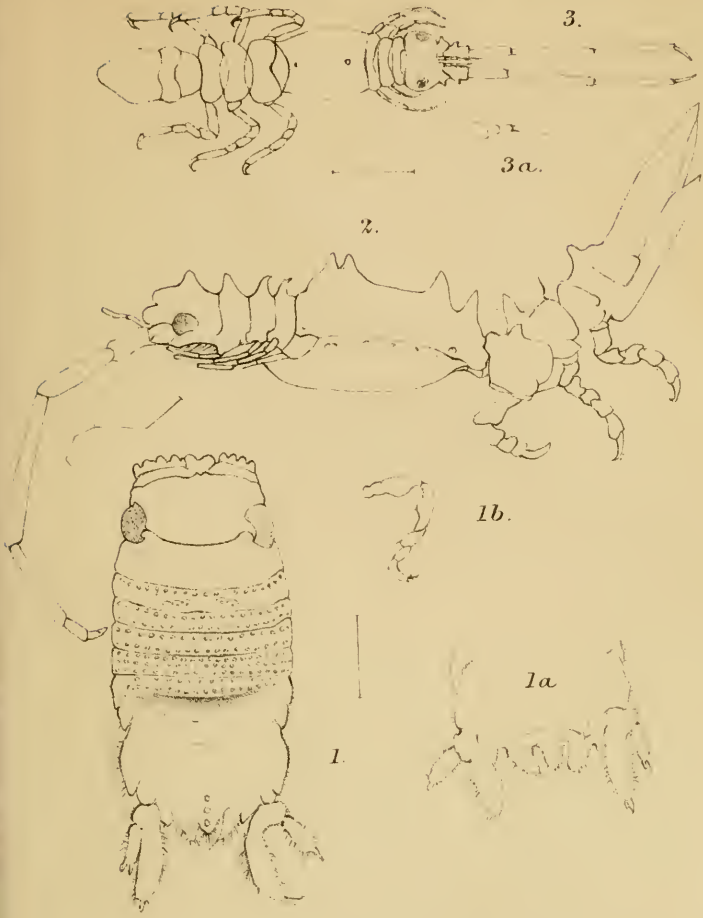
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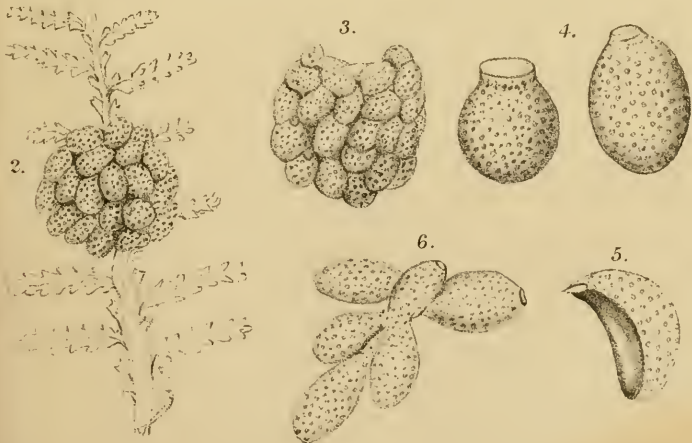


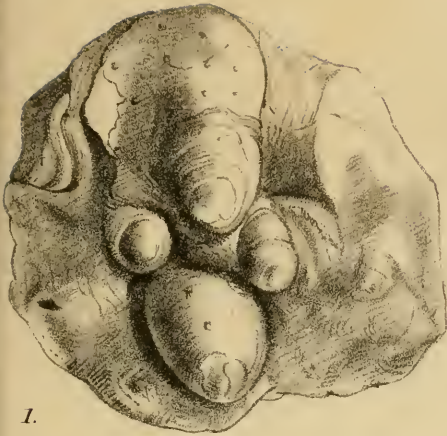


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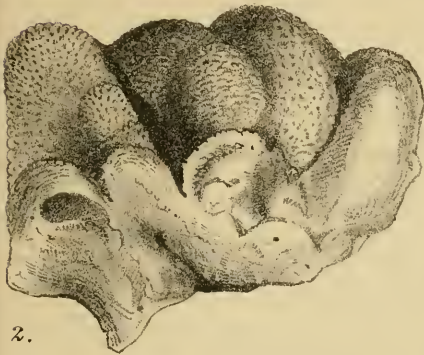




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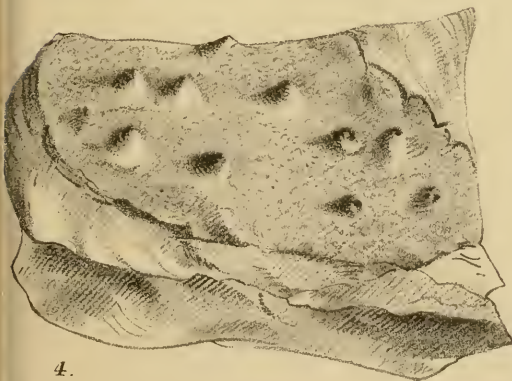
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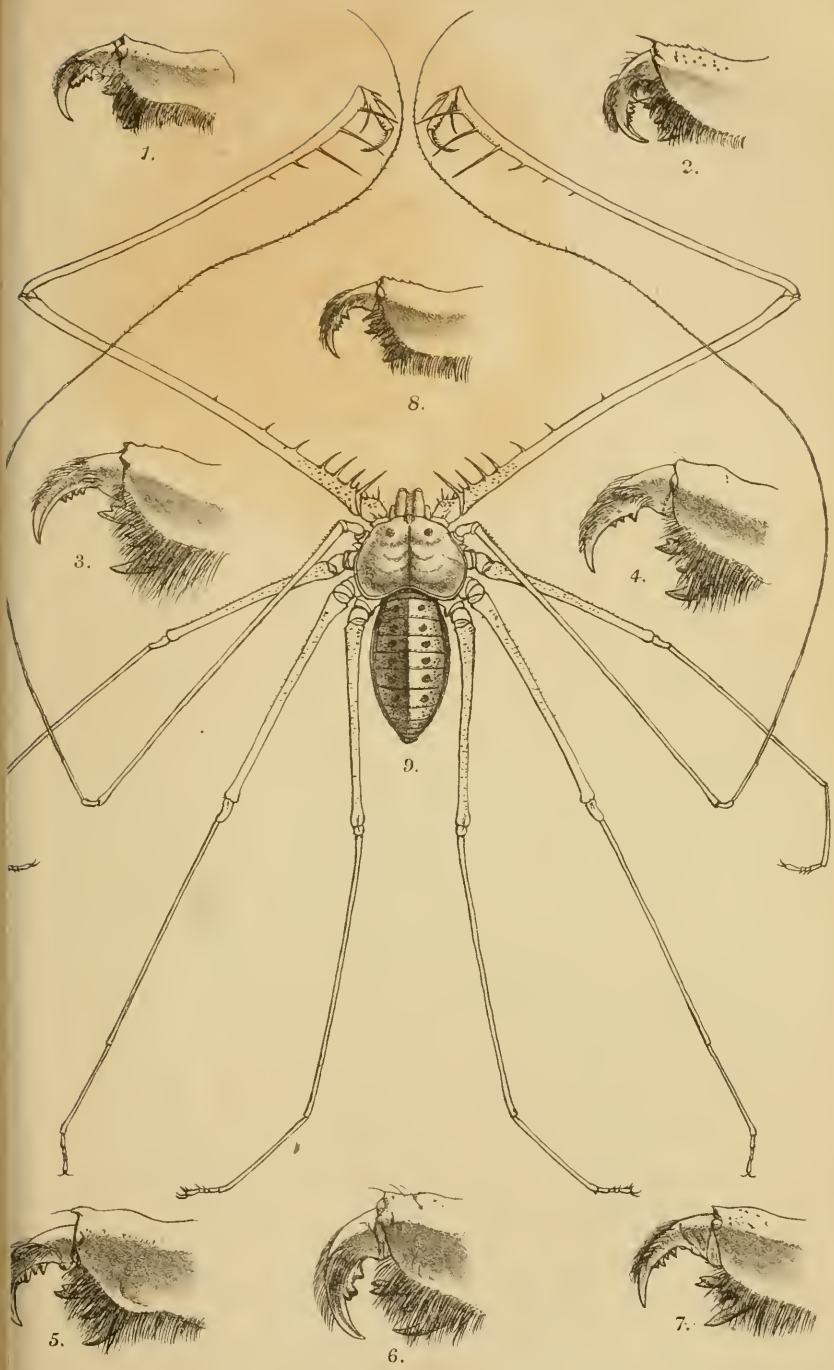
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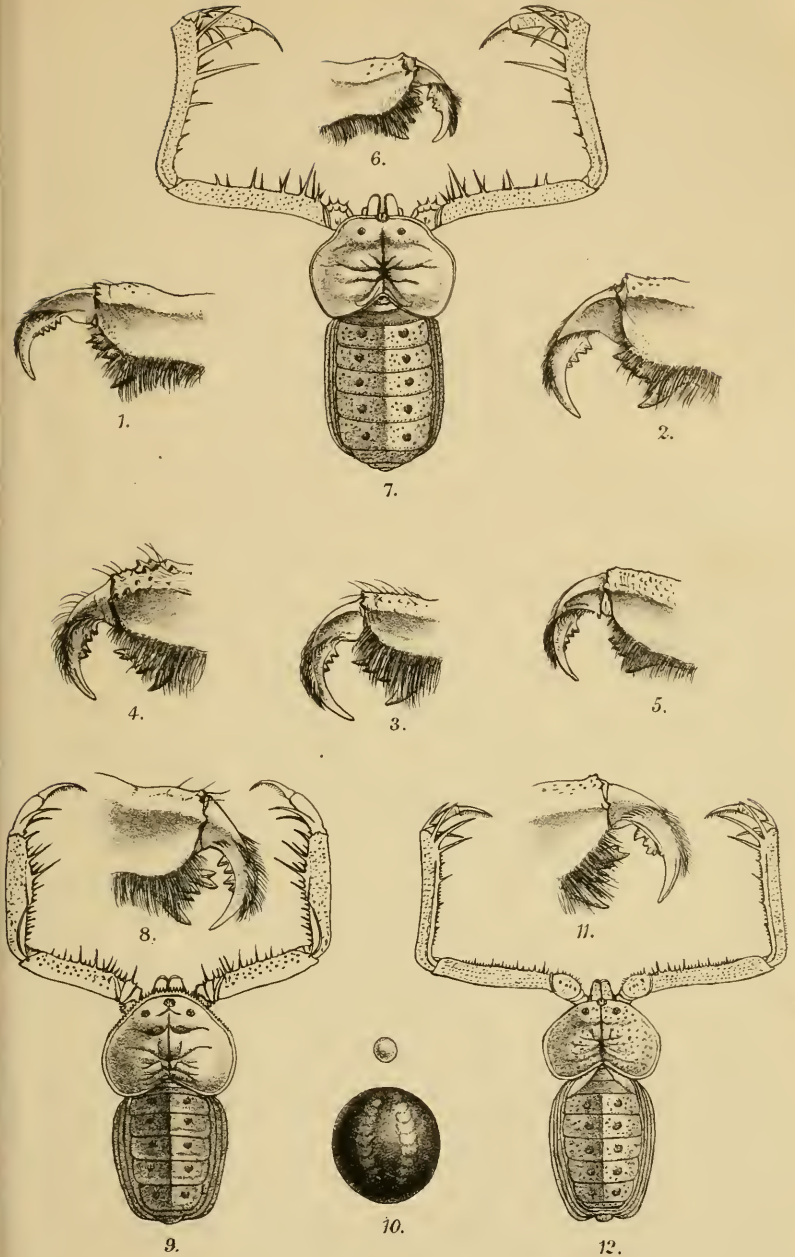
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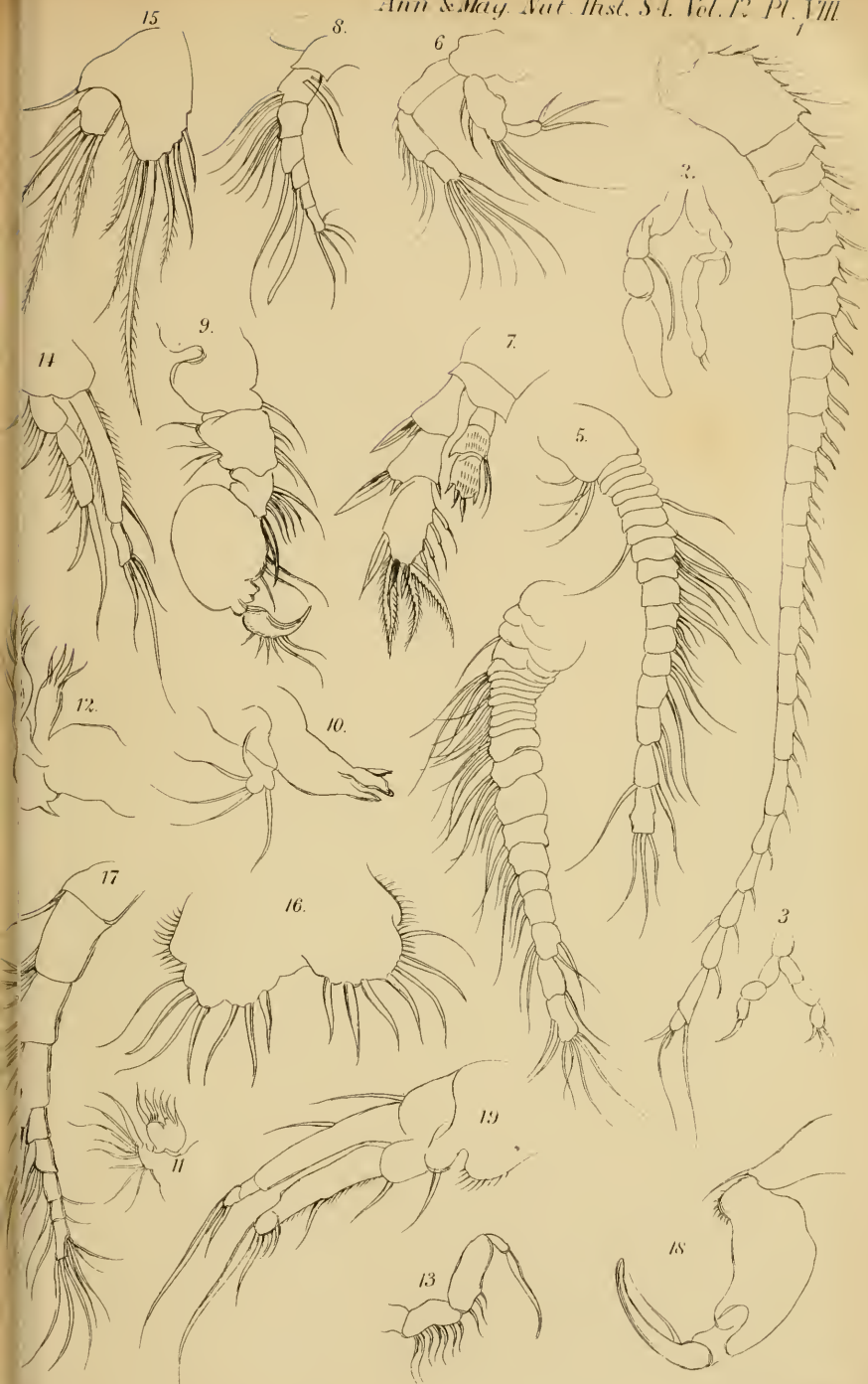
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G. Butler del. et. lith. July 1873.

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SPECIES OF PHRYNUS.



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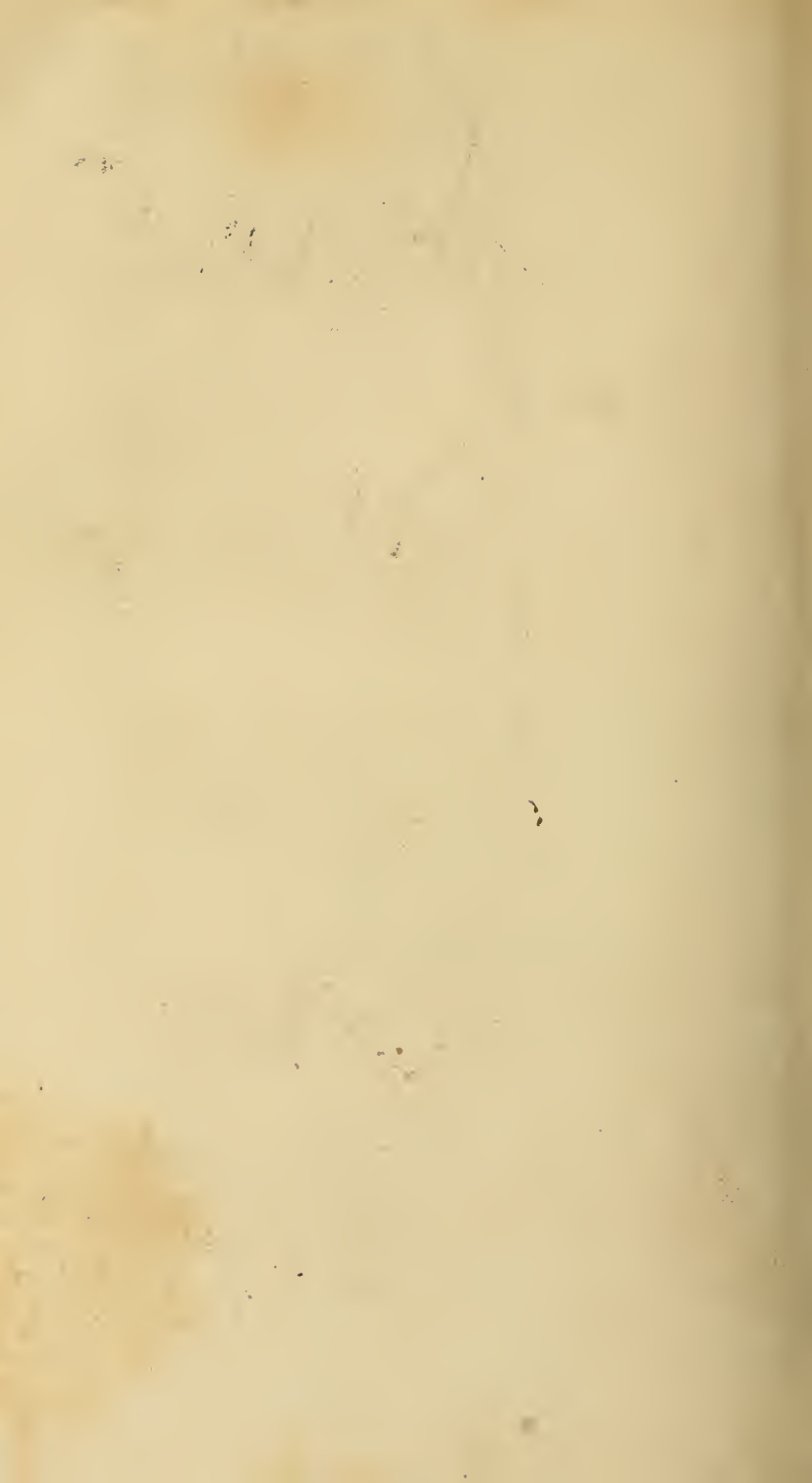
- 1 3 *Paracalanus hibernicus*
 4 7 *Pseudoecyclops obtusatus*
 8 16 *Paratachidius gracilis*
 17 19 *Thalestris hibernica*



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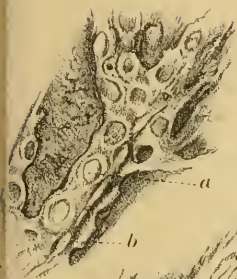
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1 5. *Hyopsyllus coriaceus*.
 6 10 *Asellopsis hispidus*
 11 16 *Microsetella atlantica*
 17 21 *Harpacticus flexus*.





1.



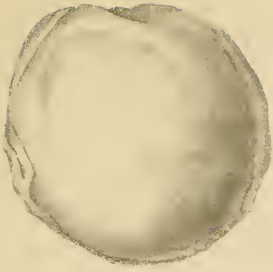
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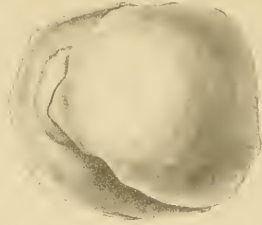
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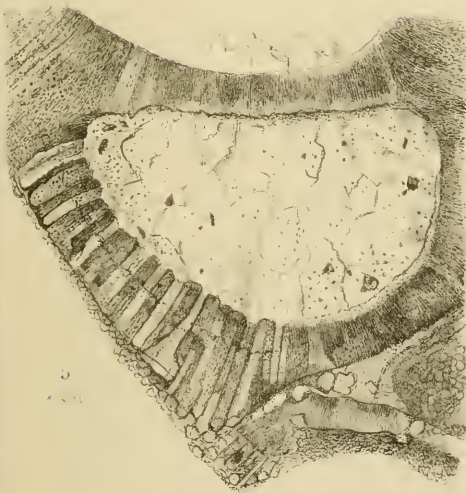
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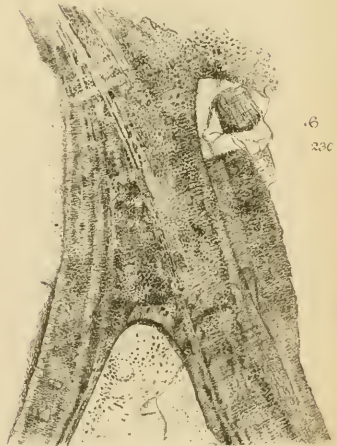
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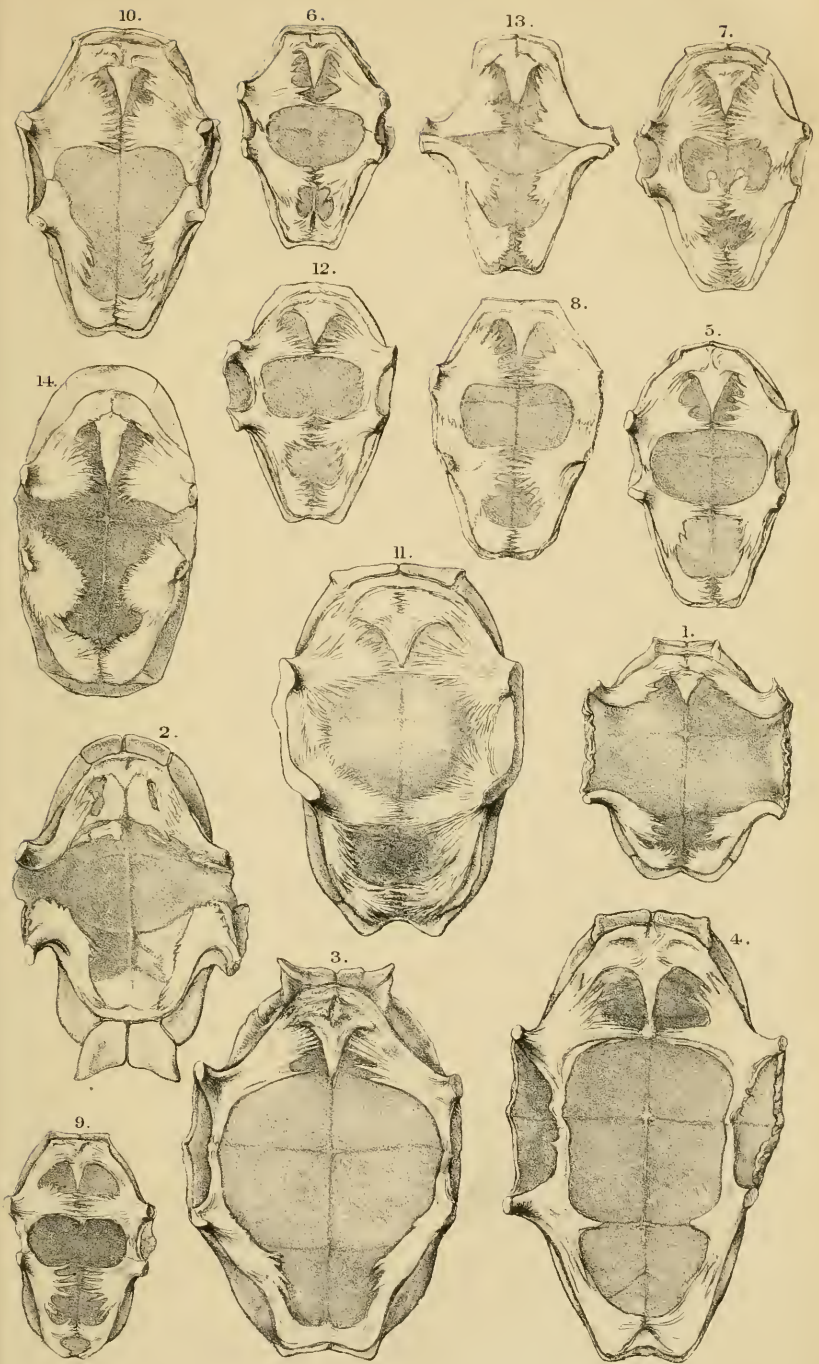


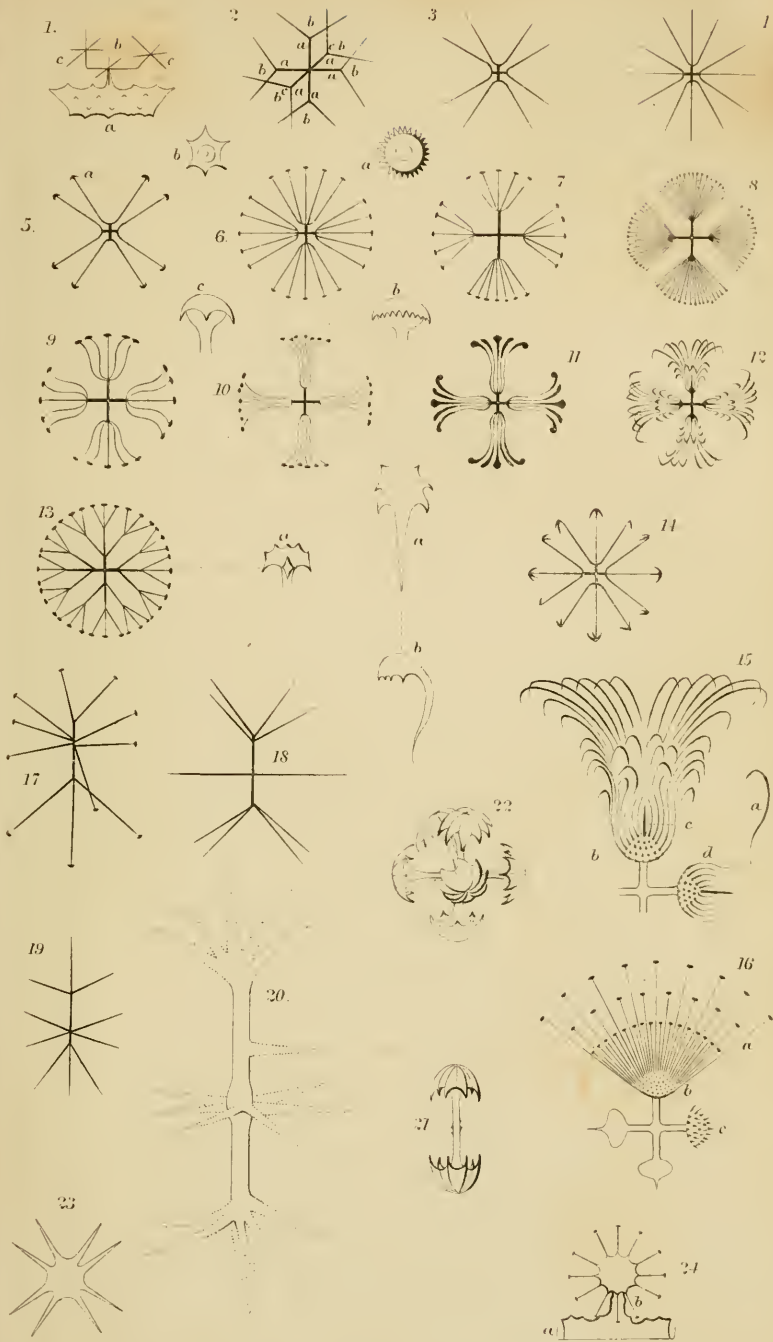
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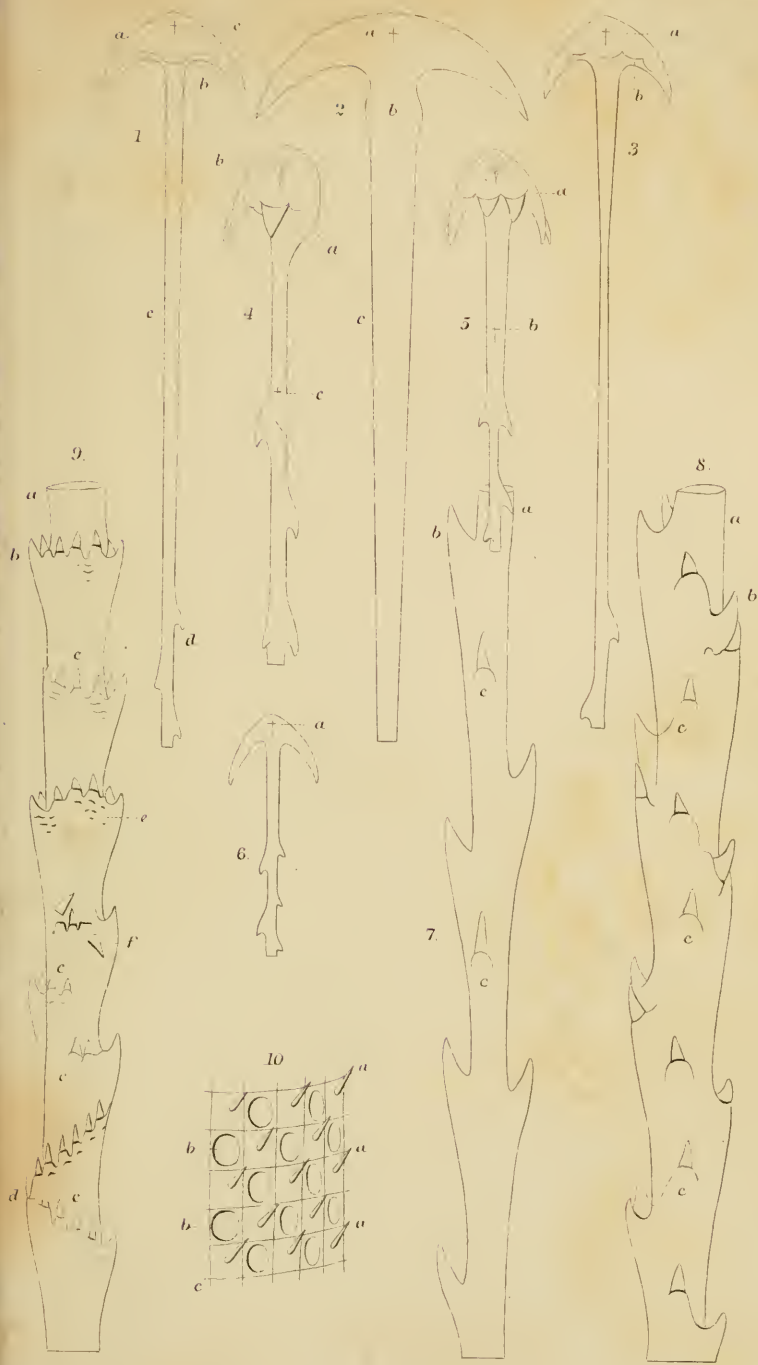
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A. T. H. sculp.

W. Wood sculp.

Archædiscus Kerreri.

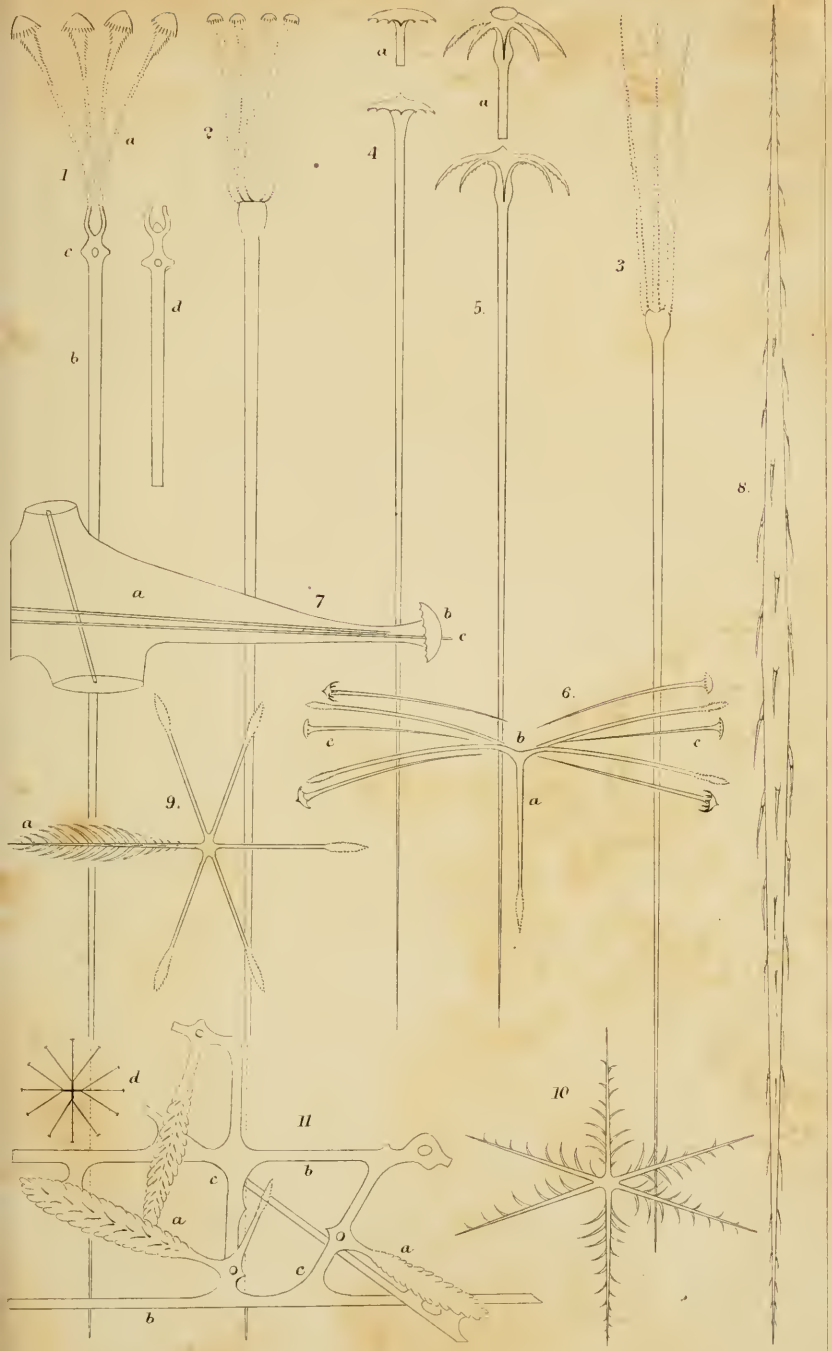




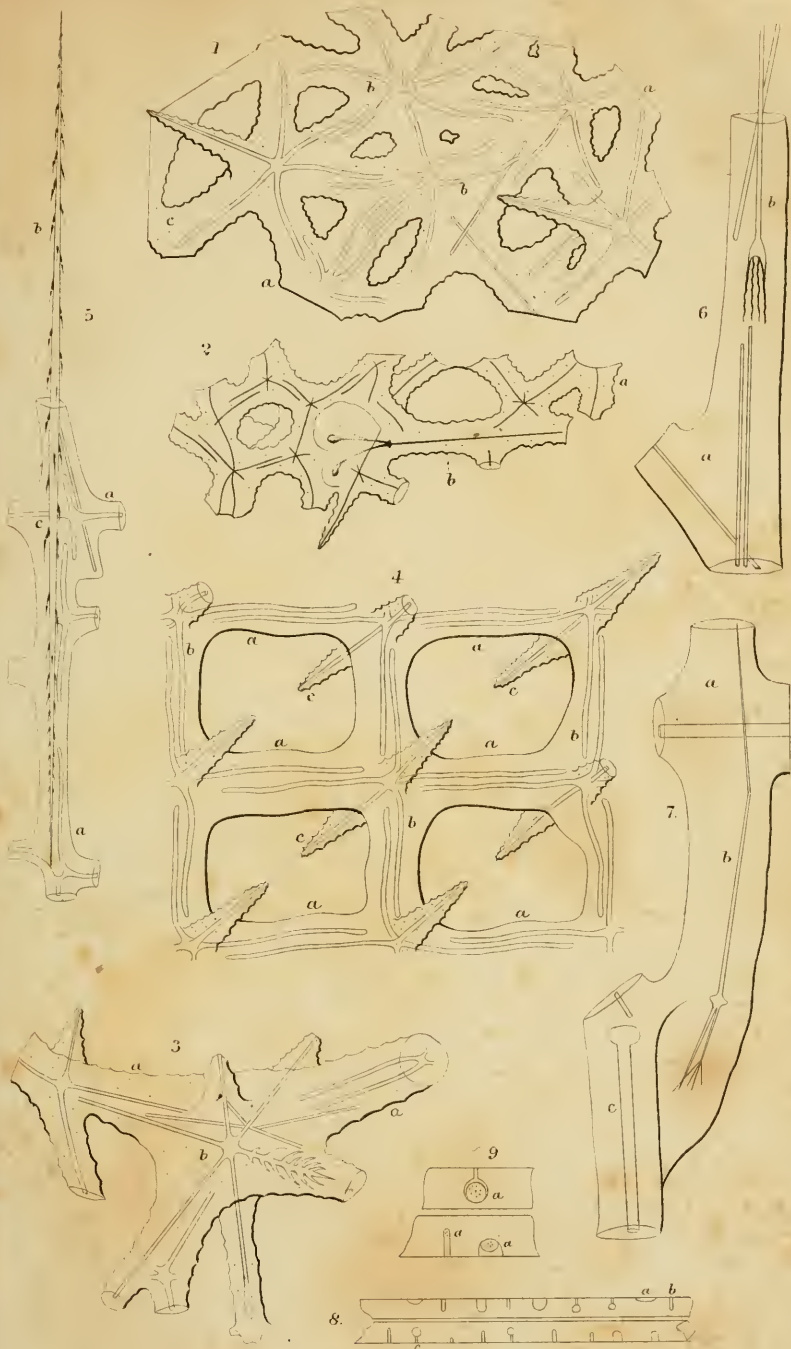


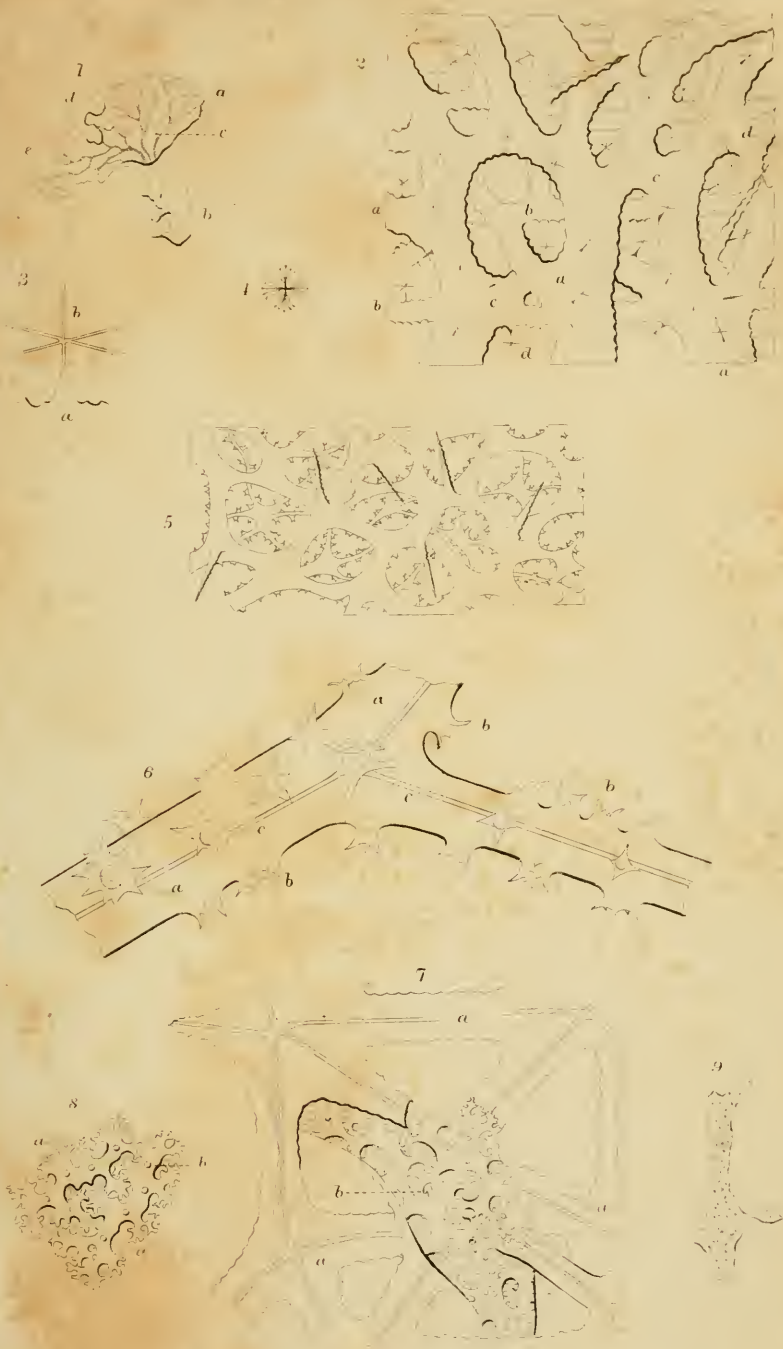
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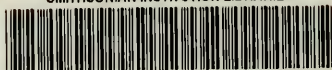








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