THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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

CONDUCTED BY

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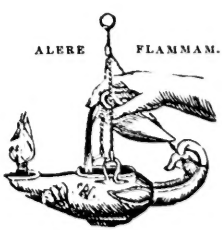
"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper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

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

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

J. TAYLOR, *Norwich*, 1818.



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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

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

No. 73. JANUARY 1894.

I.—*On certain Homes or Tubes formed by Annelids**. By W. C. M'Intosh, M.D., LL.D., F.R.S., &c., Professor of Natural History in the University of St. Andrews.

Many marine animals are known whose protective shells—insignificant in themselves—form deposits of great extent on the surface of the earth. Such, for example, are the minute calcareous tests of the Foraminifera, and the equally small but exquisitely beautiful siliceous skeletons of the Radiolarians. Moreover, by the tissue-secretions of the coral-forming polyps in the warmer seas, islands, as well as large additions to continental land, have been and are now being constructed. In other groups, again, this habit of making shelter is more or less in abeyance; thus the Echinoderms—though conspicuous by the calcareous nature of their skins—very rarely form a protective covering, almost the only instance being the Holothurian called by Dalyell the Spinner (*Holothuria nigra*), which makes a home for itself by an abundant secretion of threads of mucus. Amongst the Crustaceans a few construct tubular dwellings for themselves; and one species (*Cerapus*)† likewise adds long filamentous

* Part of the Introductory Lecture to the class of Natural History, October 1893.

† *Vide* Ann. Nat. Hist. ser. 5, vol. xvi. p. 484, pl. xiii. fig. 9.

processes to the zoophyte on which it lives, so that it can perch further out in the surrounding water. The nests of the littoral *Amphithoë* under stones are other familiar instances. In the group of the Molluscoids the gelatinous "houses" of *Appendicularians*, which in St. Andrews Bay occasionally so distend the larger nets that they burst, are examples, and the "houses" can be cast off and renewed at the pleasure of the owner. The remarkably branched structure formed by *Cephalodiscus* (one of the discoveries of the 'Challenger') is another notable instance, for this not only forms a complete protection, but probably mimics the shape of the seaweeds or other structures in its neighbourhood. Amongst the Mollusca the nests of *Lima* are perhaps the best-known examples, though the homes of others are not devoid of interest. Thus *Entoconcha* dwells as a parasite—a very rare thing in mollusks—in the interior of *Synapta*, while another (*Montacuta substriata*) clings to the spines of the purple heart-urchin. In neither, however, is a distinct "house" formed; and I may at once explain that by the term "house" or "home" I mean that foreign bodies are employed in addition to the secretion poured out by the animal itself.

In the present instance, however, we shall confine our attention to a group of marine animals not yet mentioned, viz., the marine annelids or marine worms (*Polychæta*), a series in which very great variety as well as very great complexity of structures for the protection of their soft bodies is exhibited. Moreover, the group is one in which beauty in external coloration is combined with remarkable life-histories and organization. Thus the glassy or golden bristles of some (Euphrosynidæ and Amphinomidæ) cover the back and sides with a crisp fringe, while the burnished spines and long hairs —constantly glistening with all the hues of a permanent rainbow—of such as the sea-mouse are gorgeous to behold. The pearly lustre of *Nephthys*, the brilliant tints of yellow, green, blue, red, and purple which characterize the Phyllodocidæ, Alciopidæ, Hesionidæ, and Nereidæ, the rich brown touches of the Syllidæ, and the deep red of the branchial plumes of the Eunicidæ, Terebellidæ, Sabellidæ, and Serpulidæ, can only be compared with the most beautiful types of butterflies and birds. The remarkable power of budding and even branching, the alternation of generations, the metamorphoses during development, the social (commensalistic) habits, phosphorescent properties, powers of perforating rocks, shells, and other substances, the value of almost all as food or as bait for fishes, and some even as nourishment for man,

give but a slight indication of their importance amongst the Invertebrates of our shores.

Again, it is long since the complexity of the locomotive appendages—even of the most simple amongst the marine annelids—has excited the admiration of observers. Every foot is furnished with two tufts of bristles, dorsal and ventral, or with bristles and hooks, or with hooks alone. Moreover, these organs are each capable, by their muscular apparatus, of pushing the annelid out of its tube, of fixing it in it, or of retracting it. For, as Dr. Thomas Williams* formerly pointed out, even in those with calcareous tubes the interior is not so smooth as to be slippery, or so hard as to render it impossible to fix bristles or hooks in its progress outward or inward. "Computing," as he says, "the pushing force which each seta is capable of exerting, and multiplying this amount by the number of setæ in each foot, and this again by the number of feet with which the annelid is provided, a conception may be formed of the aggregate of mechanical power with which the animal executes its 'march forwards.' A similar calculation applied to the hooks will give a correspondingly prodigious resultant of power for retreat."

The presence or absence of a special home or habitation in the marine annelids was, and still is, by some supposed to distinguish the two great groups from each other, viz., the Erratic (or Annelida Errantia) from the Sedentary (Annelida Sedentaria); but in a natural classification this does not altogether hold true. For example, the Syllidians are really errant annelids; yet many form transparent tubes, and others pass their lives in the interior of sponges. Similar habits, with strong tubes, occur in the Nereids and Eunicids. Some annelids furnished with tubes, again, are by no means sedentary, such as *Lagis* and *Amphictene*. Moreover, it is not always the most delicate forms that have such a protection: thus the Phyllodicidæ are free, while certain *Lepidonoti* occur only in the tubes of other annelids.

Limited as the group of annelids appears to be in the great world of marine animals, it is found that their habitations range themselves under at least eleven heads.

Thus some, such as *Spinther* and *Euphrosyne*, dwell on sponges, which serve them as food, and they browse on these spicular pastures after the manner of the sea-lemons amongst the Nudibranchs. Others affect the interior of the sponge, like the Syllidians, amongst which the remarkably branched *Syllis ramosa* of the 'Challenger' stands out conspicuously.

* Report Brit. Assoc. 1851, p. 204.

The second group is formed by those which inhabit sand,—some, like *Nephthys*, forcing their agile muscular bodies through the moist sand in serpentine waves, almost without an effort, while the more stationary lob-worm of the beach mimics the habitat of the familiar earthworm. Under this head are *Glycera*, *Anaitis rosea*, *Phyllodoce maculata*, *Ophelia*, *Ammotrypane*, *Aricia*, *Scoloplos*, *Nerine*, and *Scolecolepis*.

Those of the third series frequent chinks or other spaces in the rocks, such as *Nereis pelagica*, *Lumbriconereis*, *Leodice*, and *Marphysa*; while the fourth series comprises those dwelling in peat, for example *Hediste diversicolor* and *Stratonice Marionii*. The dwellers in hollow tangles, such as *Leontis Dumerilii*, form a fifth group.

A large number, again, secrete from the surface-glands of their bodies a fluid which hardens in seawater, and with which they build up for themselves houses of greater or less complexity, using it as mortar for fixing sand-grains, gravel, fragments of shells, and similar structures. Under this, the sixth group, fall *Northia*, *Chætopterus*, *Spio*, *Polydora* (in part), *Sabellaria*, *Owenia*, *Lagis*, *Amphictene*, *Cistenides*, *Ampharete*, *Amphicteis*, *Amphitrite*, *Terebella*, *Lanice*, *Axionice*, *Thelepus*, *Grymæa*, and others.

The seventh group includes those which add no foreign element to the translucent tubes which they secrete; such tubes being soft and gelatinous, as in *Myxicola*, flexible, as in *Spiochætopterus*, or so firm and tough as to be fashioned into pens for writing, as in *Hyalinœcia*.

In a subsection of this assemblage may be placed some which attach their translucent tubes to blades of tangle or other seaweeds, like *Eusyllis*; or which have dense leathery tubes amongst sponges and zoophytes, as in certain species of *Eunice*.

Many living in mud at the bottom of the sea fashion their tubular dwellings chiefly of this deposit—either pure, or more or less mixed with sand and fragments of shells, the interior being lined with a smooth layer of secretion, which, in *Sabella*, is often so abundant as to make the tubes extremely tough. Under this (the eighth) head are such as *Maldane*, *Axiothea*, *Pista*, *Dasychone*, *Chone*.

The forms which secrete hard calcareous or porcellaneous tubes constitute the ninth series—so widely and conspicuously distributed on the sea-bed from low-water mark to the greatest depth yet examined, and though generally fixed are sometimes free. *Protula*, *Filigrana*, *Hydroides*, *Pomatoceras*, *Placostegus*, *Ditrypa*, and *Spirorbis* are examples.

The tenth group includes those which perforate rocks and live in the tunnels thus fashioned, and which we examined more particularly in the Introductory lecture at the commencement of last session. A typical form is *Dodecaceria*, while *Sabella saxicava* and *Polydora* not only bore in rocks but append tubes to their tunnels.

The last, or eleventh, series is one of the most interesting, since its members—declining to form homes for themselves—become messmates (or, as they were called by Van Beneden of Louvain, commensalistic forms) of other animals—like the Nereid (*Nereilepas fucata*), which shares the shell of the whelk with the hermit-crab, or those annelids (chiefly belonging to the Polynoidæ) which are only found in the tubes of others. In this group are *Polynoë Johnstoni*, *P. scolopendrina*, *Antinoë parasitica* (under the scales of *Lepidametria*), *Hermadion pellucidum*, *Polynoë euplectellæ*, *Anoplonereis* (Giard) on *Balanoglossus*, and similar forms.

With the brief space at our disposal, however, it is manifestly impossible to do anything like justice to so many diverse heads, and accordingly I have thought it best to select a few of the most interesting types amongst those whose homes—formed of the body-secretion—present great regularity, or in which the foreign elements, mixed with the secretion, assume wonderful design or complexity. These mostly range themselves under the sixth and seventh heads already mentioned.

In surveying the members of the Invertebrate series of animals which are remarkable for their skilfully constructed homes, it is found that the majority have well-formed eyes, such as the amphipods, ants, bees, wasps, caddis-worms, and spiders. If, on the other hand, we glance at the marine annelids, it is curious that those with the largest and most complex eyes are entirely pelagic (*e. g.*, the Alciopidæ) and form no protective abode whatever. Though furnished with bright pigment their translucent bodies are even less conspicuous than the huge globular eyes, the pairs of which may be arranged so as to look laterally and ventrally. Those annelids, again, which construct complex tubes have eyes of a very elementary pattern—masses of pigment—with a simple capsule, and some of the most skilful are entirely devoid of them. The tactile sense, however, seems to be highly developed, so that, to a considerable extent, it takes the place of the other senses.

The annelids of the first group at present selected for consideration construct their tubes of large shell-fragments.

Thus in *Northia conchylega* the tube proper is, in the Zetlandic examples (fig. 1*), composed of the tough and glistening secretion, strengthened externally by entire shell-valves, large fragments of the latter, pieces of sea-urchins and heart-urchins, or, in those procured by the 'Knight Errant' in 608 fathoms in the Atlantic†, of coarse gravel; while occasionally the flattened tube is fixed to the valve of a small scallop. It is usually straight, and the perfect valve of the shell is terminal. The architecture is primitive, yet in keeping with its surroundings. The tube, moreover, can be carried about by its inhabitant, which has horny and calcareous jaws, so that it is in all probability sufficiently protected in the deep water where it is generally found.

The tubes of the representatives of this genus procured by the 'Challenger' exhibited some noteworthy features. Thus in one (*Northia sombreriana*) the flaccid tube was supported laterally by the long glassy spicules of a Hexactinellid sponge, which projected beyond each extremity. Another (*Northia abranchiata*) had its flexible tube protected by long, moniliform, brownish arenaceous Foraminifers, or by spines of heart-urchins, shells and stones. Similar tubes characterize *Northia pycnobranchiata*, but with the addition of a few white tubes pertaining to the Serpulidæ. A curious variation was observed in a species (*Northia macrobranchiata*) inhabiting the greenish mud at 350 fathoms off the coast of Japan (Jedo), which utilized the long linear leaves of the pines swept down by the rivers, besides leaf-stalks and leaves, straws, stones, and fragments of echinoderms, to strengthen its tube of greyish mud. All the foregoing, however, though considerable skill is evinced in the manner in which the foreign bodies are fixed to the tube, fall far short of the wonderful ingenuity which characterizes a species (*Northia Willemoesii*) dredged off Amboina. This annelid constructs a firm rounded tube—curved in the form of a shepherd's crook—of greyish sandy mud, lined by a tough whitish secretion. The ventral curve of the tube is comparatively smooth externally, but the rest of the surface (and especially the posterior curve) is furnished with a series of long, slightly bent, sharp elastic spines, which are formed of layer upon layer of a hyaline secretion similar to that which lines the tube, a well-formed central cavity giving the process, moreover, a resemblance to a large sponge-spicule. The distal region of the spine is veined like a finely marked piece of pitch-pine, its central portion is plaited or folded in some

* The figures, with the exception of no. 3, were kindly drawn from nature by my Prizeman, Mr. J. M. Anderson, M.A.

† Kindly sent by Dr. John Murray.

parts, while at its base is an opaque mass of granules. The latter is much enlarged at the point of attachment to the tube, and is there coated by the sandy mud forming the general investment. Few structures formed by invertebrate

Fig. 1.

Fig. 2.

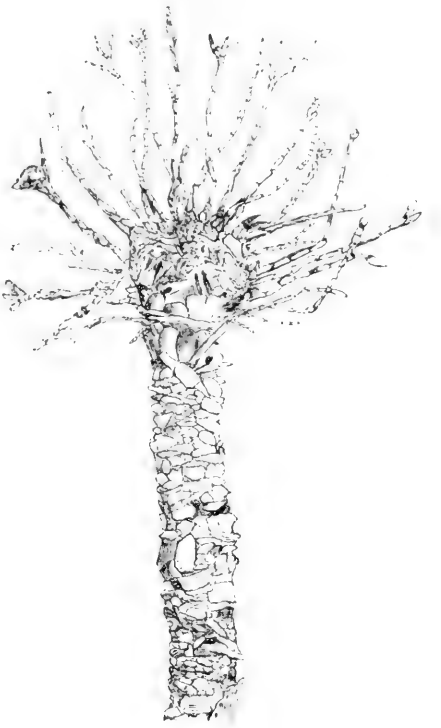


Fig. 1.—Tube of *Northia conchylega*, from Shetland. About twice the natural size.

Fig. 2.—End of tube of *Terebella* (*Lanice*) *conchilega*. Some of the fringes are broken. Slightly enlarged.

animals show greater skill or better-directed ingenuity than this wonderful tube and its complex spines. The precise nature of its enemies is unknown, but few predatory fishes would care to interfere with prey thus armed.

No form is more abundant or has more frequently come under the notice of those who are familiar with sandy shores than the next example, viz. *Terebella* (*Lanice*) *conchilega*,

the tubes of which (fig. 2) are often stranded after storms in vast multitudes, for instance on the West Sands; indeed, so conspicuous are they occasionally that more than once the question has been asked if they could not be advantageously employed for fertilizing the soil. The rounded tubes are fabricated by the annelids near low-water mark, and show a lining of the abundant secretion from the largely developed glandular tissue (*tissu clypéal* of Claparède), to which many shell-fragments, grains of sand, spines of heart-urchins, and similar bodies are fixed. No special regularity marks the attachment of the grains of sand or shell-fragments, the larger being generally laid flatly on the surface, while the smaller often overlap or are imbricated; in any case the tenacious secretion is closely covered. The tubes are deeply sunk in the sand (a foot or more), and sometimes curved round a stone, the ends alone reaching the surface. Each is furnished with two fan-shaped plates, the edges of which have a remarkable fringe of filaments, which, though they have not the beauty of the smooth processes of the species figured in the 'Challenger,' yet form a complex and gracefully branched tuft. The filaments are densely coated with foreign structures, such as shell-fragments and sand-grains, generally of a somewhat elongated form, and fixed by the tenacious cement, which shows cell-like outlines, both ovoid and elliptical, the exact nature of which is uncertain. Occasionally the cylindrical tube extends beyond the filaments and a new tuft is formed at the tip, probably after an irruption of sand has buried the free end beneath the surface.

When the animal is removed from its dwelling it does not resume possession of it, but fabricates a new one (by night), making progress, according to Sir J. Dalyell, of one or two inches daily. It likewise avails itself of the side of a glass vessel so as to economize labour. The busy tentacles soon sweep the vessel of its sand-grains and arrange them by aid of the secretion to form the tube and fringes, a careful account of the formation of both having recently been given by Mr. Arnold Watson*. As Sir J. Dalyell said of an allied species:—"Nothing is more surprising than the attention of so humble an artist being directed towards such a variety of operations at the same moment. Many tentacles are reaching after materials, many collecting, many bearing them to the orifice, some quitting their hold, others recovering the load, while the architect itself seems occupied in kneading masses in its mouth, disgorging them successively, or in polishing the rude workmanship resulting from its labours."† It, moreover, quits its tube when dying.

* Journ. Roy. Micros. Soc. 1891.

† Pow. Creat. ii. pp. 195, 196.

This species has a series of pigment-specks (rudimentary eyes) under the oral frill, and even a motion of the hand will cause retraction.

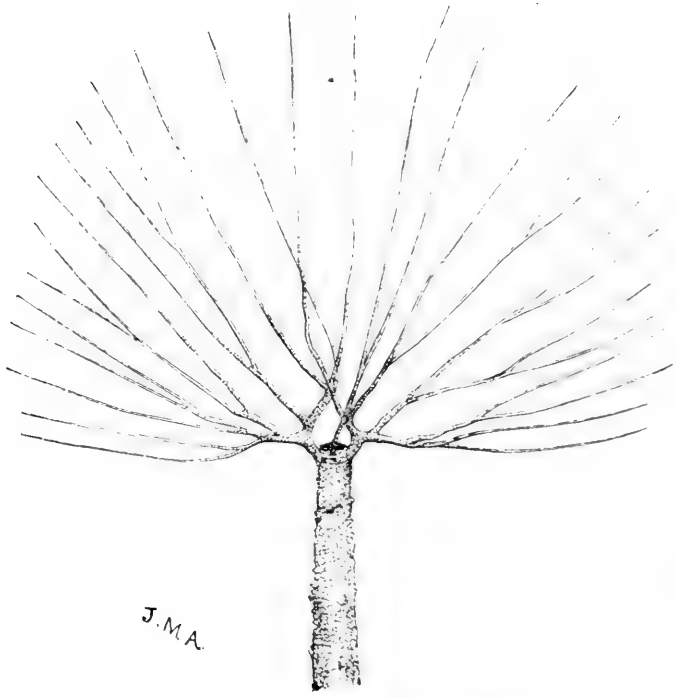
While the foregoing form presents great skill and ingenuity in the architecture of its tube, the result falls short in beauty of two species procured by the 'Challenger.' In the first, *Terebella* (*Lanice*) *seticornis*, from the mouth of the Rio de la Plata, the aperture of the tube presents a ventral tongue-shaped flap, the dorsal pillar supporting the base of a fan—split into a dozen primary filaments which, after a short course, usually become bifurcate. The lobe and the fan are composed of the ordinary tough secretion, in which grains of quartzose-sand are neatly imbedded; and as these are necessarily almost linear in arrangement in the filaments, a somewhat moniliform appearance is produced. The attenuate thread of the secretion forming the tip of each is strengthened by spicules of sponges and bristles of annelids. The extreme tip is occupied by a single long-winged bristle, which tapers to a point; while another, lower down and parallel with it, gives the region due strength and stiffness; and in the accompanying figure of the tube of a Norwegian *Terebella*, kindly sent by Canon Norman, equal ingenuity is exhibited (fig. 3, p. 10). It would be difficult to find in the whole invertebrate series an example of greater dexterity or of more methodical adaptation.

In the other, *Terebella* (*Lanice*) *flabellum*, from Prince Edward Island and the Australian region, the remarkable fan-like expansion is mainly composed of the tough secretion, stiffened by sponge-spicules and other linear structures, or by grains of sand, all neatly and ingeniously arranged.

The tubes formed by other members of the same family vary much in character, many being composed of mud and sand, as *Amphitrite* and *Lanassa*; some chiefly of mud, as *Nicolea*, *Leæna*, *Pista*, *Trichobranchus*, and *Terebellides*; while *Thelepus* and *Grymæa* have tubes containing a large amount of secretion coated externally by shell-fragments, zoophytes (calcareous and horny), spines of echinoderms, and other structures. One of the most interesting, however, is a species (*Euthelepus setubalensis*) procured by the 'Challenger' off Setubal, in which the translucent chitinous tube is invested by a remarkable *chevaux-de-frise* of Hexactinellid sponge-spicules, which form an impenetrable glassy investment. A certain amount of selective power must have been exercised by this species, since it lived in greyish mud with numerous Globigerinæ and other Foraminifers, some of which occurred in its alimentary canal. A species of *Pista* (*P. mirabilis*), again, has firm, round, tapering tubes armed all over with long spines. The majority of the tubes seem to have

been free, but others have been immersed in sponges, a situation which favoured the preservation of the long external spines. The tube is marked by close wrinkles, which are so fine as almost to be linear, a feature partly due to its composition, for it is formed of a vast number of needle-like glassy

Fig. 3.



End of tube of Norwegian *Terebella*. Slightly enlarged.

sponge-spicules held together by secretion and mud. The spines on the tube are composed of secretion, sponge-spicules, and sand-grains, the most perfect examples (*e. g.*, those removed from the enveloping sponge) being almost entirely made up of the two former. Another tube, dredged by the 'Challenger,' shows longitudinal and somewhat spiral spinous ridges, and is chiefly formed of mud.

A firm flexuous tube of sand-grains is constructed by *Axionice*; while a large and very lax tube is formed by *Terebella nebulosa*, Mont., on the southern and western shores, but it is generally protected and sheltered by valves of shells (e. g. *Pecten*) or by stones. Some show considerable discrimination in selecting materials for the tube. Thus Sir J.

Dalyell found that "*Amphitrite*" occasionally will reject small Venetian beads and make its tube of sand, but where shell-fragments can be procured they are preferred. Others (*Nicolea*) support their tubes by interweaving them with corallines; while *Leprea textrix* forms a coating for its body of thread-like strands after the manner of a web, as first described by Sir J. Dalyell. Moreover, its ova are sometimes fixed to these threads. A naked *Terebella*, further, can generally be made to unfold its coiled body by placing sand in the vessel, so as to tempt it to form a new tube.

Two species pertaining to the Ammocharidæ construct tubes lined internally by a very tough secretion, and externally strengthened by fragments of shells. In the one (*Owenia filiformis*) the shell-fragments are in many cases set on edge, so that the rounded tube is bristled with them; or they are arranged in an imbricate or scale-like manner, though the dense grouping of the fragments of shells, as a rule, causes a hirsute appearance. Others are densely coated with the tests of Foraminifers.

Amongst those which fashion homes of coarse sand-grains, and the united tubes of which form conspicuous masses on the sea-bottom or between tide-marks, the best known is *Sabellaria*. One species is abundant on the eastern shores, and especially at the East Rocks, while a larger form frequents the southern waters. The busy architects collect the coarse or fine sand-particles with their tentacles and fix them in the walls of the rounded tube by aid of the secretion, the wonderful crown of golden bristles at the anterior end doubtless performing important adaptive functions. The extensive and firm masses formed by both species (for the tubes are closely fixed together) must have a considerable influence in protecting the tidal surface or the sea-bottom, though they are disliked by the dredgers of the southern waters, who term them "Ross."

When *Sabellaria spinosa* constructs its tube on a shell or other hard surface it is extremely dense, whereas when grouped in the usual manner it is more or less brittle. Sir J. Dalyell found that pounded glass and red-brick grains were sparingly used, and by-and-by rejected altogether. It fabricates its tube chiefly at night, and, like other forms, utilizes the side of a glass vessel as part of the tube-wall, so as to save labour.

In alluding to the southern species (*S. alveolata*), one of the earlier writers on the group, viz. Dr. Thos. Williams *, gave a somewhat fanciful account of the structure and varied

* Report Brit. Assoc. 1851, p. 207.

uses of the remarkable anterior bristles. He observes that "on the three first post-occipital rings, gills, cutting-instruments, and hooks are developed, each hook-bearing ridge supporting at either end a brush of acutely cutting double-edged setæ ..... which are fitted in the most perfect manner for dressing the materials wherewith the tube is raised. By them rough-hewn stones are polished, rugged surfaces worn down, and angry projections from the interior of the tube smoothed off." After some further remarks, he concludes by predicating that "nothing in nature or art is comparable in perfection of mechanism to these exquisite organs." While I cannot go so far as Dr. Williams in his account of the functions of these organs, there can be no question that the bristles and hooks are amongst the most important structures in all the varied movements executed by the annelids generally, and, further, that they are, individually, perhaps the most reliable organs by which species can be discriminated.

The most skilful architecture in the construction of tubes, however, is exhibited by the family of the Amphictenidæ, one species of which is very abundant on the West Sands of St. Andrews, viz. *Lagis Koreni*. This annelid fashions a tube like a slightly curved horn, composed of minute pebbles or large grains of sand, carefully selected and admirably fixed to each other by the usual secretion. In placing the grains together in the tube there is no haphazard, but angle fits angle, as in a skilfully built wall, and no excess of cement hides slovenly masonry. The tube is perfectly round, and tapers from the narrow lower end to the wider upper (for thus it is inserted in the sand), and its symmetry and workmanship are faultless; yet the architect is devoid of eyes and depends entirely on its exquisite sense of touch and remarkable instinct. The tubes harmonize closely with their surroundings, the wall being formed of similar proportions of pale sand-grains of yellow, brown, and black, probably because in such a selection the average colours are fairly represented.

With a tube more distinctly curved and of a more slender and graceful outline, *Amphictene auricoma* is one of the best known as well as one of the most interesting of the series (fig. 4). In this the grains of sand are finer than in *Lagis*, especially in small specimens *, but are placed together with equal skill and care, so that the tube is perfectly rounded and apparently smooth, for the slight elevations caused by the sand-grains are only visible under a lens (fig. 5). Like the

* It is probable that the tubes in the growing animal are shed at intervals, and new ones formed. Thus the tube of the adult differs in regard to the size of the grains of sand.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

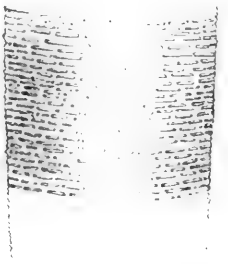


Fig. 8.

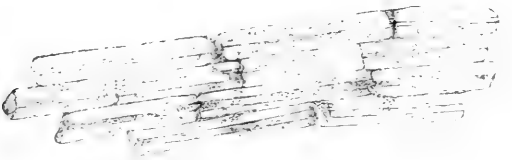


Fig. 4.—Tube of *Amphictene auricoma*. About three times natural size.
Fig. 5.—Portion of tube of *Amphictene auricoma*. Enlarged under a lens.
Fig. 6.—Tube of *Amphictene auricoma* formed of sponge-spicules. About thrice the natural size.
Fig. 7.—Portion of fig. 6, enlarged under a lens.
Fig. 8.—Portion of fig. 6, more highly magnified.

former, the colour harmonizes with the sand at and beyond low-water mark, and a certain amount of translucency is present, for the quartzose sand-particles are each fixed in the cement like a jewel in its setting, so that there is little interference with the light. Moreover, the tube has only the thickness of such grains—with a delicate coat of the secretion internally. The smaller end of the tube has grains considerably finer than the wider upper end, but they blend into each other so insensibly that it is only by comparing the distant parts that the difference is observed. Like many others, the annelid works at its tube only during the night.

Such is the ordinary condition of the home of *Amphictene*, but occasionally circumstances alter the case very materially. Thus, when amongst deep-sea mud it is debarred from laying hold of sand-grains, it fashions a perfectly circular tube—tapered and curved as in the ordinary examples—out of the only hard particles it can secure, viz. fragments of the glassy spicules of sponges, which are placed with the utmost neatness and regularity in horizontal rows from end to end, somewhat after the manner of basket-work (fig. 6). These spicules consist, so far as observed, of short fragments, and thus, with their minuteness, conduce to the perfect rotundity of the tube, which only presents the slight convexity of each spicule at the edge, the outline being minutely crenate under the microscope (fig. 7). The cement fixing the spicules is in small quantity, just sufficient to render the tube strong without interfering with its transparency* and smoothness. The workmanship of these tubes of *Amphictene*, indeed, excites admiration—no less for the skill and perseverance of the architect than for the unfailing accuracy and beauty of the result. No careless work betokens haste or weariness, but from the first translucent circle to the last the same uniform regularity is maintained. Moreover, on magnifying a portion of the tube the beauty and complexity of its structure are increased, for each of its fragments shows the central tube of the spicule either as a clear lumen or filled with extraneous granular matter (fig. 8).

Larger and stronger tubes than the foregoing are formed by two northern species. The first (*Cistenides granulata*, from Exeter Bay, Greenland) constructs a slightly curved tapering tube of rather coarse grains (the particles, however, being finer at the smaller end of the tube), which are prominent, so that the surface is somewhat rough, yet the cement

* The transparency of such a tube readily shows the cell-like bodies in the secretion which so neatly fixes the fragments of the spicules and forms a thin coating internally.

is neatly fitted. Both sand-grains and cement have a dull ochreous hue; and the paleæ are likewise dull brownish. The second form (*Cistenides hyperborea*) has a large tapering tube, also slightly curved, composed, as a rule, in the large examples of moderate grains of sand in the midst of much cement, so that the surface varies in character from the foregoing, though it is also ochreous. Moreover, the smaller diverge so considerably from the larger grains that the pattern is less uniform. Both tubes are strong and resistant, better able to cope with their rougher surroundings than those of *Lagis* or *Amphictene*; and both are more opaque. The inner surface of these tubes is smoother than the outer, and in *C. hyperborea* the lining of cement is sometimes very conspicuous.

Amongst those which fashion translucent homes from the body-secretion alone, the most remarkable type is *Hyalinœcia*, which, both in our own and in foreign seas, constructs a tube ranging in size from a crow- to a goose-quill, and in the large foreign examples gently tapered from one end to the other. The tube is so firm and yet so elastic that, like a goose-quill, it can be cut into the shape of a pen, a feature almost without parallel in other than the group of birds. The great length and perfect smoothness of this tube are characteristic. The inhabitant belongs to the same family as *Northia*, and is allied to the Eunicids with their fine red branchiæ and iridescent bodies, and, like them, has a well-armed proboscis. The Eunicidæ, however, secrete parchment-like tubes more or less opaque, and, as a rule, they are protected by immersion in sponges or placed under shells and other structures, whereas the tubes of *Hyalinœcia* stand freely in the mud.

Spiochætopterus, again, secretes a translucent flexible tube of great length, and often with a series of collars or frills, and an allied form, *Phyllochætopterus*, procured by the 'Challenger,' shows similar rings in its semiopaline tube, which also has a very neat diaphragm with a central aperture posteriorly. Moreover, many of the tubes are forked, an appearance due to fracture and the secretion of a new piece with which the tunnel is continuous, while the old fractured end has its tube closed and remains as a useless process. As a general rule ordinary chemicals have little effect on these hyaline tubes.

On the other hand, *Myxicola* surrounds itself with a translucent gelatinous investment of considerable thickness, from the midst of which it stretches its beautifully formed and gaily tinted branchial fan.

In none of the foregoing instances does the architect of the

tube or home secrete other than the transparent chitinous material for a lining, for fixing the foreign bodies, or for forming the entire structure. In all the succeeding groups a calcareous substance is poured out, which consolidates into a dense shelly tube for the inhabitant, and, moreover, in at least one instance the agglutinated tubes form considerable masses, so as to resemble certain kinds of coral; indeed, those unacquainted with the group often relegate them to the latter. As Dr. Williams observes*:—"The lime of which the tubes are built is held in solution by the mucus provided by the cutaneous glands. It is adjusted in the fluid form, and moulded by appropriate tools into the required shape; it then solidifies under water like 'Aberthaw lime.'"

Conspicuous by its relative size, the elongation of the opaque-white tube, and the absence of a plug or operculum for closing the free end, *Protula* affects the deeper water in the northern seas. The pure white tube is here and there wrinkled and more or less straight, and the aperture is smooth. It tapers from the larger anterior region to the posterior end, the former being the home of the full-grown annelid.

From deep water also come the remarkable coral-like masses already alluded to, and formed by the tubes of *Filigrana*, an annelid likewise devoid of a lid or operculum for closing its shelly tunnel. The slender tubes are united into irregular bundles, often with spaces between, and each is inhabited by its eight-gilled architect.

A white tube tinted anteriorly of a roseate hue and with a trumpet-like aperture characterizes the home of *Serpula vermicularis*, which is attached to shells and stones from deep water. Occasionally three or four trumpet-shaped tiers occur in front, where additions have been made to the tube after the first wide rim has been formed. The annelid closes the aperture anteriorly by a plug, the surface of which is marked by a beautifully radiate series of grooves. The tubes of a species (*S. narconensis*) obtained by the 'Challenger' in the Strait of Magellan show many prominent rings from the widely expanded apertures, showing that growth had apparently taken place by fits and starts; and a similar condition is mentioned by Claparède in *S. crater* from Naples. The tubes of the species from the Strait of Magellan form free masses. An allied, though smaller tube, but without the trumpet-like anterior end, is secreted by *Hydroides norvegica*; these two genera illustrating the series with circular tubes of considerable length.

* *Op. cit.* p. 205.

Those Serpulids with angular tubes of great density, and firmly fixed to shells and stones, are represented by *Pomatoceros* with its ridged tube and bold sharp oral spine, and by the vitreous home of *Placostegus*. The former often occurs in great numbers (as in Lochmaddy) under stones and on rocks between tide-marks, while the latter frequents deep water. The accuracy with which the pattern of each tube is preserved in every example is noteworthy, just as each species of mollusk secretes its special shell. This is the more evident in the shelly tubes dredged by the 'Challenger,' in which the patterns on the surface are complex. Such, for instance, is the transversely ribbed *Placostegus ornatus* from 2900 fathoms in the depths of the Pacific, and the pentagonal tube of *Placostegus benthalianus* from the middle of the same ocean at 3125 fathoms. In the latter the three upper ridges are prominent and armed with blunt teeth. Lastly, the dense tube of *Placostegus Morchii* has a deep groove on each side, and comes from the Pacific, at 2373 fathoms, midway between Sydney and Valparaiso.

Other examples of shelly tubes are seen in the little coils of *Spirorbis*, which stud the blades of seaweeds, the backs of crabs, and other marine structures.

All the foregoing are fixed, or, if free, form agglutinated masses; whereas another form (*Ditrypa*) secretes a hard, smooth, calcareous tube, tapered and distinctly curved, which remains quite free in the mud, muddy sand, or shell-gravel. It resembles the elephant's-tusk shell (the home of a mollusk), but is the product of an annelid closely allied to *Serpula*.

Such, then, is a brief outline of a few of the interesting types of "homes" formed by marine annelids. Slight as the sketch has been it nevertheless will be apparent that the amount of skill and perseverance in the construction of these dwellings can hardly be surpassed by any other group of animals—whether marine, freshwater, or land. No basket-insects' work is more ingenious, and even the combs of the bees and wasps and the nests of the most skilful birds are not more complex examples of workmanship than the tube of *Amphictene* or than that of *Terebella* with its terminal fringes. Their work is more marvellous than any home formed by fishes, which generally seek hollow seaweeds, holes in rocks or similar places; and the comparatively rough nests of the fifteen-spined sticklebacks of the tidal rocks, or those of the common sticklebacks of freshwaters, are not to be compared with the wonderful architecture of the annelids. Even man,

with all his ingenuity, has to make frames for constructing arches and circular buildings, and moulds for circular casts; his cement has to be brought from a distance and carefully manufactured, and he requires good sight and much aid to form his dwelling: whereas some of the most skilful and beautiful formations of these marine annelids are executed by creatures devoid of eyes and with a soft and delicate body, whose mortar is secreted by the glands of their skins, and whose inborn instinct enables them to dispense with all artificial aids in the construction of their homes.

II.—*The Endosternite of* Scorpio *compared with the Homologous Structures in other Arachnida.* By H. M. Bernard, M.A. Cantab. (from the Huxley Research Laboratory, R. Coll. of Science, South Kensington).

[Plate III.]

Special interest has attached to the endosternite of *Scorpio* on account of its bearing upon the question of the relationship between *Scorpio* and certain near allies of *Limulus*. The external likeness between *Scorpio* and *Slimonia* taken alone might be merely a case of convergence; but their common possession of an endosternite seemed to many to establish beyond doubt that this resemblance was due to a direct relationship. The validity of this argument depends, however, upon it being shown that their respective endosternites are morphological equivalents. Indeed, it seems to me that the whole question of the assumed relationship depends upon the settling of this point; for it is hardly possible that two forms so related should possess analogous structures of fundamental importance in the organism which are not also homologous.

Considering, then, the interest attaching to the endosternites it is somewhat to be wondered at that no serious attempt * has been made to obtain a clear idea of their essential morphology in the only way this can be obtained, viz. by comparison.

The Arachnid which at the outset seemed to promise most light on this subject was *Galeodes*, in which the three posterior cephalothoracic segments remain unfused. This primitive feature could hardly fail to find some reflection in the structure of the endosternite.

* *Cf.*, however, Lankester, "On the Skeleto-trophic Tissues of *Limulus*, *Scorpio*, and *Mygale*," Q. J. M. S. vol. xxiv., 1884.

Fairly good drawings of the endosternite in *Galeodes* have already been given by Modest Kittary * and by Blanchard †.

From both of these its essential nature can be made out. It is composed of two apodemes running in from between the first and second legs and meeting in the middle line under the gut. Fig. 1 (Pl. III.) shows the structure *in situ* and fig. 2 is a cross section showing that the junction of the two apodemes in the middle line is an interlocking apposition and not an actual fusion. Its nature as a fold of the external cuticle is also very apparent from the section. The thickness of the chitin of the fold is very irregular. Into its deeper parts (fig. 2, *s*) staining protoplasmic matter has penetrated, and similar protoplasmic matter binds the interlocking folds together. The hindermost ends of the structure are greatly expanded for the attachment of muscles.

With this key to the understanding of the morphology of the endosternite, by the kind permission of Prof. Stewart I examined the fine preparation of that of *Mygale* at the Royal College of Surgeons. The cephalothoracic segments of the Araneidæ, as is well known, are equally fused together, indication of their original separation being, however, distinct in the furrows on the dorsal wall of the cephalothorax. Instead of one pair of apodemes fusing in the middle line, such as is found in *Galeodes*, we here find four pairs meeting and fusing together (figs. 3, 4, and 5) ‡.

This is what we should expect, owing to the larger number of segments fused together. The eight apodemes further radiate from a common centre, thus repeating the curious radial arrangement of the segmental constrictions seen on the dorsal surface. Figs. 3, 4, 5 show the arrangement of these four pairs of apodemes and their place in the cephalothorax. Their principal attachments to the body-wall are now the points marked 1, 2, 3, 4 on the inner surface of the sternum in fig. 4. In very young spiders (just hatched) the original segmental constrictions running across the sternum, and now reduced to these points, are still traceable as clear lines running across the sternum.

* Bulletin de la Soc. Imp. des Naturalists, vol. xxi. (Moscow, 1848).

† 'L'Organisation du Règne Animal,' Arachnides, pl. xxv. fig. 9.

‡ There exist several drawings of both the dorsal and ventral aspects of this structure. The earliest which I can find is that of Wassmann ("Beiträge zur Anat. der Spinnen," Hamburg. Abhandlung. Bd. i., 1846). This was copied by Victor Carus in his 'Icones Zootomicæ,' Taf. xiii. Blanchard has drawings of it in his 'Règne Animal.' The latest, given by Lankester (*anteà*, p. 18), is full of detail, but the conclusions which he draws from it are vitiated by his having mistaken the ventral for the dorsal surface.

The shape of the whole fused mass has been no doubt much altered by the action of muscles, but its essential nature as a fusion of metamerically recurrent apodemes cannot be mistaken.

On comparing the segmentations of the two Arachnids we have so far considered, we find that the apodemes forming the endosternite of *Galeodes* correspond only with the second pair of apodemes forming the endosternite of *Mygale*. The first pair in *Mygale* is now only represented in *Galeodes* by a small pair of chitinous plates attached by tendons to the cuticle and to the endosternite (fig. 10), and apparently carrying the proximal ends of he main ducts of the coxal glands.

The endosternite of *Phrynus* (fig. 6) is a broad crescent-shaped plate. It apparently only has one attachment to the ventral surface, and that is to the intersegmental membrane between the second and third pair of limbs corresponding with the first pair of apodemes forming the endosternite of *Mygale*; dorsally, however, it has four pairs of ligamentous attachments to the dorsal wall. These remind us of the endosternite of *Mygale*, and a comparison of the drawings seems to bear this out. If the endosternite of *Phrynus* prove ultimately to be homologous with that of *Mygale*, its sternal attachments, except the first, must have secondarily atrophied.

The endosternite of *Thelyphonus* (fig. 7) * is again of special interest, as it clearly follows the same type as that of *Mygale* and *Phrynus*. But inasmuch as the fusion of the segments shows no such radial arrangement as in the former, nor such longitudinal compression as in *Phrynus*, the various pairs of apodemes neither radiate from a centre nor form a short crescentic plate, but a long fenestrated framework.

On turning to *Scorpio* we find that the endosternite most resembles that of *Galeodes*. Fig. 8 is from a dissection of *Palamnæus Thorellii*, Pocock, made in order to ascertain the exact points of attachment to its parent cuticle. The nerves to the first pair of legs are seen in front of these attachments, which thus correspond with the points of origin of the endosternite in *Galeodes*. Lankester describes and figures† a second pair of ventral attachments—"cornua or anterior tendons of the subneural process;" but this subneural process belongs to the "diaphragm" and not to the endosternite, as I shall presently show.

* I have borrowed this drawing by Tarnani from Schimkewitsch's recent paper in the 'Zool. Anzeiger' (July 1893), "Sur la Structure et sur la Signification de l'endosternite des Arachnides."

† Lankester, "On the Muscular and Endoskeletal Systems of *Limulus* and *Scorpio*," Trans. Zool. Soc. vol. xi. part 10 (1885).

The endosternite of *Scorpio* is somewhat complicated by the strong longitudinal compression of the thorax having caused it to fuse posteriorly with the "diaphragm" (figs. 8 and 11, *d*). This "diaphragm," like that of *Galeodes*, is the homologue of the great constriction between the sixth and seventh segments forming the "waists" of other Arachnids. In both *Galeodes* and *Scorpio* it is pierced by the dorsal vessel (*h*), the alimentary canal (*a*), and the nerve-cords (*n*), and in *Galeodes* by tracheæ (*t*). In *Galeodes* it lies some distance behind the posterior edge of the endosternite, there being no longitudinal compression of the thorax, and it also slopes from above backwards (*cf.* figs. 1 and 10). In *Scorpio* the secondary longitudinal compression of the cephalothorax, which is more marked than in other Arachnids, especially on the ventral surface, has caused the "diaphragm" to slope from above forward (*cf.* figs. 8 and 11). In fig. 8 the posterior edge given to the (shaded) endosternite is naturally arbitrary, as, except where it passes under the alimentary canal, it is fused with the "diaphragm." There seem to be four points of fusion. The ridges (*r*), caused by the dorso-ventral muscles *behind* the "diaphragm," have fused with the postero-lateral tendons (*t*) of the endosternite, to which the muscles themselves are now secondarily attached; and, further, the horizontal plate of the endosternite itself is attached by two processes (*e*) to the anterior face of the "diaphragm" which runs slantingly under it. Fig. 11 illustrates the relative positions of the endosternite and the "diaphragm;" it shows only the fusion of the plate of the endosternite with the latter, and is not intended to represent a true horizontal section. Fig. 9 is a transverse section (through the line ⁂ in fig. 11) of *Euscorpio* showing the endosternite with a portion of the "diaphragm" (Lankester's "subneural portion") which has been thrust forward under it by the ventral median portion of the seventh segment. With this portion of the "diaphragm" (*d*) so thrust forward, the extreme posterior ends of the endosternite (*e*) fuse on each side of the nerve-cord.

The figures which have hitherto been given of the endosternite of *Scorpio* really represent, then, a composite body, viz. the endosternite and the "diaphragm" fused together. This point is of great importance, as it seems to me to establish beyond question the complete distinctness between the endosternites of *Limulus* and *Scorpio*. In order to maintain the contrary it would be necessary to show that the endosternite of *Limulus* was once part of a "diaphragm," a "diaphragm" or waist being typical of Arachnids.

Histologically the endosternite proper of *Scorpio* shows its origin out of apodemes less plainly than does that of *Galeodes*. This origin out of cuticular folds is, however, clear in cross sections near their points of attachment to the body-wall between the first and second legs; in the other parts the originally simple chitinous folds still visible in *Galeodes* (fig. 2) have become changed, groups of cells having found their way in between the chitinous layers *. Full of interest is the marked difference between the cross sections of these original and ancient apodemes forming the endosternite, which have now become almost entirely detached from their parent cuticle, and the recent secondary apodemes forming the coxal endosclerites, which latter show their origin as cuticular infoldings at a glance. These structures are well developed in *Phrynus* and *Scorpio*, and they arise as an accompaniment of the longitudinal compression of the thorax which characterizes these two Arachnids. These apodemes remain continuously rigid with the posterior faces of the coxæ.

The endosternite of the Chernetidæ is now so specialized that it will be difficult to ascertain its exact origin; it appears to be due to a fusion of segmental apodemes from between the posterior thoracic segments, as it lies right back at the posterior end of the thorax †. It may perhaps be homologous with that of the Araneids.

Enough has now been said to show conclusively that the endosternites of the Arachnids are apodematous, and owe their origin and varying forms to the different methods and degrees of fusion and longitudinal compression of the cephalothoracic segments. In *Scorpio* this longitudinal compression of the thorax is so pronounced that the endosternite has fused with the diaphragm, and this has misled investigators into believing that they belong to one another as parts of one and the same structure.

We may, then, safely conclude from this comparative survey of the endosternites in Arachnids that *Scorpio* has not retained the original condition of the Arachnidan thorax. But this is after all in reality nothing more than what we can learn from any comparative study of the Arachnids. We have, for instance, every degree of fusion and longitudinal compression of the first six segments, with *Galeodes* at one end retaining the largest number of segments unfused, and *Scorpio* at the other end with all the cephalothoracic segments closely fused and compressed.

* *Cf.* Lankester (*antea*, p. 18) and Schimkewitsch (p. 20).

† *Cf.* "Notes on the Chernetidæ," Journ. Linn. Soc., Zool. vol. xxiv. p. 410.

It seems to me that, in order to answer the question, "Is *Limulus* an Arachnid?" we ought to compare *Limulus* with *Galeodes*! Indeed, I must here express a surprise, which I have long felt, that any serious attempt should have been made to establish relationship between two groups by comparing their specialized forms, practically ignoring the remaining representatives of the groups. And yet this is what has been attempted. The Merostomata and the Arachnida are supposed to be related because of the likeness between certain Eurypterids and *Scorpio*. *Scorpio* was clearly an Arachnid, and therefore related to other Arachnids, and *Limulus* was equally clearly related to the Trilobites. To attempt to build up an elaborate proof that *Limulus* must be related to *Scorpio* on the ground of their external and internal resemblance, while *Galeodes* on the one hand and the Trilobites on the other are but incidentally considered, can only lead to confusion*. The only scientific method of dealing with the question of the alleged relationship between *Limulus* and *Scorpio* lies first of all in the determination by comparative morphology of what is the essential diagnosis of the Arachnids and what is that of the Merostomata †.

Having seen that the endosternites of the Arachnids are apodematous structures due to fusion and compression of

* *Galeodes*, indeed, is often not even considered at all!

† I would here point out that it is still a matter of dispute whether the Pycnogonidæ and Pentastomidæ are or are not Arachnids. It seems to me that the only way to obtain a true insight into the essential morphology of the various groups of the Articulata is, by comparing all the available forms, to discover how the original undifferentiated condition of the segmentation of the ancestral form has been modified in each group. I have already endeavoured to do this for the Crustacea, with results which are in a way to being more rapidly confirmed than I ever expected. I am now engaged on a comparative study of the Arachnids, and I hope to find the clue to the original modification of their primitive segmentation. And here I should like to add that, although my friend Mr. Pocock's paper, "On some Points in the Morphology of the Arachnida" (Ann. & Mag. Nat. Hist., Jan. 1893) is of much service as a store of facts, the arguments which he bases upon them are not conclusive. He endeavours to show that all Arachnids *might be* deduced from a scorpion-like ancestral form. I have recently shown in 'Nature' (Nov. 16, 1893) that there is no necessity to assume the strict homology of the stigmatic segments, on which assumption much of Mr. Pocock's argument appears to rest, inasmuch as *all* the segments originally possessed tracheal invaginations. Further, it is not sufficient to take simply the *number* of the segments into account; the *fusions* of the segments are, if anything, even more important, those animals with the lesser number of fused segments being as a rule more primitive than those with a greater number. Judged by this standard, *Galeodes* or *Schizonotus*, and not *Scorpio*, is the primitive Arachnid.

the cephalothoracic segments, and later specialized for muscular attachments, let us for a moment look at the analogous structure in *Limulus*. Lankester * expressly tells us that "the inter-entapophysial ligaments which run on each side, right and left, along the dorsal surface of *Limulus*, passing from one entapophysis to the next, are of similar nature and origin to the entochondrites," *i. e.* to the endosternite. Further, we learn from Benham's researches † that these ligaments run on the *outer* sides of the entapophyses. These two facts, it seems to me, confirm the explanation of the endosternite of *Apus* and *Limulus* as derivations of the longitudinal muscle-bands given by me ‡. A comparison between cross sections of *Apus* and *Limulus* leaves little doubt that these entapophysial ligaments are the structurally degraded homologues of the dorsal muscle-bands, which, as in *Apus*, once ran *outside* the dorsal attachments of the dorso-ventral muscles. In *Limulus* these muscles have lost their physiological significance owing to fusion of the segments, and have become ligamentous.

If these ligaments, then, are derivatives of the dorsal longitudinal muscle-bands, which seems to me in the highest degree probable §, then the endosternite, which, according to Lankester, is of exactly the same nature as these ligaments, must be a derivative of the ventral muscle-bands, as I have already maintained.

The endosternite of *Limulus* thus viewed must be homologous with that of *Apus* and not with that of the Arachnids, which had, as we have seen, an entirely different origin. Indeed the evidence which we have here obtained from this short comparative study of the endosternal system appears to be conclusive against the existence of any direct genetic relationship between *Limulus* and Arachnids.

The claims of relationship between the Trilobites, *Limulus*,

* *Cf. anteà*, p. 20.

† "Muscular and Endoskeletal System of *Limulus*," Trans. Zool. Soc. vol. xi. (1885).

‡ 'The Apodidæ,' Nature Series (1892).

§ I have carefully compared the musculature of *Apus* with Benham's detailed description and drawings of that of *Limulus*, and find that that of *Limulus* can be deduced from that of *Apus* (as I have before suggested) without difficulty. This derivation further avoids the necessity of assuming that any *important muscles* or *whole series of muscles* either of *Scorpio* or *Limulus* are new formations, which Lankester shows must have been the case if *Limulus* and *Scorpio* are nearly related. I might here also mention that histologically the muscle-fibres of Arachnids are totally distinct from those of Crustacea. *Limulus* has, it appears, Crustacean, or at least certainly not Arachnidan, muscle-fibres.

and the Eurypteridæ on the one hand and *Apus* on the other I have already elaborated in the book above cited, the main conclusion of which I am in a position greatly to strengthen by new points which have lately come to light. The position of *Scorpio* among the Arachnids will be further discussed in a work on *Galeodes* on which I am now engaged.

EXPLANATION OF PLATE III.

Fig. 1. The endosternite (shaded) of *Galeodes*, shown *in situ*. *l*, labrum; *p*, pedipalp; I., II., III., IV., four pairs of legs; T, stigmatic opening of trachea; *d*, diaphragm, sloping backwards; *h*, *a*, *n*, *t*, cardiac, alimentary, neural, and tracheal apertures in *d*.

Fig. 2. Transverse sections of the endosternite of *Galeodes*, showing its nature as two infoldings of the cuticle, joined by staining protoplasmic matter, but not fused, in the middle line. *a*, alimentary canal; *m*, massive elevator muscles of the pedipalps; *s*, space filled with staining protoplasmic matter.

Fig. 3. Dorsal aspect of the endosternite of *Mygale*.

Fig. 4. Inner view of the ventral surface of *Mygale*, showing the ventral points of attachment (1, 2, 3, 4) of the endosternite to the sternum (S). *p*, pedipalp; I., II., III., IV., four pairs of legs.

Fig. 5. Ventral aspect of the endosternite of *Mygale*, showing its sternal attachments uppermost. From a comparison of these figures the endosternite is seen to be composed of four pairs of apodemes (1, 1, 1), (2, 2, 2), (3, 3, 3), (4, 4, 4), radiating from a common centre, and further joined by a web-like expansion in the middle horizontal plane.

Fig. 6. Dorsal aspect of the endosternite of *Phrynus*. The preparation was accidentally destroyed before the drawing was completed; it, however, represents its general appearance. 1, 2, 3, 4, tendinous attachments, probably corresponding with the first ventral and four dorsal attachments of the endosternite in *Mygale*.

Fig. 7. Dorsal aspect of endosternite of *Thelyphonus*, after Tarnani (*cf.* last figure).

Fig. 8. Endosternite (shaded) of *Scorpio* (*Palamnæus Thorellii*, Pocock), *in situ*. *l*, labrum; *p*, pedipalps; I., II., III., IV., legs; *b*, brain, with nerves to *p* and I.; *d*, diaphragm, with *h* and *a*, cardiac and alimentary apertures through it, and *r*, ridges produced in it by the first pair of abdominal dorso-ventral muscles. The diaphragm is seen to slope forward under the endosternite.

Fig. 9. Transverse section through the line * in fig. 11, showing the points of fusion of the endosternite of *Scorpio*, with the diaphragm, *d*. *g*, genital operculum; *l*, anterior ends of the lips of the genital aperture. The diaphragm separating the sixth from the seventh segment has here been thrust forward by the genital aperture belonging to the seventh segment. *e*, posterior ends of the endosternite, on one side fused with *d*, on the other just before fusing, the section not being accurately transverse. *t*, tendons for attachment of muscle-bands, which slope backwards along the anterior face of the diaphragm (dorso-ventral muscles); *a*, alimentary canal; *n*, nerve-cords.

Fig. 10. Diagram showing the relative positions of the endosternite and

diaphragm (*d*) in *Galeodes* from the side. *h*, heart; *a*, alimentary canal; *n*, nerve-cords passing through *d*; *c*, small plates attached by tendons to the endosternite and outer cuticle (*cf.* text, p. 20).

Fig. 11. Diagram showing the relative positions of the endosternite and diaphragm (*d*) in *Scorpio*. Lettering as in fig. 10. The line of section of fig. 9 is also indicated.

III.—*On the* Elateridæ *of Japan*. By G. Lewis, F.L.S.

The first object of this paper is to describe as simply as possible the new species of Elateridæ brought from Japan by the writer in 1882; the second and minor object is to adjust certain synonymy, to revise some previous work on the fauna, and to note and reject species which have been erroneously introduced to the Japanese catalogue. The arrangement of Candèze has been followed as closely as possible, but in two cases I have given full rank to genera merged in others by Candèze. It is also to be noted that some of the species described are very similar to American and European forms, and others again resemble species from the islands and various countries of the Asian continent, yet after a careful examination it appears that only one or two are identical.

By the kindness of Mr. Godman I have had access to the collection made by the late Mr. E. W. Janson, and this has been of considerable assistance to me; the collection also in the National Museum has been of material aid, while the specimens returned to me by Dr. Candèze, after writing his paper on the Japanese species in 1873, are of course in my possession and are now amalgamated with the more recently gathered specimens.

Some species of Elateridæ are extremely local, remaining at times as a little colony in or near one tree for many generations, so that there can be hardly any doubt that the number of species yet to be discovered must be very considerable. *Athous desertor*, Cand., is a case in point; I found two or three specimens in a glen on Maiyasan, near Kobé, in 1871, and on returning there in 1881 I found a few more, and these are, I believe, the only examples known.

The localities given are selected to furnish some information regarding the distribution of the species at present known to me; but no names are given of places which are not registered in my itinerary and do not also appear on the map published with it in the Trans. Ent. Soc. Lond. 1883. Authors in describing species would do well to remember

that "Japan" for a locality of a species, in the present state of our knowledge of the fauna of the islands, is not sufficient, and, when possible, more precise information is needed. Japan is a country which is subtropical in the south, and on a large part of the northern area and on the mountains of Central Japan snow lies to a great depth five months in the year; and whether a species comes from one or the other it is important to know.

There are five species, viz. *Elater azurescens*, Cand., *Melanotus niger* and *laticollis*, Motsch., *Cardiophorus vulgaris*, Motsch., and *Agriotes ferruginipennis*, Motsch., which are not recognizable by the published descriptions; and there are nine species which have been introduced to the Japanese Catalogue in error, viz. *Lacon trifasciatus*, Cand., *Elater Ryei*, Lew., *Melanoxanthus zebra*, Wiedm., *Limonius cylindricus*, Payk., *Cardiophorus sobrinus*, Lap., *Corymbites tessellatus*, L., *Corymbites tristis*, Cand., *Corymbites lateralis*, Lec., and *Corymbites sericeus*, Gebl. Some of these are noted in the body of this paper, but their names are not admitted to the list at the end of it. The list contains 181 species, of which 104 are considered novelties.

Adelocera Mäklinii, Cand.

Adelocera Mäklinii, Cand. Elat. nouv., Mém. Acad. Belg. 1865, p. 6; Mém. Liège 1873, p. 1.

Hab. Kobé, Wada-toge, Sapporo, and Junsai.

This species and some others are inserted in this paper to give, when it seems desirable, additional localities to show their distribution.

Adelocera antennata, sp. n.

Rufo-brunnea, parum nitida, pilosula: fronte triangulariter impressa; thorace canaliculato; elytris striis obsoletis, punctatis, interstitiis externis convexis; antennis articulis brevibus et compressis.

L. 14 mill.

Rather parallel, reddish brown, little shining, clothed with golden-grey hair; the head triangularly impressed between the antennæ, rather closely punctured; the thorax channelled in the middle, narrowest in front, and gradually and slightly widening to the hind angles, hind angles slightly turned outwards and rather more acute than those of *A. Mäklinii*, Cand., punctuation like that of the head; the elytra, striæ obscurely impressed or obliterated by the punctuation, interstices 3–6 more visibly convex than the others; the antennæ

and legs reddish brown, the first with compressed articulations, somewhat like those figured for *Scaphoderus Riehlii*, Cand., but the second and third joints correspond closely to the third and those following; all are broader than long, not serrate.

The above is extremely like a pale variety of *A. Mäklinii*, Cand., but the thorax is not sinuous before the hind angles and the peculiar antennæ are very curious and unlike any other species in this series.

Hab. Sapporo. One example.

Adelocera parallela, sp. n.

Elongata, parallela, obscure brunnea, grisco-vestita: elytris striis obsoletis, interstitiis seriatim punctatis; antennis pedibusque concoloribus.

L. 12 mill.

Elongate, parallel, dull brown, clothed with stiffish grey hairs; the head concave between the antennæ, punctate, punctures deep, circular, and somewhat closely set; the thorax punctured like the head, slightly narrower than the elytra, sinuous before the hind angles; the elytra, striæ obsolete, interstices with punctures distinctly smaller than those of the thorax, set in rows, the rows close to the suture not well-defined, the next eleven or twelve rows well-marked, those nearer the outer edge somewhat obscure and irregular; the antennæ and legs dull brown.

This insect is much smaller than *A. Mäklinii*, Cand., and the elytral sculpture is wholly different.

Hab. Sapporo.

Lacon murinus, Linn.

Candèze reported this species from Japan (Elat. nouv. i. p. 10), but later (Mém. Liège, 1873, p. 2) he considered the examples belonged to *L. binodulus*, Motsch.

Lacon quadrinodatus, sp. n.

Elongatus, subparallelus, pilis aureo-rufis dense vestitus; fronte concava, capite punctato inter oculos canaliculato; thorace 4-nodato; elytris dense punctatis, haud striatis.

L. 15 mill.

Elongate, rather parallel, densely clothed with golden reddish, short and stiff hairs; the head, forehead with a circular concavity between the antennæ, which joins poste-

riorly the canaliculation between the eyes, densely punctate like the thorax, latter arched at the sides, anterior edge behind the neck a little raised, and immediately behind are two conical elevations, separated from each other by a median channel, which reaches the base of the thorax; midway between the conical elevations and the base are two more elevations with larger bases, but not so high; the elytra are somewhat densely punctate and without striation, the sculpture being, however, obscured by the density of the pilosity.

I do not know any species resembling this.

Hab. Oyayama. One example.

Lacon brunneus, sp. n.

Brunneus, nitidus, grisco-vestitus: fronte punctata, in medio distincte impressa; thorace disco convexo; elytris punctatis; antennis pedibusque concoloribus.

L. 5 mill.

Brown, with greyish hairs; the head coarsely and densely punctate, with a median impression; the thorax very convex on the disk, at the sides punctate like the head, but less closely in the middle, arched behind the anterior angles, sides then parallel to the base, hind angles straight and not produced, at the base before the scutellum is a nodulous elevation; the scutellum clearly punctured, semicircular behind; the elytra widen out over the posterior femoral groove, punctate, punctures set in somewhat irregular rows, interstices smooth, apices obtuse; the legs and antennæ brown.

This insect should be placed next to *L. tumens*, Cand., which also has a conspicuous antescutellar elevation.

Hab. Oyama. One example.

[I took a species in Ceylon closely similar to the above, but the anterior edge of the thorax is, amongst other minor differences, oblique not arched.]

Lacon difficilis, sp. n.

Lacon trifasciatus, Cand. Mém. Liège, 1873, p. 1.

This species is larger than *L. trifasciatus*, Cand., and it is broader and more generally robust, darker in colour, infuscate on the disks of the thorax and dorsum, and the elytral fasciæ are more diffused. In other respects Candèze's description as above will serve. In *L. trifasciatus*, Cand., there is a fine carina within the humeral angle, short but distinct; this is absent in *L. difficilis*.

Hab. Nagasaki. Common on an evergreen oak.

Meristhus niponensis, sp. n.

Nigricans; fronte, thoracis margine, elytrorum limbo punctisque albido-squamulosis; thorace in medio canaliculato, extus crenato; elytris punctato-striatis, apice distincte crenatis.
L. $4\frac{3}{4}$ mill.

Brownish black, and in appearance extremely like *M. 4-punctatus*, Cand. The thoracic angles are very peculiar; from a point behind the carina is a short emargination which separates a rather prominent projection, which seems to represent the normal angle. The carina is nearly straight.

The species is shorter and broader than *M. 4-punctatus*, Cand., from Sylhet and Assam, and the scales are white, not golden.

Hab. Niigata. Several specimens.

The species of this genus inhabit places with extensive sand-banks and dunes, but are not found on the immediate sea-border.

Meristhus scobinula, Cand.

Meristhus scobinula, Cand. Mon. Elat. i. p. 164, pl. ii. fig. 26.

Candèze says this species is found in China and Mexico, but it appears to be clear that his type example came from China. Specimens I have seen in the Godman collection from Central America are very similar to those from Japan, but the elytra are relatively longer and, I think, the heads are broader. They are very difficult insects to differentiate.

Hab. Nagasaki. Occurs on bare and stony places; its saltatory powers are remarkable; my specimens measure barely 2 mill., but when disturbed jumped 10 or 12 inches high.

Alaus pini, sp. n.

Fuscus, squamulis griseo-brunneis dense vestitus; thorace infuscato-bipunctato; elytris, macula laterali infuscata, apice emarginatis.
L. 26–34 mill.

Brownish, densely clothed with greyish-brown scales; the head concave in the middle and on the anterior edge, with sides before the eyes rounded off and elevated; the thorax laterally not quite parallel, anterior angles obtuse, posterior angles blunt and slightly turned outwards, longitudinal median ridge a little elevated and free of scales, dark coloured, with scattered punctures; on each side of the ridge nearer to the head than the base is an oblong dusky spot formed by con-

gested black scales, immediately before the scutellum on the basal edge is a small nodule; the elytra punctate-striate, variegated with ashy and brown scales; near the middle on the lateral edge is a large dusky spot, semicircular on the inner side and on the sixth and seventh interstices densely black, apices widely emarginate and obtusely pointed at the fourth interstice.

This species approximately resembles *A. putridus*, Cand., but it is much more robust, frontal protuberances not pointed, thorax less parallel, and the apices of the elytra widen out more and correspond more to those figured for *A. lateralis*, Cand. (Cand. Mon. 1857, pl. iv. fig. 16). There is an undescribed species in the British Museum from N. China which resembles it more closely than *A. putridus*.

Hab. Nagasaki, Kumamoto, Konose, and Hagi (*Hiller*). I found this species not uncommonly in Higo under bark of firs (Kuromatzu). *Alaus berus*, Cand., occurs in the same fir and is common everywhere, especially at Bukenji, near Yokohama, in early summer.

Tetrigus Lewisii, Cand.

Tetrigus Lewisii, Cand. Mém. Liège, 1873, p. 6.
Tetrigus grandis, Lew. Ent. Month. Mag. 1873, p. 155.

Candèze's type is an example from Kobé measuring 25 mill. only. Ordinary examples measure 30–31 mill., and one of these I mistook for a new species.

Hab. Nagasaki, Kobé, and Sapporo.

Pectocera Fortunei, Cand.

Pectocera Fortunei, Cand. Mém. Liège, 1873, p. 6.

This species is of crepuscular habit. I saw the males in June flying in circles at Nikko near oak trees, far out of reach; but the females are very sluggish. The pectination of the antennæ in insects of this description assists in balancing the body during flight, the females with slender articulations being unable to float in mid-air.

Hab. Nagasaki, Kumamoto, Nikko, and Chiuzenji. Common.

Anchastus mus, sp. n.

Aterrimus, subopacus, griseo-pubescens; capite parvo, parum dense punctato; elytris striis tenuiter impressis, interstitiis rugoso-punctulatis; antennis pedibusque nigris.
L. 8 mill.

Densely black, little opaque, with short griseous pubescence; the head small, rather densely punctured; the thorax opalescent, punctured like the head at the sides, less closely and more finely on the disk, somewhat elongate, feebly widening out behind the middle, base markedly excavated; the elytra punctate-striate, striæ lightly impressed, interstices flat and rugosely punctulate; the antennæ densely black, second joint very small, third narrower and slightly longer than the fourth; the legs black, knees and claws reddish, lamellar process on the third joint of the tarsus pale.

Hab. Miyanoshita. Two specimens.

Anchastus rufipes, sp. n.

Ater, subnitidus, fulvo-pubescens; capite parvo; thorace parum elongato, azureo-micante, leviter punctulato; antennis rufo-brunneis; pedibus rufis.
L. 7–7¼ mill.

Black, little shining, with tawny pubescence; the thorax somewhat long and narrow, gradually widening out to the base, evenly but sparingly punctulate, opalescent; the scutellum obtuse behind, obscurely and rugosely punctured, depressed in front; the elytra, striæ finely and clearly punctured, interstices rugose; the antennæ reddish brown, second joint very small, third similar in size and shape to the fourth; the legs clear red.

In outline *A. mus* is very similar to this species, but the colours of the antennæ and legs are conspicuous distinctions.

Hab. Nikko and Yuyama. Two examples.

ELATER, Linn.

Section I. Thorax and elytra differ in colour.

Elater niponicus, sp. n.

Ater, nitidus, nigro-pubescens; thorace subtiliter punctulato; elytris luteis punctato-striatis, quarta parte postica nigris.
L. 10½–14½ mill.

Densely black, shining, with black pubescence; the head punctured evenly, not coarsely nor densely, frontal carina depressed in the middle; the thorax with an opalescent tint, finely and thinly punctulate, especially on the disk; the elytra clear yellow, apices black, the two markings together forming a cordate spot, near the scutellum on the third and fourth interstices are two small, nearly obsolete, discoloured disks; the legs and antennæ densely black, claws reddish.

Similar to *E. signatus*, Gyll., but the fine punctuation of the thorax and the absence of the black spots on the bases of the wing-cases distinguish it at once.

Hab. Chiuzenji, Miyanoshita, Kiga, and Oyayama. Six examples only.

Elater optabilis, sp. n.

Niger, nitidus, longius fulvo-pubescens; thorace subtiliter punctulato, conspicue azureo-micante; elytris rufis; antennis infuscatis, articulo tertio quam secundus longiore; pedibus infuscatis, tarsis obscure brunneis.
L. 14–15 mill.

Black, shining, with long tawny pubescence; the head evenly and rather densely, not coarsely punctured, frontal carina semicircular; the thorax narrowest anteriorly, gradually widening to base, punctuation very fine and much less thickly set than on the head, punctures laterally similar to disk, but larger close to the anterior angle; the scutellum obtusely acuminate behind and sometimes feebly carinate at the tip; the elytra punctate-striate, sutural stria most lightly impressed, interstices 1–3 equal in breadth and flatter than those outside of them, all interstices finely punctulate, those near the humeral angle slightly rugose; the antennæ infuscate, not black, with the second and third joints piceous, third joint one third as long again as the second; the legs dusky, tarsi brownish.

This is the largest species of the genus known from Japan; in general facies it agrees with *E. orientalis*.

Hab. Subashiri, in pines on the plain of Fujisan, Omine, and Oyayama.

Elater orientalis, sp. n.

Niger, nitidus, griseo- vel fulvo-pubescens; thorace subtiliter punctulato; elytris læte brunneis; antennis infuscatis (basi excepta); pedibus infuscatis vel obscure brunneis.
L. $10\frac{1}{2}$–11 mill.

Black, shining, with grey or fulvous pubescence; the head evenly and rather densely punctured, carina semicircular; the thorax with fine and much less closely set punctures, not opalescent, narrowest anteriorly, gradually widening to base; the scutellum obscurely punctured, obtusely acuminate behind; the elytra clear brown or reddish brown, sutural stria fine and scarcely punctate, second more clearly, the rest distinctly punctured, interstices feebly punctulate, second,

third, and fourth equal in width and rather wide at the base, narrowing gradually to the apex; the antennæ—third joint distinctly longer than the second, three basal joints usually reddish, others infuscate; the legs are dusky or obscure brown.

In the Japanese series this species closely resembles *E. fagi*, Lew., but it differs in size, colour of legs, and pubescence.

Hab. Miyanoshita, Hakone, Nikko, and Kashiwagi. Common in beech trees.

Elater fagi, sp. n.

Infuscatus, nitidus, longius fulvo-pubescens; thorace subtiliter punctulato; elytris luteo-brunneis; pedibus concoloribus; antennis infuscatis, articulis 1°–3^m^ brunneis.
L. 10–12½ mill.

Blackish, shining, with remarkably long tawny pubescence; the head evenly, not closely punctate, carina feebly sinuous anteriorly; the thorax narrowest anteriorly, widening out to the base, not opalescent, punctuation on disk fine, but at the anterior angle it resembles that on the head, median channel very faint, not visible in one example; the scutellum obscurely punctured, obtusely acuminate behind; the elytra clear yellowish brown, sutural stria fine and scarcely punctulate, the external striæ become gradually deeper and more punctate until after the sixth, interstices 2–4 rather wide and flat, all finely punctulate; the antennæ—three basal joints brownish, third joint one third longer than the second, dilated joints infuscate; the legs concolorous with the elytra.

The thorax is more closely punctured than in *E. orientalis*, the third joint of the antenna is longer, and the pubescence longer and more tawny.

Hab. Subashiri and Hakone, in beeches at high elevations. Three examples.

Elater convexicollis, sp. n.

Niger, nitidus, griseo-pubescens; thorace conspicue convexo, subtiliter punctulato; elytris rufo-brunneis; antennæ pedibusque infuscatis.
L. 8¾ mill.

Black, shining, with greyish pubescence; the head somewhat coarsely and rather closely punctured; the thorax finely punctulate on the disk, at the sides punctate like the head, very convex, arched behind the anterior angle, as wide in the middle as at base; the elytra reddish brown, sutural

and second stria very fine, all punctate-striate, interstices obscurely and thinly punctulate; the antennæ infuscate, second and third joints nearly equal, the second is somewhat long for this genus; the legs infuscate, tarsi paler.

Hab. Nikko, in June. Two examples.

Elater scutellaris, sp. n.

Ater, nitidus, longius nigro-pubescens; thorace subtiliter punctulato; elytris rufis, apice minute infuscatis, punctato-striatis, interstitiis punctulatis; scutello postice acuminato, antice perdepresso; antennis pedibusque nigris.

L. 11 mill.

Densely black, with rather long black pubescence; the head somewhat densely and little coarsely punctured, carina well marked and semicircular; the thorax opalescent, narrowest anteriorly, gradually widening to base, very finely, evenly, and rather thinly punctured on the disk, at anterior and posterior angles punctured like the head; the scutellum is nearly vertical and distinctly acuminate behind; the elytra reddish brown, apices minutely infuscate, evenly punctate-striate, interstices slightly concave and feebly punctulate; the antennæ and legs black, tarsi pitchy.

The almost perpendicular position of the scutellum in this species distinguishes it from all the others in this series.

Hab. Chiuzenji, Niohozan, and Sapporo. Eight examples.

Elater ainu, sp. n.

Ater, nitidus, nigro-pubescens; thorace vix dense punctulato; elytris rufis, striis internis leviter impressis, interstitiis tenuiter transverso-rugosis; antennis pedibusque nigris.

L. 11 mill.

Densely black, with black pubescence; the head rather coarsely and rather densely punctured, carina well-marked and semicircular; the thorax densely black, not opalescent, somewhat wide, convex on disk, arched at the sides, punctured laterally like the head, disk-punctures finer and less close, but not densely set, hind angles between the carina and outer edge thickly, coarsely, and somewhat rugosely punctate; the scutellum punctate, somewhat wide and obtusely acuminate behind; the elytra red (not very bright), interstices rather broad and flat, feebly and transversely rugose, striæ 1–3 fine and lightly impressed, scarcely punctate, external striæ deeper and distinctly punctate; the antennæ densely black, third joint obconical and longer than the second, dilated joints relatively robust; the legs black, tarsi pitchy.

This *Elater* agrees in many respects with *E. rubridorsus*, Lew., but in the latter the thorax is much more strongly punctured, the interstices of the elytra convex, and there is a fovea between the eyes.

Hab. Ishikari River. Four examples.

Elater Ryei, Lew.

Elater Ryei, Lew. Ent. Month. Mag. 1879, p. 156.

This species was given to me on the supposition that it came from Tsushima; the correct locality is Tangiers. It is a good species, and differs from *Elater sanguinolentus*, Schrank, in having a more convex thorax and more robust antennæ and tarsi. The type specimens are now in the British Museum.

Elater chlamydatus, sp. n.

E. montano simillimus, sed thorace magis elongato; scutello cordiformi; elytris interstitiis rugosis; antennis pedibusque nigris.
L. 9½ mill.

Black, shining, with long black pubescence; the head evenly, not coarsely nor thickly punctured; the thorax relatively longer than any in this series, with red elytra, narrowest in front, broadest at base, very finely punctured except at the anterior angle and in the interstice of the margin and the basal carina; the elytra dull red, punctate-striate, interstices transversely rugose, apex narrowly infuscate; the antennæ and legs densely black, third joint of former scarcely longer than the second.

Very similar to *E. montanus*, Lew., but the length of the thorax and rugose interstices serve to distinguish it, as well as the form of the scutellum and the basal joint of the antennæ.

Hab. Kadzusa, an island off Yokohama. One example.

Elater montanus, sp. n.

Ater, nitidus, longius nigro-pubescens; thorace subtilissime punctulato; elytris brunneo-rufis, apice minute infuscatis; antennis pedibusque nigris.
L. 8–9½ mill.

Densely black, shining, with long black pubescence; the head clearly, rather finely, not closely punctured, frontal carina depressed in the middle; the thorax not opalescent, very finely punctured (much more so than the head) on the disk,

and even between the carina and the hind angle the punctuation is not conspicuous; the scutellum is depressed in front, obtusely acuminate behind; the elytra lightly punctate-striate, interstices finely punctured, apices minutely infuscate; the antennæ black, third joint obconical and larger than the second, 4–9 triangular and very similar to each other; the legs black, tarsi pitchy.

Hab. Nikko and the higher forests in its vicinity. Six examples.

Elater pumiceus, Lew.

Elater pumiceus, Lew. Ent. Month. Mag. 1879, p. 156.

Ater, nitidus, nigro- vel griseo-pubescens; capite confertim punctato; thorace parum angustato, antice lateribusque fortius et crebrius punctatis; elytris coccineis, profunde punctato-striatis, interstitiis convexis; antennis pedibusque nigris.
L. 10–11 mill.

Densely black, shining, with black or griseous pubescence, grey when the insect faces the eye and reversely black; the head evenly, rather densely, and somewhat coarsely punctured; the thorax narrowest in front and gradually widening to base, punctures on the disk rather fine, not closely set, anteriorly and on the lateral border the punctures are rather strong and much more dense, and behind the eye the punctures are obscurely ocellate; the elytra bright red, punctate-striate, interstices convex, finely punctulate, interstices 2, 3, 5 wide, especially the third; the antennæ—third joint obconical, larger than the second, and with the legs densely black, claws reddish.

Differs from *E. canalicollis* in the punctuation of the thorax and in the absence of the median channel.

Hab. Awomori, Sannohe, and Noheji, places not far distant from each other. Three examples.

Elater miles, sp. n.

Ater, nitidus, subrobustus, nigro- vel griseo-pubescens; thorace parum lato, in medio subtiliter, ad angulos parum dense, punctato; elytris coccineis; antennis pedibusque nigris.
L. 11–11½ mill.

This species is extremely like *E. pumiceus*; the thorax is more convex and much broader, especially in the middle, with an opalescent tint; the elytra are feebly rugose and relatively shorter; the tarsi are more robust and the third joint of the antenna longer and less obconical.

Hab. Oyayama. Five examples.

Elater canalicollis, sp. n.

Ater, nitidus, nigro- vel griseo-pubescens ; thorace in medio longitudinaliter canaliculato, disco subtiliter punctulato, lateribus punctis vix differentibus ; elytris coccineis ; antennis pedibusque nigris.
L. $10\frac{1}{2}$–13 mill.

Black, shining, with a black or griseous pubescence ; the head evenly, somewhat coarsely, and rather densely punctured ; the thorax sometimes with an opalescent tint, finely punctured on the disk and sides, at the angles the punctuation is narrowly larger, in the female the punctuation is generally larger than in the male, median channel well-marked, evanescent behind the neck ; the elytra punctate-striate, interstices usually rugose ; the antennæ—third joint longer than the second and more cylindrical than that of *E. pumiceus*, and with the legs densely black, claws reddish.

Hab. Bukenji (common), Oyama, and Miyanoshita ; under bark of an *Abies* (Kuromatzu).

The three preceding species, with perhaps two others from the Korea, form a section in the genus peculiarly Eastern.

Section II. Thorax and elytra correspond in colour.

Elater hypogastricus, Cand.

Elater hypogastricus, Cand. Mém. Liège, 1873, p. 9.

The abdominal segments are sometimes black.

Hab. Nagasaki, Miyanoshita, Oyama, Sado, and Junsai.

Elater nigroventris, sp. n.

Ater, nitidus, fulvo-pubescens ; thorace parce punctulato ; abdomine nigro ; antennis infuscatis ; pedibus rufo-brunneis.
L. 12 mill.

Black, shining, with tawny pubescence ; the head rather wide, rather densely punctured, carina well-marked above the antennæ ; the thorax also rather wide, widening to the base gradually from anterior angle, feebly and sparingly punctulate on the disk, punctures larger and closer laterally, median channel feeble and not visible beyond the middle ; the scutellum rather wide, not acuminate behind, very obscurely punctured ; the elytra, striæ 1 and 2 somewhat lightly impressed and punctures scarcely visible, outside striæ clearly

punctate, interstices punctulate, second and fourth widest, all rather flat; the antennæ—three basal joints reddish brown, others infuscate, third joint longer than the second; the legs reddish brown.

This species should be placed next to *E. hypogastricus*, Cand., but the head and thorax are broader, with much finer punctures, thorax not opalescent, the elytral interstices rather flatter and distinctly wider, and the form of the insect generally more parallel. In *E. hypogastricus*, Cand., the scutellum is relatively small and acuminate behind.

Hab. Miyanoshita and Oyayama.

Elater vestitus, sp. n.

Parum niger, nitidus, densissime fulvo-pubescens; capite dense punctato; antennis pedibusque obscure rufis.
L. 11½ mill.

Blackish, shining, very densely covered with a tawny pubescence, especially on the elytra; the head densely and rather coarsely punctured; the thorax narrowest anteriorly, feebly widening at the middle, punctured like the head in the female, punctures less dense in the male, median channel faint and evanescent in front; the scutellum obscurely punctured, obtusely acuminate behind; the elytra punctate-striate, two striæ next the suture somewhat fine, interstices punctulate and feebly convex; the antennæ rather dark reddish brown, third joint a little longer than the second; the legs clear reddish brown, lighter in colour than the antennæ.

In looking at this species in certain lights the sculpture and striæ are entirely obscured by the pubescence. This remark does not of course apply to abraded examples, of which I have several.

Hab. Miyanoshita, Hakone, Hitoyoshi, and Yuyama. Apparently common.

Elater tenuistriatus, sp. n.

Niger, nitidus, infuscato-pubescens; thorace subtiliter punctulato; elytris striis internis tenuiter impressis; antennis pedibusque nigris, tarsis brunneis.
L. 10–11 mill.

Black, shining, with dusky pubescence; the head somewhat densely punctate; the thorax widens out a little behind the middle, at the sides narrowly punctured like the head, on the disk very finely and sparingly punctulate; the scutellum feebly punctulate, a little obtusely acuminate; the elytra,

striæ 1 and 2 very fine and scarcely punctured, outside striæ more visibly so, interstices flat, lightly punctured, and feebly rugose, 2–4 rather wider than the others; the antennæ rather slender, articulations a little lax, black, third joint one fourth longer than the second; the legs also black, tarsi and claws reddish brown.

Hab. Kiga, Miyanoshita, Chiuzenji, Nikko, and Yuyama. Common.

Elater rufipes, sp. n.

Ater, nitidus, griseo-pubescens; capite vix dense punctato; thorace disco subtiliter punctulato; antennis infuscatis, articulo primo rufo; pedibus læte rufis.
L. 7–8 mill.

Black, shining, with griseous pubescence; the head clearly but not closely punctured; the thorax widens out a little before the posterior angles, punctured narrowly at the sides like the head, disk lightly and sparingly punctulate; the scutellum punctured, obtusely acuminate behind; the elytra punctate-striate, sutural stria finest, interstices subrugose, punctulate; the antennæ, articulations less lax than those of *E. tenuistriatus*, basal joint red, second and third nearly equal, piceous, the others infuscate; the legs clear red.

Hab. Miyanoshita, Hakone, Oyama, Yuyama, and Konosé.

Elater carbunculus, Lew.

Elater carbunculus, Lew. Ent. Month. Mag. 1879, p. 156.

Ater, nitidus, longius nigro- vel cinereo-pubescens; antennis pedibusque concoloribus; capite punctato; thorace disco subtilissime punctulato; elytris punctato-striatis, interstitiis a basi latissimis.
L. 7 mill.

Densely black, shining, with blackish or ashy pubescence; the head clearly but not very densely punctured; the thorax, disk very lightly punctulate, sides more distinctly, but the punctures are not so large as those of the head; the elytra punctate-striate, striæ clearly but not deeply impressed, interstices widest at the base; the antennæ rather long, especially in the male, with articulations somewhat lax, entirely black, second joint very small, third widens out triangularly and is scarcely smaller than the fourth. This last character seems to be a transitional one between *Elater* and *Ischnodes*.

Hab. Miyanoshita, Hitoyoshi, and Oyayama. Chiefly from the flowers of *Deutzia* and an arboreous *Spiræa*.

Elater bicarinatus, Cand.

Elater bicarinatus, Cand. Mém. Liège, 1873, p. 9.

This species is met with in old trees, and has never been found away from them; it is of nocturnal habit and sluggish.

Hab. Nagasaki, Maiyasan (Kobé), and Sapporo.

Elater rugipennis, sp. n.

Piceus, nitidus, robustus, brunneo-pubescens; thorace punctulato, a basi bicarinato: elytris interstitiis conspicue rugosis: antennis pedibusque rufo-brunneis.

L. 11½–12 mill.

Piceous, shining, with brownish pubescence; the head somewhat densely punctured; the thorax narrowest anteriorly, little arched at the sides, punctures laterally very similar to those of the head, punctures on disk more scattered and much finer, median channel feeble, evanescent in front; the scutellum visibly punctate, not acuminate behind, striæ all well-impressed, punctate, interstices markedly transversely rugose, sutural interstices widest; the antennæ and legs dull reddish brown. In one example the hind angles of the thorax are reddish.

The peculiar colour of this species resembles that of *E. bicarinatus*, Cand., and it agrees with the latter in having an intermediate carina on the thoracic angle and in its slender lax articulations of the antennæ; but it is much larger and very robust. *E. bicarinatus* is a slender species.

Hab. Kioto and Oyama. Two examples.

Elater parvulus, sp. n.

Ater, nitidus, griseo-pubescens; capite thoraceque subtiliter punctulatis; antennis pedibusque nigris, tarsis rufis.

L. 5¾ mill.

Black, shining, with greyish pubescence; the head finely and sparingly punctulate; the thorax punctured like the head, widest behind the middle; the scutellum obscurely punctulate, acuminate behind; the elytra evenly punctate-striate, interstices scarcely flat and punctulate; the antennæ moderately serrate, wholly black, second joint a little shorter than the third, third joint obconical; the legs and basal joint of the tarsus black, claws and other joints reddish.

In form somewhat like *Elater erythrogonus*, Müll.

Hab. Yuyama. One example.

Elater pauxillus, sp. n.

Niger, nitidus, griseo-pubescens; capite distincte punctulato; elytris punctato-striatis; antennis pedibusque rufis.
L. 5 mill.

Black, shining, with a greyish pubescence; the head clearly but not densely punctulate, eyes a little prominent; the thorax widest near the middle, disk more finely punctulate than the head; the scutellum obscurely punctulate, obtuse behind; the elytra, striæ punctate-striate, striæ 1–3 very fine, outside striæ more deeply impressed, interstices flat and finely punctulate; the antennæ red, not serrate, second joint stouter and a little shorter than the third; the legs also wholly red.

This is the smallest species known from Japan. The head is smaller than that of the last species and the eyes more prominent.

Hab. Nikko. One example.

Elater gracilipes, sp. n.

Elongatus, angustatus, infuscatus, fulvo-pubescens; thorace subtilissime punctato; elytris parallelis, angulis humerali obscure brunneis.
L. 9½ mill.

Elongate, rather narrow, dusky brown, with tawny pubescence; the head rather small, not thickly nor coarsely punctured; the thorax little narrowed anteriorly from the middle, posterior carina feeble, punctuation scarcely visible on the disk, more apparent at the sides and angles; the scutellum obsoletely punctured, obtuse behind; the elytra long and parallel at the sides, faintly punctate-striate, sutural stria finest, interstices flat, rugose, and rather wide, humeral angle obscurely brown; the antennæ reddish brown, slender, serration feeble, articulation somewhat lax, third joint less robust, slightly longer than the second; the legs dusky brown, tibiæ and tarsi slender, latter reddish brown.

A second example has the elytra reddish brown, with the sutural margin broadly, and the outer margin narrowly, infuscate.

Hab. Chiuzenji. Two examples.

MEGAPENTHES, Kiesenwetter.

In the following species the apices of the elytra are peculiar.

Megapenthes opacus, Cand.

This species was described from a single specimen taken at Kobé; but in August 1880 I obtained five more examples from elder-flowers near the lake of Junsai, in S. Yezo. The thorax is red in both sexes, the second and third joints of the antenna are short, equal, and robust, the apices of the elytra are emarginate outside the first stria.

Hab. Kobé and Junsai.

Megapenthes bicarinatus, sp. n.

Elongatus, infuscatus, subnitidus, fulvo-pubescens; thorace dense punctato, angulis posticis bicarinatis; elytris a basi obscure brunneis; antennis pedibusque concoloribus.
L. 11 mill.

Dusky brown, rather shining, pubescence fulvous; the head coarsely and closely punctured, punctures subocellate, frontal carina arched; the thorax closely but less strongly punctate, elongate, somewhat parallel at sides, widest posteriorly, angles rather long and acute, slightly turning outwards, conspicuously bicarinate; the scutellum elongate, punctured like the thorax, narrowed from the middle and pointed, but not acutely, behind; the elytra punctate-striate, interstices markedly scabrous, reddish brown at base and the apices at the first and second interstices are truncate; the antennæ very long and reddish brown, like the legs.

M. luteipes, Hope, from China, appears to be similar to this species, which I have been able to notice through the courtesy of Mr. Godman, the type being in the Janson collection.

Hab. Japan (*Moore*). Probably from Nagasaki, as I believe I was with Mr. Moore at the time of capture.

In the species following (excepting *M. versipellis*) the apices of the elytra are of ordinary form.

Megapenthes higonius, sp. n.

Parallelus, ater, opacus, griseo-pubescens; thorace confertissime et parum grosse punctato, ante scutellum impresso; elytris punctato-striatis, interstitiis rugosis; tarsis infuscatis.
L. 10–10½ mill.

Parallel, densely black, opaque, with griseous pubescence; the head closely punctate, punctures somewhat coarse, frontal carina well-marked anteriorly, straight, strongest over the

basal joint of the antenna; the thorax very closely punctured, punctures circular and mostly finely ocellate, especially behind the neck, channel before the scutellum very feeble, the posterior angles and carina rather long; the scutellum subacuminate; the elytra punctate-striate, interstices markedly rugose; the antennæ—second and third joints equal and rather long, two basal joints sometimes piceous; the tarsi brownish, legs infuscate.

This insect in colour is somewhat like *M. insidiosus*, but it is longer, more parallel, punctuation coarser, and hind angles of the thorax straighter.

Hab. Ichibosayama and Oguma, in May. A small series.

Megapenthes insidiosus, sp. n.

Aterrimus, opacus, griseo-pubescens; thorace confertissime punctato; antennis nigris, articulo 1° rufo: pedibus obscure brunneis.
L. $8\frac{3}{4}$ mill.

Densely black, opaque, with griseous pubescence; the head very closely punctured, carina well-marked, anteriorly straight; the thorax punctured like the head, narrowest anteriorly, and gradually widening to the posterior angles, hind angles carinate and slightly turning outwards; the scutellum subacuminate behind; the elytra finely punctate-striate, interstices rugose and visibly broader than in *M. higonius*; the antennæ rather short and serrate, third joint scarcely as long as the second, black, basal joint reddish; the legs brownish, thighs dusky.

Less densely black than *M. higonius* and much less elongate and less parallel; antennæ shorter, articulations more compressed, serration more distinct.

Hab. Chiuzenji and Niohozan. Ten specimens, some taken from a tree-trunk imbedded in snow as late as June.

Megapenthes fugisanus, sp. n.

Æneo-niger, subopacus, vix pubescens; capite parum dense punctato, in medio leviter impresso; thorace confertissime ocellato-punctato; antennis nigris; pedibus piceis.
L. 7 mill.

Bronzy black, scarcely pubescent; the head rather thickly, rather coarsely punctured, with a median impression between the eyes, frontal carina obsolete; the thorax very clearly and very closely punctured, punctures not very large but distinctly ocellate, on either side behind the middle there is a feeble circular impression, sides narrowed anteriorly, gradually,

but not much, widening out to the base, hind angles not acute, interspace between the margin and carina relatively somewhat wide; the scutellum not acuminate; the elytra, striæ fine, interstices rather wide and rugose, the rugosities apparently obliterating the punctures usual in the elytral striæ in *Megapenthes*; the antennæ black; the legs piceous or obscure red, thighs darker.

Hab. Subashiri and on the plain of Fujisan. Two examples.

Megapenthes bifoveolatus, sp. n.

Æneus, subnitidus, fulvo-pubescens; thorace bifoveolato: antennis articulis 1°–3ᵐ pedibusque rufo-brunneis.
L. $9\frac{3}{4}$–$10\frac{1}{2}$ mill.

Æneous, somewhat shining, with short tawny pubescence; the head rather closely punctate; antennæ infuscate, with three basal joints reddish brown, longer in male than in female; the thorax—disk punctured like the head, sides more closely and slightly rugose; before the middle in a line with each eye are two well-marked foveæ, deeper and larger in female than in male, there is a median longitudinal channel also, which is more distinct in female than in male; the elytra, striæ rather fine and not conspicuously punctured, interstices flat and rugose; the legs are a clear reddish brown and the abdominal segments sometimes reddish.

This species is remarkable for its colour and thoracic foveæ.

Hab. Oyayama, Ichiuchi, Oyama, Chiuzenji, Nikko, and Miyanoshita.

Megapenthes cariniceps, sp. n.

Niger, nitidus, nigro-pubescens; capite in medio longitudinaliter conspicue carinato; thorace sparse punctulato; antennis nigris, pedibus infuscatis.

Rather densely black, shining, with black pubescence; the head sparingly punctulate, with a very conspicuous carina in the middle, which anteriorly passes beyond the frontal carina, and posteriorly it is well-shortened before the neck; the thorax punctured like the head, narrowest anteriorly, hind angles not long but acute, carina well-marked; the elytra rather deeply and very regularly punctate-striate, interstices obscurely punctulate and somewhat scabrous; the antennæ black; the legs dusky.

The facies of this species somewhat resembles that of *M. tibialis*, Lac., but the longitudinal carina on the head at once separates it from all in this series.

Hab. Kiga. One example.

Megapenthes gracilis, Cand.

Megapenthes gracilis, Cand. Mém. Liège, 1873, p. 10.

The males of this species are very different to the females; the thorax is longer, more parallel, and usually infuscate, punctures thickly set and finely ocellate; the antennæ also darker, with joints 4–11 one third longer.

L. 7–8½ mill.

Hab. Kiga, Yokohama, Kioto, and Kumamoto. Abundant at times in flowers of *Viburnum* and *Deutzia*.

Megapenthes pallidus, sp. n.

Elongatus, testaceus, subopacus, fulvo-pubescens; thorace lateribus parallelis, angulis posticis brevissimis; antennis pedibusque concoloribus.

L. 7 mill.

Elongate, pale testaceous, rather opaque, and similar to *M. gracilis*, Cand., but the hind angles of the thorax are very short, the sides very parallel; the head not densely but clearly punctured; the thorax less distinctly punctured, wider behind than in front, sides straight, angles very short and blunt; the elytra punctate-striate, interstices rugose and punctulate; the antennæ and legs concolorous, the former with the third joint distinctly one third longer than the second, which is short and obconical.

Hab. Nataksugawa and Nikko. Three individuals only.

Megapenthes insignitus, sp. n.

Aterrimus, subopacus, fulvo-pubescens: capite thoraceque confertissime punctatis; elytris 4-maculatis; antennis brunneis; pedibus testaceis.

L. 5¾–6 mill.

Black, somewhat opaque, with a tawny pubescence; the head and thorax very closely punctured; the elytra, behind the humeral angle there is a longitudinal testaceous blotch, nearly the length of one third of the elytra, occupying part of interstices 3–8, behind the middle is an oblong spot a little smaller in size on interstices 3–7, the striæ are evenly punctate, with the interspaces rugose; the antennæ darkish brown, the legs testaceous.

There is a variety in which the maculations are very small.

Hab. Miyanoshita and Yokohama. A small series at both places.

Megapenthes versipellis, sp. n.

Niger, fulvo-pubescens, ♂ thorace nigro, ♀ thorace rufo; elytris flavo-maculatis, apice obtuse productis; antennis nigris; pedibus flavis.

L. ♂ 6–6½, ♀ 6½–7 mill.

Black, rather opaque, with tawny pubescence.

♂. The head and thorax black and closely punctured, latter gradually widening out to base, posterior angles somewhat acute; the elytra, striæ fine and obscurely punctulate, interstices rugose, at the base and extending over rather more than one third of the elytral length is a yellow fascia, which leaves the humeral angle and two interstices next the scutellum black, and in extending backwards it is narrowed in the middle on the first to fourth interstices, between the middle of the dorsum and the apex is a small transverse yellow spot, the apices are obtusely produced at the ends of the fourth to fifth interstices.

♀. Thorax bright red and convex; the elytral fasciæ wider and more conspicuous than in the male; the antennæ, joints 2 and 3 small and equal, 4–10 serration well-marked in both sexes, but especially strong in male; the legs pale in both sexes.

The male varies much more in colour than the female; in one male the elytral markings are almost obliterated.

Hab. Chiuzenji, Kashiwagi, Junsai, Sapporo, and Otaru, in flowers of *Sambucus* and *Angelica.* Sometimes abundant.

Megapenthes ornatus, sp. n.

Niger, nitidus, grisco-pubescens; thorace vix dense punctato; elytris macula humerali alteraque ultra medium, pedibusque testaceis.

L. 5 mill.

Black, shining, with greyish pubescence; the head rugosely punctured; the thorax narrowest anteriorly, gradually but very moderately widening to the base, hind angles short but acute, surface rather thickly but not closely punctured, punctures in places running into transverse rows; the elytra, striæ fine, scarcely punctured, interstices rugose, humeral angle and the base up to the second interstice yellow, the spot extending backwards for about a fourth of the elytral length, about the middle of its course it is encroached upon by the third and fourth interstices being dark-coloured, behind the middle there is a small spot on the fifth, sixth, and seventh interstices; the antennæ, three basal joints reddish brown,

second and third small and equal in size, fourth to the tenth infuscate and strongly serrate on the inner edge; the legs entirely pale.

Hab. Yuyama. Two male examples.

Melanoxanthus pictipennis, sp. n.

Niger, nitidus, fulvo-pubescens: thorace angulis flavis; elytris macula basali recta, posticis fasciis duabus luteis; antennis (basi excepta) infuscatis; pedibus flavis.

L. 5–6½ mill.

Elongate, somewhat parallel, with short tawny pubescence; the head black, convex, densely punctured; the thorax similarly punctured at the sides, more finely and much less thickly on the disk, anterior angles minutely and triangularly yellow, posterior angles more broadly yellow and somewhat acutely produced; the elytra black, with a longitudinal vitta at the base, occupying part of the third and fourth interstices and more shortly part of the fifth, before the middle of the dorsum a transverse fascia commences on the second interstice, widening out on the third, narrowing on the fifth and sixth, then again widening out to the margin, and extending along the epipleura almost to the humeral angle, midway between the middle and the apices of the elytra is another yellow band, nearly regular in width, and not touching the sutural interstice nor the outside edge of the wing-case, the striæ are rather fine and punctulate, the interstices flat and relatively wide, and somewhat rugosely punctulate; the legs are yellow; the antennæ yellow at the base, and from the fourth or fifth joint infuscate.

A variety of the species has the anterior angles of the thorax black, and the median fascia interrupted on the fifth and sixth interstices.

Hab. Fukushima and Nataksugawa. Two examples only.

[To be continued.]

IV.—*On the Land-Shells of the Sulu Archipelago.*

By Edgar A. Smith.

[Plate IV.]

Our knowledge of the terrestrial Mollusca of the Sulu Archipelago is at present very limited, and the species about to be enumerated will form a considerable addition to the list of those already recorded from these islands.

The specimens just received by the British Museum were collected by Mr. A. Everett at the Tawi-Tawi group, on the islands of Sibutu, Bongao, Bilatan, and Tawi-Tawi itself, all of these being situated at the western part of the archipelago.

No land-shells have previously been recorded from any of these islands with the exception of Bongao. From this locality Dr. Möllendorff has given a list of twelve species.

The terrestrial mollusks from the remaining islands of the Sulu Archipelago are practically unknown, only two or three forms having been mentioned as occurring on Sulu itself *.

The Rev. A. H. Cooke, in his instructive paper "On the Geographical Distribution of the Land-Mollusca of the Philippine Islands, and their Relations to the Mollusca of the neighbouring Groups" †, has arrived at certain conclusions, which, in light of the material now at hand, appear altogether untenable. Commenting upon Möllendorff's list of species, he observes:—"Six out of the eight known species are peculiar, while of the remaining two, one occurs in the Philippines and one in Borneo. As to genera, no exclusively Philippine genus occurs, while *Plectotropis*, *Macrochlamys*, *Trochonanina*, *Opisthoporus*, *Lagochilus*, and *Alycæus* are Indo-Malay. In spite, then, of the deep intervening channel, Bongao is distinctly Bornean, and, in spite of the chain of islands with shallow water between them, distinctly non-Philippine."

In the first place, I would observe that *Trochonanina conicoides* ‡ is not peculiar to Bongao, as he states, for it was described many years ago from Borneo, and has been recorded from that locality over and over again. Also it must not be supposed that the above genera quoted by Mr. Cooke as "Indo-Malay" have no representatives in the Philippines. Of *Macrochlamys* there are several species; *Trochonanina* is represented by one or two forms; of *Lagochilus* Mr. Cooke himself, in another part of his paper, enumerates nine; and of *Alycæus* two species are recorded from Luzon. One *Plectotropis* at least has been found in the Philippines; and *Opisthoporus* § occurs in Palawan, which is quite as much Philippine in its molluscan fauna as Bornean.

The following table (p. 51) shows at a glance the relative

* *Trochomorpha Metcalfei*, *Corasia lais*, and *Cyclotus suluanus*.

† Proc. Zool. Soc. 1892, p. 461.

‡ The species here referred to is not the true *T. conicoides*, but a distinct species, viz. *T. bongaoensis*, mihi.

§ This genus is not known with certainty from Bongao, and the *young* shell doubtfully referred to it by Möllendorff and quoted by Cooke is, in all probability, the *Cyclotus variegatus* obtained there by Mr. Everett.

distribution of the Tawi-Tawi species. It will be noticed that the deep water (the Sibutu passage *) which separates Sibutu from the rest of the Tawi-Tawi group does not appear to have been a bar in any way to, or to have influenced, the migration of forms to or from the Philippines or Bongao, Tawi-Tawi, and Bilatan.

Only one form occurring at Sibutu is met with exclusively in Borneo, whereas seven occur in the Philippines which are not known as Bornean.

There are only four species from Sibutu which have not as yet been found in any other island of the Tawi-Tawi group, whereas eleven occur in Sibutu which are also met with in one or other of these islands.

It is worthy of notice that of the four species peculiar to Sibutu two, namely *Helix marginata* and the *Corasia*, are most characteristic Philippine forms, and altogether unrepresented in Borneo; also that the remaining two, *Sitala orchis* and *Chloritis sibutuensis*, have respective Philippine representatives.

Of the nineteen species found in the islands of the Tawi-Tawi group east of Sibutu, no less than eleven or twelve occur also in the Philippines, whereas only three are common to Borneo, and these are also met with in the Philippines.

From these facts it is therefore quite evident that the land-shells of the Tawi-Tawi Islands are distinctly Philippine rather than Bornean, and my colleague Dr. R. B. Sharpe informs me that the same is observable with regard to the avifauna.

If we proceed beyond this fact we merely enter the region of theorizing and speculation. It is natural to suppose that the species common to Tawi-Tawi and the Philippines originated in the latter locality, and that in the course of ages (how remote we know not) they have become dispersed or migrated westward.

On the other hand, we may conjecture that certain species, starting originally from Borneo, have extended to Tawi-Tawi, and so on to the Philippines.

With regard to the origin of the various genera it is hopeless to speculate. How, when, and where, for instance, did *Cochlostyla* originate? We may theorize upon such questions as these, but I am afraid our conclusions will be very far from convincing.

* The depth of this passage is marked on the Admiralty charts 500 fathoms; but Mr. Everett informs me that it has been lately sounded by Capt. Field, of H.M.S. 'Egeria,' and that the extreme depth did not exceed 267 fathoms.

The Distribution of Tawi-Tawi Land-Shells.

Names of the Species.	Borneo.	Sibutu.	Bongao, Tawi-Tawi, or Bilatan.	Philippines.	Other localities.
Macrochlamys angulata	..	*	*		
Lamprocystis myops	..	*	*	*	Balabac.
Sitala orchis	*	*			
Trochonanina bongaoensis	..	..	*		
Trochomorpha Metcalfei	*	*	*	*	Palawan.
Helix (Plectotropis) squamulifera	..	*	*		
—— (Chloritis) sibutuensis	..	*			
—— marginata	..	*	..	*	
Cochlostyla (Corasia) ægrota	..	*	..	*	
—— (Hypselostyla) boholensis	..	..	*	*	
Amphidromus maculiferus	..	..	*	*	
Cyclotus variegatus	..	..	*	*	Sulu.
—— bongaoensis	..	..	*		
Cyclophorus philippinarum	..	*	*	*	
Alycæus excisus	..	..	*		
Leptopoma atricapillum	..	*	*	*	Palawan.
—— vitreum	*	*	*	*	Balabac.
Lagochilus quinqueliratus	..	*	*		
Pupina ottonis	..	..	*	*	
Diplommatina Roebeleni	..	..	*		
Helicina Martensi	*	*	*	*	
—— lazarus	..	*	*	*	
—— contermina	..	*	*	*	

1. *Macrochlamys angulata*, Möllendorff.
(Pl. IV. fig. 1.)

Macrochlamys angulata, Möllendorff, Jahrbuch. deutsch. mal. Gesell. 1887, p. 289.

Hab. Bongao, Tawi-Tawi, Sibutu.

2. *Lamprocystis myops*, Dohrn & Semper.

Nanina myops, D. & S. Mal. Blätt. 1862, p. 206; Pfeiffer, Novit. Conch. vol. ii. p. 221, pl. lviii. figs. 5–8.

Hab. Bilatan and Sibutu; also Mindanao (*D. & S.*), Balabac (*Hidalgo*).

The specimens from Bilatan and Sibutu agree in every detail with examples from Mindanao.

3. *Lamprocystis*, sp.

Hab. Bongao.

Only two specimens of this species were collected by Mr. Everett. They are more depressed in form than *L. myops*, and the microscopic concentric striæ on the base are more apparent. It is likely that these differences will be found persistent, but I deem it advisable at present to await further material before separating this form as a distinct species.

4. *Sitala orchis*, G.-A.

Sitala (?) *orchis*, Godwin-Austen, Proc. Zool. Soc. 1891, p. 40, pl. v. fig. 3.

Hab. Sibutu.

There appears to be no difference between the specimens from the above locality and those found at Labuan and Barit Mountain, North Borneo, by Mr. Everett.

5. *Trochonanina bongaoensis*. (Pl. IV. figs. 2–2 *b*.)

Testa depressa, orbicularis, acute carinata, imperforata, fusca; spira breviter conica, vix convexiuscula; anfractus 7, planiusculi, supra suturam anguste impresse marginati, lente accrescentes, supremi 2–3 lævigati, cæteri striis incrementi obliquis aliisque spiralibus tenuibus sculpti, ultimus acute et subcompresse carinatus, inferne haud spiraliter striatus; apertura obliqua, utrinque acuta; peristoma roseo-albidum, margine basali peculiariter tortuoso et incrassato.

Diam. maj. $13\frac{1}{2}$ millim., min. $12\frac{1}{2}$, alt. 7.

Hab. Bongao and Sibutu.

This species appears to be the same as that identified by Möllendorff as a variety of *T. conicoides* (Metcalfe), to which he gave the name var. *crenulata*. It is, however, very distinct from that Bornean species in size and form. It more nearly approaches *T. paraguensis*, Smith, from Palawan, but is easily separable by comparison. It is smaller, darker in colour, the whorls are less convex, the suture less obvious, and the spire more convex. The aperture also is of a somewhat different form, and the basal margin of the peristome is rather more tortuous but similarly thickened. I have not adopted the varietal name *crenulata* for this species in case it may be different from that described by Möllendorff, and, moreover, it does not seem particularly applicable, the crenulation at the keel being so very feeble.

6. *Trochomorpha Metcalfei*, Pfeiffer.

Helix Metcalfei, Pfr. Conch.-Cab. ed. 2, p. 175, pl. xcvii. figs. 10–12, var. figs. 13, 14; Deshayes, Hist. Nat. Moll. vol. i. p. 367, pl. ci. figs. 10–12.
Helix solarioides, Reeve, Conch. Icon. pl. xxx. figs. 127 *a–c*.
Helix boholensis, Semper, Hidalgo, Journ. de Conch. 1887, pl. iv. figs. 1–1 *a*.

Hab. Tawi-Tawi, Bongao, Bilatan, Sibutu.

Two forms of this species occur at the above islands. One resembles that represented by Pfeiffer's figures 10–12 and Reeve's figures 127 *b*, *c*. The specimens, however, are smaller, and the brown zones above and below the periphery are narrower and less pronounced. The diameter of average specimens is 15 millim. This variety occurs at all four of the above islands. The other form, which occurs at Bilatan, Bongao, and Sibutu, is similar to that figured by Pfeiffer (*l. c.* figs. 13, 14) and by Reeve (fig. 127 *a*). The specimens are a little smaller than those just referred to, of a pale greenish-yellow tint, and the keel is of a very deep brown-black colour, like the narrow zones above and below, which, together with the carina, form one dark peripheral zone. In the Philippine examples figured by Pfeiffer the keel is whitish (=*boholensis*, Semper). Möllendorff is of opinion that there is sufficient difference between *Metcalfei* and *boholensis* to distinguish them, but with this opinion I cannot concur.

7. *Helix* (*Plectotropis*) *squamulifera*, Möllendorff. (Pl. IV. figs. 3, 3 *a*.)

Helix (*Plectotropis*) *squamulifera*, Möllendorff, Jahrbuch. deutsch. mal. Gesell. 1887, p. 290.

Hab. Bongao (*Mölldf. & Everett*); Sibutu (*Everett*).

The specimens described by Möllendorff were immature, and consequently he could not complete the description of the peristome. It is pinkish white, scarcely thickened at all, slightly expanded above and somewhat reflexed below. The largest example is 15 millim. in diameter, but an average specimen is only about 13.

8. *Helix* (*Chloritis*) *sibutuensis*. (Pl. IV. figs. 4, 4 *a*.)

Testa depresse globosa, anguste umbilicata, subsolida, rufo-fusca, linea saturatiore ad peripheriam cincta; anfractus 5, leviter convexi, apicales concinne punctati, cæteri lineis incrementi tenuibus striati, indistincte punctati, ultimus antice vix descendens; aper-

tura lunata, obliqua, intus lilacea; peristoma albidum, incrassatum, breviter expansum et reflexum, marginibus callo tenuissimo junctis, columellari supra umbilicum leviter reflexo.

Alt. 14 millim., diam. maj. 19½, min. 16½; apertura cum perist. 10 longa, 12 lata.

Hab. Sibutu.

This species bears some resemblance to the Bornean *C. tomentosa*, but it is, however, rather more globular, has a peripherial reddish line, a thicker lip, and the aperture is of a different shape.

9. *Helix marginata*, Müller.

Helix marginata, Reeve, Conch. Icon. figs. 129 *a*, *b*; Pfeiffer, Conch.-Cab. ed. 2, pl. lxxviii. figs. 7–9.

Hab. Sibutu.

The specimens from this locality are rather small, the largest having a diameter of 21 millim. only. They are ornamented with a single narrow deep brown line revolving up the centre of the whorls, and two others of a much paler tint and not so well defined, one above the keel and the other a little below the suture. The central basal zone is also narrower than that depicted by Pfeiffer (fig. 9) or by Reeve (fig. 129 *b*).

10. *Cochlostyla* (*Corasia*) *ægrota*, Reeve.
(Pl. IV. fig. 5.)

Helix ægrota, Reeve, Conch. Icon. fig. 95.

Testa imperforata, depresse globosa, tenuis, subpellucido-alba, nitens; anfractus 3½, celeriter crescentes, convexiusculi, lineis incrementi obliquis tenuibus sculpti, ultimus ad peripheriam primo obtuse angulatus, sed versus aperturam magis rotundatus, haud descendens; apertura magna, alta; sutura linearis, lacteo anguste marginata; spira parum elata vel subdepressa, ad apicem obtusissima; columella paulo obliqua, tenuis, superne anguste dilatata; peristoma tenue, vix expansum, albidum.

Var. *zonata*. Testa circa medium anfr. ultimi et ad suturam zona angusta ornata.

Diam. maj. 28 millim., min. 22, alt. 19; apertura 15 alta et lata.

Hab. Sibutu.

Of thirty-four specimens collected by Mr. Everett only five belong to the banded variety. Besides the lines of growth, in some examples some very faint spiral striæ are more or less discernible under a lens, especially upon the base of the last whorl towards the umbilical region. *C. magtanensis*,

Semper *, is considerably like this species in form and colour, but is less glossy, and the columella is more oblique, so that it passes more gradually into the curve of the peristome. In *C. ægrota*, being more upright, it forms a distinct but rounded angle at the base. In the latter species also it is a trifle less widely expanded above, and has perhaps a straighter and more even edge than that of *C. magtanensis*. The surface of that species is dull above and only glossy upon the central portion of the base. *C. Broderipii*, Pfr.†, is also an allied form. The latter appears quite distinct from the *C. Broderipii* as figured by Reeve (Conch. Icon. fig. 88), which can scarcely be the *H. dealbata* of Broderip, as he supposed.

The description given above is taken from the Sibutu specimens, which are all smaller than the type from Mindoro figured by Reeve. The Mindoro shell is rather more solid and consequently less pellucid and not so glossy as those from Sibutu, the latter feature being maintained in the other Philippine examples examined.

11. *Cochlostyla* (*Hypselostyla*) *boholensis*, Broderip.

Bulimus boholensis, Reeve, Conch. Icon. pl. viii. figs. 37 *a*, *b*.

Hab. Bilatan.

About two dozen specimens of this species from Bilatan do not appear separable from this Philippine (Bohol) species. Some of them are almost entirely without the undulating markings, but others have more or less of this ornamentation. *C. camelopardalis*, Brod., appears to be a form of this species.

12. *Amphidromus maculiferus*, var.
(Pl. IV. figs. 9, 9 *a*.)

Bulimus maculiferus, Sowerby, Reeve, Conch. Icon. figs. 26 *a*, *b*; Pfeiffer, Conch.-Cab. ed. 2, pl. xxxvi. figs. 1, 2, pl. xl. fig. 9, var.; Hidalgo, Journ. de Conch. 1888, p. 31, pl. vi. fig. 1.

Hab. Bilatan Island.

The specimens from Bilatan present but the faintest trace of oblique strigation, like some of the Philippine examples. They more resemble the variety figured by Hidalgo, being either pale lemon-yellow or pinkish white. They are rather smaller than normal specimens, having an average length of about 50 to 55 millim. All as yet examined are sinistral.

* 'Reisen im Arch. Philippinen,' Land-Moll. p. 170, pl. x. figs. 11 *a*, *b*.

† The dimensions given by Pfeiffer of this species do not accord with his figure.

13. *Cyclotus suluanus*. (Pl. IV. fig. 7.)

Cyclotus suluanus, Möllendorff, MSS.

Testa globosa, anguste umbilicata, pallida, rufo-fusco copiose maculata et fulgurata, apicem versus nigrescens, infra peripheriam albidam zona colorata distincta ornata, inferne circa umbilicum pallida, haud maculata: anfractus 5, perconvexi, lineis incrementi obliquis tenuibus aliisque spiralibus subobsoletis striati, ultimus antice levissime descendens; apertura circularis, longit. totius $\frac{1}{2}$ paulo superans; peristoma leviter incrassatum, vix expansum; operculum utrinque leviter concavum, anfractibus circiter 7 ad suturam carinatis, transversim oblique striatis.

Diam. maj. 21 millim., min. 17, alt. 18; apertura 10 longa et lata.

Hab. Sulu (*Dr. Hungerford's collection*).

Two specimens of this species in the British Museum originally formed part of Dr. Hungerford's collection, and they are referred to by the Rev. A. H. Cooke (P. Z. S. 1892, p. 461) under the above name. The label accompanying them, in Dr. Möllendorff's handwriting, gives the locality "Sulu," so that I think we may safely conclude that the specimens are from that island.

The species is remarkable for its globose form and its cyclophoroid appearance, considerably recalling the aspect of *C. exaltatus*, Pfr., from Hong Kong. The operculum fits within the extreme margin of the aperture, so that its outer surface is almost flush with the peristome.

14. *Cyclotus variegatus*, Swainson, var.

Cyclotus variegatus, Sw., Reeve, Conch. Icon. figs. 29 *a*, *b*; Kobelt, in Semper's Reisen im Arch. Philippinen, Landdeckelschnecken, p. 5, pl. i. fig. 5.

Hab. Sulu (*Hungerford collection in Brit. Mus.*); Bongao (*Everett*).

A fine single example of this species was obtained from Dr. Hungerford's collection with a label in Dr. O. F. v. Möllendorff's handwriting as follows:—"*Cyclotus variegatus*, Swains., var. *grandis*, Mlldff. Sulu. (Running into *batchianensis*, perhaps new!)"

I certainly agree with Dr. Möllendorff in his determination, and the example obtained by Mr. Everett at Bongao, although somewhat smaller than the shell in question, evidently belongs to the same species. *C. Boxalli* of Godwin-Austen and *C. euzonus*, Dohrn, are extremely close allies, the latter, however, being distinguishable by its distinctive coloration.

15. *Cyclotus bongaoensis.* (Pl. IV. figs. 8, 8 *a*.)

Testa minima, late umbilicata, suborbicularis, sordide albida, ad apicem purpureo-rubra, epidermide luteo-olivacea induta, plerumque limo tunicata; anfractus $3\frac{1}{2}$, perconvexi, sutura profunda sejuncti, celeriter crescentes, liris tenuissimis spiralibus ornati, lineisque incrementi tenuibus sculpti, ultimus antice paulo descendens et solutus; apertura circularis, parva; peristoma simplex; operculum album, nucleo nigrescente, leviter concavum, anfractibus angustis circiter 8 oblique striatis.

Diam. maj. 5 millim., min. 4, alt. $3\frac{3}{4}$; apertura 2 lata.

Hab. Bongao.

In form this species resembles *C. pusillus*, Sowerby, a Philippine form, and *C. linitus*, Godwin-Austen, from Borneo. It also agrees with the latter in the habit of coating its surface with earth. It is, however, a smaller species than either, and differs from them in having spiral sculpture not only upon the apical whorls but also upon the rest. The mud- or earth-coating is produced into two keels, one around the upper part of the body-whorl and the other below the middle, giving it a quadrate appearance.

16. *Cyclophorus philippinarum*, Sowerby, var.

Cyclophorus philippinarum, Sow. Thesaurus, vol. i. p. 125, pl. xxix. figs. 205–207; Reeve, Conch. Icon. figs. 64 *a*, *b*; Kobelt, Semper's Reisen im Arch. Philippinen, Landdeckelschnecken, pl. iv. figs. 24, 25.

Hab. Bongao and Sibutu.

The shells from the above localities belong to that form which has been named *C. Sowerbyi* by Hidalgo (Journ. de Conch. 1888, p. 80). They include two varieties; the pale form accords with Hidalgo's var. γ, and the dark examples correspond closely with his typical form.

17. *Alycæus excisus*, Möllendorff.

Alycæus excisus, Möllendorff, Jahrbuch deutsch. mal. Gesell. 1887, p. 287.

Hab. Bongao (*Möllendorff*).

This species was not obtained by Mr. Everett.

18. *Leptopoma atricapillum*, Sowerby.

Cyclostoma atricapillum, Sow. Thes. Conch. vol. i. p. 137, pl. xxx. figs. 230, 231.

Leptopoma atricapillum, Reeve, Conch. Icon. figs. 6 *a*, *b*; Kobelt in Semper's Reisen im Arch. Philippinen, pl. vii. figs. 6, 7.

Hab. Bilatan, Bongao, and Sibutu.

There are three varieties from these islands, but they all occur on Bilatan:—

1. Of a pale horn-colour, variegated with light brown wavy markings; peripherial keel pale.
2. Coloured like no. 1, but marked with a distinct infra-peripherial brown zone.
3. Of a uniform dark chestnut-colour, excepting the central keel and the peristome, which are white.

The two latter varieties were only obtained at Bilatan by Mr. Everett, and variety 1, met with at Bongao and Sibutu, was also found at Bilatan.

19. *Leptopoma vitreum*, Lesson.

Leptopoma vitreum, Hidalgo, Journ. de Conch. 1888, p. 91.

Hab. Sibutu, Bongao, and Bilatan.

The examples from these islands are rather small in comparison with specimens from the Philippines and other localities, and they are separable into five colour-varieties. The uncoloured form was not met with.

20. *Lagochilus quinqueliratus*, Möllendorff. (Pl. IV. figs. 10, 10 *a*.)

Lagochilus quinqueliratus, Möllendorff, Jahrb. deutsch. mal. Gesell. 1887, p. 286.

Hab. Tawi-Tawi, Bongao, Sibutu (*Everett*); Bongao (*Möllendorff*).

21. *Pupina ottonis*, Dohrn.

Pupina ottonis, Dohrn, Sowerby's Thesaurus, Pupinidæ, pl. iii. fig. 25; Reeve's Conch. Icon. vol. xx. pl. iii. fig. 25; Kobelt in Semper's Reisen im Arch. Philippinen, pl. vii. fig. 19.

Hab. Bongao and Tawi-Tawi.

Some examples are entirely devoid of colour, being quite pellucid, but others are of the normal bronzy-brown tint.

22. *Diplommatina Roebeleni*, Möllendorff. (Pl. IV. figs. 11, 11 *a*.)

Diplommatina Roebeleni, Möllendorff, Jahrbuch deutsch. mal. Gesell. 1887, p. 287.

Hab. Bongao (*Everett and Möllendorff*).

23. *Helicina Martensi*, Issel.

Helicina Martensi, Issel, Ann. Mus. storia nat. Genova, 1874, vol. vi. p. 444, pl. vi. figs. 23–25; Möllendorff, Jahrb. deutsch. mal. Gesell. 1887, p. 289.

Hab. Tawi-Tawi, Bongao, and Sibutu (*Everett*); Bongao (*Möllendorff*); Labuan (*Issel*); Barit Mountain, N. Borneo (*Everett*).

I am inclined to think that this so-called species is merely a dwarfed form of the Philippine *H. polita*, Sowerby. The specimens from the Tawi-Tawi group are small, like Bornean examples, and all of them, with one exception which is uniformly yellow, have a white band beneath the suture. A similar style of coloration occurs in some of the Zebu specimens of *polita*. The opercula of both forms are similar in colour and sculpture.

24. *Helicina lazarus*, Sowerby.

Helicina lazarus, Sow. Thes. Conch. i. p. 11, pl. ii. fig. 91, vol. iii. p. 295, pl. cclxxviii. figs. 444, 445; Conch. Icon. figs. 208 *a*, *b*; Pfeiffer, Conch.-Cab. p. 58, pl. vii. figs. 18, 19.

Hab. Bongao and Sibutu.

All the examples from the above localities are coated with earth, which at the periphery forms an acute jagged keel. No mention is made by Sowerby or Pfeiffer of this characteristic; but in the type specimens from Luzon, which have been cleaned, traces of earth are visible. *H. cyrtopoma* of Möllendorff and a few other species have a similar habit of agglutinating earth to the surface of their shells.

25. *Helicina contermina* (Semper), Kobelt.
(Pl. IV. figs. 6, 6 *a*.)

Helicina contermina, Kobelt, Semper's Reisen im Arch. Philippinen. Landdeckelschnecken, p. 76, pl. vii. fig. 32.

Hab. Sibutu and Bilatan.

The majority of the specimens collected by Mr. Everett were obtained at Sibutu, only six examples coming from Bilatan. The colour of this species is variable. It may be uniformly lemon-yellow or pinkish red, with the exception of the keel which is whitish, and a narrow reddish or brown zone beneath the carina occurs in many specimens.

EXPLANATION OF PLATE IV.

Fig. 1. *Macrochlamys angulata.*
Figs. 2–2*b*. *Trochonanina bongaoensis.*
Figs. 3, 3*a*. *Helix* (*Plectotropis*) *squamulifera.*
Figs. 4, 4*a*. —— (*Chloritis*) *sibutuensis.*
Fig. 5. *Cochlostyla* (*Corasia*) *ægrota*, var.
Figs. 6, 6*a*. *Helicina contermina.*
Fig. 7. *Cyclotus suluanus.*
Figs. 8, 8*a*. —— *bongaoensis.*
Figs. 9, 9*a*. *Amphidromus maculiferus.*
Figs. 10, 10*a*. *Lagochilus quinqueliratus.*
Figs. 11, 11*a*. *Diplommatina Roebeleni.*

V.—*On the Dentition of* Pella Burnupi, *Melvill and Ponsonby.* By Henry Suter, Christchurch, New Zealand.

[Plate V. B.]

Some time ago Mr. J. H. Ponsonby kindly sent me a number of Helicidæ from South Africa, and, on carefully examining them, I was astonished how some of them showed distinct relations to forms from New Zealand. Fortunately there was one specimen of *Pella Burnupi*, M. & P., in which the dried-up animal was left, and, after proper treatment, I succeeded in getting it out of the shell, leaving the tail well preserved. In preparing jaw and radula great care was used, as those parts of the mouth are often exceedingly fragile when the animal has been dry for a long time. The mounting of the radula was successful, but the jaw broke in several pieces, without, however, impeding the study of its detail structure.

Jaw (Pl. V. B. fig. 1) arcuate, folded in about twenty vertical plaits, which are about five times longer than broad, and strongly transversely striated. Between the plaits a small transparent interstice is left. Cutting-margin broadly indented.

Radula (fig. 2) tongue-shaped, consisting of numerous transverse straight rows of teeth, 20—1—20, of which five or six may be taken as laterals.

Central tooth quadrangular, slightly longer than broad, rounded in front; reflexion tricuspid, the median cusp reaching almost to the posterior end of the base; the side cusps short, situated at the outer sides; median cutting-point well developed, extending a little over the next row of teeth; the side cutting-points minute.

Laterals very much like the rhachidian, the median and

the inner side cutting-point increasing slowly in size, and the former being slightly directed towards the central tooth.

A number of intermediate teeth show a gradual reduction of the reflected portion from tricuspid to bicuspid, the median cutting-point and, more especially, the inner cutting-point increasing in length.

Marginals quadrangular, much broader than long, tridentate, the median denticle being the strongest. The eighteenth tooth sometimes with four denticles; the last with one only, rudimentary.

Animal.—Tail rounded, slightly tapering, with a mucous tail-gland. There is a pedal line and diagonal grooves on the sides of the foot.

Note.—I also examined the dentition of *Vitrina Hudsoniæ*, Benson, from South Africa, which proved to be a *Helicarion*, as I anticipated.

VI.—*Preliminary Notes on the Relation between the* Helicidæ *of New Zealand, Tasmania, and South Africa.* By Henry Suter, Christchurch, New Zealand.

Before entering upon the subject in question it will be necessary to say a few words as to the present classification of the New Zealand Helicidæ, which will be more or less new to most conchologists. In the "Reference List of the Land and Freshwater Mollusca of New Zealand" (Proc. Linn. Soc. N. S. W. (2) vii. p. 633) Mr. C. Hedley and the writer classed the Helices under Zonitidæ, induced by the characters of the animal—clavate eye-peduncles, distinct pedal line, diagonal grooves on the foot, and mucous tail-gland in many of them; but, in accordance with Mr. H. A. Pilsbry and Dr. von Ihering, I am now fully convinced that the New Zealand Helicidæ are really *pseudo-zonitoid* mollusks.

In 1892 I sent a collection of New Zealand land-shells to Mr. H. A. Pilsbry, and the result was his article "Observations on the Helices of New Zealand," published in 'Nautilus' (vol. vi. no. 5, p. 54). With regard to the numerous genera recognized by New Zealand conchologists the author says:—"These sections or subgenera are founded upon various modifications of the shell or jaw, but they have not sufficient distinctness to rank as genera, unless we understand that term in a much more restricted sense than it has been used by the majority of conchologists or zoologists generally." He unites

the genera which formed my family Phenacohelicidæ (Trans. New Zeal. Inst. xxiv. p. 270) in one genus, *Gerontia*, establishing, amongst others, a section *Calymna*, Hutton, for the species formerly placed in the genus *Amphidoxa*, Hutton (not Albers), and subgenus *Calymna*, Hutton. For these shells, however, the name of *Flammulina* had been proposed in 1873 by von Martens ('Critical List of New Zeal. Moll.' p. 12), and was adopted by Mr. C. Hedley and myself in our "Reference List" (*l. c.* p. 643). *Gerontia* should therefore be replaced by *Flammulina* as a generic name, the former dating from 1883.

Later on Mr. H. A. Pilsbry published his "Preliminary Outline of a new Classification of the Helices" (Proc. Acad. Nat. Sci. Philad. 1892, p. 387 &c.), in which he unites all the sections of his former genus *Gerontia* (including *Endodonta*, *Charopa*, &c.) in one large genus *Endodonta* (*l. c.* pp. 401, 402). With this I cannot agree. Mr. H. A. Pilsbry was under the impression that the New Zealand *Endodonta* and *Charopa* possess a mucous tail-gland, which is not the case. I do not attach very great importance to the presence or absence of the caudal gland, as we really do not know its true significance; but in the mollusks classed under *Flammulina* the jaw is always stegognath, the radula is more or less pseudo-zonitoid, and, besides, a mucous tail-gland is always present; whilst in *Endodonta* and *Charopa* the jaw is only striated, the radula is much more helicoid, and there is no caudal gland. Moreover, according to the geographical distribution as now known to me, the two genera *Flammulina* and *Endodonta* (including *Charopa*) belong to two different types—*Endodonta* being of *Polynesian*, *Flammulina* of *Antarctic* origin. In New Zealand the *Endodonta* stock has been immigrating from the North, the *Flammulina* forms from the South and perhaps from the West and East also, or the latter may have spread from New Zealand.

These are the reasons which induce me to separate *Flammulina* from *Endodonta*, thus forming two well-defined genera.

Following chiefly Mr. H. A. Pilsbry (*l. c.* pp. 401–403) I now propose the following classification of the New Zealand Helicidæ:—

Group **Haplogona**.

Genus 1. Flammulina (v. Martens, 1873), Suter.

Sect. 1. Flammulina, von Martens, 1873, s. str. (=*Amphidoxa*, Hutton, not Albers). Type: *F. compressivoluta*, Reeve.

Subsect. CALYMNA, Hutton, 1884.
Type: *C. costulata*, Hutton.

Sect. 2. GERONTIA, Hutton, 1883.
Type: *G. pantherina*, Hutton.

Sect. 3. PHACUSSA, Hutton, 1883.
Type: *P. hypopolia*, Pfeiffer.

Sect. 4. THERASIA, Hutton, 1884.
Type: *T. celinde*, Gray.

Sect. 5. PYRRHA, Hutton, 1884.
Type: *P. cressida*, Hutton.

Sect. 6. PHENACOHELIX, Suter, 1891.
Type: *P. pilula*, Reeve.

Sect. 7. ALLODISCUS, Pilsbry, 1892 (=*Psyra*, Hutton, 1884, not Stal, 1876).
Type: *A. dimorphus*, Pfeiffer.

Sect. 8. SUTERIA, Pilsbry, 1892 (=*Patulopsis*, Suter, not Strebel, 1879).
Type: *S. ide*, Gray.

Sect. 9. THALASSOHELIX, Pilsbry, 1892 [=*Thalassia*, Hutton (? and of Albers), not *Thalassia*, Chevrolat, 1834 (Coleopt.)].
Type: *T. zelandiæ*, Gray.

Genus 2. ENDODONTA (Albers, 1850), Suter.

Sect. 1. ENDODONTA, Albers, 1850, s. str. (+*Pitys*, Pease, not Beck).
Type: *E. lamellosa*, Férussac (Hawaii).

Subsect. PTYCHODON, Ancey, 1891 (=*Huttonella*, Suter, not Pfeiffer, =*Maoriana*, Suter, 1891).
Type: *P. leioda*, Hutton.

Sect. 2. CHAROPA, Albers, 1860 (=*Simplicaria*, Mousson, MS.).
Type: *C. coma*, Gray.

(*a*) Subsect. TESSERARIA, Böttger, 1881.
Type: *T. novoseelandica*, Pfeiffer.

(*b*) Subsect. AESCHRODOMUS, Pilsbry, 1892 (=*Thera*, Hutton, 1884, not Stephens, 1831).
Type: *A. stipulatus*, Reeve.

Group **Polyplacognatha.**

Genus LAOMA (Gray, 1849), Pilsbry, 1892.

Sect. 1. LAOMA, Gray, 1849, s. str.
Type: *L. leimonias*, Gray.

Sect. 2. PHRIXGNATHUS, Hutton, 1883.
Type: *P. Mariæ*, Gray.

We can now proceed to the investigation of the *Tasmanian* land-molluscan fauna. Having for several years regarded the Tasmanian Helices as nearly allied to those of New Zealand, I was much pleased to find that Mr. H. A. Pilsbry held a similar opinion with regard to *Patula*, *Paryphanta*, *Rhytida*,

&c. ('Nautilus,' 1892, vi. p. 57). On looking through my collection of Tasmanian land-shells I fortunately found many specimens containing the dried-up animal, and these I decided to sacrifice to enable me to examine the dentition. Moreover, a short time ago Mr. W. L. May kindly assisted me by forwarding some living snails from Tasmania.

In giving the classification of some of the Tasmanian land-shells, I wish to point out that it is based on the dentition as well as on the shell-characters. The descriptions and figures of the dentition of the species will be published occasionally. The dentition of the following thirty-two species was examined:—

Genus Flammulina (v. Mart.), Suter.

Sect. Flammulina, von Martens, s. str.

(1) F. Jungermanniæ, *Petterd.*
(2) F. sitiens, *Cox.*
(3) F. Luckmani, *Brazier.*

Sect. Gerontia, Hutton.

(4) G. albanensis, *Cox.*
(5) G. stanleyensis, *Petterd.*
(6) G. Legrandi, *Cox.*
(7) G. Marchiannæ, *Cox.*
(8) G. diemenensis, *Cox.*
(9) G. gadensis, *Cox.*
(10) G. tasmaniæ, *Cox.*
(11) G. subrugosa, *Brazier.*
(12) G. Mathinnæ, *Petterd.*
(13) G. Macdonaldi, *Cox.*
(14) G. Bassi, *Brazier.*
(15) G. tamarensis, *Petterd.*

Sect. Phacussa, Hutton.

(16) P. Savesi, *Petterd.*
(17) P. Stephensi, *Cox.*
(18) P. Hamiltoni, *Cox.*

Sect. Allodiscus, Pilsbry.

(19) A. limula, *Cox.*

Sect. Thalassohelix, Pilsbry.

(20) T. Fordei, *Brazier.*

Genus Endodonta (Albers), Suter.

Sect. Charopa, Albers.

(21) C. antialba, *Beddome.*

Genus Laoma (Gray), Pilsbry.

Sect. Phrixgnathus, Hutton.

(22) P. Weldii, *Tenison-Woods.*
(23) P. cæsus, *Cox.*
(24) P. Henryana, *Petterd.*
(25) P. furneauxensis, *Petterd.*
(26) P. pictilis, *Tate.*
(27) P. pipaensis, *Petterd.*
(28) P. Halli, *Cox.*
(29) P. Hobarti, *Cox.*

Genus Rhytida, Albers.

(30) R. Sinclairi, *Pfeiffer.*
(31) R. ruga, *Cox.*

Genus Rhenea, Hutton.

(32) R. nelsonensis, *Brazier.*

It is a most astonishing fact how close the relation between the Tasmanian and New Zealand molluscan fauna really is, more so than I ever anticipated. Of nine sections of the genus *Flammulina* occurring in New Zealand, five are represented in Tasmania. Most remarkable is the preponderance of *Gerontia*, a section represented in New Zealand by two species only, and of *Phrixgnathus*, which is also well represented in New Zealand. A very striking feature is the almost total absence of *Endodonta*, the Polynesian element, there being only one species of *Endodonta*, s. str., and one of *Charopa* known from Tasmania. *Rhytida* is more abundant in Tasmania, whilst *Rhenea* is represented by two species in each country.

With regard to the relation between the land molluscan fauna of New Zealand, Tasmania, and *South Africa*, I do not know much at present; yet the little knowledge available seems of great importance. The genus *Æropc* is no doubt nearly allied to *Rhytida*; but the most important fact has been brought to our knowledge by the examination of the dentition and part of the animal of *Pella Burnupi*, M. & P. The authors of this species state that it is of allied character to *P. bisculpta*, Benson, the type of *Pella*, and the dentition given may therefore be taken as typical for the section or genus. I have studied the dentition of most of the New Zealand land and freshwater shells, and, as shown above, of a good many from Tasmania, and I may therefore be allowed to give my opinion as to the systematic position of *Pella Burnupi*, M. & P., and *Pella* generally. I have not the slightest doubt that it must be classed under *Haplogona* next to *Flammulina*.

The dentition and part of the animal which I was able to examine closely resemble those of *Flammulina*, s. str., and *Gerontia* from New Zealand and Tasmania; and I think that the South-African genus *Pella* belongs to the *Antarctic* molluscan fauna, which no doubt dates back to the Cretaceous period at least.

There are other South-African land-shells which seem to me to be more or less closely allied to forms from New Zealand, and I hope to obtain the animals for examination.

[With regard to the genus *Pella*, as alluded to in the above article, we would refer our readers to the remarks made by Mr. Pilsbry in the 'Manual of Conchology,' vol. viii. pp. 135 *et seq.*— Eds. *Ann. & Mag. Nat. Hist.*]

VII.—*The Anatomy and Description of a new Species of* Arion.

By Walter E. Collinge, Mason College, Birmingham.

[Plate V. A.]

In July last I received from Mr. E. W. Swanton, of Bratton St. Maur, Wincanton, a series of slugs collected on a lawn at Wainsgrove, Somersetshire, amongst which I noticed a small *Arion*, which I informed Mr. Swanton was a young example of *Arion empiricorum*, Fér. On a closer examination, however, I was struck by the active way in which it crawled about, the flatness of the back, and the manner in which it elongated itself. After a few days it was killed by drowning, and preserved in alcohol. Not until now have I been able to make an examination of it internally, and it is at once evident, from the fully developed condition of the generative system, that it is an adult slug, and from the morphology of the same it can no longer be referred to *A. empiricorum*.

Although I am acquainted with most of the members of this genus and its allies, I am not aware of any species that approach at all near to the one described below. I mention this as, being described from only a single example, and collected in a garden, it might possibly have been introduced in the roots of foreign plants. Mr. Swanton has so carefully worked the slug-fauna of Somersetshire, that I am somewhat surprised he has not met with this species before. I have examined all previous consignments of small Arions which he has from time to time sent me, but find nothing approaching it amongst them.

Arion elongatus, sp. n. (Pl. V. A. figs. 1–4.)

Head and tentacles blackish, the latter slightly lighter than the head. Centre of mantle marked with a pyriform mass of deep black, bounded on either side by a narrow yellowish-grey line, below by a deep black band which gradually shades off into a yellowish grey. Whole of dorsal surface a deep black, bounded, like the mantle, by a yellowish-grey line, then a deep black band, which shades off into a yellowish grey. Foot-fringe yellow, with sepia lineoles. Sole yellowish; lateral planes distinct from median plane, which latter is marked in a dendritic manner and slightly lighter in colour. Rugæ large and flat. Respiratory orifice distinct. Keel absent, the back being almost flat. Length alive 24 millim.; length in alcohol 15 millim.; length of mantle in

alcohol 5 millim.—Externally the slug somewhat resembles certain young forms of *A. empiricorum*, Fér., and forms of *A. hortensis*, Fér.; its structure, however, is very different.

Having so far only been able to obtain a single example, I have deferred an examination of anything but the generative organs. As soon as further specimens come to hand I will describe the nervous and digestive systems, &c., which seem interesting.

There are two vestibules, an upper and a lower. The lower portion of the vas deferens—the sperm-duct ("Patronenstrecke")—is characterized by an absence of any ring-like swelling at its lower end, a feature very common in the *hortensis* group of Arions. There is no differentiation between the sperm-duct and the vas deferens, the one gradually passing into the other. There is only a very small duct to the receptaculum seminis, which is an elongated sac-like body. The free oviduct is exceedingly large; it passes from the upper vestibule as a broad tube, and at about a third of its length dilates into a sac-like body, and is then continued for a short distance as a tube, and opens into a pouch-like portion, which makes a turn towards the upper vestibule and is continued as a broad tube, which higher up becomes constricted and passes into the oviduct proper as a fine tube. Attached to the base of the pouch-like portion of the free oviduct is a short broad retractor muscle.

EXPLANATION OF PLATE V. A.

Fig. 1. *Arion elongatus.*
Fig. 2. Lower portion of the generative organs.
Fig. 3. Rugæ from dorsal surface of the body.
Fig. 4. Portion of sole of foot, showing lateral and median planes.

l.p. Lateral plane of foot-sole.
l.v. Lower vestibule.
m.p. Median plane of foot-sole.
ov. Oviduct.
pr. Prostate.
r.m. Retractor muscle.
r.s. Receptaculum seminis.
s.d. Sperm-duct.
v.d. Vas deferens.

VIII.—*Descriptions of Two new Species of* Macroscelides.

By Oldfield Thomas.

In attempting to determine an elephant-shrew of the genus *Macroscelides* brought by Dr. J. W. Gregory from East Africa, specimens already in the Museum of the two following species have been re-examined and prove to need description:—

Macroscelides fuscipes, sp. n.

Most nearly allied to *M. brachyurus*, Boc.*, with which it agrees in size and proportions. General colour above deep rufous chestnut, sides paler rufous; under surface white, the hairs slaty grey basally as usual. Eyes less completely surrounded by white than usual, the white superciliary streak being only represented by an isolated spot anteriorly, while there is no white at all between the eye and ear, the fur here being pale brown, a shade lighter than the general colour of the head; the white streak beneath the eye, however, runs along the whole lower border of the orbit, ending below the posterior canthus. Lips and chin white. Ears of medium length, laid forwards in a spirit-specimen they just reach to the anterior canthus of the eye: metatragus † of very peculiar shape, being twisted backwards on itself almost as in the Chiropterous genus *Nycteris*, its substance much thickened, so that it is almost spherical; anterior and outer margins evenly rounded, posterior sharply and angularly concave; its rounded terminal part thinly clothed with fine scattered hairs, almost too small to be seen without a lens.

Proximal portions of arms and legs coloured like the body; anterior surface of wrists and uppersides of hands and feet soft brownish fawn.

Tail short, thinly haired; its hairs above brown, below white.

Dimensions of the type (a somewhat immature female in spirit):—

Head and body 102 millim.; tail 76; hind foot 27; ear from notch 19.

Skull: basal length 30, greatest breadth 17·3, interorbital breadth 5·6.

Hab. N'doruma, Niam-Niam country (about 5° N. and 27° 30′ E.). Coll. F. Bohndorff.

Type: B. M. no. 84. 5. 1. 6.

Although the only specimen of this species is young, having still its milk-dentition in place, its characters are so well marked that I have little hesitation in describing it as new. By its short feet and tail it is readily separated from

* J. Sci. Lisb. ix. p. 27, 1882; (2) i. p. 24, 1889.

† By this name, as in the 'Catalogue of Marsupials,' I designate the small fleshy or membranous protuberance placed within the concavity of the ear-conch. It is probably homologous to what is generally called the "tragus" in the Chiroptera; but as it certainly does not correspond in position with the human tragus, I prefer now, as then, without prejudging the case of the bats, to use in other instances a name which does not suggest an incorrect homology.

all other species except *M. brachyurus*; and from this, to which it is no doubt most nearly allied, it differs in its peculiarly twisted and more thickened metatragus, its richer rufous coloration, its less white-ringed eyes, and in its brownish hands and feet, *M. brachyurus* (like all the other species of the genus) having the latter pure white.

Macroscelides pulcher, sp. n.

Most nearly allied to *M. rufescens* *, Pet., to which I doubtfully referred it in 1890 †, but distinguished by its much greyer and less rufous coloration. General colour of head and body soft fawn-grey, rather more rufous in the nuchal region, darker along the centre of the back, paler along the sides, altogether not very dissimilar to that shown in the plate given by Huet of his *M. Revoili* ‡. Arrangement of eye-markings much as in *M. rufescens*, but the superciliary line is partially interrupted posteriorly, while the fur at the large postero-inferior interruption is nearly black instead of rufous. A large patch at the back of each ear pale rufous. Metatragus apparently as in *M. rufescens*, *i. e.* thin and membranous, about as long as broad, with evenly rounded margins; but without spirit-specimens an exact description is not possible. Outer surface of ears brownish fawn. Whole under surface of body pure white, the bases of the hairs grey. A prominent gland present in the sternal region. Upper surfaces of hands and feet also pure white. Tail long, brownish above, whitish below.

Skull and dentition apparently quite as in *M. rufescens*, except that the upper canines and anterior premolars are slenderer and less distinctly bicuspid; without further material, however, I am not able to say whether even this difference may not be due to age.

Dimensions of the type (an adult skin, female) :—

Head and body 125 millim. §; tail 108; hind foot (approximate) 31.

Skull: nasals, length 12·2; interorbital breadth 6·2; palate, length 18·2; length of upper tooth-row 17·5, of lower ditto 16.

Hab. Usambiro, south of the Victoria Nyanza. Collected and presented by Emin Pasha.

Type: B. M. no. 90. 6. 8. 10.

* MB. Ak. Berl. 1878, p. 198, pl. i.

† P. Z. S. 1890, p. 446.

‡ Revoil's 'Faune et Flore des Pays Çomali,' pl. i., 1882.

§ Emin gives, as the dimensions in the flesh, "Total length 251 : tail 110 millim."

Emin says of this animal:—"*Iride nigerrima*. This single specimen found among the high dry grasses. Runs like a Gerbille. Native name 'Gosso.'"

Further examination has convinced me that my reference of this specimen to *M. rufescens* was incorrect, and that the considerable difference in the general body-colour is of sufficient importance to distinguish the two forms.

Dr. Gregory's specimen of *Macroscelides*, above referred to, obtained by him at Kibwezi, British East Africa, is itself of some interest, as, occurring in the neighbourhood of the original locality of *M. rufescens*, it differs from that animal in being of a uniform dirty slate-colour below, with nearly or quite obsolete face-markings, and of a generally much darker tone of colour. In all other respects, however, it appears to be identical, and I am therefore disposed to consider it as being possibly a melanistic example of *M. rufescens*, as its coloration seems so abnormal. Should this prove to be the case, it increases the probability, already suggested by Huet *, that Peters's *M. fuscus*, coloured somewhat similarly, is also founded on a melanistic individual of the ordinary Mozambique form. The dental peculiarities of *M. fuscus*, as described by Peters, seem merely to be due to his having mistaken milk for permanent teeth.

IX.—*On a new Species of Armadillo from Bolivia.*

By Oldfield Thomas.

The British Museum owes to the kindness of the well-known naturalist Prof. W. Nation, of Lima, a specimen of an armadillo belonging to the restricted genus *Dasypus*, but not referable to any of the previously known species of the genus.

I would propose to term it, in honour of its donor,

Dasypus Nationi, sp. n.

Intermediate in size between *D. villosus*, Desm., and *D. vellerosus*, Gray †, to the latter of which it is probably most nearly allied. Cephalic shield very broad and short, its breadth slightly exceeding its length; its scales proportionally large, smooth, and but little sculptured, their

* *T. c.* p. 10.

† P. Z. S. 1865, p. 376, pl. xviii. (animal); Hand-l. Edentates, p. 19, pl. v. figs. 1 & 2 (skull) (1873).

number just about 100: first nuchal row consisting of 11 scales and extending quite from ear to ear; second row, as usual, forming a complete collar extending from shoulder to shoulder and consisting of 28 scales. Fixed shoulder-shield consisting of three rows in the centre, the middle one of which divides laterally into four or five. Number of rows behind this to the tail 18, of which 8 or 9 appear to be movable. Central scale of the seventh row from the end perforated. Fifth body-row consisting of 39 scales.

Carapace thinly clothed with long scattered hairs, from 1 to 3 inches in length, of a pure white colour. Underneath and between these there are shorter and more numerous brown hairs, which, on the medial line of the back and on the pelvic shield, are in the majority, while on the flanks the longer white hairs are most numerous. Limbs and belly thinly clothed with whitish or pale brownish hairs.

Ears naked, black, somewhat elongate, their length about equal to half that of the cephalic shield. Tail imperfect, its proximal portion very thinly haired, almost naked.

Skull only represented by the muzzle, but this, like the cephalic shield, is of unusual proportionate breadth; nasals large, boldly expanded in their posterior half. Anterior tooth, as in typical *Dasypus*, implanted in the premaxilla, just anterior to the suture.

Dimensions of the type (an adult skin):—

Head and body, length in a straight line 268 millim., over the curves 350; cephalic shield, length 60, breadth in a straight line 61, over the curve 71; transverse length of first nuchal band (straight) 47; ear-length (approximate) 30; length of middle body-band, following the curve, 230; hind foot, length without claws (approximate) 52.

Skull: nasals, length 26·3, breadth anteriorly 7, at narrowest point 6·1, at broadest point 12·6; breadth of anterior nasal opening 8·4; anterior tooth, distance from nasal opening 9; breadth of palate between anterior maxillary teeth 7·6.

Hab. Orujo, Bolivia.

This new species differs from *D. vellerosus* in its considerably larger size, much broader cephalic shield, longer ears, less amount of hairiness, and, in the skull, in the much broader muzzle and nasal opening and in the larger and (posteriorly) more widely expanded nasals. All these characters, and its equally *inferior* size, will also readily separate it from the common hairy armadillo, *D. villosus*.

One other described species needs some reference here,

namely Fitzinger's "*Cryptophractus brevirostris*"* (later *Dasyphractus brevirostris* †), said in one place to come from Chili and in another from Bolivia, and which, although the describer himself considered it the same as *D. vellerosus*, might have been really the present form. The type of the species was at one time in the Vienna Museum; but my friend Dr. von Lorenz kindly informs me that it is no longer there, and we are therefore reduced to Fitzinger's description.

Apart from his own recognition of its identity with *D. vellerosus* (over which he unjustifiably claims priority), this description, and especially the dimensions given, prove conclusively that it really was the smaller southern form, of which the British Museum, besides the type from Santa Cruz de la Sierra, Bolivia, possesses an immature example from Chili. We may therefore dismiss the name *brevirostris* as altogether synonymous with *vellerosus*.

X.—*A small Contribution to our Knowledge of the Scorpions of India.* By R. I. Pocock, of the British Museum (Natural History).

Family **Scorpionidæ**.

Scorpio bengalensis (C. Koch).

Since giving a few brief notes about this scorpion in my paper upon the Indian species of Scorpions (J. Bombay Nat. Hist. Soc. vol. viii.), I have come across three other examples of this species, which show that it attains to a greater size than C. Koch's type. These specimens are of a very deep green throughout. The following measurements will show the dimensions and the sexual characters of two of the specimens:—

♀.—Total length 127 millim., of carapace 19, of tail 63; length of palp 71, of hand-back 15, of movable digit 19; width of hand 15, of brachium 7·8.

♂.—Total length 113 millim., of carapace 16·5, of tail 60, of palp 79, of hand-back 16, of movable digit 19·5; width of hand 12, of brachium 7.

* SB. Ak. Wien, xlii. p. 384, 1861 (descr. nulla).
† *Op. cit.* lxiv. Abth. i. p. 264, 1871 (descr. orig.).

Scorpio cæsar, C. Koch.

The specimen ticketed "Ceylon" in the Museum collection, which I identified in the 'Bombay Journal,' vol. viii., as *S. cæsar*, proves to be an aberrant example of *S. africanus* (Linn.). The locality Ceylon, which I have very little doubt is erroneous, put me off the track of its accurate determination.

Two other scorpions in the collection, which I now refer to *S. cæsar*, are nearly related to *S. megacephalus*, but may be recognized from it by having the hand wider, more convex above, and with its inner edge much more strongly convex; moreover, the keels of the tail are strongly denticulate, very much as in *S. bengalensis*.

The two examples give the following measurements in millimetres:—

♂ (in alcohol).—Total length about 125, of carapace 18, of tail 63; width of brachium 7·5, of manus 17·8; length of hand-back 13, of movable digit 19.

♀ (dry).—Total length 91, of carapace 15·5, of tail 52; width of brachium 6, of manus 15; length of hand-back 10·5, of movable digit 15.

Judging from these two specimens, both of which are from Ceylon, the sexes do not differ appreciably with regard to length of tail or of palpi.

Scorpio Phipsoni, Pocock.

Scorpio Phipsoni, Pocock, Journ. Bombay Nat. Hist. Soc. viii. pp. 307–309.

This species attains a far larger size than I suspected when describing it. Since that time the Museum has received several examples from India (Miss Emma Phipson's collection) and one from the Bombay Presidency presented by Mr. N. Masterman. The largest of these examples (a male) measures about 140 millim., of which the carapace is 20 and the tail 72, while the largest female measures (with the abdomen distended) about 138 millim., the carapace being 19 and the tail 63; in the male the palpi are very long, measuring about 90 millim., of which the brachium is 22·5, the hand-back 19, and the movable digit 21, while the width of the hand is 15·5. In the female the palp is only 67, the brachium being 15, the hand-back 14·2, and the movable digit 19, while the width of the hand is 16.

This species may be readily distinguished from *S. megacephalus* of C. Koch by having the upper surface of the hand considerably more convex, the area above the keel being vertical, the inner border also more convex, and the posterior

lobe much less strongly produced; also there is not such an elongate space on the proximal side of the first pectinal tooth as is seen in *S. megacephalus*, the superior caudal keels are much more granular, the vesicle is less globular, and the aculeus more abruptly curved in its distal half; and, lastly, although I have seen nineteen specimens of *S. megacephalus*, mostly from Ceylon, eight of which are males varying in length from about 95 to 122 millim., yet none of them present any very marked elongation of the palpi; whereas of *S. Phipsoni* I have seen in the Museum collection eleven specimens, six of which are males varying in length from 92 to about 190 millim., and they all present that elongation of the palpi that has been described.

Immature specimens of the two species now under discussion are, as might be expected, very difficult to recognize from each other; and in my diagnosis of the species I mentioned two specimens in the Museum collection from Madras, which I now believe to be referable to *S. megacephalus* of C. Koch.

Scorpio latimanus, sp. n.

Colour castaneous, with yellow legs.

Carapace finely granular laterally, the frontal lobes subgranular and wrinkled; the anterior excision very shallow and the lobes consequently rather squared, almost as in *Miaphonus*, longer than the first two caudal segments and half the third.

Tergites mostly smooth and polished, weakly granular at the sides, the last more coarsely granular laterally, but scarcely carinate.

Sternites smooth and polished, the last furnished with four distinct smooth keels.

Tail short, only a little more than three times the length of the carapace, posteriorly narrowed, the first segment one third wider than the fifth (6:4); the third segment as long as wide, the fifth twice as long as wide; the superior keels of segments 1 to 4 smooth, subcrenulate on the fourth, the inferior keels well developed and also smooth, although roughened with punctures on the fourth, those on the first segment as strong as those on the second; fifth segment with its upper keels weakly denticulate; vesicle wider than the fifth segment, serially granular beneath (aculeus fractured). The terminal fang of the immovable digit of the cheliceræ very long.

Palpi robust; *humerus* granular and convex above, denticulate in front; *brachium* smooth, subcostate, not granular;

manus very wide, as wide as long, its inner border strongly arched, the inflation beginning abruptly at the base of the immovable finger, so that the angle thus made is scarcely larger than a right angle; the inner edge denticulate in front, smooth behind; the upper surface strongly convex externally, where it rises vertically from the keel of the hand-back, covered with low anastomosing ridges and tubercles, which show a strong tendency to run into longitudinal crests in the external half of the hand; lower surface nearly smooth; length of the hand-back much less than that of the movable digit and much less than the width of the hand, which is a little less than the length of the movable digit; the immovable digit with a very distinct smooth keel upon it.

Legs almost entirely smooth, the spines on the feet of the two posterior pairs 4 or 5 in number on each side.

Pectines with 15 teeth on each side.

Genital operculum elongate, cordate.

Measurements in millimetres. — Total length (without aculeus) 72, of carapace 12·8, of tail-segments 1–5 30·5; width of brachium 4·6, of manus 11·5; length of hand-back 7·8, of movable digit 12.

A single dried (probably male) specimen, unknown locality.

This species is so well marked that, in spite of the absence of locality, I have not hesitated to describe it. Its most noticeable features are—(1) A very shallow median excision and truncate frontal lobes on the carapace; (2) the presence of four distinct keels on the last abdominal sternite; (3) the conspicuousness of the anterior inferior caudal keels; (4) the very wide hand, with vertical external surface and very widely rounded inner edge.

N.B.—Since the above was written the Museum has acquired from Mr. F. Moore a small collection of scorpions, which, in addition to the types of *Scorpiops tenuicauda* and *Chærilus insignis*, contains a small (probably female) example of a *Scorpio* which appears to be referable to this species and is ticketed "N. India." This specimen agrees closely with the type in most of its features, but the carapace is more deeply and more characteristically excavated mesially and the last abdominal sternite is less conspicuously keeled. Moreover, the genital operculum is not posteriorly elongate, and there are 12–13 pectinal teeth.

Scorpio gravimanus, sp. n.

♂. *Colour* ferruginous, legs piceous.

Carapace as long as caudal segments $1+2+\frac{1}{3}$ of 3, smooth

above, weakly granular laterally, the anterior excision normally strong, with the triangular piece at the apex of it; distance between the anterior and median lateral eyes greater than that between the median and posterior.

Tergites weakly granular posteriorly and laterally, the last with two nearly obsolete granular keels on each side.

Sternites smooth, the last only very obsoletely carinate.

Tail about three and a half times the length of the carapace, robust, the sides of the segments convex in outline, the second segment as long as wide, the third longer than wide; in segments 1–4 the superior keels are weakly granular, more strongly so on the fourth; the supero-lateral keel merely subcrenulate; the inferior keels smooth, roughened with punctures, these keels on the first and second segments strongly and equally developed, the superior and the lateral intercarinal space weakly granular; the fifth segment with denticulate inferior keels and the posterior lateral tooth very strong, the upper surface granular at the sides; vesicle narrower and lower than the fifth segment, not very robust, serially denticulate beneath.

Palpi.—Humerus lightly convex and sparsely granular above, the anterior and posterior keels strong and granular, the lower and posterior surfaces smooth, the posterior-inferior keel weak; *brachium* smooth, except for a few small granules in front, longitudinally costate; *manus* large, nearly the same shape as in *S. megacephalus*, but with its inner border a little more convex and almost entirely smooth, the angle formed by the meeting of the inner border of the hand and of the immovable digit very obtuse and nearly evenly rounded, the upper surface evenly convex from the keel of the hand-back to the inner edge, the area above the keel of the hand-back sloping and not vertical when the hand is normally at rest; the upper surface covered with low, often anastomosing tubercles, which form four smooth keels, three of which emanate from the immovable digit; the inner edge of the hand at the base of the immovable digit is raised into a distinct smooth crest; the width of the base of the immovable digit equal to nearly half its length; the movable digit shorter than the length of the hand, but a little greater than its width; the length of the hand-back much less than the greatest width of the hand, but greater than the least width, *i. e.* at the base of the digits.

Legs almost entirely smooth, femora of the fourth pair very weakly granular; the feet with 5–4 spines below.

Pectines with 13–14 teeth; the basal intermediate lamella not elongate, so as to leave a long space between the point

where the teeth begin and the point of attachment of the pecten.

Measurements in millimetres.—Total length 100, of carapace 17, of tail 53·5; length of first segment 6, of fifth 12·5; width of first 7·3, of fifth 5, of vesicle 4·6; width of brachium 5·7, of manus 14·5; length of hand-back 12·5, of movable digit 15·5.

A single male example from Ceylon (*R. Templeton*).

In addition to the specimen described above, there is a second in the Museum collection ticketed "India." It is a female, and is rather smaller than the male. The total length is 89 millim., of which the tail is only 40 and the carapace 13; the vesicle is much narrower than the fifth caudal segment (3 : 4). The manus has the same form as in the male, but the "ribs" are less pronounced.

This species is most nearly allied to *S. megacephalus*. It may be recognized by the form and structure of the hand, by the relatively shorter space between the point of attachment of the pectines and the commencement of the teeth, the less globular vesicle, &c.

Family **Iuridæ**.

Scorpiops tenuicauda, sp. n.

♀. *Colour* blackish chestnut, hands redder; vesicle and tarsi pale.

Carapace longer than the first three caudal segments, flat, finely granular, the longitudinal groove in front of the ocular tubercle very shallow and not laterally carinate; the anterior edge subtubercular; the ocular tubercle polished, smooth, the distance between the eyes equal to about twice a diameter; the posterior eye of the lateral series the smallest.

Tergites nearly smooth, at most coriaceous or minutely granular, with a smooth median crest; the last with four anteriorly abbreviated, finely granular keels.

Sternites smooth, the last obsoletely costate posteriorly.

Tail only two and a half times the length of the carapace, posteriorly narrowed, the segments increasing in length posteriorly, the fifth as long as the third and the fourth, the second about as wide as long, the first with 10 keels, the second with 8; the inferior keels smooth on the first segment and becoming progressively more and more granular towards the fourth; the superior and superior-lateral keels finely denticulate, the former terminating behind in a spiniform tooth upon the second, third, and fourth segments, the intercarinal spaces finely granular; the fifth segment with its upper sur-

face nearly flat and its edges squared, and the median lateral keel almost smooth and the inferior keels weakly granular; *vesicle* smooth, flat above, convex below, as wide as the fifth segment and a trifle higher; aculeus short, stout at the base, lightly curved in its distal half.

Palpi longish, flat; the *humerus* covered with granules above, much more finely granular below, the keels coarsely granular, the anterior surface with a median granular keel extending throughout its length; *brachium* granular, like the humerus, with a strong spine on its anterior surface and a smaller one above it; a series of 12 pores on its lower surface; *hand* not twice as thick as the brachium, the upper surface covered with a reticulated pattern of fine granules, the keels which bound this surface distinctly granular, the anterior surface finely granular, the rest of it coriaceous, the keels bounding the hand-back granular; the movable digit shorter than the hand-back.

Legs finely granular externally.

Sternum of cephalothorax flat and about as wide as long.

Pectines short, with 6–7 teeth.

♂. *Carapace* as long as the first three segments of the tail and about one third of the length of the whole tail.

Vesicle larger, thicker than the fifth and almost as thick as the second segment, and higher than any of the segments.

Palpi very long and slender (*cf.* measurements), the movable digit with a tooth in the proximal half of its length, the immovable correspondingly notched.

Pectines larger, with longer teeth.

Measurements of ♀.—Total length 36 millim.; length of carapace 6, of tail 16, of its fifth segment 4·2, of vesicle and aculeus 4; width of first segment 2, of fifth 1·3; length of humerus 5·8, of brachium 6, of hand-back 6·8, of movable digit 6·5; width of hand 4, of brachium 2·5.

♂.—Total length 38 millim.; length of carapace 5·8, of tail 17·5, of its fifth segment 4·5, of vesicle and aculeus 5, of humerus 7, of brachium 6, of hand-back 7·2, of movable digit 5·5; width of hand 3, of brachium 2·2.

Loc. Deccan (India).

This species is very distinct from all the known species of the genus in its strong superficial resemblance to *Euscorpius* or *Hormurus*. It is, however, a genuine *Scorpiops*; the only characters in which it appears to differ from the rest of this genus are merely connected with the flatness of its build, and are not, to my mind, of generic importance.

Scorpiops leptochirus, Pocock.

This species, described on pp. 325–326 of the October number of the 'Annals,' was based upon a single female example, for which no locality could be assigned. I am glad therefore to be able to supplement my original description by adding that, in Mr. Moore's collection, to which reference has already been made, there are two examples of this species. One of them, a female ticketed "N.E. Bengal," closely resembles the type, except that it is a little smaller (about 40 millim.); but the other, a male from Assam, has the palpi very elongate, as the following measurements with reference to the carapace will show :—

Length of carapace 6·5 millim., of humerus 7, of brachium 7, of hand-back 7·3, of movable digit 7.

Chærilus margaritatus, sp. n.

Colour pale (probably faded); the trunk, legs, and tail brownish yellow, at most obscurely mottled with darker tints; palpi redder, with the digits and the keels blackish.

Clothed, especially on the appendages, with white longish hairs.

Carapace as long as the first two segments and half the third, posteriorly and laterally rather sparsely studded with round shining tubercles; the keel, which runs posteriorly from the lateral eyes, weak; the interocular area tubercular anteriorly; the space between the median eyes a little larger than a diameter; the space between the lateral eyes only about half a diameter.

Tergites studded rather irregularly and closely with rounded shining tubercles, without a trace of keels; the last, however, with the inferior lateral keel conspicuous.

Tail about four times the length of the carapace, narrowed posteriorly; the first segment considerably, the second a little wider than long, the third as wide as long, the fifth two and a half times as long as wide, as long as the carapace, a trifle longer than the third and fourth segments; segments 1–4 furnished with 8 keels; a trace of the median lateral on the first, the inferior keels of the first weakly granular, of the second more strongly so, of the fourth denticulate; the rest of the keels coarsely granular or tubercular; the lateral intercarinal space tubercular, the other intercarinal spaces smooth or only weakly granular; the fifth segment flat above, with squared, coarsely granular edges; the median lateral keel large, the inferior keels denticulate, the median posteriorly bifid, the intercarinal spaces studded irregularly and sparsely

with rounded granules; the anal border elevated and denticulated, the superior tooth enlarged. *Vesicle* large, wider than the fifth segment, its height greater than the height of any of the caudal segments, smooth, except for a few granules below; aculeus about half the length of the vesicle, slightly curved at the apex, its distal half rather sharply marked off from the basal.

Cheliceræ finely granular above.

Palpi.—*Humerus* smooth behind, granular below, more coarsely granular above, tubercular in front, the two anterior keels conspicuous; *brachium* furnished with 5 distinct granular keels, the superior-anterior keel strong, the inferior-anterior denticulate, the anterior surface furnished above basally with a denticulate crest, studded with rounded granules below; *manus* not widely rounded and posteriorly produced internally, not twice as wide as the brachium, strongly convex from the keel of the hand-back to the inner edge, furnished with 7 strong, thickly and rather coarsely granular keels, and one weaker keel on the inner (anterior) aspect of the hand, the intercarinal spaces more weakly and less thickly granular than the keels; length of the hand-back greater than the width of the hand and a little less than the length of the movable digit; digits short, thickly granular at the base; furnished with ten rows of denticles.

Legs.—Femora of the third and fourth pairs externally granular; the distal tibial segment always longer than the proximal, and in the legs of the fourth pair about twice as long, this distal segment furnished behind with a series of four or five spicules, thickly hairy; feet also thickly hairy, with a spicule at the base of each of the setæ forming the lateral series on the soles of the feet.

Sternum longer than wide.

Pectines short, furnished with 4 teeth.

Measurements in millimetres.—Total length 39; length of carapace 5·5, of tail 22; width of first segment 3, of fifth 2, of vesicle 2·5; height of vesicle 2·2, of fifth segment 1·5; width of brachium 2·3, of manus 3·8; length of hand-back 4·5, of movable digit 5·5.

A single female example ticketed "India" (*Hardwicke Coll.*).

At once recognizable from *C. variegatus*, Sim., and *borneensis*, Sim., by its narrower hands (the width of these organs in the latter two species being greater than the length of the hand-back) and also by the greater strength of the hand-keels and of the granulation. From *truncatus*, Karsch, which it might be expected to resemble, it may be easily

separated by the coarseness of the granulation of the tergites, these plates in *truncatus* being described as smooth; from *cavernicola*, Pocock, and *celebensis*, Pocock, by the coarse granulation of the palpi and the great development of the keels of these appendages. In *celebensis*, moreover, the distance between the median eyes is less than a diameter and the median keel on the upper surface of the hand is partially obsolete; the anterior inferior caudal keels are scarcely visible, the upper margins of the fifth segment are more rounded, and the whole tail is much shorter, &c.; and in *cavernicola* there are 14 rows of teeth along the digits of the palpi, &c. Supposing this species to be the female of *C. pictus*, Pocock, it yet differs in the coarse granulation of the tergites and in the absence from them of incipient keels.

Charilus gemmifer, sp. n.

Allied to *C. margaritatus*.

Colour blackish, variegated with brownish red.

Trunk ornamented with coarse granulation as in *margaritatus*, but the granulation rather coarser; the tergites distinctly furnished with incipient tubercular keels.

Tail about the same length as in *margaritatus*, but not so thick, both the second and third segments being slightly longer than wide; all the keels rather weaker than in *margaritatus*, and with the granulation or denticulation less strong, but the upper surface of the segments, including the fifth, is distinctly granular; so, too, are the lateral and inferior surfaces, with the exception of the lower surface of the first and second segments, coarsely granular, and the median lateral keel is visible on the second and third segments; the edges of the fifth are less squared: the *vesicle* is narrow, elongate, and depressed, its width is equal to the width of the fifth, but its height is a little less than the height of this segment; it is, moreover, granular below, above, and at the sides; the aculeus is short, its basal portion not being sharply marked off from the vesicle.

Palpi less strongly carinate and granular than in *margaritatus*; the hands less convex above, but a little wider, being only a trifle narrower than the length of the hand-back, the intercarinal granulation being arranged in a very distinct reticulated pattern.

Pectinal teeth 3–4.

Measurements in millimetres.—Total length 38; length of carapace 6, of tail 24; width of brachium 2, of manus 4·2; length of hand-back 4·5, of movable digit 5·3.

Two dry female examples from Silhet.

Chærilus insignis, sp. n.

Colour (dry specimen) for the most part ferruginous, the keels black.

Carapace finely granular in front and at the sides; ocular tubercle elongate in front, smooth, depressed above, distance between the eyes distinctly greater than a diameter.

Tergites very finely granular; with scarcely a trace of a median keel, and the lateral keels represented by low smooth tubercles.

Sternites smooth.

Tail more than four times the length of the carapace, which is equal to the first, second, and one fourth of the third of its segments, the first segment much wider than long, the second longer than wide, the segments becoming progressively longer and wider posteriorly and from the second to the fifth; the first segment with 10 keels, of which the inferior median are smooth, the second to fourth with 8 keels, with a trace of the median lateral posteriorly; all the keels distinctly granular, the superior being even denticulate; the fifth segment longer than the carapace, its upper surface flat behind and smooth, normally keeled and denticulate; all the intercarinal spaces of the tail are at most weakly granular; *vesicle* large, pyriform, as wide as the fourth segment, smooth above and nearly smooth below, weakly granular laterally, shaped almost as in *C. margaritatus*, but with the vesicle not so thick at the base.

Palpi very long; *humerus* entirely covered with granules above and in front, and nearly as granular below, much smoother behind; *brachium* thickly and coarsely granular on the keels, the intercarinal spaces less coarsely granular, armed with a few denticles in front; humerus and brachium more than twice as long as wide: *manus* long, narrow, parallel-sided, furnished with 7 very distinct keels, the posterior lobe not large; the whole of the upper and outer surfaces granular, the granules coarser upon the keels, the inner surface of the hand weakly granular, the keel also weak, the digits coarsely granular; the immovable digit subcarinate above, with 10–11 rows of teeth; the movable digit shorter than the length of the hand-back, equalling the eighth caudal segment in length.

Legs finely granular externally, their fifth segment much shorter than the sixth.

Pectines large, furnished with 6 long teeth.

Measurements in millimetres.—Total length 64, of carapace 9, of tail almost 40; length of humerus 9·5, of brachium

10·5; width of brachium 3·5, of hand 4·8; length of hand-back 11, of movable digit 9·5.

Loc. Ladak (Cashmere), a single male example.

Differs from *truncatus* of Karsch in having the tergites granular instead of smooth; from the two species just described by the fine granulation of the tergites; from *pictus* by the difference in shape of the poison-vesicle, &c.

Chærilus ceylonensis, sp. n.

Colour a uniform dull brown; the digits, ocular tubercle, front edge of carapace, and the keels on the manus black.

Carapace a little longer than the first two caudal segments, wider than long, granular throughout, with the exception of some smooth sulci; ocular tubercle granular, without a trace of a sulcus, not distinctly defined in front, but produced behind; the eyes small, separated by a space which is greater than a diameter, and situated near the anterior extremity of the tubercle; the frontal region narrow and slightly depressed; lateral eyes subcontiguous.

Cheliceræ finely granular above.

Palpi.—Humerus convex above, smooth only behind, coarsely granular above; *brachium* coarsely granular above, finely granular above in front, the lower surface finely granular behind, coarsely granular in front; *manus* covered with a reticulated pattern of very fine granules, thickly and very finely granular on the keels and at the base of the digits, the keels normal in number, of average strength and equal development; the hand nearly parallel-sided, only a little narrower distally, not so strongly produced posteriorly as in *C. variegatus*; length of the hand-back greater than the width of the hand and greater than the length of the movable digit, which is a little shorter than the width of the hand; width of the immovable digit at the base equal to two thirds of its length; with 11–12 rows of teeth on the digits.

Legs with femora externally granular.

Tergites granular throughout, but not even obsoletely keeled; the last, however, very feebly crested.

Sternites smooth, the last only very weakly granular laterally.

Tail about four times as long as the carapace, rather slender, the second segment as long as wide, the third a little longer than wide, the fifth more than twice as long as wide; segments 1–4 with 8 granular keels each; the inferior median, however, nearly obsolete on the first, but the median lateral distinct and granular on this segment, but only visible on the

second to fourth as a few larger granules; the fifth segment with lightly convex, finely granular upper surface, the edges nearly squared and granular, the median lateral keel extending throughout the anterior half of the segment, the inferior keels denticulate; all the intercarinal spaces of the tail finely granular; *vesicle* rather large, wider and higher than the fifth segment, smooth above, coriaceous below, aculeus with a thick basal portion.

Pectines furnished with 5–6 teeth.

Measurements in millimetres.—Total length 44, of carapace 5·5, of tail 22; width of first segment 3, of second 2·5, of fifth 2; width of brachium 2, of manus 4·5; length of hand-back 5·5, of movable digit 4.

A single male example from Trincomalee (Ceylon), collected and presented by Major Barrett in October 1893.

This is the first record of the genus *Charilus* from Ceylon. This species, therefore, is of peculiar interest. It is an extremely well-marked form, differing from all that have been hitherto described in the extreme shortness of the digits, &c.

XI.—*On a new Genus and Species of* Agrionidæ *from Foo Chow.* By W. F. Kirby, F.L.S., F.E.S., Assistant in Zoological Department, British Museum (Natural History).

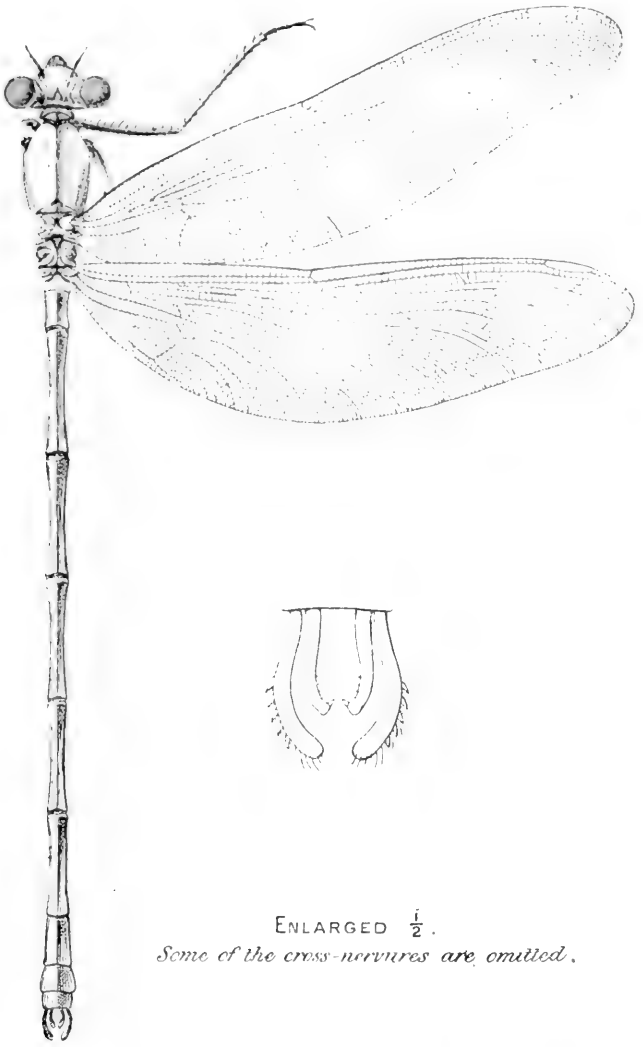
Among a small collection of insects collected in Foo Chow by Mr. De la Touche I found a single male specimen of one of the largest and most remarkable species of Agrionidæ known; and I am somewhat surprised to find that it does not appear to have been previously described. Its long pterostigma, traversed basal cells, and remarkable neuration are, in combination, sufficiently remarkable characters to separate it from every described genus of the Agrioninæ.

Archineura, gen. nov.

Head and body stout, resembling *Umma*, but with the abdomen longer; face slightly hairy in front; antennæ rather prominent, second and third joints of nearly equal length; ocelli red, forming nearly an equilateral triangle.

Wings long and broad, narrowed towards the tips, but not pointed, nodus situated a little before the middle of the wing; about 45 antenodal and postnodal cross nervures; upper antenodal space much broader than the lower; upper postnodal space, except at its basal end, if anything, narrower than the

lower; pterostigma very long, covering about nine cells, oblique and pointed at the ends, arculus nearly straight, the sector rising about its middle, apical area narrow, simple,



ENLARGED $\frac{1}{2}$.
Some of the cross-nervures are omitted.

basal area with from 9 to 11 cross nervures, sometimes meeting, but not anastomosing; subnodal sector rising from the upper sector of the arculus about six spaces from

its origin, the principal sector rising from the subnodal five or six spaces further on, the nodal sector running from the continuation of the nodal vein; the median radius and upper sector of the triangle of the usual form; the nervure closing the lower basal cell very irregular, it commences on the lower sector of the arculus, curves down to the lower extremity of the lower basal cell, and forms nearly a right angle outwards, throwing off the upper sector of the triangle at this point, and then curves inwards and downwards, turning outwards again as it approaches the inner margin. All the nervures are curved as they approach the hind margins, and between most of the principal nervures there are two long accessory nervures, and between each of these again two shorter ones as they approach the margins of the wing. Within the curve of the nervure closing the lower basal cell is a series of short semicircular accessory nervures on all the wings, as in the African genus *Sapho*, which *Archineura* perhaps most nearly resembles in neuration, though *Sapho* differs essentially in having the basal cell untraversed, and the pterostigma much shorter.

Archineura basilactea, sp. n.

Exp. al. 105 millim.; long. pter. 5 millim.; long. corp. 80 millim.

Head and body metallic green, head and thorax with brassy reflections above; antennæ, legs, and anal appendages black. Face and under surface of abdomen blackish; a short white line beneath each antenna; septa white; thorax white beneath, with a broad oblique black band: anal appendages conspicuous, upper appendages about as long as the ninth segment, curved inwards and downwards, and slightly thickened beyond the middle, with five small teeth on the upper-side; lower appendages incurved, rather shorter, with one or two very small teeth on the inside towards the tip, the largest at the tip; legs with spines of moderate length. Wings yellowish hyaline, with rufous nervures; costal nervure blackish; costal area of a deeper yellow; basal third of all the wings below the principal radius suffused with milky white.

Hab. Foo Chow.

Described from a single male specimen.

Another interesting dragonfly in the same collection appears to be the female of the rare *Libyothemis splendida*, Ramb.; but I have not enough specimens to be positive. It does not agree with the description of *R. imperatrix*, De Selys, described from "Loo Choo."

XII.—*New Genera and Species of British Spiders.*

By the Rev. F. O. Pickard-Cambridge.

[Plates I. & II.]

There seem to be few signs as yet of much interest awakening in the direction of the study of British spiders, notwithstanding that so rich a field of possibilities lies before the enterprising student.

Mr. L. Greening, of Warrington, has, however, sent some nice little collections for examination and naming, and amongst these there were several fine specimens of *Epeira alsine*, Walck.

From Ben Nevis, Scotland, Mr. Edward Whymper has forwarded a fine new species, *Lepthyphantes Whymperi*, while six other new species were either taken by myself or received from other collectors.

For the reception of two of these it has been considered necessary to form new genera, *Hillhousia* and *Coryphœus*.

These, together with *Cryphœca diversa*, Cb., taken by the present writer near Carlisle, make in all eight new species, including two new genera, added to the British list since my last communication of November 1892.

I am unable to claim that these finds are altogether the result of hard work, but have been secured chiefly by bottling a few specimens here and there during casual visits to different parts of the country.

To Mr. F. M. Campbell, of Hoddesdon, Dr. R. H. Meade, of Bradford, and the Rev. O. Pickard Cambridge I am much indebted for their kindness in furnishing me with the materials necessary for thoroughly investigating the identities of the various species of *Porrhomma*, of which a detailed account appears in this paper.

There can be little doubt that the Lake Districts will continue for many years to furnish new species of spiders, more especially, no doubt, of those belonging to the genera *Porrhomma* and *Tmeticus* and other kindred forms.

Two new Genera and eight new Species.

Coryphœus, gen. nov.

Coryphœus glabriceps, sp. n. (Pl. I. fig. 2.)

Length of adult male $1\frac{1}{4}$ line.

Cephalothorax oval-elongate; caput smooth, shining, glabrous, with a single curved hair springing from the centre

behind the ocular area, convex, not raised, depressed in front, broad, bluffly rounded.

Clypeus very high, half as high again as the ocular area, projecting slightly forwards, smooth, shining.

Falces twice as long as clypeus, convex at base, inclined beneath the cephalothorax, slightly attenuate and divergent at the apex, furnished on the inner side with a short bristle on either side, and lower down at the angle with a short sharp tooth, its apex set with two fine bristles. Upper margin of fang-groove furnished with five very minute teeth. Fang stout, circular. Basal joint striated on outer side.

Eyes.—Posterior row straight; eyes equal, equidistant, one and a half (almost) diameters apart. Anterior row slightly curved, convexity forwards; centrals slightly smaller, close together, less than half a diameter apart, one full diameter from laterals (fig. 2 d).

Sternum as long as broad, brown, set with fine black hairs, not very convex, terminating behind between the coxal joints of the fourth pair of legs in a depressed conical point.

Maxillæ and *labium* similar to *Tmeticus*.

Legs 4, 1, 2, 3, pale yellow, clothed with fine hairs. Femora without any spines; genual joints with a single, very small, oblique bristle at apex; tibiæ i., ii., iii. with two very fine oblique bristles on the upperside, iv. with a single one on the basal third of the joint. Metatarsi without any spines or bristles.

Abdomen black, glossy, clothed with short, fine, stiff curving hairs.

Palpus short; cubital joint short, convex; radial longer and broader, globular-convex, granulose, set with fine hairs on the outer side, anterior margin produced into a sharp thorn-like spur, its point depressed on the base of the digital joint (*c*); its inner anterior margin prolonged into a broad, black, rounded prominence, whose apex terminates in a short sharp point (*e*). Digital joint short, convex, shining, produced at base on inner and upper side into a conical prominence (*b*). Apex of palpal organs furnished with a short, black, sinuous spine. The falciform process on the outer side at base is small, curving, and black, somewhat concealed under the radial joint (figs. 2 a, *a*, *b*, *c*, *d*, *e*).

This spider, very distinct as a species, belongs to a group of spiders which lies somewhere not far from *Tmeticus* and *Porrhomma*, but yet, I believe, distinct from them.

The high clypeus, small teeth on the fang-groove, and the single isolated tooth on the falx distinguish it from the

majority of those described under these two genera, though in some respects it resembles *T. simplex*, F. Cb.

The specimen here described, an adult male, was taken near Carlisle in 1892.

Hillhousia, gen. nov.

Cephalothorax deeply excavated at base, oval-elongate; caput (female) raised, depressed in front, convex, furnished with some short curving hairs.

Eyes of posterior row situated in a straight line, equal, almost equidistant, one diameter apart. Anterior row curved, convexity backwards; centrals slightly smaller, almost one diameter apart, one diameter from laterals.

Clypeus as high as the ocular area, convex, projecting forwards.

Falces two and a half times the height of the clypeus, convex at base, attenuate and divergent at apex, furnished with four sharp teeth on the upper margin of the fang-groove.

Sternum as long as broad, flattened-convex, set with short black hairs.

Legs clothed with short hairs, devoid of spines, but tibiæ of all four pairs with two erect bristles above. Femora furnished with a double row of long hairs beneath.

Abdomen thickly clothed with short hairs, exhibiting beneath, just behind the spinners, a transverse slit, the entrance to spiracular breathing-organs.

The spiders for whose reception this genus is founded are very closely allied to *Tmeticus* and *Porrhomma*. The excavation at the base of the cephalothorax, however, seems to sufficiently separate them from both these genera.

In all probability as time goes on and more examples turn up it will be necessary to form more genera for the reception of species now associated together under the same generic titles, especially in the case of the numerous puzzling species of the group Linyphini, to which these spiders belong.

Hillhousia desolans, sp. n. (Pl. I. fig. 4.)

Length of female $1\frac{1}{4}$ line.

Cephalothorax and caput dull orange-yellow, striæ and margin dusky brown.

Falces yellow, fangs tinted with pink.

Sternum deep brown. Abdomen olive-green or dull black; legs pale yellow.

Epigyne conspicuous, consisting of a broad, oval, chitinous plate, wrinkled above, its posterior margin raised in the centre and furnished with a small prominence, sinuous, and raised from the abdomen.

The male, of which sex only a single immature specimen has been taken, is similar to the female; the radial joints of the palpi are very prominent, and suggest some curious development when mature.

Four adult females and a single immature male were taken by myself running in the sunshine on railings at Southwell, Notts, in July 1892.

Hillhousia turbatrix, Cb. (Pl. I. fig. 3.)

(Spid. Dor. p. 454, sub *Linyphia*.)

Length of male 1 line.

It has always appeared to me that this little spider presents features which separate it very decidedly from its near relations, and I have several times meditated forming a new genus for its reception.

The discovery of the spider last described, exhibiting the same excavation at the base of the cephalothorax, has induced me to place them both under the genus *Hillhousia*, though *turbatrix* differs considerably in not exhibiting the raised caput, but is otherwise sufficiently similar.

No figures of *turbatrix* having, I believe, been published before, I take this opportunity of supplying them.

The spiders, adult males and females, were taken by myself in Hyde Bog, Dorset, in 1888. The type specimens, also taken in Dorset, were kindly forwarded for my inspection by the Rev. O. Pickard Cambridge, and from these the figures published with this paper were taken.

Genus Micronetа.

Micronetа clypeata, sp. n. (Pl. I. fig. 5.)

Length of adult male 1 line.

Cephalothorax circular-oval, convex, narrowed in front, dull yellow, veined with brown, with central and lateral striæ of the same hue; marginal line dark brown.

Eyes small, very close together: posterior row equidistant, half a diameter apart, slightly curved, convexity backward, centrals very slightly larger; anterior row straight or nearly so, centrals smaller, almost in contact, one half a diameter from the laterals.

Clypeus more than twice as high as the ocular area, concave, anterior margin prominent.

Falces scarcely as long as clypeus, weak, straight, abruptly attenuate at apex, *i. e.* emarginate on inner side. Inner angle with a few short hairs, but no teeth. Fang circular, weak.

Sternum as long as broad, convex, set with short hairs, and granulose.

Legs 4, 1, 2, 3, short, without spines, clothed with fine short hairs, dull yellow; femora with a few long hairs beneath near apex; genual joint with a fine bristle; tibiæ with two short, fine, erect bristles on upperside; metatarsi i. and ii. suffused with dusky black.

Abdomen dull black, elongate-oval, clothed with fine hairs.

Palpus of male short, digital joint and organs large. Digital sheath produced into a fine point at base above, which curves downwards on the inner side, its upperside conical and slightly concave on the outer side. Cubital joint globular, with a short bristle at apex above.

This small species is very closely allied to *conigera*, Bl., and *innotabilis*, Cb., but the great height of the clypeus will serve to distinguish it from the latter, while the large conical prominence on the palpi of the former will prevent any confusion with it.

A single adult male was taken in Newtown Moss, Penrith, in April 1893, by the author.

Genus Bathyphantes.

Bathyphantes setiger, sp. n. (Pl. I. fig. 6.)

Length of male 1 line.

Cephalothorax dark mahogany-brown, deepening towards the margins; caput slightly raised, ocular area prominent. *Eyes* of posterior row straight or nearly so, equal, centrals one diameter apart, one and a half from the laterals; central anteriors smaller, one diameter apart, two diameters from the laterals.

Clypeus scarcely as high as the ocular area, directed obliquely forward.

Falces (male) stout, mahogany-brown, attenuate, and divergent towards apex, bearing two or three stout teeth on the inner margin near the middle; (female) stout, parallel-sided, not divergent or attenuate.

Sternum longer than broad, dark dusky brown, set with short black hairs.

Legs pale orange-yellow, apex of each joint slightly tinged with dusky brown. Femora of all four pairs without any spines; genual joints with a single fine short spine at apex. Tibiæ i. and ii. with three spines towards apex—one dorsal, two lateral, and a dorsal one towards the base; iii. and iv. with two dorsal ones only.

Abdomen dull black; dorsal area towards spinners paler, bearing in the female a very indistinct, pale, scalloped band down the dorsal area, becoming obsolete before the spinners.

Palpi.—Humeral joint yellow, slender; cubital convex, with a single short bristle in front at the apex. Radial joint broader, short, convex, furnished with a few stout bristles and hairs directed forwards. Digital joint large. Palpal organs furnished at apex with a stout spiraliform black spine having within its circumference a short, curved, black spur; also a semitransparent plumule. The falciform process, on outer side near the base, exhibits near its apex a stout black spine, composed of three closely applied separate spines. This spine is best seen from in front, but was very apparent in some specimens which had become accidentally dried. The apex of the black spine will be seen directed upwards and outwards from the outer side of the organs near the base, and will be quite sufficiently evident for identifying the spider.

Epigyne transverse-oval, convex, presenting a short, central, tongue-like prominence, flanked on either side by a deep concavity, its margin slightly sinuous. From the centre of the posterior margin extends a small dilated process, curving slightly upwards from beneath the apex of the tongue-like process.

Three males and two females of this small but very distinct little species were taken by myself in Newtown Moss, near Penrith, in April 1893. Spiders of all kinds were very scarce, this species being the only one adult.

This small spider most resembles *B. nigrinus*, Bl., and is also very similar to *B. parvulus*; the much smaller size, however, will enable it to be distinguished from the first, while the difference in the form of the falciform process of the palpal organs will prevent the males being confused with either of them or with *gracilis*, Bl. These four spiders differ from others of the genus in possessing a stout circular spine surrounding the apex of the organs. For figures and descriptions of *B. parvulus* and *B. nigrinus*, see 'Ann. & Mag. Nat. Hist.' ser. 6, vol. x., Nov. 1892.

Both sexes of setiger *may, however, be most easily recognized by the total absence of spines on the femora of all four pair of legs.*

The female may still further be recognized by the form of the epigyne, the central prominence being shorter and less stout than in *nigrinus*, but longer than in either *parvulus* or *gracilis*. The falciform process exhibits three long spines near the apex, two about the centre on the inner margin, and three or four nearer the base; *nigrinus* exhibits much the same arrangement, but the apex of the process is not *spatuliform*, as in the present species; while the spines in *parvulus* are set in a regular row round the inner margin, and this portion of structure is in *gracilis* more circularly curved, and the spines are not nearly so numerous or so stout, being, in fact, merely bristles.

Genus Lepthyphantes.

Lepthyphantes Whymperi, sp. n. (Pl. I. fig. 1.)

Length of male $1\frac{3}{4}$ line.

Cephalothorax elongate-oval, pale orange-yellow, with black marginal line. Central line bearing a row of stiff hairs directed obliquely forwards. Caput narrowed, convex, not raised nor prolonged, bearing a central row and two lateral rows of short black curving hairs. Ocular area prominent, with some short, stiff, incurving hairs.

Eyes set on black spots: posterior row straight, equal, centrals one diameter apart, one diameter from laterals; anterior row straight, or nearly so, centrals smaller, one quarter a diameter apart (almost in contact), one full diameter from laterals.

Clypeus one quarter higher than ocular area, directed obliquely forwards.

Falces two and a half times as long as clypeus, not very stout, attenuate and divergent at apex, bearing a stiff bristle on the inner side in front.

Fang-groove furnished with three stout, conical, separate teeth on the upperside.

Sternum slightly longer than broad, yellow-brown, set with long erect hairs.

Legs long, pale yellow, inclining to orange-red towards the terminal joints. Femora i. with a single stout spine towards apex on inner side; others without any; exhibiting long fine hairs beneath. Genual joints bearing a single spine at apex; tibiæ with two or more dorsal spines and a few lateral spines towards apex.

Abdomen glossy black, set with short black hairs in front and some very fine grey pubescence.

Palpus very characteristic. Humeral joint clavate; cubital as long as broad, convex, prominent in front, bearing at its apex a single, stout, sinuous spine, tapering to a fine point, and directed forwards over the base of the digital joint. Radial joint broader in front, produced beneath on the outer side into a blunt spur.

Digital joint produced at base into a dark spur, hollow beneath, terminating in a little rounded cariniform prominence (Pl. I. fig. 1 d, *b*). The falciform process is immensely developed, forming a huge concave process, its lower spur deeply bifid and extending outwards and upwards. The palpal organs themselves present some complex black processes, variously curved and pointed, with a more conspicuous, stout, circular black spine at their apex (Pl. I. fig. 1 a, *a*).

A single adult male of this fine species was captured on the summit of Ben Nevis in the autumn of 1892 by Mr. Edward Whymper, and kindly forwarded me by Mr. R. I. Pocock, of the South Kensington Museum.

It is a very interesting species, approaching as it does very closely to the genus *Taranucnus*, Sim.

The straight posterior row of eyes, however, prevents it entering that genus as at present characterized, although the length of the legs, the form of the cubital joint with its spine, and the structure of the palpal organs render it difficult to separate it.

I have great pleasure in connecting Mr. Whymper's name with this handsome spider. Ben Nevis, Scotland; autumn, 1892.

Genus Porrhomma, Simon.

This genus *Porrhomma* may be considered as forming a convenient "refuge for the destitute" for those spiders whose characters seem to place them intermediate between *Lepthyphantes* on the one hand, and *Tmeticus* on the other; and of these it may be noted that *P. cavicola*, Sim., and *P. errans*, Bl., by the possession of a single metatarsal spine approach the former genus, while *P. adiputum*, L. K., and *P. montigena*, Sim., incline towards the latter.

I have lately been enabled, by the courtesy of various collectors, to examine specimens, in many cases the original types, of a number of somewhat obscure species, variously characterized under the generic names *Linyphia* and *Neriene*, all of which appear to be more naturally included under the genus *Porrhomma*, and some of which certainly do not differ specifically *inter se*.

Of these the most noticeable will be *L. errans*, Bl., *L. oblonga*, Cb., *L. decens*, Cb., *L. microphthalma*, Cb., *L. incerta*, Cb., and *N. pygmæa*, Bl. And since considerable doubt has from time to time arisen as to the exact identity of some of these, it has been my purpose to endeavour in this paper to clear up the confusion as far as possible.

The question was first raised by Mr. Campbell, of Hoddesdon, who suggested that *L. oblonga*, Cb., and *L. errans*, Bl., were really one and the same species, basing his opinion on the presence of forms which he believed to be intermediate between the two, and not to be distinguished from either.

The Rev. O. Pickard Cambridge has, on the other hand, always maintained the validity and distinctness of these two forms, and some months ago suggested to me a careful examination of all the forms taken by Mr. Campbell, as well as his own specimens. His suggestion has been followed with the result that the distinction of *oblonga* and *errans* has been confirmed, but that a third species has been discovered amongst those named *errans*, which has hitherto been quite overlooked. A fourth type has also been distinguished as a separate species, which was looked upon by Mr. Campbell as a link between *errans* and *oblonga*.

A further difficulty of course presented itself in attempting to ascertain which of these species was the original *errans* of Blackwall.

The unravelling of the matter has been so interesting that I cannot refrain from shortly tracing the steps, more especially as I would like to fully justify my conclusions, since they differ somewhat from those of Mr. Campbell, to whom I am indebted both for the material and for the necessary stimulus required to set me to the task.

I must confine my remarks to those specimens labelled *errans*, taking it for granted for the time being that *oblonga* is a distinct species.

Three separate collections have been placed in my hands for examination, including the original types of Mr. Blackwall's *errans*, as well as specimens named by him in the possession of Dr. Meade, of Bradford.

The first collection received was a magnificent series sent me by Mr. F. Maule-Campbell, of Hoddesdon; the second, a smaller number, from the Rev. O. Pickard Cambridge; and, lastly, two tubes from Dr. Meade, of Bradford.

Of the numerous specimens, upwards of two or three hundred, in Mr. Campbell's collection, I found adult females of *L. oblonga*, Cb., and one adult male; numerous adult

males and females of the two forms hitherto regarded as *L. errans*, Bl., with the exception of one of the forms, of which no adult males appeared, curiously enough, in Mr. Campbell's collection, though there were plenty of females; and a single female of the form I hold to be intermediate.

The second collection contained specimens of *L. oblonga*, Cb., females; specimens of both forms of *errans*, including one adult male of those in collection number one, whose males were *there* conspicuous by their absence, and also four females, the original types of Mr. Blackwall's *errans*, described in 'Spiders of Great Britain and Ireland.'

Lastly, I received from Dr. Meade two tubes containing specimens seen and named by Mr. Blackwall himself as far back as 1860, just before his magnificent work was published.

With all this valuable material so generously submitted to me I have had little difficulty in disentangling the matter and ascertaining exactly what was the original *errans*, Bl., and which of the forms before me were identical with it.

In both Mr. Campbell's and my uncle's collections I observed the same two apparently distinct forms of *L. errans*, Bl.

So, also, when I came to Dr. Meade's spiders I found two tubes, both marked *N. errans* (one, however, with a label "from coal-pits"), named by Mr. Blackwall himself; and in these two tubes I recognized the same two different species accurately separated and yet labelled with the same name.

Through the kindness of Dr. Meade I have been enabled to peruse several very interesting letters bearing on the contents of these two historic tubes, written by Mr. Blackwall; and I am now in a position to show how it came about that the two, though evidently recognized as distinct, were not regarded as different species, and also to declare which of the two tubes contains the original *N. errans* of Blackwall.

It seems that Dr. Meade had already sent specimens to Mr. Blackwall which were named *N. errans*. Subsequently he received from Mr. Morison some small spiders from Pelton Coal-Pits, Durham, which he also sent on to Mr. Blackwall, expressing his opinion that they were different to the others.

I quote extracts from the correspondence which will show exactly how the matter was settled.

In a letter dated February 22, 1860, Mr. Blackwall says,

"Herewith I return Mr. Morison's letter and the two minute spiders . . . After a careful examination I am inclined to believe they constitute a variety of *Neriene errans*, the palpi and palpal organs of the male being perfectly identical in structure with those of that species."

In another letter of February 27th he says: "The *Neriene* from the Durham collieries differs from *N. errans*, as you remark, in the colour and markings of the abdomen, ... I hope you may be able to satisfy yourself that it is a distinct species, ... and will speedily publish a description of it, for its habitat and economy are certainly very remarkable."

Later, under the date of March 6th, speaking of the same spiders, he says: ". . . which I entirely concur with you in regarding as constituting a variety of *Neriene errans*, the slight difference in colour being caused in all probability, as you remark, by the influence of the remarkable situation in which they are found."

It is very evident from this interesting correspondence that Dr. Meade tried hard to find some structural difference between the specimens obtained in the colliery and those named previously *errans* by Mr. Blackwall; and thus it happens that the former were placed in a separate tube, both as a "variety of *errans*" and also as "occurring in coal-pits."

But it now also happens that the two species which are evident amongst Mr. Campbell's specimens of *errans* and those of the Rev. O. P. Cambridge correspond exactly with these two varieties, and, further, that I have myself found a distinguishing character which Dr. Meade might have considered a sufficient one to found a species on had he happened to notice it. I feel myself justified, then, in describing this form "from coal-pits," and those identical with them from the other collections, as a distinct species; while it follows of necessity that the others are the original *errans*, Bl.; for it may be further noted that these others are also identical with the four females constituting the only surviving type specimens of Mr. Blackwall's *errans*.

The following analysis will present the conclusion more clearly:—

Dr. Meade's collection:

1. Abdomen dull, unicolorous; no spines on metatarsi. From coal-pits ..... *P. Meadii*, F. Cb.
2. Abdomen olive-green; spines on metatarsi. *P. errans*, Bl.

Mr. Campbell's collection:

1. Abdomen dull; no metatarsal spines .... *P. Meadii*, F. Cb.
2. Abdomen olive-green; spines on metatarsi. *P. errans*, Bl.

Mr. Blackwall's types:

Abdomen olive-green; spines on metatarsi. *P. errans*, Bl.

Rev. O. P. Cambridge's collection:

Examples of both species.

There is now the further question as to the identity of *P. oblonga*, Cb., with *P. errans*, Bl., or the distinctness of them as different species. Mr. Campbell had been greatly puzzled, when examining his specimens, by the real or apparent variation in the position of the eyes in specimens which, judging by other characters, might have been regarded as the same species.

After much careful examination my own conclusion is this: that though it is not at all improbable that there may be considerable instability in the position of the eyes even amongst spiders otherwise similar, and though I have been compelled during my arachnological studies, as have many others before me, to conclude that such is really the case, and that in all probability the forms have not yet become fully, ultimately, and specifically differentiated, yet that, with regard to these particular examples, such a view is not wholly tenable.

I have no hesitation in saying that the apparent difference in the distances between the eyes is due in a vast number of, perhaps all, cases to the shrinking and falling away of the tissues and pigment-cells from the exoskeleton.

According to my experience this always has the effect of exhibiting the outline of the lenses of the eyes more distinctly, and making them appear further apart than when the pigment-cells are present. For instance, the eyes of a pale, young, diaphanous specimen always appear further apart than those of one in which the pigment-cells are rich and well-developed; and if the eyes of a cast-off cephalothoracic skeleton be compared with those of one in the normal condition, the truth of this statement will be perceived.

And although I am prepared to maintain that, amongst the smaller species at any rate, specific characters constantly melt

away in the presence of individual instability, and even generic barriers are broken down by a hopeless want of uniformity and exclusiveness in the distinguishing characters, yet I cannot go quite so far as to agree with Mr. Campbell on the advisability, in this particular case, of uniting all these apparent varieties under one name, *errans*, Bl.

He says*: "The oblong form of *L. oblonga*, Cb., is found with the typical eyes of *L. errans*, Bl., and the more ovate form of *errans* with the typical eyes of *oblonga*."

After careful comparison I am not able entirely to confirm this; in all probability the oblongation of form, or otherwise, is due in some measure to the state of the ovaries and liver at the time; and in all cases where there seems to be this cross-characterization I find that the falling away of the tissues from the skeleton will fully account for the apparently greater separation of the eyes in the "more ovate" forms.

One single specimen, however, an adult female, certainly exhibits this ovate form, coupled with eyes distinctly wider apart than those of the typical *errans*; but these characters are supplemented by a greater height of clypeus than exists in either *oblonga* or *errans*; and I have therefore deemed it advisable to describe it as a distinct species, *P. Campbellii*, rather than regard it as a link enabling us to unite the three forms as a single species under the name *errans*, as Mr. Campbell has suggested.

The species may be conveniently distinguished as follows:—

Porrhomma.

Males.

A. Femora without any spines.
  i. Radial joint produced into a large concave, curved process, directed over the base of the digital joint ..... *P. montigena*, Sim.
  ii. Radial joint not produced ..... *P. adipatum*, L. K.
B. Femora i. and ii. with one or more spines.
  i. Metatarsi without any spines.
    a. Anterior row of eyes straight; eyes larger. (Femora i. with two spines, ii. with one about the middle.)
      *a**. Clypeus not higher than the ocular area.
        1. Central anteriors decidedly smaller than laterals, distant from them almost two diameters ..... *P. Meadii*, F. Cb. (*L. decens*, Cb.) (*L. microphthalma*, Cb.) (*L. incerta*, Cb.)

* "Spiders of Hertfordshire," Trans. Herts. Nat. Hist. Soc. vol. ii. pt. 7, 1883, p. 269.

2. Central anteriors scarcely smaller than laterals, scarcely one and a half diameters from them ..... *P. pygmæum*, Bl.

*b**. Clypeus distinctly higher than ocular area ..... *P. Campbellii*, F. Cb.

b. Anterior row of eyes strongly curved, convexity forwards; eyes of both rows very small and wide apart; central posteriors two diameters apart, four from laterals.

1. Femora i. with two spines, and ii. with one spine ..... *P. myops*, Sim.

2. Femora i. with one spine only towards the apex; none on the others. *P. oblongum*, Cb.

ii. Metatarsi of all four pairs with a single stiff oblique bristle near the base above . *P. errans*, Bl.

Females.

1. Epigyne not produced ..... *P. montigena*, Sim.

2. Epigyne produced into a long ovipositor-like process ..... *P. adipatum*, L. K.

Note.—The females of the other species may be easily distinguished by the characters given for the males.

Porrhomma errans, Blackw. (Pl. II. fig. 1.)

(*N.* and *L. errans*, Bl. & Cb.)

Length of male 1 line; female $1\frac{1}{2}$ line.

Cephalothorax and *legs* similar in colour to those of *Meadii*, and also in other general respects.

Eyes.—Posterior row straight, centrals one diameter apart, two diameters (or almost) from laterals; anterior row straight, centrals scarcely smaller than laterals, one and a half (or scarcely) diameters from laterals, one half from each other.

Legs.—Femora i. with two spines, sometimes three, one (or two) on the upperside and one on the inner side, towards the apex; ii. with one near the centre. Metatarsi i., ii., iii., iv. bearing a stout oblique spine on the upperside near the base.

Falces, *maxillæ*, and *sternum* similar to those of *Meadii*.

Abdomen pale olive-green, clothed with short, stiff, curving hairs; dorsal area with some pale spots and lines in front, also three or four transverse sinuous pale bars towards the spinners.

Epigynal aperture similar to that of *Meadii*, but outline less bold, not so dark nor so conspicuous, and, perhaps, a little less circular, more transverse-oval in form.

This species, while readily distinguishable from *Meadii*, *oblongum*, and *pygmæum* by the single metatarsal spine, yet in

general appearance very much resembles both the first and the last.

The palpal organs present some decided differences; the point, *c*, is not so sharp or prominent; the falciform process, *a*, is broader and more circularly curved; the spines at the apex of the organs are not the same. (See Pl. II. fig. 1 a.)

The epigynal orifice is, as far as I am able to ascertain, almost always transverse-oval, never quadrate, as is that of *Meadii*.

The central anteriors are not so small in proportion, while the spine, mentioned above on the penultimate joint of all four pairs of legs, will prevent any confusion.

The pale broken transverse lines on the pale olive abdomen will prove a really reliable character.

Upwards of 250 of the female sex were received from Mr. Campbell, but no males. A single male was found amongst the Dorset specimens; while both males and females were received from Dr. Meade, in addition to the four original types, females, from Mr. Blackwall's collection.

All these specimens seem to have been taken either running upon railings or amongst grass in March and April; and a very interesting account of them is given by Mr. Campbell in 'Trans. Hert. Nat. Hist. Soc.' 1883, vol. ii. pt. 7.

Porrhomma Meadii, sp. n. (Pl. II. fig. 2.)

(Sub *Neriene errans*, Blackw.)

Linyphia microphthalma, Cb. Spid. Dor. p. 523.
L. incerta, Cb. Spid. Dor. p. 205.
L. decens, Cb. Spid. Dor. p. 217.

Length of male 1 line; female 1½ line.

Cephalothorax oval-elongate; caput bluffly rounded, bearing a longitudinal row of curved hairs.

Eyes fairly large: posterior row straight, centrals one diameter apart, two diameters (or almost) from laterals; anterior row straight, centrals smaller, half a diameter apart, two diameters (or almost) from the laterals. Clypeus as high as ocular area, vertical, set with short hairs.

Legs fairly long: femora i. with one spine on inner side and one spine on upperside, towards apex; ii. with one spine about the middle; iii. and iv. without spines. Femora clothed beneath with a double row of long setiform hairs, the pair at the apex being longest and stoutest. Genual joints with a long (three times diameter of joint) oblique spine at the apex.

Tibiæ i. with three long spines at apex (one dorsal, two

lateral) and one dorsal spine at base. *Tibiæ* ii. with two dorsal spines and one lateral one at apex on posterior side; iii. and iv. with two dorsal spines, one at base, the other at apex.

Metatarsi without any spines.

Falces three times as long as the height of clypeus, stout (in male slightly attenuate and divergent at apex); basal joint presenting no external striæ, but some small setigerous granulations towards apex; with two separate setiform hairs on inner side in front of each joint. Upper margin of fang-groove bearing two stout sharp adjacent teeth; lower margin with four or five small teeth.

Sternum rather longer than broad, slightly convex, set with short hairs.

Abdomen dull olive-green, clothed with short fine hairs, but with *no transverse pale lines and spots.*

Palpus of male slender; digital joint and organs conspicuous, the latter bearing on the outer side a large curved falciform process, its apex very slightly bilobed; and at the apex of the organs a dark black, curving, multiplex spine. (Pl. II. fig. 2 a.)

Epigyne of female presenting a very distinct, deep concavity, circular or almost square, and truncate at the posterior margin. The spermathecæ and ducts are conspicuous above the orifice.

This species can very easily be distinguished from *pygmæum* by its larger size, by the different form of the palpal organs, and by the greater distance of the anterior centrals from the laterals; from *oblongum*, Cb., by the spines on femora ii.; from *errans*, Bl., by the absence of spines on the metatarsi, and the unicolorous dusky abdomen.

Taken abundantly, of both sexes, at Hoddesdon, in Hertfordshire, by F. M. Campbell, Esq., and at Bloxworth, Dorset, by the Rev. O. Pickard Cambridge. Adult in April and May. Males and females were sent to Dr. Meade from Pelton coal-pits, near Durham, in 1860. They seem to have been conveyed down the shaft amongst the horse-fodder. Once there, they became gregarious and formed a huge web on a co-operative understanding, with a joint-stock spinning industry. Dr. Meade gives a most interesting account of the habits and circumstances of the capture of these spiders in the 'Zoologist' for August, 1860, no. ccxix.

Porrhomma oblongum, Cambr. (Pl. II. fig. 4.)

(*Linyphia oblonga*, Cb.)

Length of female $\frac{3}{4}$–1 line; male smaller.

Cephalothorax elongate-oval, parallel-sided, pale straw-yellow; caput bluffly rounded in front, clothed with short hairs.

Eyes very small: posterior row straight, centrals one and a half to two diameters apart, three diameters from the laterals; anterior row strongly curved, centrals very small, one diameter apart, three diameters (or nearly) from the laterals. (Absence of pigment will seem to increase the space of separation by half.)

Clypeus one quarter higher than the ocular area. *Falces* similar to those of *errans*, stout, with two isolated teeth towards the apex and some smaller ones behind.

Sternum a little longer than broad, convex, terminating between the posterior coxæ in a conical point.

Abdomen elongate, parallel-sided, white or pale yellow, sometimes, especially in freshly-caught specimens, dull olive-green, with pale blotches and four or five transverse pale lines above spinners; clothed with short curving hairs, transversely wrinkled above spinners at apex.

Legs slender, long, dull yellow-white, 4, 1, 2, 3, clothed with short hairs.

Metatarsi shorter than tibiæ, bearing no spines. *Femora* i. with a single spine on the inner side towards apex; ii., iii., iv. without any spines. *Tibiæ* of all four pairs armed with two spines on the upperside, one near the base, the other towards the apex. *Genual joints* with a single long obliquely-erect spine at apex. All four pairs clothed beneath with a double row of long setiform hairs on the underside, the pair at the apex being the longest.

Palpus of male very similar in general respects to that of *pygmæum*, Bl., and *errans*, Bl.

Cubital joint bearing a fine bristle at apex; radial with several long bristles directed over the digital joint. Palpal organs present a stout falciform process at the base on the outer side (Pl. II. fig. 4 a, *a*); beneath the globulous mass forming the organs are a pair of flat curving pieces; at the apex of the organs appears a stout conical spur, while a fine curved spine lies near it, crossing two other oppositely curving spines, and hence being very similar to *pygmæum*.

The *epigyne* appears as a small transverse-oval cavity, very similar to that of *Meadii* and *errans*; but I am unable to point out any real tangible difference.

About forty females of this curious species were submitted to me by Mr. Campbell, together with a single adult male, this being the first record of this sex yet published. A few females were also forwarded to me by the Rev. O. Pickard

Cambridge taken in Dorset; but all of them were small specimens and absolutely devoid of colour.

They are very distinct from any other species of *Porrhomma* hitherto taken in England, though closely allied to *egeria*, Sim., *proserpina*, Sim., *myops*, Sim., and others, characterized by the minuteness of the eyes and their great distance apart.

The single spine on the femora of the first pair in *oblongum* will distinguish it from any of these continental species; while this character and the smallness of the eyes, set very wide apart, distinguish it at once from all other British species of the genus. The more ovate, or more elongate, form of the abdomen seems to me to depend upon the state of the ovaries, and not to be too absolutely relied on for purposes of identification.

Taken at Hoddesdon, Hertfordshire, in April and May by Mr. Campbell, and at Bloxworth, Dorset, by Rev. O. P. Cambridge, and kindly forwarded for my inspection.

Porrhomma pygmæum, Blackw. (Pl. II. fig. 3.)

(Sub *Neriene*.)

Length of male 1 line.

Cephalothorax deep red-brown, sometimes paler, smooth; caput bluffly rounded; not very convex; clypeus as high as the ocular area, rather closely set with short erect hairs.

Eyes.—Posterior row straight; centrals one diameter apart, one and a half from laterals; central anteriors one half diameter apart, one diameter from laterals, scarcely smaller than laterals.

Falces three times the length of the clypeus, convex at base, slightly attenuate towards the apex, bearing two conical teeth on inner angle and a third less conspicuous.

Sternum dark, convex, shiny.

Legs orange-red, dull. Femora i. with two spines, one in front at apex, another on inner side a little above middle; ii. with one about the centre of the joint. Tibiæ similar to those of *errans*.

Metatarsi with no spines at all.

Abdomen varying from deep black to olive-green, clothed with short curving hairs.

Palpus of male orange-red, dull; cubital joint short, convex, one very fine hair in front at apex. Radial joint broad, rounded in front, bearing a fringe of long curving hairs along the interior margin; exterior angle bearing two longer more conspicuous curved hairs.

Palpal organs bearing usual falciform process on outer side at base; apex of organs on inner side exhibit two short stout spines, curving slightly towards each other, while a third springs from near the base of the upper of these and curves round and over its apex behind. The bulb bears the usual short, conical, apical prominence common to several of the genus.

Epigyne consisting of a deep orifice, oval-triangular; anterior margin forming an angle, posterior margin slightly rounded; otherwise closely similar to those of the allied species.

P. pygmæum is a much darker spider than any others of the genus; the eyes are nearer together and the hairs on the clypeus are more numerous. The palpal organs considerably resemble those of *oblongum* and *errans*, but the very small eyes of the former and the metatarsal spine of the latter will prevent any confusion.

This small spider does not seem to be very plentiful, but perhaps has been overlooked. It occurs, however, abundantly in and around Carlisle, running upon railings, parapets of bridges, on walls, in buildings, on the pavements, &c., in the month of April and again in October.

Dorset, Carlisle, Hertfordshire, Lancashire, North Wales, Scotland.

Porrhomma Campbellii, sp. n. (Pl. II. fig. 5.)

Length of female 1½ line.

Cephalothorax dull orange; caput broad and bluffly rounded.

Eyes small: posterior row straight, centrals a full diameter apart, two and a half from the laterals; anterior row curved, convexity forwards; centrals smaller, one quarter diameter apart, two full diameters from laterals.

Falces rather more than twice the height of clypeus, with the usual three sharp teeth on inner anterior angle.

Legs pale yellow. Femora i. with two spines towards apex; ii. with one near the centre, iii. and iv. without any. Genual joints with a single spine at apex; tibiæ i. and ii. with three towards apex, one towards base on upperside; iii. and iv with two on upperside, one near the base, the other towards the apex.

Metatarsi without any spines.

Clypeus scarcely once and a half as high as ocular area.

Abdomen dull sooty olive-green, with numerous pale spots.

This single female, discovered amongst Mr. Campbell's spiders and remarked upon by himself as distinct from the

others, seems to occupy a position intermediate between *myops* on the one hand, with its high clypeus, and *Meadii* on the other, with its larger eyes, more closely situate.

The caput is broader and more bluffly rounded than in *errans* and *Meadii*, while from the former it may be further distinguished by its rather smaller eyes and higher clypeus, from the latter by these characters and the absence of a metatarsal spine.

It is much larger than *oblongum*, Cb.; its eyes are larger and closer together, and though the form of the caput is somewhat similar, yet the clypeus is much higher when compared with the ocular area than in that species.

Received from F. M. Campbell, Esq., August 1892, amongst a number of specimens of *oblongum*, *errans*, and *Meadii* taken at Hoddesdon, Hertfordshire, running on iron railings in the sunshine, in March and April 1883.

Porrhomma decens, Cb. (Pl. II. fig. 7 b.)

(Spid. Dor. p. 217, sub *Linyphia*.)

I am unable to recognize any sound distinguishing character which may separate this male specimen from *P. Meadii*. The apparent smallness of the eyes and their apparent greater distance apart are to my mind fully accounted for by the absence of pigment.

The palpal organs are similar to those of *Meadii* (see Pl. II. fig. 2 a).

A single adult male, the type specimen, which was kindly forwarded for my inspection by the Rev. O. Pickard Cambridge, was taken in Dorset in 1862.

Porrhomma microphthalmum, Cb. (Pl. II. fig. 7 a.)

This specimen also seems to me identical with *Meadii*. The palpal organs are precisely similar. The eyes, having lost a large proportion of the pigment-cells, appear smaller and wider apart (very slightly), but are not, I believe, really so. The spines on the legs, being lost, furnish no clue as to its identity.

A single adult male, the type specimen, was forwarded for my inspection by the Rev. O. P. Cambridge. Taken by the late Mr. Beck near London many years ago.

Porrhomma incertum, Cb.

(Spid. Dor. p. 205, sub *Linyphia*.)

I can find no reason for considering this female, the type of which I have carefully examined, as differing from *Meadii*. The eyes appear to be the same and there are no metatarsal spines.

Forwarded for my inspection by the Rev. O. P. Cambridge. Taken on a wall, in the month of June 1877, at Bloxworth, Dorset.

Porrhomma montigena, Sim.

(Ann. & Mag. Nat. Hist., Jan. 1891, sub *Tmeticus niger*, F. Cb.)

Porrhomma adipatum, L. K.

(Spid. Dor. vol. ii. p. 521, sub *L. reticulata*, Cb.)

Porrhomma myops, Sim. (Pl. II. fig. 6.)

A single specimen forwarded to me, together with specimens of *oblongum*, by Rev. O. Pickard Cambridge, Oct. 1892.

Rare Species observed between 1891–93.

Genus Agrœca.

Agrœca celans, Bl. (Pl. II. fig. 8.)

Adult females of this spider were taken by myself amongst moss on the banks in the woods at Wreay, near Carlisle, in April 1893.

No adult males were taken.

The form of the epigyne may be seen on Pl. II. fig. 8.

Genus Cryphœca.

Cryphœca diversa, Cambr.

An adult female of this species, new to science, was taken by myself, running on a rail in the sunshine, on the banks of the Caldew, on Oct. 11, 1892, near Carlisle.

The specimen was submitted to Rev. O. Pickard Cambridge, who has described and figured it in Proc. Dor. Nat. Hist. Soc. 1893.

Genus Lepthyphantes.

Lepthyphantes pinicola, Sim.

An adult male was taken by myself on the Cross-Fell range of hills (the Pennines) near Croglin. This is only the second locality in which it has been taken, it having previously been taken only once on Helvellyn in 1890.

Genus Decymbium.

Decymbium tibiale, Bl.

Several adult males of this rare species were found in the same locality in which I had taken them two years ago and at the same time of the year.

Woods at Wreay, near Carlisle, April 23rd, 1893.

Genus Tapinocyba.

Tapinocyba subitanea, Cb.

A single adult male was taken by myself in an outhouse in Carlisle in September 1892.

Genus Epeira.

Epeira patagiata, C. K.

This species appears to be abundant along the shores of Lake Derwentwater. The webs are hung on the palings or, more often, amongst the stone walls. The colour of these spiders, like that of many others, varies considerably with the nature of the habitat, tending always, of course, to that of the surrounding objects.

Epeira alsine, Walck.

Four fine adult females of this rare species were received from Mr. L. Greening, of Warrington, Cheshire, together with numerous splendid specimens of *E. sclopetaria* of both sexes.

The former were taken at Chateris, near Cambridge, by a friend of Mr. Greening, in the autumn of 1892, when sweeping amongst the herbage in woods for beetles.

Genus Lycosa.

Lycosa Trailii, Cb.

In crossing the Styhead Pass, from Borrowdale to Wastdale

Head, I had noticed numerous Lycosids scrambling about amongst the stones which surround the pathway. These I took to be *L. amentata*, and in the hurry of the march and in the distraction of company did not stop to identify them more certainly.

A few weeks later, however, having secured several specimens, I discovered them to be very different to *amentata*, and submitted them to the Rev. O. Pickard Cambridge, who pronounced them to be *L. Trailii*, discovered many years before in Scotland and described by himself.

Their habits are peculiar, for they seem to dwell entirely in that wilderness of loose stones, acres in extent, which lies around the base of the Great Gable Mountain. Exceedingly swift in their movements, they are very difficult to capture, for they seem seldom to venture far from the shelter of the rocks, and when once amongst the stones all further pursuit is useless.

They resemble *amentata* very much in general appearance, but are very decidedly larger, with longer legs; very black, with grey hairs.

It was a little late for them when I discovered their value, so that only twenty or thirty adult males and females were taken.

It is, however, evidently a very abundant spider, and probably inhabits the "screes" of sunny aspect throughout the whole of the Lake Districts.

Styhead Pass, June 1893.

Spiders noted, figured, or described.

EXPLANATION OF THE PLATES.

Plate I.

Fig. 1. *Lepthyphantes Whymperi*, sp. n.
- a. Left palpus of male from above. *a*, base of digital joint; *b*, spine at apex; *c*, cubital spine; *d*, falciform process.
- b. Left palpus from outer side.
- c. Caput and falces from in front.
- d. Left palpus of male.
- e. Profile of cephalothorax.

Fig. 2. *Coryphæus glabriceps*, sp. n.
- a. Right palpus of male from outside. *a*, falciform process; *b*, base of digital joint; *c*, *e*, radial spurs.
- b. Palpus from inner side.
- c. Palpus from above.
- d. Caput and falces from in front.
- e. Inner angle of falx enlarged. *a*, isolated tooth.

Fig. 3. *Hilthousia turbatrix*, Cb.
- a. Palpus of male from outside. 1, falciform process; 2, spine at apex.
- b. Palpus from above.
- c. Palpus, another view.
- d. Epigyne of female.
- e. Caput and falces from in front.
- f. Profile of female.
- g. Cephalothorax from above.

Fig. 4. *Hilthousia desolans*, sp. n.
- a. Profile of female.
- b. Cephalothorax and abdomen from above.
- c. Epigynal area from in front.
- d. Epigynal area from above.
- e. Caput and falces from in front.

Fig. 5. *Micronetа clypeata*, sp. n.
- a. Profile of male.
- b. Cephalothorax and abdomen from above.
- c. Right palpus of male from above.
- d. Sternum, maxillæ, and falces.
- e. Caput and falces from in front.
- f. Left palpus from outside.

Fig. 6. *Bathyphantes setiger*, sp. n.
- a. Right palpus of male from above. *a*, apex of falciform process; *b*, spiral spine at apex of organs; *c*, plumule; *d*, central spine.
- b. Right palpus from outer side.
- c. Falciform process. 1, spatuliform apex; 2, group of long setæ.
- d. Falciform process, another view.
- e. Epigyne of female.

Fig. 7. *Bathyphantes nigrinus*, Bl.
- 7′. Palpal organs from outer side. *a*, falciform process; *b*, spiral spine at apex; *c*, plumule; *d*, central spine.
- 7″. Falciform process, enlarged.
- 7 a′. Epigyne of female from above. *a*, upper stylum.
- 7 a″. Epigyne of female, lateral view.

Fig. 8. *Bathyphantes approximatus*, Cb.
8′. Palpal organs from outer side. *a*, falciform process; *b*, spiral spine at apex.
8″. Falciform process, detached.
8 a′. Epigyne of female, lateral view. *a*, upper stylum.
8 a″. Epigyne of female from above.
Fig. 9. *Bathyphantes dorsalis*, Wid.
Palpus of male from outside. *a*, falciform process; *b*, spine at apex.
Fig. 10. *Bathyphantes pullatus*, Cb.
a. Palpus of male from outer side. *a*, falciform process; *b*, apophysis with serrulate apex; *c*, spine.
b. Palpus from beneath.

Plate II.

Fig. 1. *Porrhomma errans*, Bl. E Coll. F. M. C., R. H. M., O. P. C.
a. Palpal organs from outer side. *a*, falciform process; b^1, b^2, b^3, spines on ditto; *c*, small spur at apex of bulb; *e*, basal spur of digital sheath.
b. Caput and falces from in front. Lines at side show relative height of clypeus and ocular area.
c. Epigyne of female from above.
d. Epigyne of female, lateral view.
Fig. 2. *Porrhomma Meadii*, sp. n. E Coll. F. M. C. and R. H. M.
a. Palpal organs from outer side. Small letters have the same signification as in fig. 1 a.
b. Caput and falces from in front. Lines at side as in fig. 1 b.
c. Epigyne from above.
Fig. 3. *Porrhomma pygmæum*, Bl. E Coll. O. P. C., type.
a. Palpal organs from inner side. Small letters as above.
b. Caput and falces from in front. Lines as above.
c. Palpus from outer side. Letters as above.
Fig. 4. *Porrhomma oblongum*, Cb. E Coll. F. M. C.
a. Palpal organs from outer side. Small letters as above.
b. Caput and falces from in front. Lines as above.
c. Palpus from above. Small letters as above.
Fig. 5. *Porrhomma Campbellii*, sp. n. E Coll. F. M. C.
Caput and falces from in front. Lines as above.
Fig. 6. *Porrhomma myops*, Sim. E Coll. O. P. C.
Caput and falces from in front. Lines as above.
Fig. 7. a. *Porrhomma microphthalmum*, Cb. E Coll. O. P. C.
Palpal organs from above. Letters as above.
b. *Porrhomma decens*, Cb. E Coll. O. P. C.
Palpal organs, different views. Letters as above.
Fig. 8. *Agræca celans*, Bl.
Epigyne of female.

XIII.—*A Month on the Trondhjem Fiord.*

By the Rev. Canon Norman, M.A., D.C.L., F.R.S., &c.

[Continued from vol. xii. p. 452.]

[Plates VI. & VII.]

Genus Kinekoskias, Danielssen.

(Additional notes on the genus.)

Kinekoskias Smitti, Dan.

Add to the synonymy of my previous notes given on p. 448 of vol. xii. the following :—

1875. *Bugula flexilis,* Verrill, "Brief Contrib. XXXII. Results Dredging New England Coast, 1874," Amer. Journ. Sci. vol. ix. p. 415, pl. vii. figs. 1, 2.
1879. *Kinekoskias flexilis,* Verrill, "Recent Additions Marine Invert. N.E. Amer.," Proc. U.S. Nat. Mus. p. 189 (no description).
1879. *Kinekoskias Smitti,* Dub. & Kor.,=*Bugula flexilis,* Verr., Verrill, Prelim. Check-List Marine Invert. Atlantic Coast, Cape Cod to Gulf of St. Lawrence, p. 29 (name only).
1885. *Kinekoskias* (*Bugulopsis*) *flexilis,* Verrill, "Results Explor. 'Albatross,' 1883," Ann. Rep. Comm. Fish and Fisheries for 1883, p. 530 (no description).—*Bugulopsis,* to which the species is here referred, is a genus established by Verrill, with *Cellularia Peachii,* Busk, as the type, upon the valid grounds that *Cellularia* of Busk is not Pallas's genus of that name.

Since the last part of these notes was published, having had occasion to refer to some of Verrill's papers, I came across his figure of *Bugula flexilis,* and was at once struck with the absolute identity of his illustrations and my own of *Kinekoskias Smitti,* and I find that he subsequently referred his species to that of Danielssen. Verrill speaks of the branches as "tapering gradually to the point of attachment," but makes no mention of a stalk; but even should the species assume a different habit on the other side of the Atlantic, the zoœcial characters being the same, there can, I take it, be no question as to the propriety of uniting the forms. It is interesting that Danielssen's species has its range thus extended. It occurs in deep water (194 fathoms) off the coasts of Maine and Nova Scotia. I have found a fragment labelled "*Kinekoskias Smitti,*=*Bugula flexilis,*" which was sent to me by Professor Verrill. It is in spirit, but in bad condition, having been apparently at some time dried; but it appears to bear out the synonymy.

Kinetoskias arborescens, Danielssen, = *Bugula umbella*, Smitt.

It may be well, as I am noticing this genus, to refer also to this other northern species. *K. arborescens* has the zoarium attached not by one chitinous tube, but by many, and these are short; the zoarium is more calcareous than in *K. Smitti*, all the branches arch over and bend downwards, like an opened umbrella *, while the stems bear the proportionate height of its handle. The zoœcia are on the upper surface of the branches; they have their backs marked with curved lines, as represented by Dan. & Kor. On the front there is no spine-point at the upper outer angle, but, instead, this angle is the point for the attachment of the avicularium, which thus occupies a different position from that in the three other known species; the avicularium is much shorter and more tumid—Dan. & Kor. correctly say "it resembles an eagle's head in shape,"—with the crown much arched.

The points I have mentioned distinguish this species from *K. pocillum*, Busk, of the 'Challenger' Expedition, as well as from the species here previously described. Specimens examined are from the Gulf of St. Lawrence (*Mr. Whiteaves*) and Kara Sea, 'Dijmphna' Expedition (*Copenhagen Museum*). This last specimen has oœcia, which have not previously been observed. They are semiglobose and similar in character to those of the other species.

7. *Bugula Murrayana*, Johnston.

Rödberg.

Genus Electra, Lamouroux, 1816

(type *Electra verticillata*, Lamx., = *Flustra pilosa*, Linn.).

= *Amphiblestrum*, Gray, 1848 (type *A. membranacea*, Abildg.†), =

* Busk is mistaken in supposing (*vide* 'Challenger' Report, p. 45) that Smitt has represented his specimen "the wrong way up in his figure."

† Busk, in 'Challenger' Report, Cheilostomata, 1884, makes *Membranipora Flemingii* the type of *Amphiblestrum*. In order to understand this we must refer to his Cat. Marine Polyzoa in Brit. Mus., Cheilostomata, p. 58, where, in describing *M. Flemingii*, he makes *Flustra membranacea*, Abildg., a synonym. It is strange how he can have fallen into such a mistake, for there is nothing in Abildgaard's description or figure applicable to *M. Flemingii*. The following words are important in that author's description, which is confirmed by the figure:—"Cellulis margine calcareo cinctis, et membra hyalina tectis. In medio marginali basis prostat mucro elevatus plus minus elongatus, etc."[a] What, then, is

[a] Abildgaard, in Müller's Zool. Dan. vol. iii. 1789, p. 63, pl. cxvii figs. 1, 2.

Conopeum, Gray, 1848 (type *C. reticulum*, Gray *), = *Annulipora*, Gray (type *A. pilosa*, Linn.), = *Reptelectrina*, d'Orb. 1851 (type *R. dentata*, Sol. & Ell.), = *Electrina*, d'Orb. (type *E. lamellosa*, d'Orb.), = *Pyripora*, d'Orb. (type [recent] *P. ramosa*, d'Orb.), = *Electra*, Busk ('Challenger'), partim.

Zoœcium more or less elongated, typically turbinate, the basal portion enclosed by a calcareous crust, which may be either punctate or entire; anterior portion consisting of an area oval or oblong in shape, covered by a thin membrane, at the summit of which is the oral opening; border of the area calcareous and often surmounted with spines, in which latter case one at the base is either the only one present or is usually larger than the rest. No oœcia known in recent species. No avicularia. Larva a "cyphonautes." Zoarium either incrusting or erect and free.

The species are subject to extraordinary variation, and in certain conditions the basal portion becomes nearly or quite obsolete.

Other European species referable to the genus are *E. Lacroixii* (Aud.) (including *M. monostachys*, Busk) and *E. catenularia* (Jameson). There are many representatives in other parts of the world.

Electra verticillata, Lamx., has long been a puzzle to authors, and parts of the original figures have again and again been reproduced without any additional light being thrown on the species. Paul Fischer † and Smitt were the first who rightly referred it to *Flustra pilosa*, Linn. That this is the case, and that it owes its peculiar verticillate arrangement of the zoœcia to the situation on which it was developed, is, I think, clear, though not hitherto explained. An examina-

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Abildgaard's *Flustra membranacea*? It is most certainly the form figured by Smitt (pl. xx. fig. 46) as forma *membranacea* of *Membranipora pilosa*, and rightly referred by him to Abildgaard's species, and which has since been well figured by Freese ("Anatom.-histol. Unters. von *Membranipora pilosa*, Linn.," Archiv f. Naturg. 1888, pl. i. figs. 3, 4). There can be no doubt that these figures, however, do not represent *M. pilosa*, but *M. Lacroixii*, var. *monostachys*, a species which Levinsen has lately recorded as *M. monostachys* from the Baltic (Levinsen, Vidensk. Udbytte 'Hauchs' Togter Polyzoa, 1891, p. 277), whence also the specimens of Abildgaard, Smitt, and Freese came.

* About twenty-five years ago I examined in Brit. Mus. the specimens which Gray had named *Conopeum reticulum*, and found that most of them at any rate were referable to *M. Lacroixii*, Aud., which, differing widely as it does from the type of *M. monostachys*, I am nevertheless unable to separate from certain undoubted forms of that so-called species.

† Fischer, "Bryozoaires, Echinodermes et Foraminifères de la Gironde," Actes Soc. Linn. Bordeaux, vol. xxvii. 1870, p. 15.

tion of the figures * shows it to be incrusting the main stem and extremities of the branches of some such seaweed as *Cladostephus verticillatus*, Lightfoot. The magnified view is taken from the extremity of a branch, and apparently the verticillate ramuli of the seaweed have compelled a corresponding verticillate arrangement of the zoœcia of the polyzoon. I have seen such an arrangement, though not so marked, at the extremity of a zoarium coating a seaweed (Pl. VII. fig. 1). Moreover the quincuncial disposition of the zoœcia is sometimes departed from in *Electra pilosa* without any apparent cause, since in the widest foliations of an erect Flustriform variety of the species (var. *flustriformis*, specimen *a*, presently to be described), which I dredged at Florö, there occur many succeeding transverse rows of cells arranged parallelly side by side across the frond (see Pl. VI. fig. 6).

8. *Electra pilosa*, Linn., var. *carbasiiformis*, Norman. (Pl. VII. fig. 2.)

The only example of the species found was taken at Rödberg living absolutely free and in a "Hemescharan" state. It is described below under the above name, and is the only specimen I have ever seen or heard of in which this mode of growth has been assumed by the species.

I take this opportunity of directing attention to the extraordinary variation exhibited in this species. The variations may be divided into two classes—first, as regards the structure of the zoœcia themselves, and, secondly, as affects the ultimate forms into which the zoœcia arrange themselves. The zoœcium is normally more or less produced at the base, and this basal portion is always, when present, beautifully punctate; in advance of this crustaceous hinder portion comes the area, usually ovate, sometimes nearly oblong, covered with a thin membrane, at the anterior end of which is the small mouth-opening; the enclosing calcareous margins of the area are almost invariably furnished with spines ranging from four to ten in number in different varieties on the lateral margin, and one at the centre of the hinder margin, rarely of the same size and character as those of the sides, but usually conspicuously larger and stouter, or converted into a setose appendage, which attains often gigantic proportions; and in one instance I have seen, in addition to this great seta, one, two, or three of the neighbouring lateral spines, together with the basal spine, changed into great setæ (Pl. VI. fig. 4).

* Lamouroux, Expos. méthod des genres de l'Ordre des Polypiers, pl. iv. figs. *a*, A.

In a specimen incrusting the flat leaves of a *Fucus* the margins are much more thickened than usual, the zoœcia have their areas brought close together, the hinder calcareous punctate portion of the zoœcium being reduced to the small portion which gives support to the great seta, at the base of which a few puncta may still be seen; but here and there even these few are absent (Pl. VI. fig. 5). A remarkable modification in the opposite direction takes place in var. *Reaumuriana*, where the zoœcia are elevated into a semierect position and the punctate crust is carried forwards and forms side walls on which rest the usual margins of the area (Pl. VII. fig. 1).

In the seas of our own islands this species has only been met with in an incrusting state, and Mr. Hincks has remarked* that "amidst all the varieties of this protean species from various parts of the world" he had never seen the erect free-growing form until he received a specimen from New Zealand. Nowhere have the seas been more closely examined for Polyzoa than around our own islands. It is therefore very curious that, while free-living states of this species are met with on the coasts of West France, of Belgium, and of Norway, no instance of such growth should have ever occurred in our seas.

There is also a very curious reproductive difference as connected with the genus *Electra* and forms which are certainly at least very closely allied. In the North Atlantic no ovicell has ever been known on any specimen of either of the three species which I would refer to this genus, *E. pilosa*, *E. Lacroixii* (including *M. monostachys*), and *E. catenaria*; and this fact has deep significance. Yet Mr. Waters has described from New-Zealand Tertiary beds forms so like to the foregoing that he has even referred them to the same species as *Membranipora monostachys* and *Membranipora Lacroixii*, var. *grandis*; in these reproduction takes place by means of oœcia†. The absence of oœcia in recent forms would not, moreover, seem to be confined to North-Atlantic species. I cannot recall to mind any out of many exotic recent species which I should refer to the genus in which oœcia are known. It is probable therefore that Waters's species must find their place in another genus, notwithstanding the close resemblance of such a form as that shown in his fig. 3 to the genus *Electra*.

* Ann. & Mag. Nat. Hist. ser. 5, vol. x. 1882, p. 169.

† Waters, "Tertiary Cheilostomatous Bryozoa from New Zealand," Quart. Journ. Geol. Soc. vol. xliii. 1887, p. 45 (*M. monostachys*, pl. vi. figs. 6, 3; *M. Lacroixii*, var. *grandis*, pl. vi. fig. 1).

Section I. Adherent varieties.

Var. 1. *dentata*, Ell. & Sol. (Pl. VI. fig. 1).—Zoœcium more or less produced and punctate; margin of area crowned with spines, variable in number, usually from four to ten, rarely twelve, and one at the base larger and stronger than the rest, but, like them, calcareous. Very common in the British Isles, incrusting shells, stones, and weeds. (Busk, Brit. Mus. Cat. Cheilostomata, pt. ii. pl. lxxi. fig. 1; Hincks, Brit. Mar. Pol. pl. xxiii. figs. 2, 3.)

Var. 2. *tenuis*, Norman (Pl. VI. fig. 2).—This form corresponds in all respects with the last, except that it is more delicate in structure, the spines more slender, and the basal spine reduced in size, so as to be no larger than the others.

An extreme form of var. *tenuis* in my collection (formerly in Barlee's), incrusting a *Mytilus*, has the greater portion of the zoœcia wholly devoid of spines or setæ; other zoœcia have two or three little denticles (rather than spines); others resemble Hincks's pl. xxiii. fig. 4; while some few show the passage to the usual state of var. *tenuis*.

Forma *stellata*, Thompson.—This is either of the foregoing varieties living on the inside of bivalves or on broad-leaved seaweeds, and the zoarium growing out into digitate extensions at the margins, so that its form is more or less stellate.

Var. 3. *typica*, Norman, = var. *Lœflingiana*, Moll (Pl. VI. figs. 3–5).—I have never seen this variety incrusting stones or shells, but always seaweeds. The zoœcia have the margins much stronger than in the preceding varieties; the posterior punctate portion is often reduced to a minimum, especially in the central portions of the zoarium, where the punctated structure is wholly absent or can only be seen at the base of the posterior spine. The lateral spines are usually six, stout and strong; the posterior central spine is greatly developed, sometimes still preserving its spine-like character, at another transformed into a great chitinous seta, which is two, three, or even four times the length of the zoœcium: when incrusting a flat weed these long setæ are developed most freely at the margins; when investing small round weeds the whole zoarium elegantly bristles with them, and sometimes two, three, or four spines are changed into the great setæ. (Blainville, Man. d'Actinol. pl. lxxv. fig. 2; Hincks, pl. xxiii. fig. 1.)

Var. 4. *Reaumuriana*, Moll, = *Electra verticillata*, Lamx.

(Pl.VII. fig. 1).—Zoœcia much more delicate in structure than in the last variety, *semierect*, so that in most cases the punctate crust is to be seen not only on the hinder portion, but on the sides beneath the area; lateral spines mostly four, but sometimes six or eight; posterior seta of moderate length, equal to about two zoœcia. The zoœcia are more irregularly disposed than in any other variety, often one series is developed on the top of another, and here and there at the extremity of the branches they take on a verticillate arrangement; but this verticillate arrangement is rarely to be found, and I regard it in my specimens as purely accidental; but the tendency of the zoœcia to erect themselves, and hence their form, and the four lateral spines clearly indicate this as the form described by Lamouroux. I have a large quantity of this variety clothing in every part masses of a small round branched weed about $3\frac{1}{2}$ inches high. It is part of that portion of my British collection which was Barlee's, but the locality has not been preserved. (Lamouroux, Expos. méth. Polypiers, pl. iv. figs. *a*, A; Moll, *Eschara*, ex Zooph. ord. genus 1803, pl. iv. fig. 6, A–E.*)

Var. 5. *hippothoiformis*, = var. *laxa* (Pl.VI. fig. 7), Hincks's names for Smitt's pl. xx. fig. 49.—In this beautiful and most remarkable variety the zoarium consists of lines composed of a single series of zoœcia, whence branches diverge right and left from every cell (normally) †; these branches also consist of cells in single file and give origin to other pinnulæ, thus in all respects conforming to the habit of *Hippothoa divaricata*. It runs over *Fuci* and is most fully and perfectly developed on their air-bladders. The following is the description of the arrangement of the zoœcia in a portion of a specimen:—A main branch consists of a chain of 34 cells, the first twenty-five of which give origin, both on right and left, to branches, the structure thus being elegantly pinnate. We will now follow the course of three consecutive pinnæ on the left side. Pinna A ‡ 1–5, 6 (1), 7 (1), 8–12, 13–31 (1); from 13 to 31

* Moll's specimen had six lateral spines on the cells; that of Lamouroux four.

† To understand how this takes place, see Jules Barrois, 'Mém. sur l'embryol. des Bryozoaires,' 1877, pl. xv. fig. 6, where we have represented the "mother-cell" giving off the commencement of the three next cells, one in front and one from each shoulder. Each cell in var. *hippothoiformis* in this respect acts as the "mother-cell," giving off three buds, but the lateral, instead of being directed forwards, are directed outwards.

‡ A number as the first "1–5" means that the first five cells of the pinna have no branches, "6 (1)" means that the sixth gives origin to a branch (pinnula) on one side, "7 (2)" would mean that the cell gives rise to two pinnulæ, right and left.

the pinna runs side by side with pinna B, the cells touching those of B on the right; on the left and free side every cell gives origin to a pinnula. Pinna B, 1–3, 4 (1), 6–12 (2); now it comes into contact with pinnæ A and C, and passes between them, the three running side by side from 13–17; here pinna C has diverged to the right, but A is still to the left, so one side only is free and we have 18–29 (1). Pinna C, 1–5, 6–9 (1), 10, 11; here it is running along the side of B, which is on its left, so that on that side it cannot branch, and we have 12–18 (1); here it diverges from B to the right, and, being free, we have 19–29 (2), and then a terminating creeping base equal in length to six cells, on which the cells are imperfectly or as yet not at all developed. The zoœcia are elongated both in the posterior calcareous portion and in the long and often nearly oblong area; the lateral spines are 4 or 6, rarely 8, the posterior spine is no larger than the others*; the branches diverge from what may be called the shoulders of the zoœcium. In every case where a branch is not given off to right or left it is from want of room; the animal seems to discover by its tentacles that there is a neighbour too near to enable itself to develop a zoœcium in that direction: but the direct onward growth of the main stem, pinna, or pinnula is not so easily stopped; it will run up close to the side of a neighbour and accompany it in its onward course (see Smitt's figure), or it will ride over its back, if at an angle, and pursue its journey. The pure white lace which this variety forms is a beautiful object seen against the black background of the *Fucus* on which it is developed. My specimens are from Florö, and it is not unlikely that those of Sars, which Smitt describes, were from the same locality, the fauna of which Sars knew so well.

Section II. Free-living forms.

Var. 6. *carbasiiformis* (Pl. VII. fig. 2).—Imagine the form *stellata*, Thompson, living absolutely free, consisting of a lamina composed of a single layer of zoœcia, with calcareous back, and you have this variety. The specimen is 20 millim. in its greater and 16 millim. in its lesser diameter, the outline very stellate; the area of the zoœcia has four, rarely six, or even eight spines on the margin, the posterior spine a little larger than the others. I can see no sign of attachment even at the "mother-cell." Rödberg, Trondhjem Fiord, 1893.

* It was so in Smitt's specimen, and, of course, there may be this variation.

Var. 7. *flustriformis*, = var. *Ellisiana*, Moll.—The variety may or may not have originally invested a seaweed; in the former case the seaweed or hydrozoon having been covered, the zoarium develops free growth and forms flattened branches of greater or less width. The following notes will show wide divergence in the mode of growth of the branches of var. *flustriformis*.

Form *a* (Pl. VII. fig. 3) exhibits great difference in the character of the free branches in the same specimen: some are broad and leaf-like, of twenty to thirty zoœcia in width; others ligulate; others so narrow as at first sight to appear to be round, but closer examination shows an ovate section, they are two or three zoœcia wide. These narrow branches are at the base, but the expanded leaves have digitate terminations. The lateral spines are usually six, sometimes eight; basal spine not long on the central portion of the leaves, but produced into a rather long seta on their margins and on the narrower branches. Height 2½ inches, not based at all on a seaweed. Batalden, which is a few miles from Florö, Norway, 1882.

Form *b* (Pl. VII. fig. 4). A dense bush, composed of a large number of stems springing from one base, and dichotomously and trichotomously branching; all branches and branchlets flat and narrow, mostly four to eight zoœcia in breadth, but occasionally widening before again dividing to fifteen or even twenty zoœcia. Armature as in the last, but many cells in the wider portion of one of the specimens wholly devoid of spines. Height 2 inches. Bukken, in the Bergen Fiord, 1878 (*A. M. N.*); Ostende (*Prof. E. van Beneden*).

When visiting the museum at Liège in 1892 I saw a great quantity of this form preserved in spirit, some of which, above described, Prof. E. van Beneden kindly gave me. He told me that it was very common on the coast. This is interesting, because Pallas, who wrote his excellent 'Elenchus Zoophytorum' 127 years ago, tells us that this present form was known in Belgium as "Zee-moss," and writes:—"Nullibi abundantiorem novi hanc Escharam, quam in Mari Belgium alluente. *Sertulariam longissimam*, ibidem copiosissimam et magnis acervis sæpe in littore conspicuam, in certis tractibus, maxime versus autumnum, totam incrustat, et ab extremis ejusdem ramulis insuper frondescens, elegantissimas formas assumit, primoque tunc aspectu *Spagnum palustre* fere æmulatur. Sic incrustatæ hujus Sertulariæ immanis vis ineunte imprimis hyeme Ann. 1764 in tota occidentali Belgii ora, a flantibus Austris egerebatur, ut in brevi passim spatio, ad onerandum vehiculum sufficere potuissit" (p. 51).

Form *c* (Pl. VII. fig. 5).—Based on a seaweed, from which

base, when covered, have arisen hundreds of free strap-formed branches, usually simple, very rarely dichotomously divided. The uniform strap-shape of the branches and their nearly uniform breadth of three to five zoœcia, and length of about half an inch, give to this specimen a very marked character. The zoœcia are always quincuncially arranged, and have six strong lateral spines, the basal spine as a long seta. Height 5 inches. Picked up on the sands at Cap Breton, S.W. France, in 1880 (*A. M. N.*).

Var. 8. *cellariiformis* (Pl. VII. fig. 6).—A most elegant form. A little bush with erect, *round* branches; the undivided branches are from ½ to 1½ inch long, but seldom more than half a millimetre in diameter; built up generally of four rows of zoœcia, which are rather more elongated than usual, with 4 or 6 lateral spines, and the basal spine slender but not setiform. Height 2 inches. Florö Bay, Norway (*A. M. N.*).

Var. 9. *gemellariiformis* (Pl. VII. fig. 7).—Here we meet with *E. pilosa* performing a most extraordinary gymnastic feat. Two zoœcia stand back to back, shoulder to shoulder; on them mount two similar zoœcia, and so the main stem is built up of pairs of cells; then from both right and left shoulder of every cell stands out at nearly a right angle a cell, which is back to back again with the cell which has been developed from the opposite side of the main stem, and the growth of the branches proceeds as that of the main stem; and in this way an erect pinnate structure is built up, ultimately becoming bipinnate, and even tripinnate, and the whole composed of only a double row of cells. Zoœcia and spines as in the last. Florö Bay, Norway, 1882 (*A. M. N.*).

Var. 10. *eucrateiformis* (Pl. VII. fig. 8).—This is var. *hippothoiformis* living free, the entire structure being formed of a single series of cells and pinnately branched. In this case, however, the branches are few and the general appearance is of a mass of long chains lying heaped together. Found with the many other remarkable forms in Florö Bay.

Vars. 1 to 4 are British forms, the rest are not yet known in our fauna.

The truly marvellous forms above described exhibit an amount of variation in *Electra pilosa*, to which I know no counterpart in the whole range of marine zoology, or, indeed, in any other animal. One extraordinary circumstance at once strikes us. There seems to be common mind at work

and exhibited by the members of a colony, who determine to erect their building after a special and prearranged plan. This is no case of inherited instinct which prompts the members of a family to act together to build as their fathers built; but the founder of a colony settles the course she will adopt, and this determination, it would seem, must somehow be communicated by means of the colonial nervous system, and be acted upon by all the descendants to whom she gives birth by gemmation. Natural selection cannot account for this. A very difficult problem is here presented to us. We cannot appeal to vast periods of time. We see enormous changes brought about apparently at the will of individuals, who, building colonies after the various fashions characteristic of a large number of genera belonging to the same class as themselves, simulate the general forms of a *Membranipora*, a *Hippothoa*, a *Carbasea*, a *Flustra*, a *Cellaria*, a *Gemellaria*, and a *Eucratea* *.

Bugula Murrayana is another species given to "sports." The *Menipea fruticosa*, Packard (= *Cellularia quadridentata*, Lovén), has been often regarded as a distinct species, differing from the type in its narrower fronds, fewer spines, and absence of large lateral avicularia; but the reason I refer to this species is not on account of that variety, but because it also is known to take on a *Eucratea*-like form, composed of a line of single cells. This curious variation is figured by Smitt (pl. xviii. fig. 27), and I have also myself met with it.

I have used the word "sports" advisedly in the preceding sentence, because the remarkable variations of *Electra pilosa* seem to find a parallel in the "sports" of plants.

Genus Ramphonotus *, gen. nov.

The zoœcia, if developed freely in form, remind us of those of *Electra*, being turbinate, with a calcareous part posterior

* It has been argued by recent writers that the form which the colony of a polyzoon belonging to the Cheilostomata assumes is of no moment in generic character. *Electra pilosa* lends strong support to this view. Yet it is a view nevertheless in which I am not prepared in all cases to acquiesce. The zoœcial characters are unquestionably all important, but no lasting classification can be based on any one part of the zoœcium, whether it be the mouth-opening, wall, rosette-plates, or anything else. Why also in all instances is the ultimate growth and form of the zoarium to be excluded from generic character among certain families of the Cheilostomata, and at the same time to be recognized among the Cyclostomata and Ctenostomata, and even other groups of the Cheilostomata? This is surely scarcely consistent. In some instances, as, for example, *Electra pilosa*, the form of the colony is of no generic or specific value, but in other cases it may be and, I believe, is.

* Ῥάμφος, a bird's beak, and νῶτος, the back.

to the area, widening upwards from the base; but ordinarily, in their crowded state, only a sufficient part of this posterior portion remains to support the avicularium; the area is nearly as wide as long and often somewhat trifoliate in form; the mouth-opening is a slit close to its anterior margin, the border surrounding the area is calcareous and may be armed with spines. Oœcia large, globose, and imperforate. An avicularium of large size (sometimes monstrously so), with acute mandible, would seem to be habitually present on the adult zoœcia, situated on the central portion of the zoœcium on or immediately behind the hinder margin of the area, and is often elevated on a pedestal. [Zoarium incrusting in type species.]

Type, *Ramphonotus minax* (Busk).

This genus approaches *Foveolaria*, Busk; but the first species (type) described (*F. elliptica*, Busk) would seem to have a regularly articulated large operculum, besides other points of distinction.

9. *Ramphonotus minax* (Busk).

Membranipora Flemingii, forma *minax*, Smitt, Œfvers. K. Vet.-Akad. Förhand. 1867, p. 367, pl. xx. figs. 43, 44.
Membranipora minax, Hincks, Brit. Pol. p. 169, pl. xxii. figs. 2, 2 *a–c*.

On a stone from about 100 fathoms, Rödberg. I also have it in my collection from Shetland, Hardanger and Bergen Fiords, Norway (*A. M. N.*), Gulf of St. Lawrence (*Whiteaves*).

Hincks was of opinion that Smitt's figure 44 could not belong to this species; but it gives an accurate representation of the avicularium in the fully developed state.

10. *Tessarodoma gracile*, M. Sars.

1851. *Pustulipora gracilis*, M. Sars, Beret. om en i Somm. 1849, Zool. Reise i Lofoten og Finmark, Nyt Mag. f. Naturvidens. p. 26.
1860. *Onchopora borealis*, Busk, Quart. Journ. Micr. Sci. vol. viii. p. 213, pl. xxviii. figs. 6, 7.
1863. *Quadricellaria gracilis*, M. Sars, Beskr. over nogle norske Polyzoer, Videnskabs Förhand. for 1862, p. 14 (separate copy).
1864. *Quadricellaria gracilis*, Alder, "New British Polyzoa, &c.," Quart. Journ. Micr. Sci. n. s., vol. iv. p. 7 (separate copy), pl. ii. figs. 9–12.
1867. *Anarthropora borealis*, Smitt, "Krit. Förteck. Skand. Hafs-Bryozoer," Œfvers. af K. Vet.-Akad. Förhand. p. 8, pl. xxiv. figs. 25–29.
1869. *Tessarodoma gracile*, Norman, "Last Report Dredging Shetland," Brit. Assoc. Rep. for 1868, p. 309.
1873. *Tessarodoma boreale*, Smitt, Florida Bryoz., Kongl. Svens.

Vetens.-Akad. Handl. vol. xi. p. 32 (separate copy), pl. vi. figs. 143–145*.

1880. *Porina borealis*, Hincks, Brit. Polyzoa, p. 229, pl. xxxi. figs. 4–6.

1884. *Tessarodoma boreale*, Busk, Report 'Challenger' Polyzoa, I. Cheilostomata, p. 174, pl. xxiv. fig. 8.

On the precipices at Rödberg.

This genus differs from *Porina*, d'Orbigny, in having:—(*a*) oœcia; (*b*) avicularia; (*c*) a row of large marginal pores ("origelles"). The oœcia, figured by Alder, are very rarely developed—in not one in a dozen specimens could I find them at all; they are, if present, only to be seen on the very young cells at the extremity of the branches; they are very small, with a granulated surface, and immediately become wholly immersed and invisible by overgrowth of the surface of the zoarium, while at the same time the tubular orifice goes on developing and keeps well above the surface. The avicularia also will be seen best on the young cells; but the presence of these is constant or nearly so.

With respect to the specific name, it seems to me that the one given by Sars should be used. He first described the species, and Busk, in ignorance of the fact, redescribed it; both assigned it to a wrong genus: Sars called it a *Pustulipora*, Busk an *Onchopora*. Sars was the first to correct his own mistake and Busk's, and, although there was a previous *Pustulipora gracilis*, Milne-Edwards, in justice I think Sars's specific name should be retained.

Genus Hemicyclopora, gen. nov.

Zoœcia with pores confined to the sides and sometimes anterior portion of front wall. Mouth-opening well arched above, lower margin straight (no denticle within the lip). Reproduction by oœcia, which are imperforated. No avicularia. No special pore ("fenestrelle").

Type, *Hemicyclopora polita* (Norman).

11. *Hemicyclopora polita* (Norman).

Discopora emucronata, Smitt, Öfvers. af Kong. Vetensk.-Akad. Förhand. 1871, p. 1129, pl. xxi. figs. 27, 28.

Lepralia polita, Hincks, Brit. Pol. p. 315, pl. xxxii. fig. 5.

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* Busk questions whether Smitt's "fig. 143 and the lowermost zoœcia in fig. 144 really form part of *Tessarodoma* at all, or have merely become accidentally associated with it. The latter figures at any rate might well be regarded as *Lepralia* (*Porina*) *ciliata*." Certainly the semicircular oral opening is very different from the circular form which always prevails in the youngest cells at the extremities of the branches in *Tessarodoma*, and there are no lateral pores shown in the figures in question.

This genus comes very near to *Mucronella*, but differs in the absence of the denticle ("lyrula"). Hincks placed the type in *Lepralia*, but with doubt. *Discopora stenostoma*, Smitt, is also referable to this genus.

On a stone from deep water, Rödberg. Other specimens in my collection are the types from Shetland, 70–100 fath.; the Minch; Greenland ('Valorous' *Exped.*); Parry's Island, Spitsbergen, 20–70 fath. (*Smitt*, as "*Discopora emucronata*").

12. *Schizoporella Alderi*, Busk.

Deep water, Rödberg.

13. *Schizoporella linearis*, Hassall.

On stems of Hydroids, Rödberg.

14. *Mucronella ventricosa*, Hassall.

On a stem, deep water, Rödberg.

15. *Mucronella abyssicola*, Norman.

With the last.

16. *Mucronella laqueata*, Norman.

Discopora coccinea, forma *ovalis*, Smitt, "Krit. Förteck. &c.," Efvers. af K. Vet.-Akad. Förhand. 1867, p. 27 (separate copy), pl. xxvii. fig. 175 (vix fig. 174, quæ forsan ad *Mucronellam abyssicolam* referenda est).

Precipices, Rödberg, on stone.

17. *Porella compressa*, Sowerby.

On the precipices, Rödberg.

18. *Porella concinna*, Busk.

On shell, 40 fath., Rödberg.

19. *Porella bella*, Busk.

1860. *Lepralia bella*, Busk, Quart. Journ. Micr. Sci. vol. viii. p. 144, pl. xxvii. figs. 2, 3.
1868. *Escharella Landsborovii*, Smitt, "Krit. Förteck. &c.," Efvers. K. Vet.-Akad. Förhand. 1867, p. 12 (separate copy), pl. xxiv. figs. 60–65 (nec figs. 66, 67, nec *Lepralia Landsborovii*, Johnston).
1880. *Smittia bella*, Hincks, Brit. Pol. p. 352, pl. xlii. figs. 7 and 9.
1880. *Porella concinna*, Hincks, var. *gracilis*, ibid. p. 324, pl. xlvi. fig. 9.
1889. *Porella concinna* (nec Busk), Hincks (partim), "Polyzoa St. Lawrence," Ann. & Mag. Nat. Hist. ser. 6, vol. iii. p. 428, pl. xxi. fig. 4.

Zoœcia generally elongated—longer in proportion to breadth

than in *P. concinna*—varying in colour from brownish yellow to red, very rarely white; whole front wall punctate, the pores round the base being larger than the rest.

The oral opening shows the following variations:—In the youngest state it is semicircular, the lower margin straight (Microporellidan); then a sinus is developed on the lower margin (and it is Schizoporellidan); next a bifid tooth appears within the sinus (it is now Mucronellidan); then the round avicularium is developed in front of the bifid denticle, which last appears to be taken into the wall of the avicularium (and it is now typical Porellidan); lastly, a denticle is sometimes, but rarely, developed again within the avicularium and is seen behind it (and the orifice is now typically Smittian).

Nor are these all the variations, for others occur in the position of the oral avicularium: this sometimes is so deeply seated that it cannot be seen at all from the front, and is only found by looking down into the throat; a large form of the species having the zoœcia measuring 1 millim. long instead of 0·6 to 0·7 millim., which is the usual size, which I have from the St. Lawrence and Greenland, seems always to have the avicularium in this position; this form may be called var. *grœnlandica*; next and typically it is seen just within the oral margin; lastly, sometimes it is on the margin, which it interrupts.

The oœcia are very little raised and granulated. Overgrowth takes place with certain variations:—(*a*) A thick crust is developed over the zoœcia, in which the punctations are even more conspicuous than in the first cell-wall; the form of the zoœcia is preserved. (*b*) The zoarium is covered with a similar punctate crust to the last, but here the hollows between the zoœcia are filled up, the surface becomes nearly flat, and on it the zoœcia are mapped out by means of narrow raised marginal lines.

I have a pretty variety from the St. Lawrence (*Whiteaves*). The zoarium is a Hemescharan free form; its surface is nearly flat, the zoœcia not being so much raised as usual; the punctations are all over the surface and conspicuous, except on a granulated fillet, which, raised above the general surface, completely and evenly encircles the mouth.

This species may be distinguished from *P. concinna* by its punctate front wall, as well as by its form, colour, &c. The latter species always has the general surface of the front wall imperforate and granular, though it has "origelles" (pores) at the base; the form of the zoœcia is almost invariably shorter, and consequently wider in proportion; the colour is usually

white, though sometimes, as at Guernsey, it is pinkish or pale brownish yellow.

Specimens of *P. bella* are in my collection from Shetland (*Barlee and A. M. N.*) ; Aberdeen (*the late Robert Dawson*) ; Bergen and Hardanger Fiords, Norway (*A. M. N.*) ; Greenland (*'Valorous' Exped.*) ; Gulf of St. Lawrence (*Whiteaves*).

What is *Lepralia Belli*, Dawson? As few persons would have the opportunity of consulting the paper in which the species is described, I give here its characters :—

"In large patches. Young cells granular, semihyaline, confluent ; mouth immersed, sinuated, with a vibraculum or avicularium inside the middle of the lower lip ; ovicells rounded, granulous like the cells. Old cells white, opaque, flat above, and separated by a deep sinuous furrow. Cells having a strong tendency to form rows radiating from the centre of the patch. It is allied to *L. concinna*, Busk, but differs in essential points from his description and figure." *

Now the words "Young cells granular, semihyaline," apply very accurately to *Porella concinna*, but not at all to *P. bella*, Busk. Mr. Hincks, in Brit. Pol., pl. xlvi. fig. 6, figures from a Canadian specimen—authoritatively named? —*Porella concinna*, var. *Belli*. It represents accurately a common overgrown state of *P. concinna*, which is very different from the same condition of *P. bella*. I have before me a mounting, belonging to Mr. Whiteaves, who would certainly know Dawson's species, which exactly corresponds with Hincks's figure, and is labelled "*Lepralia Belli*." I think therefore there can be no question that Dawson's species is a synonym of *P. concinna*. Mr. Hincks has hitherto united the forms which I have here deemed distinct, *P. concinna* and *P. bella* ; but I think his second opinion was, at any rate, mistaken when in a recent paper† he transferred the *L. Belli* of Dawson from the form to which he had at first assigned it, and applied it to one which is undoubtedly what I call *P. bella*. Of course it is quite possible that Dawson may have confused the species and

* Described by Principal Dawson in "Contributions to Canadian Natural History by W. S. M. d'Urban and Robert Bell" (extracted from the 'Report of the Canadian Survey' for 1858), 1860, p. 33. Two other new forms are in this paper described by Dawson—*Hippothoa expansa*, which subsequently, ignorant of this paper, I by a singular coincidence described under the same name ; and *Lepralia plana*, afterwards named by Smitt *Myriozoon coarctatum*.

† Hincks, "Polyzoa of the St. Lawrence," Ann. & Mag. Nat. Hist. ser. 6, vol. iii. p. 428, pl. xxi. fig. 4.

sent *P. bella* to Mr. Hincks as his *P. Belli*; but, if so, it will not accord with Dawson's own description.

20. *Smittia Landsborovii*, Johnst.

An example taken at Rödberg with small round avicularium and bifid denticle. It does not bear any oœcia, to prove whether these are punctate or not. Neither Johnston's nor Busk's figures show any ovicells; they are both, it would seem, drawn from Landsborough's specimen, now in the British Museum. Busk (Cat. Mar. Pol., Cheilostomata, pl. cii. fig. 1) figured as *S. reticulata* a form which seems indistinguishable from *Smittia Landsborovii*.

The figure which was next supplied to us was by Alder (Quart. Journ. Micr. Sci., n. s., vol. iv. pl. iv. figs. 1–3); here for the first time we have the oœcium as well as the round oral avicularium, together with a larger spatulate avicularium which he found scattered here and there among the cells. The oœcium is figured as *punctate*. It is punctate in every specimen I have seen from the British Islands; it is punctate also in *S. crystallina*, Norman, and in *Escharella porifera*, Smitt, forma *typica*, which I regard as another form of my species. *S. crystallina* may always be distinguished from *S. Landsborovii*, of which it is at least a marked northern form, and I think specifically distinct. But *Escharella porifera*, Smitt, forma *majuscula* and forma *minuscula*, differ from all the preceding in having the oœcia *imperforate*, and, as compared with *S. Landsborovii typica*, the zoœcia are more tumid and the front wall more densely punctate. I propose to call this form

Smittia arctica, sp. n. (type *E. porifera*, var. *majuscula*, Smitt).

Escharella porifera, var. *majuscula*, Smitt, Krit. Förteck. Skand. Hafs-Bryoz. pt. iv. 1867, p. 9, pl. xxiv. figs. 36–38, and forma *minuscula*, figs. 33–35.

Forma *majuscula*: Kingsbay, Spitsbergen, 172 fath. (*Smitt*); Greenland ('*Valorous*,' 1875); Gulf of St. Lawrence (*Principal Dawson*).

Forma *minuscula*: Gulf of St. Lawrence (*Whiteaves*). All in Mus. Nor.

21. *Smittia trispinosa*, Johnston.

Trondhjem and Rödberg.

Fam. **Celleporellidæ.**

= *Diazeuxidées*, J. Jullien (Cap Horn).

Genus Celleporella, J. E. Gray, 1848.

1848. *Celleporella*, Gray, List Brit. Anim. Brit. Mus., Radiated Animals, p. 128.
1888. *Diazeuxia*, J. Jullien, Miss. Scien. Cap Horn, Bryozoaires, p. 28.

M. Jullien, in the synonymy of the genus, gives "*Celleporella*, Gray (partim)"; but the only species which Gray placed in his genus was *C. hyalina*, and Jullien's name is an absolute synonym of the before-described genus.

Jullien has drawn attention to the striking features in this genus, not only as shown in the larval state and early development, for the elucidation of which we are indebted to the admirable work of J. Barrois, but also to the fact that the erect oœcia, which are developed in great profusion on the heaped-up central portion of the colony, are not on the summit of polypide-bearing cells, but of small cells connected with the reproductive function. Jullien's work should be consulted with respect to the genus, as I have only referred to the more remarkable characters. Levinsen, though apparently unacquainted with Jullien's work, has more recently added to our knowledge by illustrating the mode of growth of the oœcium-cells (Levinsen, 'Hauchs' Togter Polyzoa,' 1891, p. 286, pl. iii. figs. 10–15).

22. *Celleporella hyalina*, Linn.

Trondhjem, on shell.

Var. *catenifera*, Norman.

This name may be given to a variety from Florö, Norway. It is very prettily reticulated, the cells being separated from each other by a regular chain-like interstitial development, the openings in which are oval, arranged in single file. It is an intermediate form between *C. hyalina* and *C. discreta* (Busk)*; in the latter the interspaces are wider and the openings not arranged in such regular order.

* Jullien (Cap Horn Bryoz. p. 33) has renamed this *Diazeuxia reticulans*, quoting as a synonym "*Lepralia hyalina*, var. *discreta*, G. Busk"; but Busk (B. M. Cat. Polyz., Cheilos. p. 85) has given no such *varietal* name; he described a species, *Lepralia discreta*, and his specific name must therefore be retained.

Jullien has united *Hippothoa patagonica*, Busk, with *C. hyalina*. The North-Atlantic species of *Hippothoa*, *H. divaricata*, *H. flagellum*, and *H. expansa*, all have the oœcia borne on imperfectly-developed cells, and the latter often has the zoœcia in clusters instead of following the usual unicellular arrangement. If *Hippothoa* is not to be united with *Celleporella* (*Diazeuxia*, Jullien) it certainly comes very near it. Since Jullien apparently declines even to place them in the same family, it is better to wait for his further views rather than at once merge *Celleporella* in the earlier genus *Hippothoa*. Jullien states that there is only one European genus and species of his family *Diazeuxidées*; and of *Hippothoa divaricata* he writes:—"Smitt déjà avait indiqué l'*Hippothoa divaricata*, Lamouroux, comme étant une variété de sa *Mollia hyalina*, qui n'est autre que la *Cellepora hyalina*. Mais l'*Hippothoa divaricata* est tellement différente de la *Cellepora hyalina*, que je me refuse à admettre cette manière de voir."

I quite agree in not uniting these species; the zoœcia of *H. divaricata* are much more produced, and the oœcia are imperforate, while in *C. hyalina* they are always punctated; but Jullien has not yet explained why he does not unite the genera, nor referred in any way to the similarity of the oœcium-cells exhibited in *Celleporella* (*Diazeuxia*) and *Hippothoa*. The illustrations which he gives of the oœcium-cells of *D. hyalina*, var. *patagonica*, closely accord with those of *Hippothoa*.

23. *Hornera lichenoides*, Linn.
On the precipices at Rödberg.

24. *Hornera violacea*, M. Sars.
Rödberg, on precipices.

25. *Idmonea atlantica*, E. Forbes.
Rödberg, 70–250 fathoms.

26. *Stomatopora dilatans*, Johnston.
On a stone, deep water, Rödberg.

27. *Diastopora obelia*, Johnston.
Rödberg.

28. *Lichenopora hispida*, Fleming.
Trondhjem and Rödberg.

29. *Barentsia gracilis*, M. Sars.

On a hydroid, Rödberg.

30. *Rhabdopleura Normani*, Allman.

A single specimen on a *Serpula*, precipices, Rödberg. I sought in vain for this species on the *Lophohelia* at Rödberg, on which coral I had dredged it in the Hardanger Fiord, where it is also found on the tests of Ascidians.

The literature of this remarkable genus is becoming voluminous. In the latest paper, by Mr. G. H. Fowler*, that author says, "As to the affinities of *Rhabdopleura* in one direction there can be no doubt. Every positive anatomical feature which it possesses points to a close relationship to *Cephalodiscus* and *Balanoglossus*, while it only differs from these forms negatively, namely, in the absence of two important structures, gill-slits and proboscis-pore." He then arranges these genera as three groups of the Hemichordata. He adds that "there is another possible alliance, obscure and confused at present," to the genus *Phoronis*.

Thus *Rhabdopleura* is to take its place, according to Mr. Fowler, in the Phylum Vertebrata; on which Lankester's views are thus summarized in the latest edition of the 'Encyclopædia Britannica,' article "Vertebrata":—

Phylum Vertebrata.

Branch *a*. Craniata (Cuvierian Vertebrata).
„ *b*. Cephalochorda (*Amphioxus*).
„ *c*. Urochorda (Tunicata).
„ *d*. Hemichorda (*Balanoglossus*).

Into the last Branch Fowler, in his paper, removes *Rhabdopleura* and *Cephalodiscus* from the Polyzoa, to keep company with *Balanoglossus*, its only previous occupant.

Lankester says, "*Balanoglossus* gives the most hopeful hypothetical solution of the pedigree of Vertebrata;" and, as emphasizing the high interest which attaches to these remarkable animals, I would call to mind that previously to *Balanoglossus* being thus placed in the Phylum Vertebrata, Gegenbaur had instituted an entirely new phylum in the animal kingdom for its reception under the name of *Enteropneusta*. On the other hand, the larva of *Balanoglossus* ("*Tornaria*") seems to point to affinity with the Echinoder-

* G. Herbert Fowler, "The Morphology of *Rhabdopleura Normani*," Festschr. z. siebenzigsten Geburtstage Rudolf Leuckarts, 1892, p. 293, pl. xxx.

mata, while those of *Rhabdopleura* have as yet evaded the most careful search, and that of *Cephalodiscus*, from the habitat of the animal, 245 fathoms in the Strait of Magellan, is not likely soon to come under the section-knife of any naturalist, unless one is forthcoming—even more ardent than those two able men, Lankester and Harmer, who at different times have spent their summer holidays on the Hardanger Fiord, seeking, but in vain, for light on the developmental history of *Rhabdopleura*—who is willing to devote a year in the journey to and search at *Cephalodiscus's* far distant and inhospitable home.

[To be continued.]

EXPLANATION OF THE PLATES.

Plate VI.

All figures illustrate *Electra pilosa*, Linn.

Fig. 1. Var. *dentata*, Ell. & Sol., an ordinary form of this variety. In the zoœcia figured the oral aperture has fallen inwards and left a gaping aperture, which does not therefore represent the proper mouth-opening.

Fig. 2. Var. *tenuis*, Norman.

Fig. 3. Var. *typica*, Norman; a condition of this variety incrusting a round stem in which the basal setæ are of great length.

Fig. 4. A single zoœcium from the same specimen as the last, in which two lateral spines, as well as that at the base, are converted into long setose appendages.

Fig. 5. Var. *typica*, Norman. From the central portion of a specimen coating a frond of *Fucus serratus*: at the lateral margins the long setæ are developed, and a punctate portion of the base of the cell is visible, while in the central part of the zoarium (that is, on the side of the frond of the *Fucus* which it incrusts) the zoœcia (as here figured) are oblong, and consist only of the area and bounding walls, the basal punctate portion being wholly absent; the lateral spines short, stumpy, and strong, and usually upright; the basal spine is strong and also erect.

Fig. 6. Three zoœcia from each of three rows running across the broad part of a frond of var. *flustriformis* from Batalden, showing an unusual parallel arrangement instead of the quincuncial order which usually prevails.

Fig. 7. Var. *hippothoiformis*, Norman; Florö, Norway. The cells of the main stem in the part figured are for some reason in an abnormal condition, and constricted at the origin of the pinnæ. The figure is somewhat diagrammatic, because I have not seen the pinnulæ commence so low down as on the first or second zoœcium; they may be expected about the fifth, but apparently the only cause for this is want of room; but in the drawing for a similar reason, "*want of room*," the illustration of what subsequently takes place at a greater distance from the main stem in reality has been here given nearer the origin of the pinnæ.

N.B.—The figures on the Plate are drawn to different degrees of enlargement.

PLATE VII.

All figures illustrate the varieties of *Electra pilosa*, Linn.

Fig. 1. Var. *Reaumuriana*, Moll. The tip of a coated stem from the specimen which was procured by George Barlee. The punctate wall will here be seen extended forwards along the sides of the area.

Fig. 2. Var. *carbasiiformis*, Norman. Natural size.

Fig. 3. Var. *flustriformis*, Norman. Form *a*. One of the broad branches of the specimen from Batalden; natural size.

Fig. 4. Var. *flustriformis*, Norman. Form *b*. A portion of the specimen from Bukken, Bergen Fiord; natural size.

Fig. 5. Var. *flustriformis*, Norman. Form *c*. A fragment of the specimen from Fosse de Cap Breton, Bay of Biscay; natural size. The central portion of this fragment consists of the *Electra* coating a seaweed; the strap-like terminations are the Polyzoon in a free state.

Fig. 6. Var. *cellariiformis*, Norman. A fragment of a specimen from Florö, Norway; the ramifications, which would naturally be all erect, have been outspread for the purpose of more clear illustration. Natural size.

Fig. 7. Var. *gemellariiformis*, Norman. Florö, Norway. Natural size.

Fig. 8. Var. *eucrateiformis*, Norman. Florö, Norway. Natural size.

BIBLIOGRAPHICAL NOTICE.

Les Coquilles des Eaux douces et saumâtres de France. Par ARNOULD LOCARD. 8vo. Paris, 1893.

THIS work in scope and method is similar to 'Les Coquilles marines des Côtes de France,' by the same author. In the 'Annals' for January 1892 we offered some remarks upon that volume, which, in a great measure, are applicable to the book before us.

It consists of 327 pages of text, containing brief descriptions of the families, genera, and the innumerable so-called species, and is illustrated with about three hundred not very good figures. The descriptions of the families and genera average about two lines each, and contain no mention whatever of the soft parts or animals; so that their true value may readily be estimated. The *specific* (!) descriptions in hundreds of cases are nothing more than mere diagnoses of individual specimens or groups of specimens belonging to one and the same species from different localities.

The rate at which the number of species increases in France is truly miraculous! Let us take two instances. M. Moquin-Tandon in 1855 recognized only five indigenous *Anodontæ*; in 1882 M. Locard enumerated 109 species, but a decade later this number has increased to 279. One author in 1882 was content with the modest number of 31 species of *Limnæa*, but now 127 are required to satisfy him! Of this genus M. Moquin-Tandon recorded but seven distinct forms.

These statistics are sufficient to show the character of the work, and we confess that, for our part, we cannot perceive any other ultimate purpose in it than the creation of a supreme contempt in rational persons for such so-called science, and a feeling of hopeless confusion in the minds of students, especially young inquirers.

MISCELLANEOUS.

On two new Types of Choniostomatidæ *from the Coasts of France:* Sphæronella microcephala, *G. & B., and* Salenskia tuberosa, *G. & B.* By MM. A. Giard and J. Bonnier.

We have shown in a previous memoir * that the family Choniostomatidæ, established by Hansen for the single genus *Choniostoma*, ought to include, besides forms which Kröyer and Max Weber partially discovered some time ago, a new genus discovered by us upon a *Mysis* already attacked by an Epicarid, and lastly the enigmatical Copepod *Sphæronella Leuckarti*, so well investigated by Salensky.

Hitherto no crustacean belonging to this family had been met with on the shores of France. Upon the occasion of our note upon *Podascon Dellavallei*, an Epicarid parasite of *Ampelisca diadema*, Costa, M. Chevreux sent us a certain number of specimens of *Ampelisca spinipes*, Boeck, *A. tenuicornis*, Lilljeborg, and *A. spinimana*, Chevreux, collected at Le Croisic, and which he thought were infested by *Podascon*. A careful examination of these Amphipods, which were all females, convinced us that a single specimen of *A. spinimana* bore a *Podascon* belonging to a new species, *Podascon Chevreuxi*, G. & B.

All the other parasites were, not Epicarid Isopods, but Copepods of the family Choniostomatidæ, belonging to two different genera. The parasite of *Ampelisca tenuicornis* is a *Sphæronella* distinct from the Mediterranean species studied by Salensky: we shall designate it *Sphæronella microcephala*. The parasite of *A. spinipes* belongs to a new genus: we shall give it the name of *Salenskia tuberosa*, in honour of the eminent Russian zoologist to whom we owe the first explicit information upon the evolution of the Choniostomatidæ.

These two species of parasites are found surrounded by their numerous sacs of ova in the brood-chambers of the *Ampelisca*, which are rendered barren in consequence of *parasitic sterilization* (*castration parasitaire*). The brood-lamellæ are often caused to gape widely, allowing grains of sand and other foreign bodies to enter, which never happens when the *Ampelisca* are carrying their eggs or are in the normal non-gravid condition.

In spite of the most minute investigation of the four infected individuals, we have been unable to find a single male of *Sphæro-*

* Giard and Bonnier, "Note sur l'*Aspidaecia Normani* et la famille des Choniostomatidæ," Bulletin scientifique de la France et de la Belgique, t. xx. 1889, pp. 341–372; four figures in the text, and pls. x. & xi.

nella microcephala. The female differs from *Sphæronella Leuckarti* in the small size of the cephalic portion when compared with the total mass of the body. The buccal apparatus is more simple. We have distinguished but one pair of mandibles, which, it is true, are very stout, and project by their free extremity in the centre of the sucker. The first pair of maxillipedes is better developed than the second, contrary to what is the case in *S. Leuckarti*. The genital area exhibits a different arrangement. The corneous papillæ are very large and represent the evacuatory apertures of two cement-glands. These cement-glands must not be confounded with the colleterial glands which secrete the substance of the ovisacs, and which open in the immediate vicinity of the female aperture.

We have counted as many as nine sacs of ova around a single female. Each sac may contain from sixty to eighty eggs with a very bulky germinal vesicle and a very distinct germinal spot.

Segmentation is epibolic. The endodermic macrospheres contain large fatty globules, analogous to those which are seen in the eggs of many fishes. We have not met with fully-developed embryos.

The genus *Salenskia*, of which but a single specimen has come into our possession, in consequence of the degradation of the adult female, is allied to *Choniostoma* and still more to *Aspidæcia*. The body of the female is irregularly pyriform, with a conical buccal region.

All trace of masticatory or locomotory appendages has entirely disappeared. We only find at the head an apparatus for attachment in the shape of an amphidisk or sleeve-link. The genital area is more simple than in *Sphæronella*. There is nothing in the shape of ornament, except a chitinous hair situated on the inner side of each female aperture.

In the neighbourhood of these apertures we have found three dwarf males. These exhibit a very interesting peculiarity. They have not undergone the regressive metamorphosis which we observe in the case of the males of *Sphæronella Leuckarti* and *Aspidæcia Normani*: they have retained the characteristic shape of the embryos of *Sphæronella* and *Choniostoma*. Nevertheless the existence of the two enormous spheroidal reservoirs, which are regarded as spermathecæ in the case of the males of the other Choniostomatidæ, permits us to believe that they have attained their sexual maturity. In this case therefore we should be confronted with an instance of *progenesis* entirely comparable to that which is exhibited by the Cryptoniscid males of certain Epicaridæ; and the question may be mooted whether, as in the case of certain of these latter, *dissogony* might not occur in the male sex of *Salenskia*, that is to say, whether, after having performed their function in the larval form, these males, or at least one among them, might not be capable of undergoing the regressive metamorphosis which has been proved to take place in the case of the males of *Aspidæcia* and *Sphæronella Leuckarti*. Perhaps, too, these dwarf males are only complemental males, such as are known in several groups of parasitic Metazoa. The excretory ducts of the spermathecæ appeared to us to open in the neighbourhood of the mouth, contrary to what occurs in *Aspidæcia*.

We have only observed a single sac of ova belonging to this species and that was in bad condition, so that we are unable to say anything as to its embryogeny. It is probable, however, that the embryos greatly resemble the progenetic males of which we have just spoken.

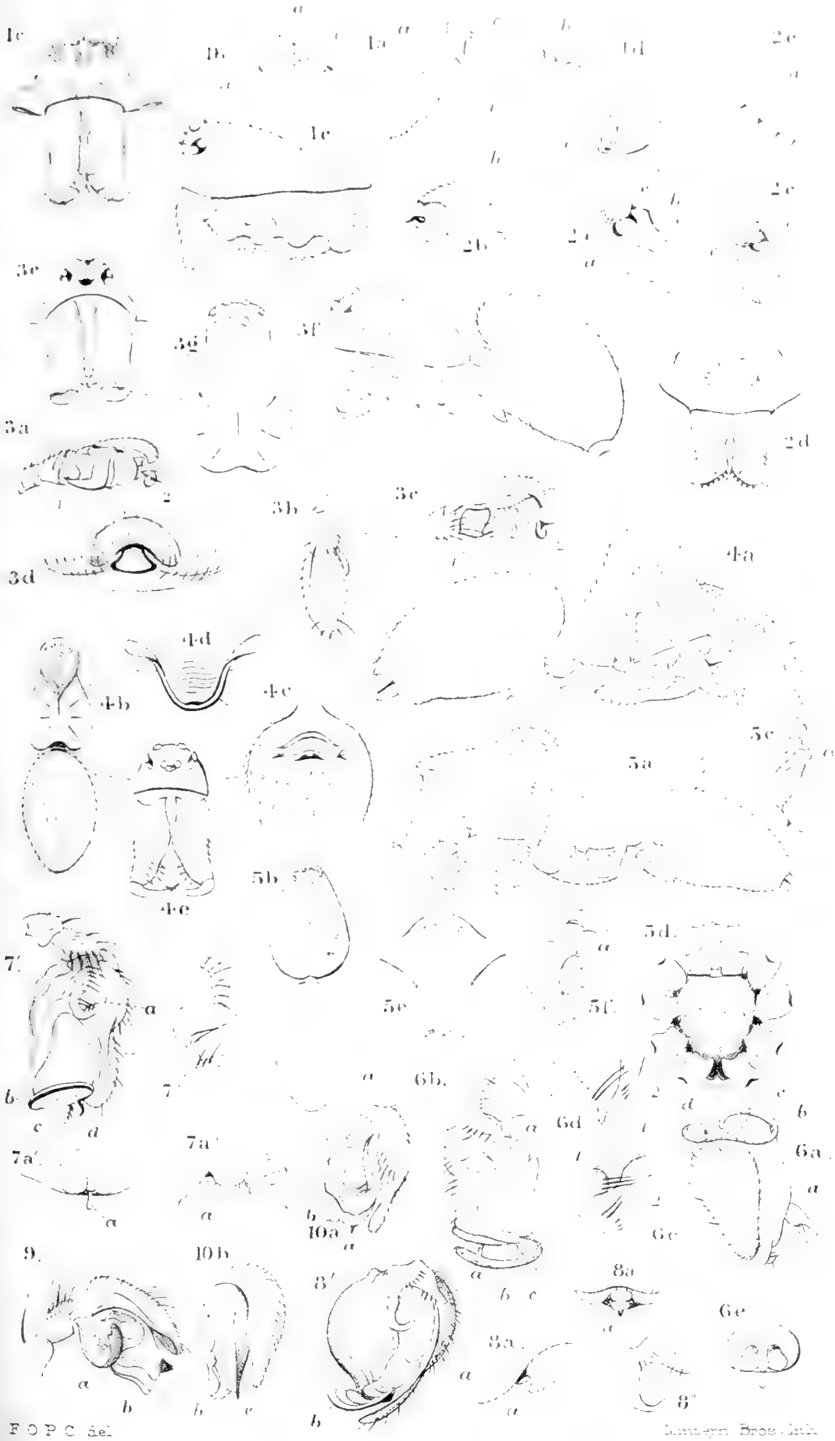
The co-existence of *Podascon Chevreuxi* and *Podascon Dellavallei* with the Choniostomatidæ mentioned in this note, upon species of the same genus *Ampelisca*, once more raises the problem, to which we have already drawn attention, of a possible ethological relation between the two groups of parasites, Epicaridæ and Choniostomatidæ. From what we know of the habits of *Choniostoma* and *Aspidarcia* we are inclined to think that the Epicaridæ open the way *at the present time*, or in certain cases perhaps have opened it *phylogenetically*, to the Choniostomatidæ. But this is a point that demands fresh investigations conducted as far as possible upon the living animals.—*Comptes Rendus*, t. cxvii. no. 23 (September 25, 1893), pp. 446–449.

Who first found Balanoglossus? By the Rev. Canon Norman, M.A., D.C.L., F.R.S., &c.

By a curious coincidence two works have reached me to-day. The first of these is a new volume of the 'Fauna und Flora des Golfes von Neapel,' a magnificent monograph by Dr. D. W. Spengel upon the Enteropneusta (Hemichorda, which includes *Balanoglossus* and allies). The second is 'Atlante di Figure sceverate dalle tavole incise e da disegni originali illustranti di Memorie postume di F. Cavolini pubblicate per cura ed a spese di S. D. Chiaje'; I have only been able to procure the plates of this work. From Carus and Engelmann's Bibl. Zool. p. 121, I find that there should be 344 pages and that the date is 1853. This work is by "Fil. Cavolini," the Italian naturalist who wrote at the end of the last century. The plates seem to be of the character of that period, and the last is apparently intended to illustrate a paper on the great eruption of Vesuvius which overwhelmed the houses of the 10,000 inhabitants of the town of Torre del Greco in 1794. If these plates date from the end of the last or from the beginning of the present century, then Cavolini was the first to notice and figure, and, perhaps, describe, the genus *Balanoglossus*. On pl. xiv. fig. 4 will be found a very good illustration of a form which seems most closely to resemble *B. Kowalevskii*, among those figured by Spengel. Spengel makes no allusion to Cavolini's work in his Bibliography, and gives Eschscholtz as the earliest discoverer of a species of the group (*Ptycodera flava*, 1825). Eschscholtz's figure is a very inferior one to that of Cavolini.

Probably there is a copy of Cavolini's work in the Brit. Mus. or other library. Will some one clear this matter up? The plates, moreover, in Cavolini appear, from their different sizes and the double numbers on them, to have illustrated previously published papers, here brought together; but I cannot find any such papers referred to in Bibl. Zool.

Burnmoor Rectory,
Dec. 16, 1893.



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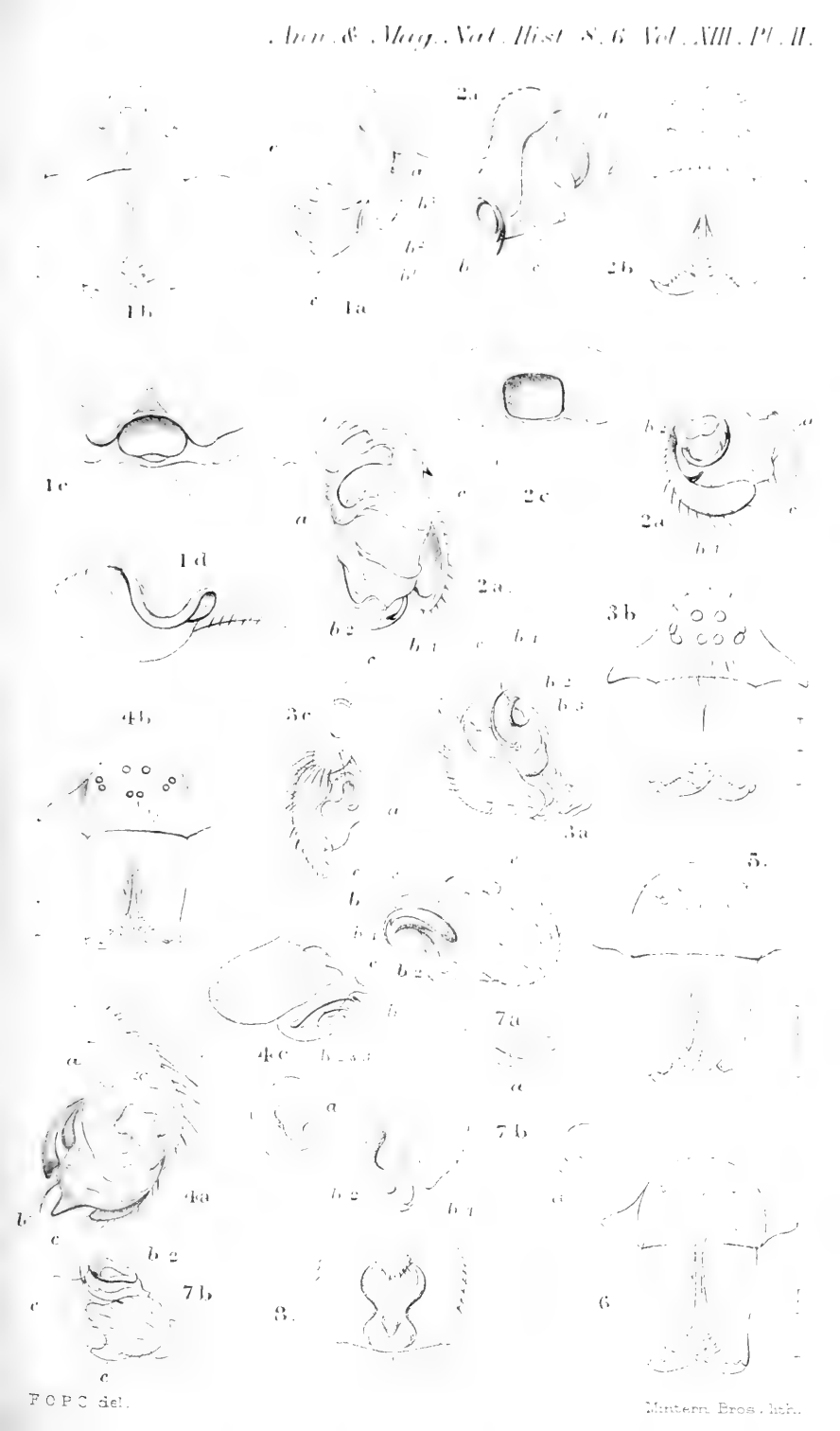
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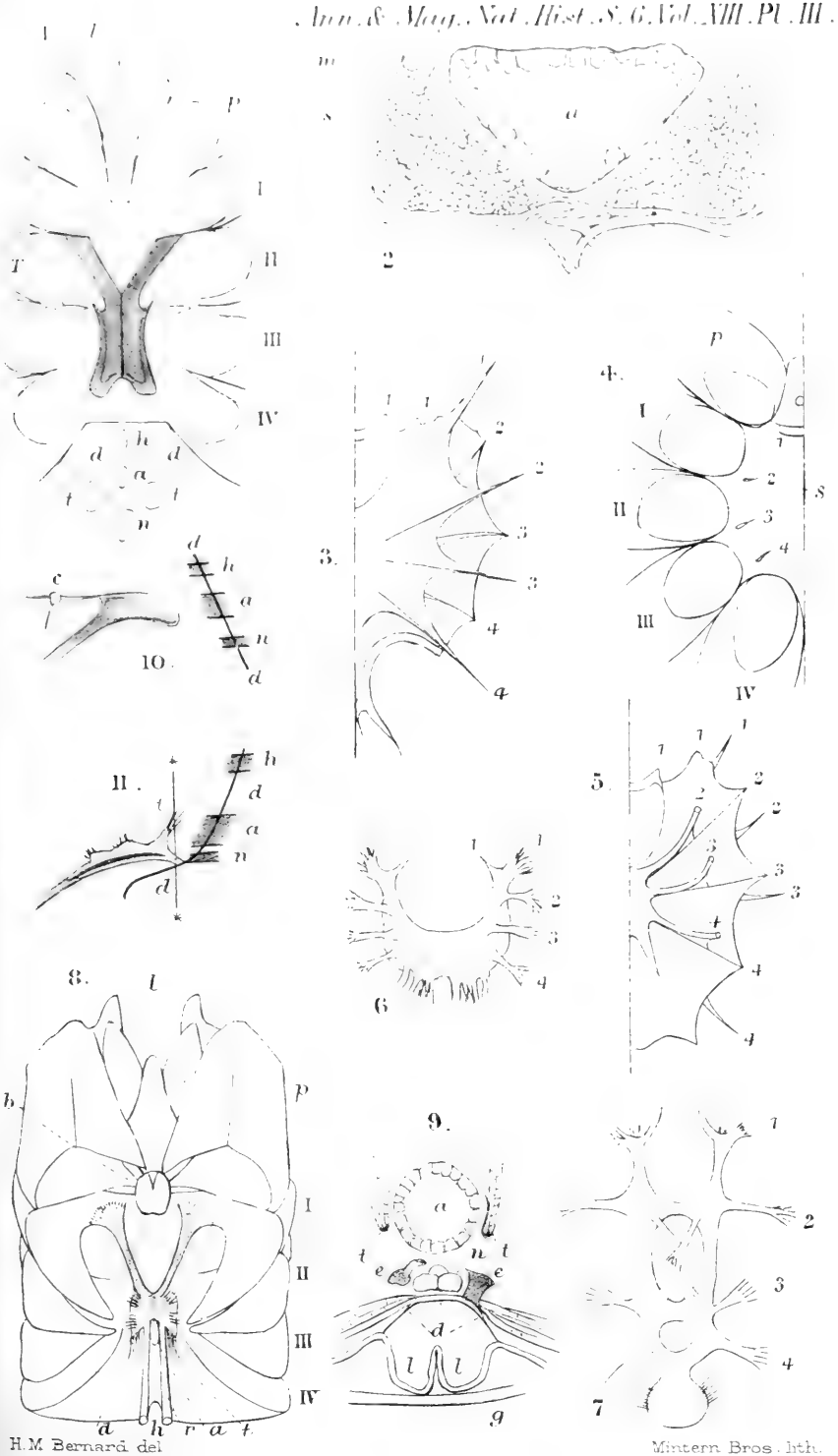
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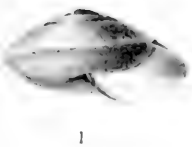
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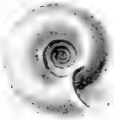
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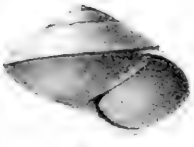
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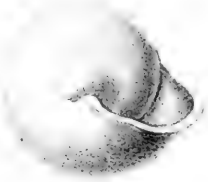
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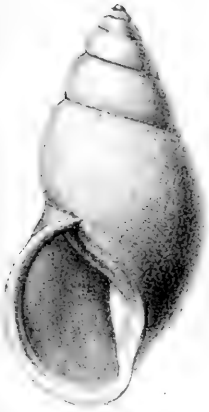
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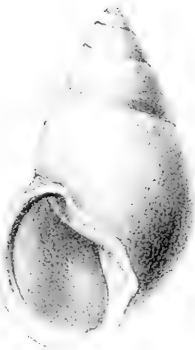
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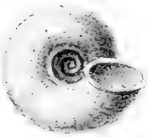
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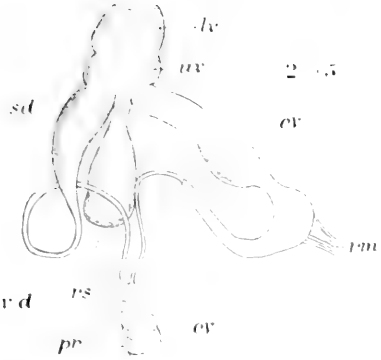

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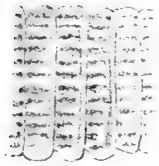

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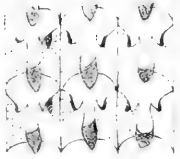

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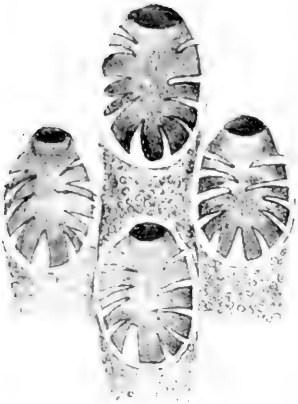

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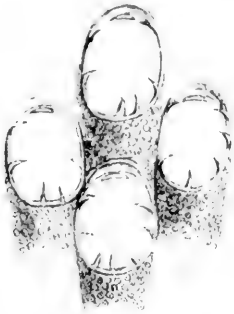

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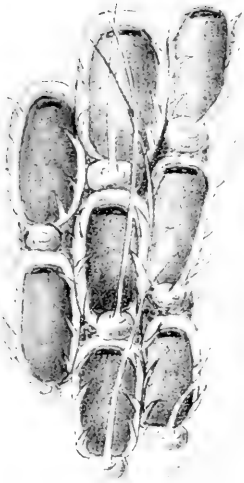

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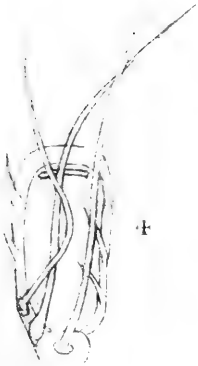

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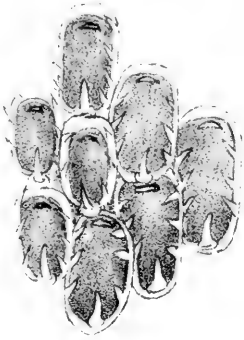

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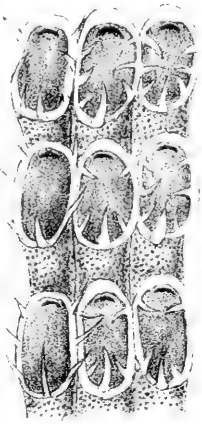

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 74. FEBRUARY 1894.

XIV.—*On some new and rare Crustacea from Scotland.* By THOMAS SCOTT, F.L.S., Naturalist to the Fishery Board for Scotland, and ANDREW SCOTT.

[Plates VIII. & IX.]

A CONSIDERABLE quantity of material (mostly marine), obtained by dredging and shore-collecting, has been examined by us during the past few months. The material was from various places in the Moray-Firth district and from the Firth of Forth. The examination of the material has yielded a number of species of rare and interesting Crustacea, and especially of Copepoda, and descriptions, with suitable drawings, of these are being prepared; those we now propose to record comprise five species of the Harpacticidæ and two of Ascomyzontidæ, with notes on a few other apparently rare forms.

Harpacticidæ.

Amymone nigrans *, sp. n. (Pl. VIII. figs. 1–7.)

Length ·4 millim. ($\frac{1}{62}$ of an inch). The ventral edge of the first body-segment is truncate and sinuate, and the free portion of its posterior edge slightly crenate; the ventral edge of the posterior body-segments is produced into four irregular tooth-like processes (fig. 1). The two male postero-ventral processes (*a*, *a*) are more acutely angular than those of the male of *Amymone sphærica*, Claus. The anterior antennæ (antennules) are seven-jointed; in those of the female the

* *Nigrans*, blackish.

first joint is considerably longer than any of the others, the second to the fifth joints gradually decrease in length, while the penultimate joint is about one third of the length of the preceding one and half the length of the next; the formula shows the proportional lengths of the joints—

$$\frac{15 . 11 . 9 . 7 . 6 . 2 . 5}{1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7}.$$

In the male antennæ the third and fifth joints are much shorter than either of the joints that precede or follow them, and the sixth and seventh, which are subequal, are each fully twice the length of the fifth. Posterior antennæ nearly as in *Amymone sphærica*. Mandibles and maxillæ also somewhat similar to those of that species, but the second joint of the mandible-palp is proportionally considerably longer, while the mandible is armed with longer apical teeth. The anterior foot-jaws are provided with a claw-like terminal spine, and the marginal process at the base of the last joint bears two spiniform terminal setæ. The posterior foot-jaws resemble those of *Amymone sphærica*, but the interior edge of the last joint is not so densely fringed with hairs. The outer branches of the second and third pairs of swimming-feet are two-jointed (fig. 4), and of the fourth pair three-jointed; the first joint of the outer branches of the fourth pair is much shorter than either the second or third joints, and a strong spiniform seta springs from the inner edge and near the middle of the last joint; the length of this spiniform seta is at least equal to the whole of the outer branch (fig. 5); the first and second joints of the inner branches are nearly of equal length and shorter than the last joint; the only setæ on the inner branches of the fourth pair are—one on the inner margin near the distal end of the second joint, and three (two terminal and one subterminal) on the last joint. The basal joint of the fifth pair in the female is broadly foliaceous, the inner margin is rounded and bears three short plumose setæ, while the apex is somewhat oblique and angular and armed with two stout spiniform setæ; the secondary joint is narrow and extends to the apex of the basal joint, and is furnished with three stout hairs on the outer edge and a small terminal hair. The male fifth foot has no secondary joint, it is long and very narrow and slightly curved, and furnished with three marginal and two terminal setæ; one of the terminal setæ is much longer than the other. Colour irregularly diffused, dark cinereous, nearly black in some parts, as at the posterior end.

Hab. Cromarty Firth, near Invergordon, frequent. The

bottom here, in mid-channel, is composed largely of irregular lumps of hardened mud, formed of the agglutinated tubes of a species of *Sabella*. Some of this mud was dredged and carefully washed; the water in which the mud was washed was then passed through a muslin sieve, and when the contents of the sieve were afterwards transferred to a bottle of sea-water numbers of the little *Amymone nigrans* appeared as blackish specks swimming about, and their peculiar movements characteristic of this remarkable genus formed an interesting study.

Remarks. Though *Amymone nigrans* does not agree with any described species known to us, it is yet possible that it may be the form ascribed by Boeck to *Amymone sphærica*, Claus, and which he described as having the outer branches of the swimming-feet two-jointed. It is supposed by some authors that Boeck has somehow mistaken the number of joints in the outer branches, because the outer branches of the second and third as well as of the fourth pair of swimming-feet in *Amymone sphærica* are all three-jointed, and certainly the Scottish specimens of what we believe to be that species have three-jointed outer branches to the second and third pairs; but the discovery of *Amymone nigrans* will tend to show that Boeck's description may be right after all, and that the mistake was made in ascribing to *Amymone sphærica*, Claus, a form that was probably quite distinct from that species. But, whatever be the explanation, there can be no doubt that the form we have here described as *Amymone nigrans* has the outer branches of the second and third pair of feet in both sexes two-jointed.

In all the specimens of *Amymone sphærica* examined by us we observe that each stylet is furnished with a broad lancet-shaped seta, the breadth of each seta at the widest part being equal to about two fifteenths of the length. We have not observed these peculiar setæ on any other species of *Amymone*.

Ameira exilis *, sp. n.

(Pl. VIII. figs. 18–20; Pl. IX. figs. 1–3.)

Body elongate, slender. Length 1·4 millim. ($\frac{1}{18}$ of an inch). Anterior antennæ of the female nine-jointed, somewhat longer than the first body-segment and sparingly setiferous, and with the seventh and eighth joints very small; the lengths of the joints are nearly as shown in the formula—

13	18	13	10	8	9	3	3	12
1	2	3	4	5	6	7	8	9

* *Exilis*, slender.

The male anterior antennæ are ten-jointed, and the last six are more or less modified for grasping; the sixth and seventh joints are very short, but the others are of moderate length. Mandibles elongate, narrow, and with an oblique tooth-apex; the basal part of the mandible-palp is considerably dilated, while the secondary joint is narrow and furnished with one marginal and four terminal setæ. Maxillæ and foot-jaws nearly as in *Ameira longipes*. The first pair of swimming-feet are elongate and somewhat like those of *Ameira longipes*, but the first joint of the inner branches is only about one sixth longer than the combined lengths of the second and third joints; while the outer branches reach to near the middle of the second joint of the inner ones (Pl. IX. fig. 2). In the female the inner branches of the next three pairs reach to about the middle of the second joint, and are scarcely equal to half the length of the elongate outer branches; in the male the inner branches of the third pair reach to the end of the second joint of the outer branches, and each of the three joints is rather longer and narrower than the joint that precedes it, while the last joint, besides being furnished with four long plumose marginal setæ, is armed with a terminal spine (Pl. IX. fig. 3). The basal joint of the fifth pair in the female is broadly triangular, and its blunt-pointed apex bears five setæ, the second one of which, counting from the outside, is very long, being more than double the length of the seta on either side of it; the secondary joint is oblong-ovate, its greatest breadth being equal to about two fifths of the length; there are five setæ of variable length, ranged at intervals from the middle of the exterior margin to the apex, in addition to a very long intero-subapical seta; the apex of the basal joint reaches to about the middle of the secondary one (Pl. VIII. fig. 19). The fifth pair in the male are smaller than those of the female, and both joints are proportionally shorter and broader, and want the very long setæ of the female fifth pair. Caudal stylets shorter than the last abdominal segment and broadly pyriform; the principal tail-setæ are as long as the abdomen.

Hab. Obtained by washing some black sandy mud near low-water mark at Seafield, in the vicinity of Leith, Firth of Forth.

Remarks. *Ameira exilis* somewhat resembles *Ameira longipes*, Boeck, but is larger and more slender, and the proportional lengths of the joints of the female anterior antennæ differ considerably in the two species; they also differ in the proportional lengths of the branches of all the swimming-feet.

Stenhelia dispar *, sp. n. (Pl. VIII. figs. 8–12.)

Length ·55 millim. ($\frac{1}{1\frac{8}{5}}$ of an inch). Rostrum prominent. Anterior antennæ eight-jointed; the first four joints are robust, the next three are small, and the last is comparatively long and narrow, being equal to the combined lengths of two preceding joints. The formula shows the proportional lengths of the joints—

$$\frac{27 \cdot 19 \cdot 13 \cdot 14 \cdot 6 \cdot 9 \cdot 8 \cdot 18}{1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8}.$$

The secondary branch of the posterior antennæ is three-jointed, the first being nearly equal to twice the combined lengths of the other two. The mouth-organs are nearly as in *Stenhelia ima*, Brady. The first four pairs of swimming-feet also somewhat resemble those of that species. The fifth pair are broadly foliaceous, like those of *Stenhelia hispida*, Brady, but the distance between the various setæ with which they are furnished is greater in *Stenhelia dispar*. Abdomen and caudal stylets nearly as in *Stenhelia ima*.

Hab. Vicinity of the Bass Rock, Firth of Forth, dredged in 23 fathoms; bottom sand and gravel.

Remarks. *Stenhelia dispar* appears to be intermediate between *Stenhelia ima* and *Stenhelia hispida*; it resembles *Stenhelia ima* in the form of the first four pairs of swimming-feet and *Stenhelia hispida* in the form of the fifth pair, but differs from both in the structure of the anterior antennæ.

Cletodes irrasa †, sp. n. (Pl. VIII. figs. 13–17.)

Length ·8 millim. ($\frac{1}{3\,0}$ of an inch). Body elongate-cylindrical, all its segments except the first furnished with a transverse fringe of small hairs a little in front of the posterior margin. Anterior antennæ stout and sparingly setiferous, shorter than the first body-segment, six-jointed; the second and last joints are longer than any of the others, while the fifth joint is very small, as shown by the formula—

$$\frac{20 \cdot 26 \cdot 20 \cdot 10 \cdot 3 \cdot 24}{1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6}.$$

Posterior antennæ three-jointed, the first and second joints are nearly of equal length and about one and a half times the length of the next; a very small secondary branch bearing

* *Dispar*, different, *i. e.* from any known species.

† *Irrasus*, unshaven.

a single apical seta springs from the end of the first joint. Mandibles stout, the biting part armed with short blunt-pointed teeth, except at the lower angle, where there is a moderately long conical tooth. The inner branches of the first pair of swimming-feet are composed of two nearly equal joints, and reach to about the middle of the second joint of the outer branches; they are also furnished with two short spiniform apical setæ; the first joint of the outer branches is somewhat longer and the second joint shorter than either of the other two joints. The inner branches of the fourth pair consist of two nearly equal joints bearing a few short setæ, the extremity of these branches does not reach to the end of the first joint of the outer branches; the outer branches are elongate, and the second joint is shorter and the third somewhat longer than either of the other two. The basal joint of the fifth pair forms a broad shallow lobe, bearing one short and two long setæ, the inner one being spiniform and plumose; the secondary joint is elongate-narrow, being about four times longer than broad and furnished with four unequal setæ at the apex and one near the proximal end of the outer margin. Caudal stylets slender and as long as the last abdominal segment; each stylet bears two small setæ on the inner margin, one on the outer margin, and three or four at the apex.

Hab. Vicinity of the Bass Rock.

Remarks. Cletodes irrasa belongs to a group the distinguishing character of which is the more or less nearly obsolete basal joints and the elongate and narrow secondary joints of the fifth pair of thoracic feet, and *Cletodes limicola*, Brady, may be considered the type of this group. The form of the fifth pair in this group presents a marked difference to the fifth pair in those other species of the same genus that have both the basal and secondary joints well developed, as, for example, in *Cletodes linearis*, Claus.

Thalestris forficuloides, sp. n. (Pl. IX. figs. 4–9.)

Length ·73 millim. ($\frac{1}{34}$ of an inch). Anterior antennæ in the female nine-jointed and provided with long slender setæ; the joints gradually decrease in length from the second to the fifth, while the sixth joint is one and a half times longer than the fifth and equal to the combined lengths of the next two; the last joint is as long as the sixth; the proportional lengths are as shown in the formula—

$$\frac{15 \cdot 18 \cdot 13 \cdot 10 \cdot 8 \cdot 11 \cdot 6 \cdot 5 \cdot 11}{1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8 \quad 9}.$$

The secondary branches of the posterior antennæ are composed of two moderately long joints; the first joint is provided with a plumose seta at the distal end and the second with two marginal setæ near the base and three at the apex; all the setæ are plumose. Posterior foot-jaws stout, the last joint somewhat ovate, its greatest breadth being equal to fully half the length; it is furnished with a comparatively long slender seta near the middle of the inner margin, and the terminal claw reaches to beyond the proximal end of the joint to which it is attached. The first pair of swimming-feet have the inner branches slender and considerably longer than the outer ones; the outer branches are only about two thirds the length of the inner; the inner terminal claw of both branches is very slender and elongate, and, like the others, only slightly curved at the extremity. The second, third, and fourth pairs are somewhat like those of *Thalestris forficula*, Claus, but the proportional lengths of the joints are slightly different; in the fourth pair the last joint of the inner branches is only equal to three fourths of the combined lengths of the first and second joints; the inner branches of the third pair in the male are armed with a spiniform and slightly hooked claw-like terminal appendage (fig. 7). The basal joints of the fifth pair are broadly triangular and the apex reaches to near the middle of the secondary joints; the inner and outer margins are fringed with small close-set hairs, the basal joints are also each furnished with five plumose setæ of unequal length arranged round the distal end—one at the apex, one on the outer margin, and three on the inner margin; the apical seta is considerably longer than any of the others; the outer secondary joints are subcylindrical, fringed with small close-set hairs on both margins, and furnished with eight setæ—three on the distal half of both the outer and the inner margins, and two at the apex; the inner apical seta and the one on the inner margin next to it are much longer than any of the others; there are only two small spiniform apical setæ on the basal joint of the fifth pair in the male. Abdomen and caudal stylets nearly as in *Thalestris forficula*.

Hab. Among mud near low-water mark at Seafield, in the vicinity of Leith, Firth of Forth.

Remarks. This species somewhat resembles *Thalestris forficula*, Claus, but differs in the following among other particulars:—The anterior antennæ (the antennules) are nine-jointed, and the sixth and last joints are each of them equal to the combined lengths of the seventh and eighth and of greater length than either of the fourth or fifth. The inner branches of the first pair of swimming-feet are very long and slender,

while the outer branches are only equal to two thirds the length of the inner ones. It also differs in the proportional lengths of the other thoracic feet, as shown by the description and figures.

Ascomyzontidæ.

*Dermatomyzon gibberum**, sp. n. (Pl. IX. figs. 10–14.)

Length ·5 millim ($\frac{1}{50}$ of an inch). Cephalothorax very tumid, broadly obovate or pear-shaped, the forehead being regularly and boldly rounded; the first body-segment is more than half the entire length of the cephalothorax and abdomen combined, and its breadth is about one and one sixth times the length; the abdomen is very short, and, including the caudal stylets, is scarcely equal to one fourth of the length of the cephalothorax. Anterior antennæ stout, seventeen-jointed, but the second joint from the base appears to be formed of two (or three) coalescent joints; the proportional lengths of the joints are shown by the formula—

40	(19	10	7)	8	10	12	16	9	9	16	12	12	12	12	16	18	8	26
1		2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17.

The mandibles are stylet-shaped, stout, and elongate; the mandible-palp consists of a single oblong joint, the length of which is rather greater than twice the breadth, and three stout, moderately long, and nearly equal setæ spring from its truncate apex. The maxillæ are composed of two parts of nearly equal length; the one part (the primary) is sub-triangular in form and furnished with three apical setæ, while the other (the secondary part) is narrow, cylindrical, and provided with four setæ at the apex (fig. 13). The basal joint of the anterior foot-jaws is stout, but the end joint is slender and curved and forms a claw-like appendage. The posterior foot-jaws are nearly as in *Dermatomyzon nigripes* (Brady and Robertson). The swimming-feet are also somewhat similar to those of that species: the fifth pair are simple, two-jointed; the first joint is short, and its breadth is about equal to twice the length, it also bears a seta at the upper distal angle; the second joint is longer and narrower than the first, its breadth being only equal to half the length, and it is furnished with two setæ at the apex. The caudal stylets are nearly as long as broad, and equal to the combined lengths of the last two abdominal segments.

* *Gibberum*, hunch-backed.

Hab. Vicinity of the Bass Rock, Firth of Forth. Hitherto only one specimen, a female, has been obtained.

Remarks. The proportionally large and tumid cephalothorax gives this species a curious and striking appearance, that at once distinguished it from any of the other Copepoda observed by us. It possesses all the characters of a *Dermatomyzon*, except that the anterior antennæ are apparently only seventeen-jointed; the second joint, however, is probably composed of three coalesced joints, so that the difference in this respect is trifling. It differs also in the abdomen being composed of only three instead of four segments, and so far it agrees more closely with *Asterocheres*, Boeck, than with *Dermatomyzon*, Claus. The Forth specimen would thus appear to form an intermediate link between these two genera, but with a closer affinity to the last.

Acontiophorus elongatus, sp. n. (Pl. IX. figs. 15–20.)

Length 1 millim. ($\frac{1}{25}$ of an inch). Cephalothorax and abdomen elongate; the abdomen slender and equal to about two thirds the length of the cephalothorax. Anterior antennæ slender, seventeen-jointed; the fourth, fifth, sixth, and eighth joints are shorter, and the first and last longer than any of the other joints; the formula shows their proportional lengths—

24	12	14	6	6	6	9	6	8	14	12	13	13	14	14	14	24
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

The posterior antennæ are three-jointed, and a very small secondary branch springs from near the end of the elongate basal joint; end joint small, and furnished with a long, slightly curved, and slender terminal spine and a small marginal seta. Mandibles extremely long and slender, being about equal in length to the elongate siphon; the siphon, which reaches to near the end of the cephalothorax, consists of two slender filaments of equal length, one of which has a ring-like structure and is armed with a small apical stylet; the basal part of the siphon is stout and cone-shaped, and encloses for some distance the proximal ends of the filaments (fig. 18). Maxillæ two-branched—one branch stout and conical in shape, and furnished with one short and two long setæ; the other branch narrow, not half the length of the first, and bearing three setæ of unequal length. Anterior and posterior foot-jaws somewhat like those of *Acontiophorus scutatus*, Brady and Robertson; but the last two joints of the posterior foot-jaws are proportionally much longer than

in that species. The swimming-feet are also somewhat similar to those of *Acontiophorus scutatus*, but the fourth pair has remarkably broad and stout dagger-shaped spines on the exterior margins of the outer branches, as well as broad sabre-like terminal spines on both outer and inner branches; the setæ on the inner margins of both branches are also densely plumose. The fifth pair of feet consists each of a single broadly elliptical joint, which is furnished with three apical setæ (fig. 20). The first or genital segment of the abdomen is equal to twice the length of the next, and three and a half times longer than the third segment. Caudal stylets very short; they are each provided with two moderately long plumose terminal setæ in addition to a few small hairs.

Hab. Vicinity of the Bass Rock, Firth of Forth, frequent.

Remarks. The species now described is an easily recognized one, because of its being more slender and having a longer abdomen than any other of the described species. It agrees with *Acontiophorus armatus*, Brady, in having the anterior antennæ seventeen-jointed (though sixteen joints is the number stated in the description of *Acontiophorus armatus* in 'British Copepoda,' the figure shows seventeen joints). The posterior antennæ have only one long and slender spine at the apex instead of the "two lancet-shaped" apical spines that form one of the generic characters; but otherwise the Forth species now described is a true *Acontiophorus*.

Stenhelia hirsuta, I. C. Thompson.
Stenhelia denticulata, I. C. Thompson.

These two distinct species have been obtained by us during the past summer in material from the Firth of Forth, dredged two or three years ago. They have not been previously recorded for the east of Scotland.

Nannopus palustris, Brady.

This apparently rare Copepod has recently been obtained in material collected by hand-net in 1891, at the mouth of the "Cocklemill Burn" near Largo, Firth of Forth.

Pseudanthessius Sauvagei, Canu.

This interesting addition to the British fauna was obtained in dredged material from the "Fluke Hole" off St. Monans, Firth of Forth. Only two specimens have as yet been obtained.

Sunaristes paguri, Hesse.

A single specimen (a male) of this rare and curious species was captured in the Cromarty Firth in September last; it occurred in material dredged near Invergordon, and although it was not taken on a hermit-crab, or in the shell occupied by a hermit-crab, several hermit-crabs were observed in the same material in which it was obtained. The Cromarty Firth specimen measures 2·3 millim. ($\frac{1}{11}$ of an inch). The terminal claws with which the powerful anterior antennæ are armed are of a dark horn-colour, and so also are the large spines on the inner branches of the second pair of swimming-feet. *Longipedina paguri*, W. Müller, is very likely the same species as that described by Hesse; and in fact our specimen agrees better with Müller's figures than with those of Hesse; but we have adopted Hesse's name as having priority over that of W. Müller.

AMPHIPODA.

Harpinia crenulata, Boeck.

A few specimens of this *Harpinia* have been obtained in the Moray Firth and in the Firth of Forth. The more prominent and distinctive characters of the species appear to be the following:—The second-last pair of pereiopods are very long, and, when bent backwards, extend considerably beyond the body of the animal; the posterior expansion of the basal joint of the last pair of pereiopods has the margin irregularly serrate and furnished with several comparatively long hairs; and the last pair of epimeral plates of the metasome have the lower distal angles rounded and furnished posteriorly with a single small tooth or with two or three small teeth of unequal size. But the long second-last pair of pereiopods seem to be in themselves a very obvious character, and one by which the species may be readily distinguished.

Amphilochoides pusillus, G. O. Sars.

Several specimens of this Amphipod have been obtained by us in material from the Firth of Forth and from St. Andrews Bay. The Forth specimens were dredged in the vicinity of the Bass Rock in twenty-two to twenty-three fathoms. This species is readily distinguished from *Amphilochoides odontonyx* (Boeck), which has already been recorded for the Forth, by the absence of a basal tooth on the claws, or *dactyli*, of the first gnathopods, and by the inner margin of the hand of the same gnathopods being distinctly angular;

the palm of the second gnathopods is finely serrate only on the distal half, while the proximal half is even or nearly so and bears a few minute setæ. The postero-lateral angles of the last epimeral plates of the metasome are also simply angular, and not produced posteriorly into a tooth-like projection as in *Amphilochoides odontonyx*.

Metopa robusta, G. O. Sars.

A few specimens of this interesting species were dredged this summer in deep water in the Moray Firth; it was easily distinguished by the structure of the gnathopods, the form of the large fourth pair of coxal plates, and by the very robust posterior pereiopods; the posterior part of the meros of these pereiopods, and especially of the seventh pair, is greatly developed. The contrast between the feeble and slender first pair of gnathopods and the powerful second pair is very marked in this species.

So far as we know, the three Amphipods just referred to do not appear to have been previously recorded as British.

Additional Note.

Cletodes monensis, I. C. Thompson.—In our paper in the 'Annals and Magazine of Natural History' for October last we recorded the occurrence of this Copepod in the Moray Firth, and in doing so we inadvertently called it *Laophonte monensis* instead of *Cletodes monensis*.

Stephos minor, T. Scott.—This genus and species were described and figured in the 'Tenth Annual Report of the Fishery Board for Scotland (1892).' Dr. W. Giesbrecht, in a paper recently published by him *, refers to this genus and identifies it with the genus *Mobianus* described in his new and great work on the Pelagic Copepoda of the Gulf of Naples. He makes a few remarks on the question of priority, and appears to be in doubt as to whether *Stephos* or *Mobianus* was published first. As the result of personal investigation and inquiry we are now able to say that we quite agree with Dr. Giesbrecht as to the identity of the two genera; but the species from the Gulf of Naples is, we think, different from that from the Firth of Forth, additional specimens of which have been recently obtained by us. As

* "Mittheilungen über Copepoden," von Dr. W. Giesbrecht (Abdruck aus den Mittheilungen aus der Zoologischen Station zu Neapel, 11 Band, 1./2. Heft) p. 102.

to the question of priority, we find that the 'Tenth Annual Report of the Fishery Board for Scotland,' in which *Stephos* is described, was published on September 22nd, 1892, and that Dr. Giesbrecht's work on the Pelagic Copepoda of the Gulf of Naples, in which *Mobianus* is described, and which bears the date 1892, was published on January 26th, 1893.

EXPLANATION OF THE PLATES.

Plate VIII.

Amymone nigrans, sp. n.

Fig. 1. Male, seen from the side, × 80. 2. Anterior antenna, female, × 190. 3. Mandible and palp, × 380. 4. Foot of third pair, × 170. 5. Foot of fourth pair, × 170. 6. Foot of fifth pair, female, × 253. 7. Foot of fifth pair, male, × 190.

Stenhelia dispar, sp. n.

Fig. 8. Female, seen from the side, × 70. 9. Anterior antenna, female, × 380. 10. Foot of first pair, × 190. 11. Foot of fourth pair, × 127. 12. Foot of fifth pair, female, × 253.

Cletodes irrasa, sp. n.

Fig. 13. Female, seen from above, × 70. 14. Anterior antenna, female, × 253. 15. Foot of first pair, × 506. 16. Foot of fourth pair, × 506. 17. Foot of fifth pair, female, × 380.

Ameira exilis, sp. n.

Fig. 18. Female, seen from the side, × 36. 19. Foot of fifth pair, female, × 127. 20. Abdomen and caudal stylets, × 40.

Plate IX.

Ameira exilis, sp. n.

Fig. 1. Anterior antenna, female, × 100. 2. Foot of first pair, × 127. 3. Foot of third pair, male, × 84.

Thalestris forficuloides, sp. n.

Fig. 4. Female, seen from the side, × 54. 5. Anterior antenna, female, × 190. 6. Foot of first pair, × 190. 7. Foot of third pair, male, × 127. 8. Foot of fifth pair, female, × 127. 9. Abdomen and caudal stylets, × 53.

Dermatomyzon gibberum, sp. n.

Fig. 10. Female, seen from above, × 80. 11. Anterior antenna, × 253. 12. Mandible, × 304. 13. Maxilla, × 304. 14. Foot of fifth pair, × 253.

Acontiophorus elongatus, sp. n.

Fig. 15. Female, seen from above, × 48. 16. Anterior antenna, × 190. 17. Mandible, × 152. 18. Siphon, × 152. 19. Foot of fourth pair, × 127. 20. Foot of fifth pair, × 253.

XV.—*A Month on the Trondhjem Fiord.*

By the Rev. Canon Norman, M.A., D.C.L., F.R.S., &c.

[Continued from p. 133.]

GEPHYREA.

1. *Bonellia viridis*, Rolando.

1822. *Bonellia viridis*, Rolando, Mem. d. Reale Accad. d. Sc. di Torino, vol. xxvi. p. 539, pl. xiv. figs. 1–3, pl. xv. figs. 5–7.
1840. *Bonellia viridis*, H. Milne-Edwards, Règ. Anim. édit. Crochard, Zoophytes, pl. xxi. fig. 3.
1852. *Bonellia viridis*, Schmarda, Denks. Ak. der Wiss. Wien, vol. iv. p. 117, pls. iv.–vii.
1858. *Bonellia viridis*, Lacaze-Duthiers, Ann. Sc. Nat. Zool. sér. 4, vol. x. p. 49, pls. i.–iv.
1875. *Bonellia viridis*, Kowalewsky, "Du mâle planariforme de la *Bonellia*," traduit par J. C. Catta *, Rev. Sci. Nat. de Dubreuil, vol. iv. p. 313, pl. vii.
1885. *Bonellia viridis*, Selenka, Report Gephyrea 'Challenger,' p. 9, pl. ii. figs. 7–10, ♂.

Five specimens, dredged in 250–300 fath. at Rödberg, the largest being rather more than an inch long exclusive of proboscis. I had previously seen Norwegian specimens in the Christiania Museum, and it has been recorded from the Bergen district, 100 fath., by Koren and Danielssen ('Fauna litt. Norv.' part iii. 1877, p. 151). I think that this Norwegian form may prove to be distinct from *B. viridis*.

2. *Phascolosoma squamatum*, Kor. & Dan.

1868. *Phascolosoma olivaceum*, M. Sars, "Forsatte Bemærk. over det dyriske Livs Udbredning i Havets Dybder," Vidensk.-Selsk. Förhand. p. 258 (name only).
1877. *Phascolosoma squamatum*, Koren & Dan. Fauna litt. Norv. pt. iii. p. 130, pl. xiii. fig. 11, pl. xiv. figs. 14, 15.
1883. *Phascolosoma squamatum*, Selenka, Reisen Archip. Philippinen, Die Sipunculiden, p. 40.
1885. *Phascolion squamatum*, Selenka, Report 'Challenger' Gephyrea, p. 15, pl. iv. figs. 18, 19.

I do not follow Selenka in removing this species to the genus *Phascolion*, seeing it does not agree with *Phascolion* in its habit, for it lives free and not in shells, and consequently it has not the attaching papillæ characteristic of that genus, from which also it differs in the much more coiled intestinal tube.

* The original paper was published in Russian in 1870.

Trondhjem and Rödberg, 150–300 fath. I have also taken it in the Hardanger and Kors Fiords; Koren and Danielssen record it from the latter and from Bergen Fiord. By the 'Porcupine' Exped., 1869, it was taken off the south-west of Ireland and near the *Holtenia*-ground—and it is thus a British species—and in the chops of the British Channel. It was again taken by the 'Triton' near the "*Holtenia*-ground."

3. *Phascolion strombi*, Montagu.

Var. *tuberculosum*, Théel.

1876. *Phascolion tuberculosum*, Théel, "Géph. inermes de Skand. Spitsberg et Grönland," K. Svenska Vet.-Akad. Hand. vol. iii. p. 15 (separate copy), pl. i. fig. 1, pl. iii. fig. 16.
1877. *Phascolosoma strombi*, var. *verrucosum*, Kor. & Dan. Fauna litt. Norv. pt. iii. pp. 141 and 154.
1883. *Phascolion strombi*, var. *verrucosum*, Selenka, Reisen Archip. Philipp., Die Sipunculiden, p. 52.

Several specimens of this variety at Rödberg; the type was not found.

4. *Onchnesoma Steenstrupii*, Kor. & Dan.

1859. *Sipunculus pyriformis*, Danielssen, Vidensk.-Selsk. Förhand. Christ. 1859, p. 251 (quoted from Dan. & Kor.; I have not this paper, but suppose the species was not described).
1868. *Phascolosoma pusillum*, M. Sars, "Forsatte Bemærk. over det dyriske Livs Udbredning i Havets Dybder," Vidensk.-Selsk. Förhand. p. 252 (name only).
1877. *Onchnesoma Steenstrupii*, Dan. & Kor. Fauna litt. Norv. pt. iii. p. 142, pl. xx. figs. 28–36.
1884. *Onchnesoma Steenstrupii*, De Man, Bülow, and Selenka, Reisen Arch. Philipp., Sipunculiden, pt. ii. p. 130.
1892. *Onchnesoma Steenstrupii*, Shipley, Quart. Journ. Micr. Sci. n. s., vol. xxxiii. p. 233, pl. ix.

Trondhjem and Rödberg, 150–300 fath. I have also found it at Dröbak, in the Christiania Fiord, and in the Bergen and Hardanger Fiords.

PANTOPODA.

In 'Den Norske Nordhavs-Expedition,' XX. Pycnogonoidea, G. O. Sars, 1891, will be found everything that could be desired in the way of description and illustration of all the following species.

1. *Pycnogonum crassirostre*, G. O. Sars.

The three specimens from which this species was described

by Prof. Sars were found by him mixed with *N. littorale* collected from many Norwegian localities, and he was unable to give a particular habitat. I have found *N. crassirostre* in the following localities:—Trondhjem Fiord, in about 70 fath.; Kors Fiord, which is the entrance to Bergen Fiord, 180 fath.; and in two places in the Hardanger Fiord, namely off Midso Lighthouse, 50–100 fath., and Stoksund, 80–100 fath.

2. *Anoplodactylus petiolatus*, Kröyer.

1863. *Pallene attenuata*, Hodge, Ann. & Mag. Nat. Hist. ser. 3, vol. xi. p. 463; Trans. Tyneside Nat. Field-Club, vol. v. 1863, p. 281, pl. xv. figs. 1–5.
1864. *Phoxichilidium petiolatum*, Hodge, Ann. & Mag. Nat. Hist. ser. 3, vol. xiii. p. 4; Trans. Tyneside Nat. Field-Club, vol. vi. 1864, p. 199 (name only, making his *P. attenuata* its synonym).
1864. *Pallene pygmæa*, Hodge, Ann. & Mag. Nat. Hist. ser. 3, vol. xii. pl. xiii. figs. 16, 17; Trans. Tyneside Nat. Field-Club, vol. vi. 1864, p. 198, pl. v. figs. 16, 17.
1881. *Phoxichilidium longicolle*, Dohrn, Faun. und Flor. des Golfes von Neapel, Die Pantopoden, p. 177, pl. xiii. figs. 1–8.
1881. *Phoxichilidium exiguum*, id. ibid. p. 181, pl. xii. figs. 19–22.
1882. *Phoxichilidium pygmæum*, Hoek, "Nouvelles études sur les Pycn.," Arch. de Zool. exp. et gén. vol. ix. p. 514, pls. xxvi. and xxvii. figs. 22–25.

A single typical specimen in Laminarian zone, Trondhjem Fiord.

A specimen of *P. longicolle*, Dohrn, from Naples, identified by Dohrn *, is certainly *A. petiolatus*.

Specimens received at the same time from Naples of *P. exiguum*, Dohrn, are certainly the same as *Pallene pygmæa*, Hodge, with the type specimen of which, now in the Newcastle Museum, I have compared them; and *Phoxichilidium pygmæum*, Hoek, is proved by his drawings to be the same thing. This form I also have from the Spanish coast, kindly sent to me by Señor Pedro Antiga. The question remains, Is *Pallene pygmæa*, Hodge, the immature state of *A. petiolatus*? I think so. The specimens are very small—Hodge's type, length of body 1 millim.; the Spanish specimen the same; Naples specimens in my collection the same; and Dohrn writes "Länge des Körpers 1 mm." in his description, though in explanation of plate we have "natural size 1½ mm." In favour of this small form being a distinct species is the shortness of the cephalic segment and the fact that Dohrn figures an

* I conclude that this was the case, as the Neapolitan species here mentioned were sent to me from the Zoological Station by Dr. Dohrn's kind directions very soon after the completion of his Monograph.

egg-bearing male, and Hoek found three such specimens. On the other hand, it is not uncommon for animals to be sexually mature before they have attained their full development. It seems easy to account for the more frequent occurrence of the smaller than the larger specimens. This species, like *Phoxichilidium coccineum*, undergoes its metamorphosis within the bodies of Hydrozoa; these small specimens (*P. pygmæa*) cannot have long left that shelter, but they have now reached a period of life when they would be exposed to constant danger, and thus comparatively few would live to maturity. The length of the cephalic segment might be expected to increase with growth; except in the difference of this organ the resemblance of the two is most exact. The terminal joints of the legs are identical in their armature; the propodos, which is narrower in proportion to its length with increasing growth, has the spines quite similar, and, above all, there is the "*thin undivided lamina*" occupying the distal portion of the palm, beyond the "row of small anteriorly curved spines." This thin, perfectly transparent, undivided lamina is, I believe, unique, and constitutes a peculiar specific character of *Anoplodactylus petiolatus*.

I have also examined two type specimens in Hodge's collection labelled "*Pallene attenuata*, Seaham, 1862," and "*Phoxichilidium petiolatum*, Seaham, 1863." They are both the present species.

3. *Nymphon mixtum*, Kröyer.

Three specimens in shallow water at Rödberg. I have dredged it also in 100 fathoms off Huglen Island in the Hardanger Fiord.

4. *Nymphon leptocheles*, G. O. Sars.

In 150–250 fathoms at Rödberg. I have also taken it with the last in the Hardanger Fiord; at Florö, in 25–50 fath., and at Dröbak in Norway; and it was procured by the 'Porcupine' Exped., 1879, Stat. 47 *a*, lat. 59° 34′ N., long. 9° 18′ W., in 542 fathoms.

5. *Nymphon Strömii*, Kröyer.

This large species is very frequently met with in the Trondhjem, Bergen, and Hardanger Fiords. It is usually taken in 15–30 fath., but I have dredged it once in 100 fath.

6. *Nymphon macrum*, Wilson.

Among Alcyonarians and corals on the precipices at Rödberg, in 150–250 fath.

7. *Chætonymphon spinosissimum*, nom. nov., = *Chætonymphon spinosum*, G. O. Sars (? *Nymphon spinosum*, Goodsir).

Rödberg and Trondhjem; also in several places in the Hardanger Fiord, in 120–190 fath.; 'Porcupine' Exped., 1869, Stat. 64, lat. 61° 21′ N., long. 3° 44′ W., and Stat. 65, near the same spot, in 640 and 345 fath.; Stat. 78, lat. 60° 14′ N., long. 4° 30′ W., 290 fath.; Stat. 88, lat. 59° 26′ N., long. 8° 23′ W., 705 fath. It also occurs on the western side of the Atlantic, since a specimen, kindly sent to me from the U. S. Nat. Mus. as "*Nymphon hirtipes*, Bell, ♀," is this species; the bottle containing this *Nymphon* had three other labels relating to the specimen—"Albatross, 2488," "lat. 44° 35′ 0″ N., long. 57° 13′ 30″ W., 150 fathoms," and the number "10984"*.

The above habitats would seem to show that this is usually a deep-water form. Professor Sars thought it might be *N. spinosum*, Goodsir, but I am of opinion that it can scarcely be that species. The only *Chætonymphon* from the British coast that I have seen is *N. hirtum*, Kröyer, and of this species I have specimens from the Firth of Forth, whence Goodsir procured his *N. spinosum*.

The following list of habitats of *N. hirtum*, Kröyer, will show how widely diffused that species is on our coast:—

In my own collection:—Shetland; Cullercoats, Northumberland (*A. M. N.*); Aberdeenshire (*late Mr. R. Dawson*); Firth of Forth (*Dr. Henderson*). And on examination of Mr. Hodge's collection in the Newcastle Museum I find *C. hirtum* from several localities off the Durham and Northumberland coasts in depths ranging from 10–100 fath.

Undoubtedly Sars, relying on Goodsir's rough figures, was right in regarding them as more like his *N. spinosum* than *N. hirtum*; but, taking into consideration the circumstances I have mentioned, I do not think we are justified on the evidence of those figures in admitting the species described by Sars into the British fauna, but must regard them as referable to *C. hirtum*.

* This does not affect *N. hirtum* or *hirtipes*, E. B. Wilson, which Sars rightly refers to the true *N. hirtipes*, Bell. This is proved by examples in my collection of "*N. hirtum*" received from the late Mr. Wilson and labelled "Off Halifax, 35 f. U. S. F. C. 1877, Loc. 118," which are the true *N. hirtipes*, Bell.

CRUSTACEA.

I have in an earlier part of this paper made a few remarks on the higher Crustacea of the north of Europe and the Arctic seas, and shown that the proportionate number of Brachyura and Anomura rapidly decreases as we approach the Arctic Ocean. The following is the list of species in the Trondhjem Fiord which have been either recorded by Herr V. Storm, the Curator of the Trondhjem Museum, who has done much dredging, or found by myself:—

Cancer pagurus, *Linn.*
Carcinus mænas, *Linn.*
Portunus depurator, *Linn.*
Hyas araneus, *Linn.*
Inachus dorsettensis, *Penn.*
—— coarctatus, *Leach.*
Stenorhynchus rostratus, *Linn.*
Lithodes maia, *Linn.*
Eupagurus pubescens, *Kröyer.*
—— Bernhardus, *Linn.*
Galathea strigosa, *Linn.*
—— squamifera, *Fabr.*
Galathodes tridentatus, *Esmark.*
Munida rugosa, *Fabr.*
—— tenuimana, *G. O. Sars.*

It is not likely that this list can in the future be materially extended, since the only species which have been met with to the north of Trondhjem and not already found there are *Galathea nexa*, Embleton, and *Galathea intermedia*, Lilljeborg.

I have drawn up the annexed Table, which is intended to show the distribution of all the higher Crustacea known on the coasts of Norway, including Finmark. In the Brachyura and Anomura, a glance will show as the eye passes over the first ten columns how the number of species dies out northwards, while the well-filled columns after the tenth testify to the large proportion of the Norwegian forms which occur southwards. Passing on to the Macrura we come upon many species which are not known southwards, while correspondingly the Arctic columns are more filled in. The gaps in the southern columns among the Schizopoda and Cumacea are yet more conspicuous, partly because Professor G. O. Sars has paid so much attention to these on the Norwegian coast, partly also because very many of the species are deep-water forms, living below 100 fathoms, which are not likely to be found in the shallower water which occurs round Sweden, Denmark, and Britain.

The list of species is, with a few alterations in nomenclature and some additions made from the discoveries of the Norwegian North-Atlantic Expedition, copied from that of Sars, given in his 'Oversigt af Norges Crustaceer,' 1882.

The distribution of species has been filled in from all the leading books and papers on the Crustacean fauna of the seas

referred to; and in every case I have indicated the authority on which the species are marked in the particular columns.

N. indicates that the species has been found or identified by myself. It does not apply to any species which, though in my collection, have been received from those whose authority is recognized in this table. There is an exception in the British column, where N. stands for those forms which I have identified whether collected by myself or others. In this way are notified the following Mysidea and Cumacea which have recently been added to our fauna by Mr. Thomas Scott, the energetic naturalist of the Scotch Fishery Board:—*Erythrops Goësii*, *E. elegans*, *Petalomera declivis*, *Campylaspis rubicunda*, and *C. costata*. Two species in this column have not previously been recorded as British:—*Mysideis insignis*, G. O. Sars, of which I have found a specimen, from a dredging I took in 112 fathoms off Valentia, Ireland, in 1870; and *Campylaspis sulcata*, G. O. Sars, dredged by me in 1885 off Little Cumbrae, in the Firth of Clyde.

Authorities relied on in the Table.

Columns 1–6.—Norway (including Finmark).

A. Aurivillius (C. W. S.). "Hafsevertebrater från nordlicaste Tromsö Amt och Vestfinmarken." Svenska Vet.-Akad. Hand. vol. ii. 1866.

Bk. Boeck (A.). As mentioned by G. O. Sars in paper from which the following list of species is taken.

Bv. Bovallius (C.). "Anmärkninger om Portunidslägtet Thranites," Œfvers. af K. Vet.-Akad. Förhand. Stockholm, 1881, p. 9.

Da. Danielssen. 'Beretning om en Zool. Reise, 1857,' 1859; and Danielssen and Boeck (A.), 'Besk. af nogle til Crustacea Decapoda henhörende Norske Arter,' 1872.

Dü. Von Düben. *Fide* G. O. Sars (see below).

S. Sars (G. O.). Whose very numerous papers have been carefully consulted.

MS. Sars (Michael). "Overs. over de i den Norsk-arctiske Region forekommende Krybsdyr," Videns.-Selsk. Förhand. 1858.

ISS. Schneider (I. Sparre). 'Unders. af dyrelivet i de arktiske fjorde: II. Crustacea og Pycnog. indsamlede i Knænangsfjorden,' 1851–1855.

VS. Storm (V.). 'Kong. Norske Videns.-Selsk. Skrifter,' Trondhjem, 1879, p. 109.

Column 7.—Greenland.

H. Hansen (H. J.). "Oversigt over det vestlige Grönlands Fauna af malakostraka Havskrebsdyr," Vidensk. Meddel. fra den Foren. i Kjöbh. 1887.

Columns 8 and 9.—Iceland and Spitsbergen.

S. Sars (G. O.). These columns are filled in from the table of distribution in 'Den Norske Nordhavs-Exped. 1876–78, Crustacea, ii.,' 1886, p. 83.

Column 10.—Kara Sea.

H. Hansen (H. J.). 'Oversigt over de paa Dijmphna-Togtet indsamlede Krebsdyr,' 1886.
S. Sars (G. O.). From the same source as in columns 8 and 9.
Sx. Stuxberg (A.). "Faunan på och Kring Novaja-Semlja," 'Vega' Exped. Vetenskapliga Iakttagelser, vol. v. 1886.

Column 11.—Sweden.

G. Goës. "Crust. decap. podoph. marina Succiæ etc. enumerat A. Goës," Œfvers. af K. Vet.-Akad. Förhand. 1863.

Column 12.—Denmark.

M. Meinert (Fr.). "Crustacea, Isopoda, Amphipoda, et Decapoda Daniæ," Naturhist. Tidsskrift, 3de Rækkes, vol. xi. 1877, p. 57, vol. xii. 1880, p. 465; 'Det Videnskabelige Udbytte af Kanonbaaden 'Hauchs' Togter, III. Crustacea Malacostraca,' 1890.

Column 13.—British Isles.

Kin. Kinahan (J. R.). Nat. Hist. Review, vol. vi. 1858, Proc. Societies, p. 40.
B. Bell. 'Brit. Stalk-eyed Crustacea.' *Cf.* G. O. Sars, "Overs. af Norges Crustaceer, I.," Vid. Selsk. Förhand. Christ. 1882, p. 43, pl. i. fig. 4.
G. Goodsir (H.). *Vide* Bell, 'Brit. Stalk-eyed Crustacea,' p. 326.

Column 14.—Mediterranean.

C. Carus (V.). 'Prodromus Faunæ Mediterraneæ,' vol. i. 1885.

Column 15.—North-east America.

Sm. Smith (S. I.). "Stalk-eyed Crustaceans of the Atlantic Coast of North America, north of Cape Cod," Trans. Connect. Acad. vol. v. 1879, p. 27.

Table of Distribution of the Higher Crustacea of Norway.

	Norway.														
	1. South Norway.	2. West Norway to lat. 62° N.	3. Lat. 62° N. to Arctic Circle.	4. Arctic Circle to West Finmark.	5. West Finmark.	6. East Finmark.	7. Greenland.	8. Iceland.	9. Spitsbergen.	10. Kara Sea.	11. Sweden.	12. Denmark.	13. British Isles.	14. Mediterranean.	15. N.E. America.
CRUSTACEA.															
BRACHYURA.															
Cancer pagurus, *Linn.*	S	N	VS	MS	..	..	..	..	..	..	G	M	N	C	
Perimela denticulata, *Mont.*	S	N	Du	..	..	..	..	..	..	..	G	M	N	N	
Xantho hydrophila, *Herbst*,=X. rivulosa, *Risso*	S	S	..	..	..	..	..	..	..	..	G	M	N	N	
Geryon tridens, *Kröyer*	S	S	..	..	..	..	..	..	..	..	G	M	N	C	
Carcinus mænas, *Linn.*	S	N	VS	S	MS	..	..	..	..	..	G	M	N	C	Sm
Portunus arcuatus, *Leach*	S	..	..	..	..	..	..	..	..	..	G	M	N	N	
—— pusillus, *Leach*	..	N	..	..	..	..	..	..	..	..	G	M	N	N	
—— depurator, *Linn.*	..	N	N	..	..	..	..	..	..	..	G	M	N	N	
—— holsatus, *Fabr.*	S	..	..	..	..	..	..	..	..	..	..	..	N	C	
Bathynectes superba, *O. G. Costa*,=Thranites velox, *Bovall.*	..	Bv	..	..	..	..	..	..	..	..	..	..	N	C	
Atelecyclus septemdentatus, *Mont.*	..	S	Du	..	..	..	..	..	..	..	..	..	N	N	
Pinnotheres pisum, *Linn.*	S	..	..	..	..	..	..	..	..	..	G	M	N	N	
—— veterum, *Bosc*	..	Bk	..	..	..	..	..	..	..	..	..	M	N	N	
Ebalia tumefacta, *Mont.*	S	..	MS	..	..	..	..	..	..	..	G	..	N	N	
—— tuberosa, *Penn.*	..	..	S	..	..	..	..	..	..	..	..	..	N	N	
—— Cranchii, *Leach*	S	N	..	..	..	..	..	..	..	..	G	M	N	C	
Eurynome aspera, *Penn.*	S	N	..	..	..	..	..	..	..	..	G	M	N	N	
Hyas araneus, *Linn.*	S	N	VS	MS	MS	..	N	S	S	S	G	M	N	..	Sm

Inachus dorsettensis, *Penn.*	..	N	..	..	..	..	..	..	..	..	G	M	N	N	
—— dorynchus, *Leach*	S	S	..	..	..	..	..	..	..	..	G	M	N	C	
Stenorhynchus rostratus, *Linn.*	S	N	VS	Da	..	MS	..	..	..	..	G	M	N	C	
ANOMURA.															
Lithodes maia, *Linn.*	S	N	VS	S	MS	N	H	..	..	..	G	M	N	..	Sm
Eupagurus Bernhardus, *Linn.*	S	N	S	Da	MS	MS	..	..	..	..	G	M	N	C (?)	Sm
—— Prideauxii, *Leach*	S	S	S	..	..	..	..	..	..	..		M	N	C	
—— pubescens, *Kröyer*, =E. Kröyeri, *Stimp.*	..	N	N	S	S	N	N	S	S	H	G	M	N	..	Sm
—— meticulosus, *Roux*, =P. tricarinatus, *Norman*	..	..	S	..	..	..	..	..	..	..	..	..	N	N	
—— cuanensis, *Thomp.*, =P. Lucasi, *Heller*	S	N	..	..	..	..	..	..	..	..	G	M	N	N	
Anapagurus lævis, *Thomp.*	..	N	..	..	..	..	..	..	..	..	..	M	N	N	
—— chiroacanthus, *Lillj.*, =P. ferrugineus, *Norman*	S	N	S	..	..	..	..	..	..	..	G	M	N		
Porcellana longicornis, *Linn.*	S	N	..	..	..	..	..	..	..	..	G	M	N	N	
Galathea strigosa, *Linn.*	S	N	N	..	MS	..	..	..	..	..	G	M	N	C	
—— squamifera, *Fabr.*	S	..	VS	..	..	..	..	..	..	..	G	M	N	C	
—— nexa, *Embleton*	S	N	..	S	A	..	..	..	..	H	G (?)	M	N		
—— dispersa, *Bate*	S	N	..	..	..	..	..	..	..	..	..	..	N	N	
—— intermedia, *Lillj.*	S	N	Da	S	..	..	..	..	..	..	G	M	N	N	
Galathodes tridentatus, *Esmark*	..	N	N	S	..	..	..	..	..	..	G				
Munida rugosa, *Fabr.*	S	N	VS	S	S	..	..	..	..	..	G	..	N	C	
—— Rondeletii (*Bell*), *G. O. Sars*	S	..	..	..	..	..	..	..	..	..	..	..	B		
—— tenuimana, *G. O. Sars*	..	S	VS	S	..	..	..	..	..	..	..	..	N	C	
MACRURA.															
Calocaris Macandreæ, *Bell*	S	N	N	S	..	..	..	..	..	..	G	M	N	..	Sm
Gebia stellata, *Mont.*, =G. littoralis, *Risso*	S	..	..	..	..	..	..	..	..	..	G	M	N	N	
Astacus fluviatilis, *Rond.*	S	..	..	..	..	..	..	..	..	..	..	M			
Homarus vulgaris, *Bell*	N	N	..	..	..	..	..	..	..	..	G	M	N	C	
Nephrops norvegicus, *Linn.*	..	N	..	..	MS	..	..	..	..	..	G	M	N	C	
Crangon vulgaris, *Linn.*	S	N	S	S	..	N	..	..	..	..	G	M	N	C	Sm
—— Allmanni, *Kinahan*	..	N	S	S	S	..	..	..	..	..	..	M	N		
Cheraphilus echinulatus, *M. Sars*, =C. serratus, *Norman*	S	S	..	..	..	..	..	..	..	..	..	..	N		
—— nanus, *Kröyer*	S	N	N	..	..	..	..	..	..	..	G	M	N		

Table of Distribution of the Higher Crustacea of Norway.

	1. S. Norway.	2. W. Norway to lat. 62° N.	3. Lat. 62° N. to Arct. Cir.	4. Arct. Cir. to W. Finmark.	5. W. Finmark.	6. E. Finmark.	7 Greenland.	8. Iceland.	9. Spitsbergen.	10. Kara Sea.	11. Sweden.	12. Denmark.	13. Brit. Isles.	14. Mediter.	15. N.E. Amer.
Cheraphilus neglectus, *G. O. Sars*	S	N	N										N		
Sclerocrangon boreas, *Phipps*	..	..	..	S	ISS	N	N	S	S	S	..	..	..	..	Sm
—— ferox, *G. O. Sars*	..	..	S	..	..	..	H	..	..	Sx	..	..	..	..	
Pontophilus spinosus, *Leach*	S	N	MS	..	..	..	..	..	..	..	G	M	N	C	
—— norvegicus, *M. Sars*	S	N	S	S	S	S	H	..	..	..	G	M	N	..	Sm
Sabinea septemcarinata, *Sab.*	..	S	..	S	ISS	N	N	S	S	Sx	..	..	N	..	Sm
—— Sarsii, *S. I. Smith*	..	..	S	..	..	..	H	..	..	..	..	..	..	..	Sm
Nika edulis, *Risso*	..	S	..	..	..	..	..	..	..	..	..	M	N	N	
Athanas nitescens, *Leach*	S	S	..	..	..	..	..	..	..	..	G	M	N	N	
Spirontocaris Gaimardi, *M.-Edw.*	S	N	N	S	S	N	N	S	S	Sx	G	M	N	..	Sm
—— polaris, *Sabine*, = H. cultellata, *Norman*	S	N	N	N	S	N	N	..	S	H	..	..	N	..	Sm
—— grœnlandica, *J. C. Fabr.*	..	..	S (?)	..	..	..	N	..	..	..	..	..	..	..	Sm
—— spinus, *Sars*	..	..	S	..	S	Da?	N	..	S	..	G	M	N	..	Sm
—— securifrons, *Norman*	S	N	N	S	ISS	N	..	..	..	..	..	M	N	..	Sm
—— turgida, *Kröyer*	..	..	..	S	ISS	N	N	..	S	H	G	..	..	..	Sm
—— Cranchii, *Leach*	S	N	..	..	..	..	..	..	..	..	G	M	N	N	
—— pusiola, *Kröyer*	S	N	N	S	ISS	N	..	..	S	..	G	M	N	..	Sm
Hippolyte varians, *Leach*	S	N	S	S	..	..	..	..	..	..	G	M	N	C	
—— fascigera, *Gosse*	S	S	..	..	..	..	..	..	..	..	..	M	N		
Bythocaris Payeri, *Heller*	..	..	..	S											
—— simplicirostris, *G. O. Sars*	..	..	N	S	..	..	..	..	S						
Cryptocheles pygmæa, *G. O. Sars*	..	N	N	S											
Pandalus brevirostris, *Rathke*	S	N	N	S	..	..	..	..	..	..	G	M	N	C	
—— annulicornis, *Leach*	S	N	S	S	ISS	Da	H	S	..	..	G	M	N	..	Sm
—— propinquus, *G. O. Sars*	..	N	VS	S	..	..	..	..	..	..	..	..	N	..	Sm
—— leptorhynchus, *Kinahan*	S												Kin		
—— borealis, *Kröyer*	S	N	S	S	S	..	H	..	S	H	G	M	..	..	Sm

—— Fabricii, *Rathke*, ?=P. Leachii, *Bell*	S	..	..	..	..	..	..	..	..	..	..	G	M	N	..	
Pasiphæa tarda, *Kröyer*,=P. norvegica, *M. Sars*	MS	S	N	MS	..	..	H	..	..	..	..	M	..	..	Sm	
—— sivado, *Risso*	MS	N	..	..	..	..	..	..	..	..	..	..	N	N		
Hymemodora glacialis, *Buchholz*	..	S	..	S	..	..	S									
? Synhimatites typicus, *Dan. & Boeck*	..	..	Da													
Sergestes Meyeri, *Metzger*	..	..	VS													
SCHIZOPODA.																
Lophogaster typicus, *M. Sars*	S	N	..	..	..	..	..	..	..	..	..	..	N	N		
Nyctiphanes norvegica, *M. Sars*	S	S	S	S	S	S	H	..	..	..	G	M	N	..	Sm	
Euphausia pellucida, *Dana*,=Thysanopoda bidentata, *G. O. Sars*	..	..	S													
Boreophausia Raschii, *M. Sars*	S	..	..	..	..	..	H	..	..	..	..	..	N			
—— inermis, *Kröyer*	..	..	S	S	IS	S	H	..	S	H	..	M	N	..	Sm	
Thysanoessa neglecta, *Kröyer*,=T. borealis, *G. O. Sars.*	..	..	S	S	S	S	H	..	..	..	..	..	N	..	Sm	
—— longicaudata, *Kröyer*,=T. tenera, *G. O. Sars*	..	..	S	S	..	S	N	..	..	..	..	M	N			
Boreomysis arctica, *Kröyer*	S	S	..	S	..	..	H									
—— tridens, *G. O. Sars*	..	..	N	S												
—— megalops, *G. O. Sars*	..	S	..	..	S											
Erythrops Goësii, *G. O. Sars*	S	N	S	S	IS	S	N	..	..	S	Sx	G	M	N	..	Sm
—— elegans, *G. O. Sars*,=E. pygmæa, *G. O. Sars*	S	S	S	..	..	..	..	..	..	..	..	..	N	S		
—— microphthalma, *G. O. Sars*	S	S	..	S	S											
—— serrata, *G. O. Sars*	S	N	S	S	S		..	..	..	..	..	M	N			
—— abyssorum, *G. O. Sars*	S	..	..	S	S	N	..	..	..	H						
Pseudomma roseum, *G. O. Sars*	..	N	N	S	S	..	..	..	..	..	..	M	..	..	Sm	
—— affine, *G. O. Sars*	..	N	N	S												
—— truncatum, *S. I. Smith*	..	..	..	..	..	S	..	..	S	H	..	..	..	..	Sm	
Parerythrops obesa, *G. O. Sars*	S	N	S	S	S											
—— abyssicola, *G. O. Sars*	..	S	N	S	S	S										
—— robusta, *S. I. Smith*	..	..	..	S	..	S	..	..	S	H	..	..	..	..	Sm	
—— spectabilis, *G. O. Sars*	..	..	S													
Amplyops abbreviata, *G. O. Sars*	S	S	S	S	..	..	H									
Mysidopsis didelphys, *Norman*	S	N	S	S	..	..	..	..	..	..	..	M	N			
—— gibbosa, *G. O. Sars*	S	S	S	..	..	..	..	..	..	..	..	M	N	N		
—— angusta, *G. O. Sars*	S	S	S	..	..	..	..	..	..	..	..	..	N	S		

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	1. S. Norway.	2. W. Norway to lat. 62° N.	3. Lat. 62° N. to Arct. Cir.	4. Arct. Cir. to W. Finmark.	5. W. Finmark.	6. E. Finmark.	7. Greenland.	8. Iceland.	9. Spitsbergen.	10. Kara Sea.	11. Sweden.	12. Denmark.	13. Brit. Isles.	14. Mediter.	15. N.E. Amer.
Siriella norvegica, *G. O. Sars*	S	N	..	..	..	..	..	..	..	..	..	..	N	N	
Leptomysis gracilis, *G. O. Sars*	S	S N	..	..	..	..	..	..	..	..	..	..	N N		
—— lingvura, *G. O. Sars*	S	S N	..	..	..	..	..	..	..	..	..	..	N N		
Mysideis insignis, *G. O. Sars*	S	S	N	S	..	..	..	..	..	..	..	..	N N		
Stilomysis grandis, *Goës*	..	..	S	..	S	S	..	..	S	..	..	..	..		
Heteromysis lamornæ, *Couch*	..	..	S	S	..	S S	..	..	..	..	G	M	N	N	
—— abyssicola, *G. O. Sars*	S	S	..	S	..	..	..	..	..	..	..	..	..		
Gastrosaccus spinifer, *Goës*	S	S	S	..	..	..	..	..	..	..	G	M	N		
Macromysis flexuosa, *Müll.*	S	S N	S	..	..	..	..	..	..	..	G	M	N N		
—— neglecta, *G. O. Sars*	S	S N	..	S	..	..	..	..	..	..	..	M	N N		
—— inermis, *Rathke*	S	N	N	S	I S	N	..	..	..	..	G	M	N		
Schistomysis spiritus, *Norman*	S	S	..	..	..	..	..	..	..	..	..	M	N N		
—— ornata, *Goës*	S	N	N	S	..	..	..	..	..	..	..	M	N		
Mysis oculata, *Fabr.*	S	..	..	..	I S	N	H	S	S	N	..	..	..	..	Sm
—— relicta, *Lovén*	S	..	..	..	..	..	..	..	..	..	G	..	N	..	Sm
—— mixta, *Lilljeb.*	S	..	S	N	I S	N	H	S	..	..	G	M	..	..	Sm
Neomysis vulgaris, *Thomp.*	S	..	S	..	M	..	..	..	..	..	G	M	N		
Chiromysis formosa, *S. I. Smith*, =C. norvegica, *G. O. Sars*	..	S	..	..	..	..	..	..	..	..	..	..	N	..	Sm
Mysidella typica, *G. O. Sars*	..	S													
—— typhlops, *G. O. Sars*	..	S													
CUMACEA.															
Cuma scorpioides, *Mont.*, =C. pusilla, *G. O. Sars*	S	..	S	..	..	..	..	..	..	..	..	M	N	S	

—— Edwardsii, *Goodsir*	S	S	..	..	..	..	..	..	..	..	..	..	G	N	
Cyclaspis longicaudata, *G. O. Sars*	..	N	..	S	..	..	..	..	..	..	..	..	N		
Iphinoë trispinosa, *Bate*	S	..	..	..	..	..	..	..	..	..	..	M	N		
Lamprops fasciata, *G. O. Sars*	S	..	N	N	..	N	..	..	..	..	..	M	N		
—— fuscata, *G. O. Sars*	..	..	..	S	ISS	N	H								
Hemilamprops rosea, *Norman*	N	N	N	S	..	N	..	..	..	..	..	M	N		
—— assimilis, *G. O. Sars*	..	..	..	..	..	S									
—— uniplicata, *G. O. Sars*	..	N	S	S	S										
—— cristata, *G. O. Sars*	..	N	N	S											
Platyaspis typica, *G. O. Sars*	..	S	..	S											
Leucon nasicus, *Kröyer*	N	N	N	S	ISS	N	H	..	..	Sx	..	M	N	..	Sm
—— nasicoides, *Lilljeborg*	S	S	..	S	S	..	H	..	..	..	..	M	..	..	Sm
—— fulvus, *G. O. Sars*	..	..	S	S	..	..	..	S	S	..	..				
—— acutirostris, *G. O. Sars*	S	..	N	..	..	..	..	..	..	..	..	M			
—— pallidus, *G. O. Sars*	S	S	N	S	..	..	..	..	S						
Eudorella truncatula, *Bate*,=E. inermis, *Meinert*, ♂	S	N	N	..	..	N	..	..	..	..	..	M	N		
—— emarginata, *Kröyer*	N	N	N	S	ISS	N	H	..	..	Sx	..	M	N	S	Sm
—— hirsuta, *G. O. Sars*	S	..	N	..	..	..	..	..	..	..	..	M			
Eudorellopsis deformis, *Kröyer*	..	S	..	..	..	..	H	S	..	..	..	M	N	..	Sm
Diastylis Rathkei *, *Kröyer*	N	N	..	S	ISS	N	N	..	S	N	..	M	N	..	Sm
—— cornutus, *Boeck*	N	N	N	S	..	..	..	..	..	..	..	M	N		
—— lucifer, *Kröyer*	S	S	N	S	S	..	..	..	..	..	..	M	N	..	Sm
—— rugosus, *G. O. Sars*,=D. strigata, *Norman*, ♂	N	N	N	..	..	..	..	..	..	..	..	M	N	N	
—— spinulosus, *Heller*	..	..	..	..	..	S	H	..	..	Sx					
—— echinatus, *Bate*	S	N	N	S	..	N	..	..	..	..	..	M	N		
—— Edwardsii, *Kröyer*	..	..	..	S	ISS	N	N	..	..	S					
—— Goodsiri, *Bell*	..	..	..	ISS	..	N	H	..	S	Sx					
—— tumidus, *Lillj.*	N	N	N	..	..	..	..	..	..	..	..	M	N		
—— lævis, *Norman*	S	..	..	..	..	..	..	..	..	..	..	M	N		
—— serratus, *G. O. Sars*	N	N	N	S	S	..	..	..	..	..	..	M			
—— biplicatus, *G. O. Sars*,=D. lamellosa, *Norman*	N	N	N	S	..	..	..	..	..	..	..	M	N		

* Aurivillius (*l. c.*) records *Diastylis ambigua*, Lilljeborg, and *Diastylis* 4-*plicata*, Lilljeborg, from Finmark. I do not know where these are described.

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Diastylis resimus, *Kröyer*	..	..	N	..	..	N	H	..	S	Sx	..	M			
Leptostylis longimanus, *G. O. Sars*	N	..	..	..	..	..	..	..	..	..	..	M	..	..	Sm
—— macrurus, *G. O. Sars*	..	..	S	S	S	..									
—— villosus, *G. O. Sars*	S	S	..	S	..										
—— ampullaceus, *Lillj.*	N	..	N	S	S	..	..	..	..	..	..	M	..	..	Sm
Pseudocuma cercaria, *J. van Ben.*, = Cuma bella, *Meinert*	S	..	..	S	..	..	..	..	..	..	..	M	N	N	
Petalomera declivis, *G. O. Sars*	..	..	..	..	..	S	..	..	S	..	..	..	N	..	
Cumella pygmæa, *G. O. Sars*, = Cuma agilis, *Norman*	S	..	S	..	..	..	..	..	..	..	..	..	N	S	
Campylaspis rubicunda, *Lilljeborg*	S	S	S	S	..	N	N	..	..	..	..	M	N	..	Sm
—— affinis, *G. O. Sars*	..	..	..	S	..	..	..	..	..	..	..	..	..	..	
—— costata, *G. O. Sars*	N	N	N	S	..	..	..	..	..	..	..	..	..	..	
—— undata, *G. O. Sars*	..	..	..	S	..	..	..	..	..	..	..	..	N	..	
—— sulcata, *G. O. Sars*	..	N	..	S	..	..	..	..	..	..	..	..			
—— verrucosa, *G. O. Sars*	S	N	N	S											
—— horrida, *G. O. Sars*	..	S	N	S											

[To be continued.]

XVI.—*Description of a new Species of* Epiphora (Saturniidæ) *from Uganda.* By W. F. Kirby, F.L.S., F.E.S., Assistant in Zoological Department, British Museum (Natural History).

Epiphora Lugardi, sp. n.

Exp. $4\frac{1}{4}$ inches.

Female.—Upperside dark vinous red, with a very large subvitreous ocellus on each wing, surrounded by white and yellow rings, and, lastly, by a narrow black line. Anterior wings with the ocellus truncated on the basal side and slightly conical on the outer side; beyond it, but not touching it, runs a paler reddish line, nearly obsolete above, but slightly marked with whitish below, beyond which the ground-colour of the wing becomes rather lighter. The subapical ocellus is rather large, black, and oval, narrowly edged with white towards the base, and with the adjacent part dusted with blue; above it an irregularly zigzag line runs to the costa, bordered within by a lilac patch and without by a dull orange space dusted with red; there is also a smaller orange space below the ocellus; beyond this the hind margin is yellowish buff, but from the outer side of the upper orange patch descends a brown submarginal line, forming four deep curves inwards below the eye and also slightly indented on each of the nervures; the spaces between these curves, as well as beyond the eye and within the line below the last curve, are yellowish green.

Posterior wings with the large ocellus subrotund, the black outer ring wider, the pale curved line beyond more dusted with whitish and curved outwards on the inner margin. Hind margin buff, edged within by a black line, within which is a yellowish-green space, dentated on the inner side above and intersected by a series of long black nearly confluent spots.

Underside much paler, thickly dusted with white, and with a well-marked white line, edged within with blackish, beyond the ocelli, in place of the nearly obsolete line above. The outer part of the wings inclines to dull green, and on the anterior wings between the festoons, and on the posterior wings within the inner greenish-yellow submarginal band, are a series of white sagittate spots on each side of the nervures. Anterior wings with a buff space on the inner margin as far as the white line, bordered above with blackish. Posterior wing with the base of the costa white to the subcostal nervure.

Body too much injured to be described; but abdomen

probably with white bands; legs yellowish, thickly clothed; femora white beneath.

Taken by Capt. F. D. Lugard in Uganda.

Most nearly allied to *E. atbarinus*, Butler, from Abyssinia, but the more uniform colour, the absence of a distinct white patch on the base of the inner margin of the anterior wings above, and the almost obsolete pale line beyond the ocelli above, instead of the broad white one of *E. atbarinus*, will at once serve to distinguish this species.

XVII.—*Description of a new Species of* Hirdapa, *Moore, from Dinner Island, New Guinea, in the Collection of the British Museum.* By W. F. Kirby, F.L.S., F.E.S., Assistant in Zoological Department, British Museum (Natural History).

Hirdapa rezia.

Exp. ♂ $2\frac{5}{6}$, ♀ $3\frac{1}{12}$ inches.

Male.—Upperside. Anterior wings dark brown, shading into blackish towards the costa, and inclining to rufous brown towards the base and margins; from the base a large fawn-coloured blotch spreads over the wing from above the median nearly to the submedian nervure and above and between the two lower median nervules for half their length, the greater part of this outer portion being filled up with whitish. Below the lowest median nervule, and just before its middle, is an oval bluish-grey spot. A row of six violet-blue submarginal spots between the nervure to above the lowest median nervule, the middle ones smallest, the two nearest the costa marked with white.

Posterior wings dark brown, shading into rufous brown below the cell to the lower part of the hind and inner margins as far as the anal angle; apex dusted with white; a large buff costal patch spreading over the upper half of the cell, but not reaching its base or extremity.

Underside. Anterior wings brown; only the outer part of the fawn-coloured patch well marked; it is smaller and paler than above, and ends as a whitish blotch above the lowest median nervure. Below the median nervure, and for half the length below the lowest median nervule, the wing is pale buff, the place of the white spot above being marked by a narrow black oval outline; on the inner margin the wing is whiter on both sides of the submedian nervure as far as the anal

angle; submarginal spots smaller and whiter than above, the fifth obsolete.

Posterior wings uniform rufous brown.

Body dark brown, inclining to blackish in front, with a white spot behind each antenna; four spots at the back of the head; a white spot on each side of the thorax in front, and diverging crests of grey hair on the front of the thorax above; sides of the head and thorax and base of the wings spotted with white beneath.

Female.—Upperside. Anterior wings nearly as in the male, but the fawn-coloured patch much longer than in the male and not marked with white, except at the extremity, where the white suffusion forms a pear-shaped spot, covering the place of the sixth submarginal spot; the submarginal spots are larger and whiter than in the male, and are continued by a seventh, followed below by a short streak, above the submedian nervure; the fawn-coloured patch nearly extends here to the seventh spot; the white oval spot of the male is, of course, wanting.

Posterior wings rufous brown, darkest in the centre, dusted with grey along the costa, especially towards the tip, but with no buff space over the upper part of the cell.

Underside. Anterior wings rufous brown, the pale patch very large, fawn-coloured in and just below the cell, the rest mostly whitish as far as the inner margin, and along it nearly to the anal angle; of the submarginal spots, the two nearest the costa are represented as white dots, the sixth is large and connected by a neck with the outer part of the pale blotch, and there are two small white dots close together between the lowest median nervule and the submedian nervure.

Head, body, and base of wings below spotted with white nearly as in the male, two white streaks at the back of the pectus being particularly conspicuous, much more so than in the male.

Hab. Dinner Island (*H. O. Forbes*).

Allied to *Hirdapa usipetes*, Hewitson (*Euplœa usipetes*, Ex. Butt. ii., *Eupl.* t. i. fig. 4), but may be distinguished at once by the submarginal spots. Hewitson's type of *E. usipetes* is from New Guinea, and appears to be the same species as a series from Aru in the British Museum. All these are males, and the insect which Hewitson describes as the female is evidently *Sarobia Grayi*, Feld. I hope shortly to have an opportunity of figuring *H. rezia*.

XVIII.—*Descriptions of some new Species of Heterocera from Central America.* By Herbert Druce, F.L.S.

Fam. **Sphingidæ.**

Unzela, Walk.

Unzela pronoe, sp. n.

Male.—Primaries brown, very similar to those of *U. japix*, but without the distinct brown band that crosses the wing in that species; a small dark brown spot on the costal margin, and a larger dark brown patch at the anal angle: secondaries semihyaline pale brown, broadly bordered from the apex to the anal angle with dark brown. Palpi, head, and thorax dark brown; upperside of the abdomen pale brown; underside of the head, thorax, and abdomen white; antennæ and legs brown.—*Female* almost identical with the male, but with the primaries slightly paler in colour.

Expanse, ♂ $2\frac{1}{4}$ inches, ♀ $2\frac{4}{10}$ inches.

Hab. British Honduras, Belize (*Mus. Druce*); Panama, Chiriqui (*Trötsch*).

This species is allied to *U. japix*.

Chærocampa, Duponchel.

Chærocampa damocrita, sp. n.

Male.—Primaries dark brown, thickly marked with black streaks near the base and along the costal margin; a pale brown line extends from the base, partly along the inner margin and then crosses the wing to the apex; on both sides of the pale line are several narrow dark brown lines; a golden-brown mark just above the anal angle; the outer margin finely speckled with minute black dots: secondaries black, with a rather wide golden-brown submarginal band extending from the apex to the anal angle. Underside of both wings bright reddish brown, thickly irrorated with black scales. Head, thorax, and abdomen dark brown; the sides of the head and thorax fawn-colour; the sides of the abdomen streaked with golden brown.—*Female* very similar to the male, but larger, and with the black spots on the primaries more distinct.

Expanse, ♂ 3 inches, ♀ $3\frac{1}{2}$ inches.

Hab. Mexico, Jalapa (*M. Trujillo*).

This species is allied to *C. libya*.

Chærocampa potentia, sp. n.

Male.—Primaries pale fawn-colour, darkest along the costal margin from the base almost to the apex; the costal margin dark yellow; a small black dot at the end of the cell; a rather wide dark brown line extends from the base to about the middle of the inner margin and then crosses to the apex; the outer margin of the wing thickly irrorated with black scales; the fringe dark brown: secondaries dark brownish black; the inner margin, apex, and outer margin fawn-colour. Underside of both wings pale yellowish fawn-colour, thickly irrorated with brownish-black scales; the basal half of the primaries black. Head, thorax, and the upperside of the abdomen pale brown; the sides of the head, thorax, and underside of the abdomen pale brownish white; legs pale brown; antennæ above white, dark brown on the underside.

Expanse 4 inches.

Hab. Mexico (*in Mus. Staudinger*).

This species resembles *Chærocampa clotho*, Drury, but the brown line crossing the primaries is in a very different position. I have only seen the specimen in Dr. Staudinger's collection, which has no exact locality attached to it.

PSEUDOSPHINX, Burm.

Pseudosphinx crocala, sp. n.

Primaries dark brown; a few scales at the base; a wide band crossing the wing, about the middle, from the costal to the inner margin; the apex and outer margin dark grey, irrorated with brown scales; a zigzag black line extends from the apex, curving round to the costal margin; the fringe alternately brown and grey: secondaries dark brown, slightly greyish at the base. Underside brown, palest at the base of both wings. Head, thorax, and abdomen greyish brown; a row of black spots on each side of the abdomen; the underside of the thorax and abdomen white; legs pale brown; antennæ above grey, underside dark brown.

Expanse 4½ inches.

Hab. Honduras (*Wittkugel, in Mus. Staudinger*).

A very distinct species, quite unlike any other known to me.

Pseudosphinx morelia, sp. n.

Primaries greyish brown, irrorated with darker scales, and crossed from the costal to the inner margin with several zigzag narrow black lines; the centre portion of the wing,

from the costal margin almost to the inner margin, deep blackish brown; a rather wide curved black line at the apex, and a zigzag black line, extending from near the anal angle along the outer margin; fringe alternately black and grey: secondaries black, crossed from the costal to the inner margin by two greyish-white bands; the outer margin brownish grey, irrorated with black scales. Underside of both wings brown: secondaries with the pale bands very indistinct. Head and thorax black; front of the head and sides of the thorax greyish brown. Abdomen yellowish brown; the sides black, with a large yellow spot on each segment, below which is a row of small white spots. Underside grey-white. Antennæ pale greyish brown; legs black on the upperside, brown on the underside.

Expanse $5\frac{1}{2}$ inches.

Hab. Mexico, Orizaba (*Mus. Druce*).

Subfam. *Euchromiinæ*.

Eupyra, Herr.-Schäff.

Eupyra dama, sp. n.

Primaries greenish-bronze colour, pinkish along the inner margin from the base almost to the anal angle; the cell, three oval spots below and a large spot beyond crossed by the black veins, all hyaline: secondaries hyaline, the inner and outer margins broadly bordered with greenish bronze; the veins and fringes of both wings black. Underside similar to the upperside, but much blacker in colour. Head, thorax, abdomen, antennæ, and legs black; the collar spotted with white.

Expanse $1\frac{3}{4}$ inch.

Hab. Mexico, Orizaba (*in Mus. Druce*).

A very distinct species, not closely allied to any known to me.

Scena, Walk.

Scena propylea, sp. n.

Euchromia styx ?, var. ?, Walk. Cat. i. p. 264.

Hab. Mexico, Orizaba (*Mus. Druce*).

The type of *Zygæna styx*, Fabr., with which Walker placed this species, is in the Banksian collection in the British Museum; it is very distinct from the specimen Walker described as a variety of it, to which I have now given a name: the specimen in the National Collection is from an unknown locality, but is almost identical with the Mexican

specimen in my collection. The following is Walker's description:—"Deep black. Head and thorax thickly clothed with bright orange hairs. Thorax with two purple spots in front; scutellum purple. Pectus clothed with black hairs. Fore wing narrow, very long, with a blue spot at the base, and a curved blue mark beyond the middle towards the fore border. Abdomen tapering towards the tip, with a row of blue spots and of white dots along each side; underside with two blue stripes. Hind tarsi white, with black tips. Length of the body 8 lines, of the wings 24 lines."

COSMOSOMA, Hübn.

Cosmosoma protus, sp. n.

Primaries and secondaries hyaline: primaries, the costal margin, base, and inner margin, a short band extending from the apex to the end of the cell all bright orange-yellow; the apex and outer margin black: secondaries broadly bordered with black. Head, thorax, and abdomen bright blue-black, with bright blue spots; tegulæ bright orange; legs and antennæ black; antennæ with the tips white.

Expanse $1\frac{1}{4}$ inch.

Hab. Mexico, Jalapa (*M. Trujillo*).

Allied to *C. elegans*, Druce.

Cosmosoma? cucadma, sp. n.

Primaries and secondaries black, streaked with greenish blue at the base: primaries with a small streak near the base, and beyond a rather wide band partly crossing the wing nearest the apex, both hyaline: secondaries with a hyaline line down the middle. Head, thorax, and abdomen black; the abdomen with a greyish line on each side.

Expanse $1\frac{1}{4}$ inch.

Hab. Panama, Bugaba 800 to 1500 feet (*Champion*).

One specimen.

CHLOROPSINUS, Butl.

Chloropsinus potentia, sp. n.

Primaries and secondaries brownish black, with all the veins darker than the wings; thorax and tegulæ bright orange. Head, antennæ, abdomen, and legs brownish black.

Expanse $1\frac{1}{2}$ inch.

Hab. Mexico, Orizaba (*Mus. Druce*).

THRINACIA, Butl.

Thrinacia pontia, sp. n.

Primaries and secondaries semihyaline smoky black; the veins, head, thorax, antennæ, and legs black; the abdomen pale yellow.

Expanse 1 inch.

Hab. Mexico, Jalapa (*M. Trujillo*).

Allied to *T. intermedia*, Druce.

Thrinacia prometina, sp. n.

Primaries and secondaries semihyaline black; the veins and costal margin of the secondaries darkest. Head, antennæ, thorax, and legs black; the sides of the head and thorax pale yellow; the abdomen yellow, with a rather wide black band extending from the base to the anus.

Expanse 1 inch.

Hab. Mexico, Atoyac in Vera Cruz (*Schumann*).

EUCEREON, Hübn.

Eucereon promathides, sp. n.

Primaries and secondaries very pale whitish fawn-colour; primaries slightly speckled with minute brown scales. Antennæ, head, and thorax pale fawn-colour; abdomen red, with a row of small black dots extending from the base to the anus.

Expanse 1¼ inch.

Hab. Mexico, Presidio (*Forrer*).

Eucereon prometina, sp. n.

Primaries pale fawn-colour; a small spot on the costal margin and a rather indistinct narrow band which crosses the wing from the inner margin beyond the middle to the apex, both darker fawn-colour: secondaries dusky, darkest at the apex and along the outer margin. Head fawn-colour; thorax, antennæ, abdomen, and legs pale brown.

Expanse 1 inch.

Hab. Panama, Bugaba 800 to 1500 feet (*Champion*).

IDALUS, Walk.

Idalus alba, sp. n.

Primaries and secondaries pure white. Head, thorax,

abdomen, and legs white; antennæ white above, black on the underside.

Expanse $1\frac{1}{4}$ inch.

Hab. Mexico, Jalapa (*M. Trujillo*).

ZATREPHES.

Zatrephes (?) *pronapides*, sp. n.

Primaries pale fawn-colour, thickly spotted with cream-coloured dots at the base and on the costal margin near the apex: secondaries pale yellow, the apex and a short streak near the anal angle fawn-colour. Head and collar cream-colour; thorax fawn-colour; abdomen pale yellow; antennæ brown; legs yellow and brown.

Expanse $1\frac{3}{10}$ inch.

Hab. Panama, Bugaba (*Champion*).

One specimen.

HALISIDOTA, Hübn.

Halisidota jalapa, sp. n.

Primaries brownish fawn-colour, with a pinkish tinge at the apex and along the outer margin: secondaries semi-hyaline yellow. Head, collar, and abdomen yellow; thorax and tegulæ brown; antennæ black.

Expanse $1\frac{1}{2}$ inch.

Hab. Mexico, Jalapa (*M. Trujillo*).

PHÆGOPTERA, Herr.-Schäff.

Phægoptera daraba, sp. n.

Primaries hyaline, the costal, outer, and inner margins edged with yellowish fawn-colour; three very indistinct brown bands cross the wing from the costal to the inner margin; the fringe brownish yellow: secondaries hyaline yellowish fawn-colour on the outer margin near the apex; the inner margin and anal angle shaded with bright reddish pink. Antennæ brown; head and thorax yellowish fawn-colour; abdomen bright red; anus yellow; a small black spot on the tegulæ.

Expanse 2 inches.

Hab. Mexico, Orizaba (*Mus. Druce*), Jalapa (*M. Trujillo*).

Phægoptera rhoda, sp. n.

Primaries hyaline, costal, outer, and inner margins shaded with pale brown; a submarginal row of indistinct brown

spots extends from the apex to the anal angle; the fringe pale brown: secondaries hyaline, slightly shaded with pink at the anal angle. Antennæ, head, and thorax pale greyish brown; abdomen dull red; anus yellowish.

Expanse $2\frac{1}{4}$ inches.

Hab. Guatemala, in the city (*Rodriguez*).

Opharus, Walk.

Opharus dolens, sp. n.

Primaries and secondaries semihyaline dull blackish brown. Head, antennæ, thorax, abdomen, and legs black; abdomen with a row of small white spots on each side.

Expanse 2 inches.

Hab. Mexico, Orizaba (*Mus. Druce*).

Arachnis, Hübn.

Arachnis pompeia, sp. n.

Male.—Allied and similar to *A. aulæa*, but generally darker, the white marking on the primaries much smaller: secondaries nearly black, with the red marking very narrow. The head and thorax black; sides of the head yellow; abdomen black, red at the base, with some yellow spots on the last two or three segments.—*Female* very similar to the male, but considerably larger, and with the secondaries almost entirely black.

Expanse, ♂ $1\frac{3}{4}$ inch, ♀ $2\frac{1}{4}$ inches.

Hab. Mexico, near Durango city (*Becker*).

Subfam. *Pericopiinæ*.

Pericopis, Hübn.

Pericopis Gaumeri, sp. n.

Male.—Primaries semihyaline white, the costal margin, a spot in the cell, one at the end of the cell, the apex, and part of the outer margin all dark brown; the inner margin broadly banded from the base almost to the anal angle with dark brown: secondaries pure white, the marginal line and the ends of the veins dark brown. Underside of both wings white, the primaries almost without the brown marking. Head and thorax dark brown; a large yellow spot on each side of the head, and a small red spot at the base of the wings. Abdomen bright red, with a black line down the middle which does not reach the anal segments; the anus

black; underside of the abdomen bright yellow. Antennæ and legs dark brown.—*Female.* Primaries dark brown: secondaries pinkish red, broadly bordered with brown from the apex to the anal angle. Head, thorax, and abdomen similar to the male.

Expanse, ♂ 2¾ inches, ♀ 3¼ inches.

Hab. Mexico, North Yucatan, Temax (*Gaumer*).

Pericopis prætides, sp. n.

Male.—Primaries dark brown, similar to *Pericopis tibesis*, Druce, but with the marking smaller, and with a row of marginal white spots extending from the apex to the anal angle: secondaries hyaline white; the apex, outer and inner margins broadly bordered with dark brown; a marginal row of small white spots extends from the apex to the anal angle. Head, antennæ, thorax, and abdomen dark brown; the sides of the abdomen bright red; underside of the abdomen yellowish white, banded with dark brown.

Expanse 2½ inches.

Hab. Mexico, Jalapa (*M. Trujillo*).

Pericopis cydon, sp. n.

Male.—Primaries dark black-brown, with paler markings beyond the cell: secondaries hyaline, the inner margin clothed with blackish hairs; the apex and outer margin broadly bordered with black, edged on the inner side for about halfway from the anal angle by a wide orange-yellow band; two blue spots close to the anal angle, and a marginal row of white dots; veins all black. Head, antennæ, thorax, and base of the abdomen black; the sides of the abdomen red; underside yellow.—*Female.* Primaries dark brown: secondaries orange-yellow, the apex and outer margin black; a row of marginal white spots extends from the apex to the anal angle.

Expanse, ♂ 3 inches, ♀ 3¼ inches.

Hab. Mexico, Jalapa (*M. Trujillo*).

Fam. **Lithosiidæ.**

Brycea, Walk.

Brycea cynara, sp. n.

Primaries black, with a wide band extending from the base to beyond the cell and a submarginal band from the apex almost to the anal angle, both dark chrome-yellow: second-

aries black, chrome-yellow at the base; the fringe black. Underside the same as above. Head, antennæ, thorax, abdomen, and legs black; collar and tegulæ chrome-yellow.

Expanse $1\frac{4}{18}$ inch.

Hab. Mexico, near Durango city (*Becker*).

Allied to *B. disjuncta*, Walk.

RUSCINO, Walk.

Ruscino cypris, sp. n.

Primaries black, crossed from the costal to the inner margin with two orange-yellow bands—the first wide, nearest the base, the second submarginal, slightly curved: secondaries black, with the base orange-yellow; the fringe black. Head, antennæ, thorax, abdomen, and legs black; collar and tegulæ orange-yellow.

Expanse $1\frac{4}{10}$ inch.

Hab. Mexico, Lake Chapala, Jalisco (*Richardson*).

Ruscino praxis, sp. n.

Primaries black, crossed about the middle from the costal to the inner margin by a narrow pale yellow line, and a marginal line extends from the apex almost to the anal angle: secondaries black, with the basal part of the wing pale yellow; the fringes of both the wings black. Underside similar to the upperside.

Expanse $1\frac{1}{4}$ inch.

Hab. Mexico, near Durango city (*Becker*).

Ruscino cynossema, sp. n.

Primaries similar to those of *R. latifasciatus*, Butler, but with the black bands much straighter and the apex blacker: secondaries with the base black, the yellow colour forming a wide band across the wing. Head, thorax, and abdomen yellow; antennæ and legs black.

Expanse 1 inch.

Hab. Mexico, Rincon in Guerrero 2800 feet, Acaguizotla in Guerrero 3500 feet (*H. H. Smith*).

This species differs from all the others known to me in having the base of the secondaries black.

Ruscino prusias, sp. n.

Primaries deep chrome-yellow, the base, a wide straight band beyond the middle, and the outer margin black: secondaries chrome-yellow, broadly bordered with black from the

apex to the anal angle. Underside the same as above. Head, thorax, and abdomen chrome-yellow; antennæ, palpi, and legs black.

Expanse $1\frac{1}{4}$ inch.

Hab. Mexico, Jalisco (*Schumann*).

Bænasa, Walk.

Bænasa polyphron, sp. n.

Primaries pale brown, with a white streak on the inner margin extending from the base almost to the anal angle, and a small white streak near the apex: secondaries carmine, the outer margin from the apex to the anal angle broadly bordered with black. Head, thorax, abdomen, antennæ, and legs black; anal tuft carmine.

Expanse $\frac{3}{4}$ inch.

Hab. Mexico, Morelia (*F. D. Godman*).

Lithosia, Fabr.

Lithosia (?) *cytherœa*, sp. n.

Primaries pale greyish brown; the costal and inner margins edged with yellow; secondaries yellowish grey. Head, collar, and tegulæ yellow; thorax and abdomen greyish brown; antennæ black.

Expanse $1\frac{1}{4}$ inch.

Hab. Mexico, near Durango city (*Becker*).

Eudule, Hübn.

Eudule daxata, sp. n.

Primaries and secondaries orange-yellow. Primaries: the costal margin edged with black at the base; the apex and part of the outer margin edged with black; a curved black line nearly crosses the wing beyond the middle, extending from the costal almost to the inner margin, from which a rather wide line extends to the outer margin; two black streaks near the base of the wing. Underside the same as the upperside; head, antennæ, and legs black; abdomen and thorax orange-yellow.

Expanse $1\frac{1}{4}$ inch.

Hab. Mexico, Omilteme in Guerrero 8000 feet (*H. H. Smith*).

Allied to *E. tripunctata*, Druce.

Eudule rhotana, sp. n.

Primaries and secondaries semihyaline yellowish white; the costal, outer, and inner margins of both wings pale yellow; the veins black. Head, thorax, and abdomen yellow; palpi and antennæ black; legs brown.

Expanse $1\frac{1}{2}$ inch.

Hab. Mexico, Xucumanatlan in Guerrero 7000 feet (*H. H. Smith*).

Allied to *E. lineata*, Druce.

Fam. **Saturniidæ.**

Attacus, Linn.

Attacus (?) *cydippe*, sp. n.

Male.—Primaries and secondaries dark brown, thickly irrorated with reddish-brown scales. Primaries crossed from the apex to the inner margin by a dark brown line, on the inner side of which is an indistinct waved brown line; the apex and outer margin irrorated with grey scales, and a submarginal waved greyish line extends from the apex to the anal angle; an elongated hyaline spot at the end of the cell; the fringe dark reddish brown: secondaries crossed above the middle by a very indistinct dark brown line; an elongated hyaline spot at the end of the cell; two zigzag submarginal dark brown lines extend from the apex to the anal angle; the outer margin broadly irrorated with grey scales; the fringe dark reddish brown. Underside considerably more grey than above, and with the submarginal line much more distinct. Head, thorax, and tegulæ dark brown; abdomen pale brown; the base of the thorax and abdomen thickly clothed with reddish-brown hairs; antennæ brown; legs reddish brown.

Expanse $3\frac{1}{2}$ inches.

Hab. Mexico, Orizaba (*Mus. Druce*).

Copaxa, Walk.

Copaxa denda, sp. n.

Male.—Primaries and secondaries citron-yellow. Primaries: the costal margin greyish to beyond the middle; a reddish-brown waved line crosses the wing near the base from the costal to the inner margin; a small hyaline spot at the end of the cell edged with dark grey; a blackish-brown line extends from the apex to about the middle of the inner margin; on the inner side of the line the wing is shaded with reddish yellow; the fringe yellow. Secondaries crossed

above the middle by a blackish-brown line, and below the hyaline spot at the end of the cell by a waved reddish-brown line; the outer margin shaded with grey; the fringe dark yellow. Underside pale brown; both wings crossed by two indistinct brown bands. Head, thorax, and abdomen yellow, front of the thorax greyish brown; antennæ pale brown; legs pinkish brown.—*Female* similar to the male, but considerably darker in colour, and with all the markings much blacker.

Expanse, ♂ $4\frac{3}{10}$ inches, ♀ $4\frac{1}{2}$ inches.

Hab. Mexico, Orizaba (*Mus. Druce*).

Allied to *C. expandens*, Walker, but very distinct.

Automeris, Hübn.

Automeris randa, sp. n.

Male.—Primaries light greyish fawn-colour, crossed from the costal to the inner margin by two yellow lines, the first waved nearest the base, the second beyond the middle slightly curved near the apex; a dark spot at the end of the cell, with four little black dots round the outer margin paler than the other part of the wing: secondaries pinkish yellow; a large fawn-coloured ocellus broadly bordered with deep black, with a central white spot slightly below the middle and nearest the apex; a submarginal broken black line, edged with yellow, extends from near the apex almost to the anal angle; below the black line is a wide, reddish-fawn-coloured band; the outer margin broadly edged with fawn-colour; the fringe pale fawn-colour. Underside: both wings yellowish fawn-colour; primaries with a large round black spot at the end of the cell, with a white dot in the centre; secondaries with a white spot at the end of cell. Head and thorax dark reddish brown; abdomen pale yellow; antennæ yellowish brown.—*Female* very similar to the male, but larger, rather darker in colour, and with all the markings more distinct.

Expanse, ♂ 4 inches, ♀ $4\frac{3}{4}$ inches.

Hab. Mexico, near Durango city (*Becker*).

Automeris Daudiana, sp. n.

Male.—Primaries pale greyish brown, dark brown at the base, four small spots at the end of the cell, and a narrow curved line extending from the costal margin to the inner margin dark brown; the veins yellow; the fringe greyish brown: secondaries bright yellow; the costal and outer margin broadly bordered with greyish brown; the inner margins thickly clothed from the base almost to the anal angle

with reddish hairs; a large black ocellus with a bluish-white centre at the end of the cell, and two rather wide, black, submarginal lines extend from near the apex to the inner margin; the fringe pinkish brown. Underside pinkish brown; the costal margin and the veins yellow; primaries with a large black spot at the end of the cell. Antennæ, front of head, and palpi reddish brown; head and thorax dark brown; abdomen bright red.

Expanse $2\frac{1}{2}$ inches.

Hab. Guatemala, in the city (*Rodriguez*).

Fam. **Lasiocampidæ.**

EUTRICHA, Hübn.

Eutricha Conradti, sp. n.

Male.—Primaries reddish brown, crossed beyond the middle from the costal to the inner margin by several indistinct bands of paler brown; three small black spots near the anal angle; the fringe brown: secondaries uniformly dark reddish brown; the fringe slightly paler in colour. Head, antennæ, thorax, and abdomen reddish brown; legs dark brown.

Expanse $3\frac{1}{4}$ inches.

Hab. Guatemala, Coban in Vera Paz (*Conradt*).

Eutricha crossæa, sp. n.

Male.—Primaries and secondaries reddish fawn-colour; primaries crossed from the costal to the inner margin by a submarginal row of small dark brown spots. Head, thorax, antennæ, abdomen, and legs reddish brown; the anal tuft yellowish.

Expanse $2\frac{3}{4}$ inches.

Hab. Mexico, Bolaños Jalisco (*Richardson*).

Eutricha denda, sp. n.

Male.—Primaries and secondaries very dark brown: primaries with a small grey spot at the end of the cell and crossed from the costal to the inner margin by five narrow, zigzag, pale greyish-brown lines, the first two close to the base, the third and fourth much beyond the middle, the fifth submarginal with black points near the anal angle; a reddish-brown band extends from near the apex to the inner margin above the anal angle; the fringe dark brown: secondaries crossed about the middle with two faint reddish-brown lines; the fringe greyish. Underside dark brown; both wings

thickly irrorated with grey scales and crossed from the costal to the inner margins by two waved greyish lines; the inner margin of the secondaries clothed with reddish-brown hairs. Head, antennæ, thorax, abdomen, and legs dark brown.

Expanse $3\frac{1}{4}$ inches.

Hab. Mexico, Jalapa (*M. Trujillo*).

Tolype, Hübn.

Tolype levana, sp. n.

Primaries and secondaries greyish white: primaries crossed from the costal to the inner margin by a considerable number of waved black lines; a black spot at the end of the cell; a marginal row of black spots extends from the apex to the anal angle; the fringe alternately black and grey: secondaries dusky at the base and beyond the middle. Head, thorax, and abdomen greyish black; abdomen banded with grey.

Expanse $1\frac{1}{4}$ inch.

Hab. Mexico, Jalapa (*M. Trujillo*); Guatemala, in the city (*Rodriguez*).

Tolype deboma, sp. n.

Primaries pale grey, crossed from the costal to the inner margin by five white lines, the first two near the base curved inwards, the third and fourth beyond the cell waved, the fifth waved submarginal, between the fourth and fifth line the wing is clouded with black at the apex and along the outer side of the fourth line; the veins and fringe white: secondaries white, clouded with black at the anal angle; fringe white. Head, front of thorax, and tegulæ white; the thorax black; abdomen white; anal tuft yellowish; antennæ and legs white.

Expanse $2\frac{3}{10}$ inches.

Hab. Mexico, near Durango city (*Becker*).

Hydrias, Herr.-Schäff.

Hydrias praxithea, sp. n.

Primaries dark blackish grey, paler at the apex and on the costal margin; a pale grey line crosses the wing near the base, and a submarginal waved white line extends from the apex to the anal angle: secondaries greyish white, broadly bordered with dark grey along the costal margin to the apex; the inner margin and basal half of the wing dark greyish brown; a submarginal dark grey waved line extends from the

apex to the anal angle; the fringe of both wings dark grey. Head, thorax, and legs dark grey; a rather wide black line down the middle of the thorax, extending to the base; abdomen black, thickly clothed with dark reddish-brown and dark grey hairs. Underside of the thorax and abdomen yellow.

Expanse 2 inches.

Hab. Mexico, Orizaba (*Mus. Druce*).

Hydrias deceana.

Primaries and secondaries brown: primaries crossed from the costal to the inner margin by four fine waved black lines, the first near the base, the others beyond the middle; a large blackish spot at the end of the cell; the fringes of both wings dark brown. The head, antennæ, thorax, abdomen, and legs dark brown.

Expanse $1\frac{1}{4}$ inch.

Hab. Mexico, Orizaba (*Mus. Druce*), Jalapa (*M. Trujillo*).

Some specimens are paler in colour than others.

XIX.—*On the* Elateridæ *of Japan.* By G. Lewis, F.L.S.

[Continued from p. 48.]

Melanoxanthus similis, sp. n.

Niger, nitidus, fulvo-pubescens; thorace nigro; elytris macula obliqua humerali fasciaque postica flavo-testaceis; antennis (basi excepta) infuscatis; pedibus flavis.

L. 4 mill.

Elongate, somewhat parallel, with tawny pubescence; the head densely and a little coarsely punctured, black; the thorax more coarsely punctured than that of *M. pictipennis* and the punctures are more densely set on the disk, wholly black, carina well marked; the elytra black, with a basal longitudinal vitta, which covers the humeral angle and on the fifth interstice continues down to the middle of the dorsum, and before the middle occupies part of the fourth and third interstices, behind the middle there is a broad lobe-shaped band which leaves the sutural interstice and outer edge black, the striæ are more coarsely punctured than in *M. pictipennis*, and the interstices smoother, narrower, and more convex; legs and antennæ coloured as in the last species.

Hab. Fukushima, Nikko, and Osaka. Fairly common in flowers of *Viburnum*.

Melanoxanthus zebra, Wiedm.

Melanoxanthus zebra, Wiedm. Zool. Mag. 1817, p. 107.

Candèze records this species from Japan (Mon. ii. p. 516). It is a common Javan species, and I think it requires confirmation before admitting it to the Japanese Catalogue. Schönfeldt apparently is also of this opinion, as he has refused to give it a place in his Catalogue.

As I think it is undesirable to place insects such as the three following in the same genus as the small *Cryptohypni*, I have utilized the genus proposed by Eschscholtz for *Cryptohypnus hyperboreus*, Dej. (*planatus*, Eschs.), to receive them. In two of the Japanese species the expanded basal joint of the antennæ is very remarkable, in the third (*H. fluviatilis*) the basal joint agrees more with *C. hyperboreus*.

Hypolithus saxatilis, sp. n.

Depressus, niger, subnitidus, nigro-pubescens; antennis articulo primo valde expanso; thorace in medio carinato; pedibus infuscatis vel ferrugineis.
L. $7\frac{1}{2}$–10 mill.

Depressed, black, with rather short black pubescence; the head, frontal carina well marked behind the antennæ, punctured not closely in the middle, but thickly and roughly near the eyes, forehead impressed; the thorax densely and rugosely punctate, with a longitudinal smooth line in the middle, hind angles slightly turned outwards, short but acute; the scutellum very feebly punctulate; the elytra striate, striæ rather deep, interstices flat, rather closely punctured, little rugose; the antennæ, basal joint flattened out and expanded, nearly semicircular on the anterior edge, posterior edge nearly straight, second, third, and fourth joints equal in length, reddish or pitchy brown; the legs dusky.

Resembles somewhat *H. hyperboreus*, Gyll., but is more depressed, and the basal joint of the antennæ flatter and more expanded. I believe *C. Sanborni*, Horn, resembles *H. saxatilis*.

Hab. Kiga, Hakone, Chiuzenji.

Hypolithus expansicornis, sp. n.

H. saxatili simillimus, sed antennis articulis latioribus et pedibus flavis.
L. 7 mill.

This species has the basal joint of the antenna expanded like that of *H. saxatilis*, but the other joints are broader and much less constricted at their bases. The thorax is relatively longer, sides more parallel, hind angles straight, and the antennæ and legs pale yellow.

Hab. Junsai. One example found under a stone by the lake.

Hypolithus fluviatilis, sp. n.

Subdepressus, niger, griseo-pubescens; capite punctato; thorace angulis haud acute productis; pedibus infuscatis.
L. 7 mill.

Rather depressed, black, with griseous pubescence; the head, frontal carina less conspicuous than that of *H. saxatilis*, punctures not closely set in the middle nor very differently near the eyes; the thorax densely and rugosely punctate, with a median smooth line, hind angles slightly turning outwards, not acute; the elytra striate, interstices rather convex, punctulate and a little rugose; the antennæ, first joint robust but not expanded like those of the last two species, reddish brown, articulations constricted at base; the legs infuscate.

Resembles closely *H. hyperboreus*, Gyll.

Hab. Kashiwagi. One example.

Cryptohypnus rivalis, sp. n.

Brunneus, nitidus; capite thoraceque supra æneo-nigris; elytris brunneis, striatis; antennis brunneis; pedibus testaceis.
L. $4\frac{1}{4}$ mill.

Brown, shining; head and thorax (above only) blackish, with an æneous tint; the head uneven, rather irregularly punctured; the thorax convex, punctures fine and sparse on the disk, larger and more dense behind the anterior angle, posterior angles somewhat robust, reddish brown; the elytra striate, striæ near the outer margin punctate, interstices with a few very fine punctures; the antennæ brown, dusky at the apices of the articulations; the legs testaceous.

Very much like *C. rivularius*, Gyll.; hind angles of the thorax more robust; elytra relatively shorter, antennæ

stouter and more abbreviated, thighs and tibiæ thicker. Also similar to *C. silaceipes*, Germ.

Hab. Iwakisan. I took two examples at the side of a small brook near the summit of this mountain (alt. 4921 feet), Sept. 1st, 1880.

Cryptohypnus optatus, sp. n.

Æneo-niger, nitidus, cinereo-pubescens; elytris macula humerali lutea; antennarum articulis duobus pedibusque flavis.
L. $3\frac{1}{2}$ mill.

Black, with brassy tinge, pubescence ashy; the head longitudinally impressed in the middle, rather densely punctulate, little strigose, carina feebly angulate behind the antenna, arched anteriorly; the thorax punctulate like the head, median line smooth, convex, not much widened laterally, hind angles slightly turning outwards; the elytra, humeral angle pale, maculation extending to half the fifth interstice, striate, the fourth stria hamate at base and touches the scutellum, interstices finely but thickly punctulate; the antennæ, basal joint bulbous and with the second pale, remaining joints infuscate; the legs clear yellow.

Hab. Otsu, by the lake Biwa.

Cryptohypnus interstinctus, sp. n.

Parum elongatus, niger, nitidus, fulvo-pubescens; elytris macula humerali elongata, rufo-brunnea; antennis basi testaceis; pedibus flavis, femoribus obscuris.
L. $2\frac{3}{4}$ mill.

Rather long, black, shining, with fulvous pubescence; the head clearly and evenly punctulate, carina arched anteriorly; the thorax convex, punctulate like the head, somewhat long, feebly widening out about the middle, hind angles a little acute and narrowly pale; the elytra finely striate, second and third striæ most visible, punctulate, interstices very finely punctulate, on the humeral angle on the sixth interstices is an elongate reddish-brown spot, and before the apex on the fifth interstices there is a discoloured disk, clearly visible in my unique example; the antennæ, three joints at base testaceous, the others infuscate; the legs pale, with the thighs dusky.

Hab. Wada-toge (alt. 5578 feet).

Cryptohypnus tutus, sp. n.

Æneo-niger, nitidus, cinereo-pubescens; thorace in medio lato, perconvexo; antennis nigris; pedibus testaceis.
L. $3\frac{3}{4}$ mill.

Brassy black, shining, with ashy pubescence; the head rather flat, rugosely punctulate, carina well marked, semicircular; the thorax punctured like the head, with a median smooth line behind the neck, which becomes evanescent towards the disk, disk very convex, sides conspicuously widened in the middle, hind angles very feebly turned outwards, moderately acute; the elytra with a brassy greenish tinge, striate, interstices finely and densely punctulate; the antennæ, basal joint bulbous, piceous, other articulations black; the legs clear yellow.

Should be placed next to *C. curatus*, Cand.

Hab. Fukushima.

Cryptohypnus modestus, sp. n.

Niger, opacus, pubescens; capite thoraceque densissime punctulatis; elytris macula humerali rufo-brunnea, stria interna basi incurvata; antennis nigris (basi excepta); pedibus flavis, femoribus obscuris.
L. $3\frac{1}{2}$ mill.

Black, rather opaque, with short pubescence; the head very densely and somewhat rugosely punctulate, carina a little bent behind the antennæ; the thorax convex, widest in the middle, hind angles scarcely turned outwards, not acute, basal carina curved and well-marked, median smooth line feeble, very densely punctulate; the elytra striate, striæ feebly punctate, interstices flat, densely punctulate, humeral angle broadly reddish brown from the outer edge to the fourth stria, before the apex there is an indication of a second spot, the sutural stria is hamate at the base of the elytra, and in a marked manner turns outwards close to the scutellum; the antennæ, basal joint bulbous, obscurely red, second red, others black; the legs pale, thighs dusky.

Hab. Kumamoto. One example.

Cryptohypnus humeralis, Cand.

Cryptohypnus humeralis, Cand. Mém. Liège, 1873, p. 13.

I found a variety of this species in which the humeral spot is absent.

Hab. Nagasaki. Found at most of the places in my itinerary given for Feb. 13 to April 21, 1881.

Cryptohypnus telluris, Lew.

Cryptohypnus telluris, Lew. Ent. Month. Mag. 1879, p. 156.

Longiusculus, æneo-niger, nitidus, griseo-pubescens; capite thoraceque subtiliter punctatis; elytris striatis, interstitiis convexis, crebre punctatis; antennis nigris (basi excepta); femoribus infuscatis, tibiis tarsisque flavis.
L. $3\frac{1}{2}$ mill.

The thorax is widest before the middle, convex, the hind angles turned outwards and somewhat acute; the thighs are usually infuscate and the tibiæ pale, but sometimes the latter are dusky; the antennæ, basal joint sometimes dusky, sometimes pale, second and third pale, the others black.

Hab. Konose, Nikko, Hagi, Oyama, Yokohama, Miyanoshita, Sapporo, and Hakodate. Common in various flowers.

Cryptohypnus difficilis, sp. n.

Infuscatus, subnitidus, dense griseo-pubescens; thorace angulis posticis obscure brunneis; elytra striis tenuissime impressis, macula humerali inconspicua; antennis nigris (basi excepta); tibiis tarsisque pallidis.
L. $3\frac{1}{2}$ mill.

Infuscate, little shining, with dense griseous pubescence; the head, carina semicircular, not much raised, feebly impressed between the eyes, not densely punctulate; the thorax convex, punctured laterally like the head, punctuation of the disk fine and obscure, hind angles obscurely red, carina not well raised nor much curved; the elytra obscurely brown at the humeral angles, striæ very fine, evanescent in certain lights, interstices very finely punctulate; the antennæ, basal joint bulbous, partly black, second red, others blackish; the thighs dusky, legs pale.

To be placed near *C. telluris*, Lew., and *C. luteipes*, Cand.

Hab. Hakodate. One example.

Cryptohypnus atomarius, sp. n.

Brevis, opacus, niger, albo-pubescens; antennis nigris; pedibus dilutioribus.
L. $1\frac{1}{2}$–$1\frac{3}{4}$ mill.

Short, very opaque, black, with whitish pubescence; the head somewhat broad, densely opaque, with close sculpture, frontal carina slightly projecting before the eyes, eyes coarsely granulate; the thorax densely sculptured, median smooth

line visible behind the disk, hind angles nearly rectangular; the elytra finely but very evenly striate; the antennæ black, first joint enlarged, others much smaller; the legs pale, or pale with infuscate tibiæ and thighs.

This little species, the smallest of this series, is to be placed next to *C. albipilis*, Cand.

Hab. Torii-toge (alt. 4016 feet). Three examples.

Cryptohypnus carinicollis, sp. n.

Parum latus, niger, nitidus, griseo-pubescens; thorace angulis posticis divaricatis, carina marginem anticum attingente; elytris obsolete striatis; antennis pedibusque nigris.
L. $3\frac{1}{4}$–$3\frac{3}{4}$ mill.

Black, shining, with greyish pubescence; the head finely punctulate, frontal carina angulate anteriorly; the thorax rather more finely punctured than the head, angles scarcely acute, but turning outwards, lateral carina strong and complete; the scutellum rather wide, acuminate behind; the elytra, in certain lights only are striæ visible, interstices very finely punctulate; the antennæ and legs are black, the former being much more robust than in any of the minute species of this series.

This species and *C. ellipticus*, Cand., are the only two known from Japan in which the thoracic carina is continued from the base to the anterior edge. In *C. carinicollis* it is much more elevated than in *C. ellipticus* and the antennæ are more robust. There is a specimen from Nikko with the frontal carina semicircular; it is possibly a closely allied species.

Hab. Torii-toge, Miyanoshita, and Subashiri. Not common.

Cryptohypnus minutissimus, Germ.

Cryptohypnus minutissimus, Germ.; Cand. Mém. Liège, 1873, p. 14.

This species has been determined by Dr. Candèze; it does not appear in Heyden's Catalogue of Siberian species, and it is the only European species said to be found in Japan.

Hab. Nagasaki, Seba, Hosokute, and Nikko.

Cryptohypnus cinefactus, sp. n.

Parum elongatus, cinereo-niger, opacus, densissime punctulatus; antennis pedibusque concoloribus.
L. $2\frac{1}{4}$ mill.

Elongate, very opaque, ashy black, very densely and

minutely sculptured on the upper surface; the head under the microscope ocellately punctured, frontal carina projecting in front of the eyes, eyes somewhat coarsely granulate; the thorax, median line obsolete, basal carina short, not much raised, curved, hind angles short and blunt; the scutellum relatively large; the antennæ wholly black, first joint rather large and short, the others fine and small and equalling each other in size; the tarsi are not quite so black as the tibiæ.

In size and opacity somewhat like *C. agilis*, but the frontal carina projecting before the eyes is a salient specific character and one, as regards this series, peculiar to it.

Hab. Nikko.

Cryptohypnus agilis, sp. n.

Angustatus, niger, opacus, griseo-pubescens; supra densissime punctulatus; antennis pedibusque elongatis.
L. $2\frac{1}{3}$ mill.

Narrow, black, opaque, with very short grey pubescence; upper surface very densely punctulate; the head with a median longitudinal impression well-marked, carina semicircular; the thorax, median smooth line clearly visible behind the neck (but in one specimen wholly absent), widest in the middle, more parallel in male than in female, basal carina fine, rather long and curved, hind angles short and blunt; the elytra, striæ very even and well-marked; the antennæ wholly black, basal joint rather large, the others long and rather slender; the legs black, tarsi long and dusky brown.

This species is not like any in the present series except *C. cinefactus*, which is not so narrow and is more opaque.

Hab. Yokohama. Taken at Bukenji in a dry arable field. Found running actively in the sunshine in early spring accompanied by a variety of *Blechrus maurus*, Sturm.

Section I. Scutellar fovea absent.

Cardiophorus pinguis, sp. n.

Robustus, niger, nitidus, griseo-pubescens; supra minute et parum dense punctulatus; scutello haud foveolato; antennis pedibusque nigris.
L. $7\frac{1}{2}$ mill.

Robust, black, shining, pubescence griseous; the head evenly and very finely punctured, anteriorly depressed, carina semicircular in the middle; the thorax punctured like the head, hind angles short, nearly straight and obtuse; the

scutellum somewhat acuminate behind, without an anterior fovea; the elytra punctate-striate, interstices evenly and finely punctured; the antennæ and legs black, claws pale. Two examples have an æneous tint on the elytra.

Belongs to the same section as *C. sequens*, Cand., but the large size and the absence of the scutellar fovea will distinguish it at once.

Hab. Hakodate. Six examples in my collection and one in the British Museum.

Cardiophorus niponicus, sp. n.

Elongatus, niger, nitidus, grisco-pubescens; scutello postice parum producto, subacuminato; antennis pedibusque nigris.
L. $8\frac{1}{2}$ mill.

Elongate, black, shining, pubescence grey; the head rather small, finely and rather closely punctulate, frontal carina semicircular; the thorax gradually narrows from the anterior angles to the middle, punctuation extremely fine, hind angles obtuse, scarcely turning outwards; the scutellum impressed, not foveolate in front, posterior tip a little prolonged and pointed; the elytra punctate-striate, interstices convex and obscurely punctulate; the antennæ black, third joint much longer than the second; the legs black, with the knees, ends of tarsal joints, and claws palish, last thickened at base, not dentate.

The shape of the scutellum and the relatively long third joint of the antennæ are characters not seen in any other species of this series.

Hab. Nishimura. One example.

Section II. Scutellar fovea more or less conspicuous.

Cardiophorus opacus, sp. n.

Niger, opacus, grisco-pubescens; fronte carina utrinque angulata; elytris interstitiis dense rugosis; antennis pedibusque nigris.
L. 6 mill.

Elongate, black, very opaque, with short grey pubescence; the head closely punctured, punctures not very fine, frontal carina angulate before the eyes; the thorax punctured like the head, widest behind the middle, hind angles blunt, not turning outwards; the scutellum somewhat acuminate behind, anterior fovea very distinct; the elytra punctate-striate, interstices very markedly rugose, giving an appearance of complete opacity; the antennæ and legs black, claws pale, not dentate.

This very distinct species is narrower than *C. sequens*, Cand.; the scutellum more cordate and the interstices of the elytra densely rugose.

Hab. Subashiri. One individual only.

Cardiophorus ferrugineus, sp. n.

Cardiophorus sobrinus, Cand. Mém. Liège, 1873, p. 17.

Ferrugineus, nitidus, albo-pubescens; capite grosse punctato; thorace parum dense punctulato haud canaliculato; antennis pedibusque concoloribus.

L. 7½ mill.

Ferruginous, shining, with whitish pubescence; the head rather roughly, coarsely, and densely punctured except on a very small space between the eyes, frontal carina arched anteriorly and distinctly angulate before the eyes; the thorax very finely but very evenly punctulate throughout, not canaliculate in the middle, rather parallel at the sides, hind angles obtuse and nearly straight; the scutellum, anterior fovea scarcely visible; the elytra punctate-striate, interstices convex; the antennæ and legs ferruginous, claws not strongly dentate.

Agrees in colour with *C. sobrinus*, Cand., but the frontal carina is formed differently, head coarsely punctured, thorax without a canaliculation, and the claws much less strongly dentate. In *C. sobrinus* the scutellar fovea is large and deep. This species, with *C. pauper*, *nothus*, *rameus*, and *adjutor*, belongs to Candèze's Section II. with dentate claws.

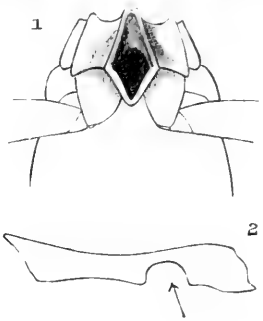
Hab. Kagoshima.

Melanotopsis, gen. nov.

This genus is founded to receive several species it does not seem desirable to leave in *Melanotus*. Both genera are alike in general characters, but the keel of the prosternum in *Melanotopsis* is continued horizontally behind the coxæ (woodcut, fig. 2, ⅄, coxal cavity), not obliquely, nor vertically as it is in some species of *Melanotus*, and the posterior prosternal process is received into a cavity in the mesosternum cut out in the form of a **V** (fig. 1), not gradually shelving like that in *Melanotus*. I consider *Melanotus cete*, Cand., the type of the new genus, and it is from this species the drawings are made. *M. restrictus* and *M. regalis*, Cand., must also be transferred to it.

Melanotopsis cete.

Melanotus cete, Cand. Mon. El. iii. 1860, p. 332.
Melanotus amussitatus, Cand. Mém. Liège, 1873, p. 19.



A comparison of specimens in the Janson collection enables me to give the above synonymy.

Hab. Nagasaki, Kobé, and Yokohama. Common.

Melanotus longipennis, sp. n.

M. legato simillimus, sed differt thorace relative lato ; elytris magis elongatis ; prosterno grosse et profunde punctato.
L. 18–21 mill.

This insect closely resembles *M. legatus*, Cand., in colour, pubescence, articulation of the antennæ, and in the falciform anterior tibiæ ; but the thorax is wider, especially before the middle, punctuation more dense, the scutellum broader, the elytra more elongate, and, above all these differences, the prosternum has very large and deep punctures, some of the punctures being ocellate.

Hab. Kobé and Kioto. Three examples, and there is another in the Janson collection which is larger than any of mine.

Melanotus spernendus, Cand.

Melanotus spernendus, Cand. Mém. Liège, 1873, p. 21.

I place this species next to *M. legatus*, Cand., although the facies of the species is very dissimilar ; the anterior tibiæ are falciform and the declination of the prosternal process and somewhat widening out of the keel between the coxæ are characters which bring them together.

Hab. Nagasaki, Hitoyoshi, and Yuyama. Twelve examples.

Melanotus annosus, Cand.

There is little to distinguish this species from *M. correctus*, Cand., except the longer third joint of the antennæ and lesser declination of the prosternal posterior process. In *M. annosus*, however, the antennæ are usually red, and in *M. correctus* they are usually fuscous.

Hab. Both species are from Nagasaki.

Melanotus ocellato-punctatus, sp. n.

Niger, subopacus, griseo-pubescens; antennis pedibusque obscure rufo-brunneis; capite thoraceque confertissime ocellato-punctatis, hoc angulis subdivaricatis; elytris punctato-striatis, interstitiis rugosis et punctulatis.

L. 13 mill.

This insect has the facies of the European *Melanotus rufipes*, Hbst., but it is darker, and the thorax thickly covered with deep ocellate punctures; the antennæ have the second joint short and bulbous and the third nearly as large again.

Hab. Junsai. One example only.

Melanotus senilis, Cand.

Melanotus senilis, Cand. Mém. Ac. Belg. 1864, p. 47.

The type of this species is in the Musée de Helsingfors, but there are five examples in my collection which, I think, correspond to the description of it. The thorax is "creberrime et fortiter punctato," and the type measures 13 mill. My specimens measure $11\frac{1}{2}$–$12\frac{1}{2}$ mill., and some of the thoracic punctures are distinctly ocellate; the second joint of the antennæ (of which Candèze says nothing) is short and bulbous, the third nearly as long again and obconical.

Hab. Kobé.

Melanotus invectitius, Cand.

Melanotus invectitius ♂, Cand. Mém. Ac. Belg. 1864, p. 47.
Melanotus Fortnumi, Cand. Ann. Soc. Belg. 1878, p. 167?

The description of *M. invectitius* was drawn from a single male in the collection of M. Mäklin, and Candèze compares both it and *M. Fortnumi* to *M. niger*, F. I think both his descriptions refer to the sexes of one species. In *M. invectitius* the second and third joints are said to be "subæqualibus," and in *M. Fortnumi* "æqualibus." This is a sexual distinction which I notice in a species I found very commonly and which I think I have rightly assigned to *M. invectitius*, Cand.

Hab. Miyanoshita, Kiga, Hakone, and Kobé.

Melanotus caudex, Lew.

Melanotus caudex, Lew. Ent. Month. Mag. 1879, p. 156.

Very similar to *M. erythropygus*, Cand., in facies, but the declination of the posterior prosternal process is almost vertical behind the coxæ, and in this respect agrees with *M. seniculus*, Cand. The second and third joints of the antennæ are small, bulbous, and equal in length, tarsi somewhat short and robust, and the median smooth line on the thorax is more plainly seen in the female than in the male.

Hab. Kumamoto and Wakayama. Ten examples.

Melanotus seniculus, Cand.

The elytra are usually pale in this insect and the declination of the posterior prosternal process is nearly perpendicular.

Hab. Nagasaki and Yokohama.

Limonius niponensis, sp. n.

Obscure æneus, nitidus, grisco-pubescens; fronte ocellato-punctata haud emarginata; thorace convexo, punctato; antennis pedibusque nigris.
L. 12 mill.

Obscurely æneous, shining, pubescence grey; the head slightly depressed between the antennæ, carina anteriorly straight, densely punctured, punctures deep and somewhat ocellate; the thorax clearly, closely, and deeply punctured, punctures microscopically ocellate, disk convex, angles short and blunt; the scutellum densely punctulate, pubescent; the elytra punctate-striate, interstices flat, rather wide, and sparsely punctulate; the antennæ black, second and third joints rather long and equal; the legs black, knees and claws pale, tibiæ stouter than those of *L. montivagus*.

Motschulsky (Bull. Mosc. 1866, p. 166) records the capture of *Limonius cylindricus*, Payk., in Japan. I think he refers to this species, as it closely resembles it, and I have rejected *L. cylindricus* from the list.

Hab. Junsai.

Limonius montivagus, sp. n.

Obscure æneus, nitidus, fulvo-pubescens; fronte carina conspicue elevata; thorace dense punctato; tibiis tarsisque flavis.
L. 9 mill.

Obscurely æneous, shining, with yellowish tawny pubescence; the head convex, densely punctate, frontal carina bent

and well raised; the thorax closely and clearly punctured, convex, gradually but slightly widening to base, hind angles short and blunt; the scutellum closely punctulate, pubescent; the elytra punctate-striate, interstices rugose and somewhat closely punctulate; the antennæ black, second and third joints equal and shorter than those of *L. niponensis*; the legs slender, thighs infuscate, tibiæ and tarsi pale.

In some respects this species resembles the last.

Hab. Nikko.

Limonius marginipennis, sp. n.

Æneus, nitidus, griseo-pubescens; scutello postice minutissime tuberculato; elytris margine anguste rufescentibus.
L. 8–9 mill.

Æneous, shining, with grey pubescence; the head densely punctured, depressed between the antennæ, carina not prominent; the thorax convex, widest at the base, evenly punctured, punctures not large, not very closely set; the scutellum punctulate, with a minute (but remarkable) smooth boss on the posterior edge; the elytra punctate-striate, interstices punctulate (in one example the punctuation of the interspaces obscures the striæ), outer margin red, under the humeral angle the red margin is very narrow, but it widens gradually out from thence to the apex; the antennæ black, the third joint visibly longer than the second; the legs also black, knees and claws reddish.

Hab. Nikko district. One example came from bark under snow on Niohozan in June.

Limonius brunneus, sp. n.

Rufo-brunneus, nitidus, sat longe brunneo-pubescens; thorace æqualiter, haud dense, punctato; elytris punctato-striatis, interstitiis tenuiter et sparse punctulatis; antennis, epipleuris pedibusque rufis.
L. 10 mill.

Reddish brown, shining; the head, frontal carina feebly arched, with two depressions behind it, surface closely but not densely punctate; the thorax somewhat elongate and rather parallel laterally, with a feeble median canaliculation, punctures very clear and less closely set than those of the head; the scutellum somewhat densely punctured, with a minute smooth carina; the elytra punctate-striate, striæ somewhat fine, interstices rather convex, punctuation very fine and scattered; the epipleura, abdomen, hind angles of the

thorax, legs, and antennæ are paler than the general colour of the body, second joint of the antennæ scarcely so long as the third.

The punctuation of the thorax is similar in both sexes.

Hab. Nikko. Two examples (male and female) in August 1881.

Limonius marginicollis, sp. n.

Ferrugineus, æneo-tinctus, nitidus, griseo-pubescens; capite dense punctato; thorace margine antice anguste rufo; antennis basi pedibusque rufis.
L. $7\frac{1}{2}$–8 mill.

Reddish brown, shining, with a brassy tinge, thorax and head darker, pubescence grey; the head in the female very densely punctate, in the male the punctures are less close, frontal carina feebly emarginate; the thorax rather closely punctured, punctures deep and round, sides parallel in male, anterior angles rounded off anteriorly in female, hind angles short and blunt and with a narrow margin behind the neck red; the scutellum closely punctured; the elytra punctate-striate, interstices convex and rugosely punctulate; the antennæ, three basal joints red, others dusky, second and third joints equal; the epipleuræ and legs reddish brown.

I have a dark variety in which the basal joints of the antennæ are marked with black.

Hab. Oyayama, Nikko, Miyanoshita, and Kashiwagi.

Limonius imitans, sp. n.

Æneescens, nitidus, fulvo-pubescens; thorace sat dense punctulato; scutello carinato; elytris late testaceo-vittatis.
L. $7\frac{1}{2}$ mill.

Greenish bronze, shining; the head densely punctulate and uneven between the eyes, frontal carina feebly emarginate; the thorax somewhat long, rather parallel laterally, rather finely and closely, not densely, punctured; the scutellum markedly carinate; the elytra punctate-striate, interstices punctulate and feebly rugose, interstices of the fifth, sixth, and seventh striæ testaceous, this colour also extends narrowly along the base; the antennæ black and moderately dilated after the third joint, third joint scarcely longer than the second; the legs black, tibiæ and claws pale.

L. vittatus, Cand., in colour closely resembles this species, but the first cannot be mistaken for the female of the second, as the antennæ of *C. vittatus* are the most dilated. In *L. vit-*

tatus the punctuation of the thorax is very dense, which might suggest its being the female.

In coloration both species have a very close resemblance to a species found in Hongkong (see Cand. Mém. Liège, 1873, p. 22).

Hab. Miyanoshita. Three individuals, all males.

Limonius rufipennis, sp. n.

Niger, parum nitidus, griseo-pubescens; capite thoraceque subæneis; elytris fortiter punctato-striatis, rufis; antennis pedibusque nigris.
L. 7 mill.

Black, rather shining, with grey pubescence; the head densely and somewhat rugosely punctate, frontal carina well-marked; the thorax rather long, parallel on sides, punctuation finer and less close than that of the head; the scutellum punctulate; the elytra bright red, punctate-striate, punctures large and deep, especially those of the fourth, fifth, and sixth striæ; the antennæ densely black, second and third joints short and equal; the legs black, knees and claws pale.

Hab. Hitoyoshi. Three examples on Ogumayama, alt. 2000 feet.

Limonius atricolor, Lew.

Limonius atricolor, Lew. Ent. Month. Mag. 1879, p. 157.

Ater, opacus, griseo-pubescens; antennis pedibusque concoloribus; elytris punctato-striatis, interstitiis rugoso-punctatis.
L. 8½ mill.

Black, opaque, with grey pubescence; the head uneven, densely and rather coarsely punctured, carina well-marked; the thorax convex on the disk, a little swollen at the anterior angles, punctures closely set, finer than those of the head, posterior angles obtuse; the scutellum very finely but closely punctured, carinate; the elytra punctate-striate, interstices punctulate and rather rugose; the antennæ and legs black, second and third joints of the former short and equal, claws pale.

The example noticed in 1879 was quite black; more recent specimens have an æneous and sometimes bluish tint.

Hab. Wakayama in Kii and Miyanoshita.

Limonius ignicollis, sp. n.

Purpureo-niger, opacus vix pubescens; capite thoraceque aureo-

rufis, nitidissimis; elytris opacis, punctato-striatis, interstitiis dense punctatis; antennis pedibusque nigris.
L. $6\frac{3}{4}$ mill.

Purple-black, head and thorax golden red, with crimson tint, very shining; the head clearly, deeply, not very closely punctured, frontal carina feebly emarginate, impressed between the eyes; the thorax convex, punctate like the head, faintly canaliculate; the scutellum strongly punctate, distinctly carinate; the elytra purple-black, punctate-striate, interstices densely rugose and punctured, opaque; the antennæ densely black, second and third joints very small and equal, 4 to 7 triangular, rather widely dilated on the inner edge; the legs pilose, black.

Evidently somewhat similar to *L. aurifer*, Lec.

Hab. Nikko. One specimen from the forest near the chief temple in June 1880.

Limonius approximans, sp. n.

Obscure æneus, nitidus, griseo-pubescens; antennis nigris; thorace angulis posticis pedibusque rufis.
L. $6\frac{1}{2}$ mill.

Somewhat brassy, shining, with grey pubescence; the head clearly, not closely punctured, frontal carina feebly emarginate; the thorax convex, evenly, not densely punctured, hind angles narrowly red; the scutellum carinate and obscurely punctured; the elytra deeply punctate-striate, interstices rather flat, rugose, and little closely punctured; the antennæ densely black, second and third joints small and equal, 4 to 10 rather wide, much less dilated than those of *L. ignicollis* and not much more so on the inner than on the outer edge; the legs clear red.

Hab. Nikko. Two examples only.

Athous umbratilis, sp. n.

Brunneus, subnitidus, cinereo-pubescens; elytris bifasciatis cum marginibus anguste castaneis; antennis pedibusque ferrugineis.
L. 17–$21\frac{1}{2}$ mill.

Brown, with ashy pubescence; the head with a median impression behind the antennæ, not very closely punctured (punctures coarser in female); the thorax darkest in the median area, reddish brown at the sides, laterally rather closely punctured (punctures in female larger and ocellate), in median region punctures much less close and in male rather fine; the elytra punctate-striate, interstices sparsely

punctulate, suture and outside margin narrowly castaneous, bifasciate, the fascia before the apex somewhat triangular in outline; the antennæ and legs ferruginous.

In general appearance corresponds with *A. rufus*, De Geer, and *A. rhombeus*, Ol.

Hab. Junsai, Chiuzenji (Niohozan, bred from pupæ), and Oyayama.

Athous subcyaneus, Motsch.

Athous subcyaneus, Motsch. Bull. Mosc. 1866, p. 166.

This fine species has the scutellum conspicuously elevated and shaped like the two sides of a prism, and the antennæ are very markedly serrate in both sexes. Motschulsky did not notice the curious scutellum, and, I think, Harold (Deutsch. ent. Zeitschr. 1878, p. 73) and also Frivaldszky (Term. füzetek. xv. p. 124) have mistaken *A. virens*, Cand., for it.

Hab. Chiuzenji, Oyama, Oyayama, and Junsai. In August at Junsai it was flying abundantly at a low elevation at noon in the shady recesses of the forest, but in south and central Japan it is confined to mountainous places of high elevation.

Athous secessus, Cand.

Athous secessus, Cand. Mém. Liège, 1873, p. 23.

The scutellum in this species is feebly carinate, the legs usually black; but in a long series I find two examples with red legs.

Hab. Kioto, Osaka, Nara, and Nikko.

Athous sinuatus, sp. n.

Niger, nitidus, griseo-pubescens; thorace ante angulos posticos conspicue sinuato; elytris striis tenuiter impressis, interstitiis planis; antennis nigris, pedibus rufis.

L. 10–12½ mill.

Black, shining, with griseous pubescence; the head not closely but rather coarsely punctured; the thorax very finely and sparsely punctured, strongly sinuous before the posterior angles; the scutellum feebly carinate; the elytra punctate-striate, striæ very lightly impressed, especially those next to the suture, interstices punctured like the head; the antennæ black, basal joints pitchy red; the legs pale red or rarely infuscate.

There is a variety with the elytra pitchy brown.

Hab. Wada-toge, Fukushima, Yumoto, Nishimura, and Nowata.

Athous virens, Cand.

Athous virens, Cand. Mém. Liège, 1873, p. 24.

In about eighty examples eleven have the elytra wholly brown (var. *brunneipennis*).

Hab. Wada-toge (in great profusion), Chiuzenji, Maiyasan, and Shimonosuwa.

Athous sanguinicollis, Frivaldszky.

Athous sanguinicollis, Frivaldszky, Term. füzetek. xv., 1892, p. 124.

The above is very similar to *Athous desertor*, but it is larger and the thorax is wholly red. It is also very near to *A. virens*, Cand.

Hab. East Japan (*Frivaldszky*), Oyama (*Pryer*).

Athous desertor.

Psephus desertor, Cand. Mém. Liège, 1873, p. 7.

Hab. Kobé. Found near the temple of Maiyasan.

Athous comes, sp. n.

♂. Rufo-brunneus, subopacus, griseo-pubescens; elytris marginibus rufo-ferrugineis; antennis gracilibus, rufo-brunneis.
L. 12 mill.

Reddish brown, rather opaque, with grey pubescence; the head rather coarsely punctured, anterior margin rather broadly raised, with a triangular depression behind it; the thorax straight at the sides, scarcely narrowed anteriorly, rather closely punctured, hind angle very feebly turned outwards, tips rounded off; the elytra punctate-striate, interstices markedly rugose, obscurely punctured, sutural and two outside interstices and apices broadly ferruginous, interstices 2 to 7 dark brown for two thirds their length; the antennæ long and slender, not serrate; the legs pale reddish brown.

This insect is similar to *A. suturalis*, Cand. (♂), but it is more opaque, the thorax less narrowed anteriorly, and the antennæ are longer and more slender.

Hab. Sapporo. Three specimens, all males.

Athous suturalis, Cand.

Athous suturalis, Cand. Mém. Liège, 1873, p. 23.

This species belongs to the same group as *A. difformis*, Lac. Candèze placed it near *A. ferrugineus*, Eschs., but Candèze had only the female and mistook it for the male. The female has the thorax conspicuously sinuous along the anterior edge, the sinuosities behind the eyes being deeper

than the one behind the middle of the neck, and the punctuation is round and deep, while in the male the punctures are fine. In the male also there is a triangular impression behind the frontal carina.

Hab. Kobé, Fukushima, and Fukui. Not uncommon.

Athous porrecticollis, sp. n.

Rufo-brunneus, submitidus; thorace utrinque parallelo, dense punctato; elytris ferrugineis vel testaceis, interstitiis rugosis; antennis brunneis, pedibus pallide rufo-brunneis.

L. ♀ 10, ♂ 9 mill.

Reddish brown, rather shining, pubescence grey; the head, frontal margin rather broadly raised, hollowed out somewhat triangularly behind the margin, densely punctate, particularly in female; the thorax punctured like the head (corresponding in the sexes), narrowest anteriorly, sides straight in male, slightly bent in female, basal carina short and close to the external edge, hind angles rounded off at the tips; the elytra testaceous or reddish brown, punctate-striate, interstices distinctly rugose, feebly punctured, rather convex; the antennæ rather short and serrate, not much longer in the male than in the female, in colour like the head; the legs pale.

Resembles *A. ferruginosus*, Eschs.

Hab. Junsai. Eight examples.

Athous singularis, sp. n.

♂. Fusco-brunneus, parum nitidus, cinereo-pubescens; thorace a basi transversim abrupte excavato, angulis posticis elongatissimis extrorsum incurvatis; antennis pedibusque ferrugineis.

L. 9½ mill.

Dusky brown, rather shining, with rather long ashy-grey pubescence; the head rather wide, impressed anteriorly, frontal carina not emarginate, punctate, punctures rather small and not closely set; the thorax widest in the middle, hind angles long and markedly turned outwards, similar to those figured for *Eudactylus carnifex* (Cand. Mon. ii. pl. iii. fig. 16); posteriorly about one fourth of the thorax is transversely and abruptly excavated at the base; the elytra widest at the base, gradually narrowing to the apex, with fasciæ like those of *A. undatus*, De Geer, punctate-striate, interstices rugose, sutural interstices rather pale; the antennæ and legs ferruginous.

The female is unknown to me.

Hab. Junsai. Three examples.

[To be continued.]

XX.—*Description of a new Species of Reed-Rat* (Aulacodus) *from East Africa, with Remarks on the Milk-dentition of the Genus.* By Oldfield Thomas.

Among the mammals obtained by Dr. J. W. Gregory on his recent expedition to East Africa are five specimens belonging to the genus *Aulacodus*. Of these, four—a skin with its skull, a separate skull, and two young specimens in spirit—all obtained at Ngatana, on the Tana River, belong evidently to *A. swindereniamus* *, Temm., the common species, which is spread over the whole of the Ethiopian Region, from Senegal to the Cape. The fifth specimen, however—a skull alone—shows such differences from the others that I cannot but consider it to represent a distinct species. It belonged to a specimen obtained by Dr. Gregory in the Kikuyu Country, near Mount Kenia; but the skin was most unfortunately stolen, so that the only part which remains is the skull.

I propose to term the species

Aulacodus gregorianus, sp. n.

Size much smaller than in *A. swindereniamus*, the difference especially well-marked in the molar teeth; frontal region broad and flat, not convex or inflated, but, on the contrary, with distinct concavities just internal to the rudimentary postorbital processes. Opening between the olfactory and cerebral fossæ much broader above than below, the converse being the case in the other species; this difference appears to be due to the absence or reduction of the frontal sinuses. Anterior palatine foramina penetrating less than usual into the maxillæ, the most posterior point of the premaxillæ, on the palatal surface, being exactly level with their posterior margin.

Upper premolar (P^4) with a small third external root midway between the two main external roots, a character not present in any of the fourteen skulls of *A. swindereniamus* in the Museum. Upper incisors with the innermost of the four spaces between the grooves rather broader and the outer much narrower than in the ordinary species; in fact, in *A. swindereniamus* the part of the tooth outside the outermost groove is nearly equal to the whole remaining portion, while in *A. gregorianus* the same part is but little broader than the next section, between the outer and middle grooves.

* This name has generally been misspelt either as *swinderianus* (the original) or *swindernianus*; but as Temminck distinctly states that it is named in honour of Prof. van Swinderen, the proper form is clearly as above.

Dimensions of the typical skull (♂) :—

Basal length * 72·7 millim.; basilar length * 65; greatest breadth 54·3; nasals, length 28, breadth 15·8; interorbital breadth 30; intertemporal breadth 29; height of skull from palate to middle of frontals 26·5, ditto from basion to top of occipital crest 26; palate, length from "henselion" 34·8; diastema 18·2; length of palatine foramina 9·4.

Teeth.—Diameter of $\frac{i.1}{}$, longitudinal 4·3, transverse 5·5; length of upper molar series (crowns) 16; breadth of crown of $\frac{p.4}{}$ 4·8, of $\frac{m.1}{}$ 5·5; $\frac{}{i.1}$, longitudinal diameter 4, transverse ditto 5·3; length of lower molar series 19; length of $\frac{}{p.4}$ 5·4.

Hab. Luiji Reru River, Konu, Kikuyu Country, British East Africa. Alt. 5700 feet.

Coll. Dr. J. W. Gregory, June 10, 1893.

The above differential characters will no doubt be supplemented by others when, as I hope will soon be the case, perfect specimens of this interesting animal are obtained. It may be just noted that Heuglin's *A. semipalmatus*, of which I have seen the typical skull in Stuttgart, has a basal length of 85 millim. and an upper molar series of 18·2 millim., exactly as in average *A. swinderenianus*.

I am indebted to Dr. Gregory for the following note on the specimen of which the skull is here described :—

"While in a 'shauri' with the chiefs of the Konu district of Kikuyu, beside the Tana tributary Luiji Reru, which forms the northern boundary of the cultivated districts, a native came up with the *Aulacodus*, which he had just caught in the swamp in which the stream rose. I purchased it for two strings of beads, an empty meat-tin, and two used brass cartridges. The man declared that they were not common, and that the specimen was full-sized. I prepared the skin, but this was subsequently stolen and sold for food by my tent-boy.

"The following notes were made at the time :—It was a male; general appearance like that of the larger specimen caught at Ngatana. It appears to differ from that in the shortness and softness of the hair; the skin is lighter in colour on the lower part of the sides of the body; it is somewhat mottled, like that of a tabby cat. I also noted that the head appeared longer and the tail shorter than in the Ngatana

* By a convenient practice, now becoming general, the term *basal* length is restricted to that from the basion to the front of the premaxillæ (gnathion), while the *basilar* length is that introduced by Hensel, to the back of the alveoli of the incisors. For brevity's sake this latter point might be called the "henselion," as it is already so universally connected with the name of the great German craniologist.

specimen; but as I had skinned this latter more than six months before, the recollection is probably of little value. The measurements have unfortunately been lost with the skin, to which they were tied.

"I know nothing of its habits; but the natives say it occurs only in the reed- and sedge-covered swamps, which are here very numerous, owing to the windings of the stream."

The Milk-dentition of Aulacodus.

In connexion with the working out of the above, an examination of the teeth of *Aulacodus* at different ages has been made, and this has been rewarded by the discovery, in a fœtal specimen about 110 millim. in length, with a basal length of 34 millim., of minute and quite rudimentary milk-teeth fixed in the gum just above each of the premolars. This discovery confirms the usually accepted homology of the last-named teeth and also bears out the original suggestion of Schlosser * that the milk-teeth are shed in extreme youth, a suggestion which he afterwards unfortunately withdrew in favour of the theory that there is an ordinary tooth-change, the milk and permanent teeth being very like each other, except that the lower milk-teeth are more complicated than their successors. This error is evidently due to his having been deceived by the great difference between worn and unworn permanent teeth. This latter view is, of course, now finally disproved.

The contrast between *Hystrix*, with its long persistent $\frac{mp.4}{}$, and *Aulacodus*, with its rudimentary and early shed one, is very striking.

Hensel † has recorded his failure to find any trace of rudimentary milk-teeth in *Phyllomys* and *Dactylomys*, and, to the best of my belief, they have not hitherto been observed in any members of the subfamily Echinomyinæ.

XXI.—*Note on* Mus Burtoni, *Thos.* By Oldfield Thomas.

In the 'Annals' for 1892 ‡ I described a West-African mouse under the above name; but Prof. T. Tullberg, of Upsala, who has himself given a most excellent account § of

* 'Palæontographica,' xxxi. p. 131 (1885). See also Forsyth Major, Atti Soc. Ital. xv. p. 5 (1872).

† Abh. Ak. Berl. 1872, p. 53.

‡ (6) x. p. 182.

§ "Ueber einige Muriden aus Kamerun," Ges. Wiss. Upsala, 1893.

the anatomy of the species under the heading of *Mus maurus*, Gray, has kindly drawn my attention to the fact that Mr. Ramsay had already described an Australian "*Mus Burtoni*" *, so that the name of the African one must be changed.

I would therefore suggest for the latter the name of *Mus Tullbergi*, in recognition of Prof. Tullberg's valuable paper on the Muridæ of the Cameroons, where this species appears to be so common.

XXII.—*Preliminary Notice of South-American* Tubificidæ *collected by Dr. Michaelsen, including the Description of a Branchiate Form.* By Frank E. Beddard, M.A., F.R.S.

The Oligochæta of which I give a preliminary account in the following pages were collected by Dr. Michaelsen in South America. The material was, of course, excellently preserved, and I am able therefore to give, I trust, an accurate account of the principal structural features of the new forms.

The bulk of the aquatic species which he collected prove to belong to the family Tubificidæ, and they are all new species, four of them representing a new and evidently highly characteristic South-American genus. So far as I am aware there is nothing known about the aquatic worms of this part of the world, save a few notes on an *Æolosoma* and Naids by Frenzel† in a paper devoted to the Protozoa met with in the Argentine, and the description by myself‡ of two aquatic members of the genus *Acanthodrilus* from the Falkland Islands and of a new genus, *Kerria*, also referable to the Acanthodrilidæ, from the upper reaches of the Pilcomayo River, and, lastly, the description of "*Mandane stagnalis*" by Kinberg, from the same continent, and of one or two forms by Schmarda. The collection contains a few Naids, not sexually mature, and one or two Enchytræids. I have not yet subjected these to a careful examination. The Tubificidæ comprise five species, of which four, as already stated, belong to a new genus, for which I proposed the name *Hesperodrilus* in a note published in a recent number of 'Nature'§. The fifth species I call

* Proc. Linn. Soc. N. S. W. (2) ii. p. 553 (1887).

† "Untersuchungen über die mikroskopische Fauna Argentiniens," Arch. f. mikr. Anat. xxxviii. p. 1.

‡ "Contributions to the Anatomy of Earthworms &c.," Quart. Journ. Micr. Sci. xxx. p. 421; and "On some new Species of Earthworms from various parts of the World," Proc. Zool. Soc. 1892, p. 678 &c.

§ Jan. 25th.

Bothrioneuron americanum, sp. n.

This worm was collected in great abundance, and is described in a note by Dr. Michaelsen as having the general appearance of *Tubifex*. It was collected in the neighbourhood of Buenos Ayres.

The genus *Bothrioneuron* itself, to which I refer the present species, has been lately described by Stole *. It differs from all other Tubificidæ, except *Monopylephorus* of Levinsen † and *Vermiculus* of Goodrich ‡, in having an unpaired male orifice. In his description of *Monopylephorus* Levinsen has not referred to the spermathecal pores. As these are absent in *Bothrioneuron* it may be that the two genera are identical; but it is impossible to be certain about the matter. These three genera, moreover, agree with each other (and with *Limnodrilus* and *Clitellio*) in having only uncinate setæ; the capilliform setæ of other Tubificids are entirely absent. The principal reason which leads me to place my new species in the genus *Bothrioneuron* is the absence of spermathecæ, the absence of capilliform setæ, the presence of an integumental blood-plexus, and the existence of what Vejdovsky § has termed a "paratrium," a diverticulum of the spermiducal gland, to which, in *Bothrioneuron Vejdovskyanum*, the prostate is attached. In my species, however, the male pores are double, but the paratrium apparently resembles that of *Bothrioneuron Vejdovskyanum*. The atrium or, as I prefer to call it, spermiducal gland is wrapped in a thick glandular covering, as in the Lumbriculidæ and the Moniligastridæ. Such a coating appears to be absent from *Bothrioneuron Vejdovskyanum*. In short, there is no doubt whatever as to the specific distinctness of this worm; the only doubt is as to whether I am right in referring it to the genus *Bothrioneuron* at all. I found no trace of the peculiar spermatophores described by Stole, or, indeed, of any spermatophores at all.

HESPERODRILUS, gen. nov.

Four species of Tubificids from Valdivia, Port Stanley, and Uschuaia represent a perfectly new genus of Tubificidæ; I cannot refer them to any known genus. The most salient characters of this genus are:—

(1) The presence of capilliform setæ only in the dorsal bundles.

* "Monografie Ceskych Tubificidu," Abh. k. Böhm. Ges. 1888.

† "Systematisk-geografisk Oversigt over de nordiske Annulata &c.," Vid. Med. 1882, p. 223.

‡ "Note on a new Oligochæte," Zool. Anz. no. 408 (1892).

§ "Sur une Tubifex d'Algérie," Mém. Soc. Zool. Fr. 1891.

(2) The presence of two setæ only in each ventral bundle, of which one is uncinate, the other simple.
(3) The opening of the spermathecæ in segment xiii. behind the male pores.
(4) The fact that the sperm-duct opens independently of the spermiducal gland into the penis.

This combination of characters occurs in no other Tubificid. In fact more than one of the characters is peculiar to the present genus. The curious arrangement of the ventral setæ is peculiar, and so is the position of the spermathecæ.

It is the rule among the Tubificidæ for the sperm-duct to open into the extremity of the spermiducal gland, which has ordinarily the appearance of being a continuation of it. To this rule there has hitherto been only a single exception recorded. This exception is the remarkable genus *Branchiura* *, in which the sperm-duct opens into the lowest part of the spermiducal gland just before the latter becomes continuous with the penis. In *Hesperodrilus* the same state of affairs is met with, but the gland is not enveloped, as it is in *Branchiura*, by a thick outer coating of glandular cells; there is only the lining of cells, which are, however, extremely glandular; the distinct prostate found in so many Tubificidæ, but wanting in *Branchiura*, *Clitellio*, and *Ilyodrilus*, is also wanting in *Hesperodrilus*. As to the peculiar condition of the setæ of the ventral bundles, it might perhaps be thought that there is some error; it is so frequently the case that one of the teeth of the bifid seta is worn. In the present instance there can, I think, be no doubt about the matter; the two kinds of setæ occurred with far too great a regularity to admit of any such explanation as that suggested.

The following is a brief description of the main characters of the four species belonging to this new genus:—

1. Hesperodrilus branchiatus, sp. n.

I refer first to this species on account of its interest in being another branchiate species. This is now the second Tubificid in which organs clearly of a branchial nature exist. The other species is *Branchiura Sowerbii*, which I discovered two years ago in the "*Victoria regia*" tank at the Botanical Society's Gardens in the Regent's Park. At first I naturally supposed that I had before me an example of that worm, the habitat of which is very possibly South America; but in the

* "A new Branchiate Oligochæte, *Branchiura Sowerbii*," Quart. Journ. Micr. Sci. 1892, p. 1.

present species the branchiæ, though apparently similar in structure to those of *Branchiura*, have a different arrangement. In *Branchiura* they are dorsal and ventral, attached to the median line of the body on those aspects. In *Hesperodrilus branchiatus* they are lateral in position, being attached a little below the lateral setæ. These were, moreover, in the single specimen examined by me fewer in number; I counted only thirteen pairs. In the interior of each branchial process was a capillary loop; their length is about the diameter of the body; no doubt during life they extend on each side for a considerable distance beyond the body. It is an interesting fact that in both the present species and in *Branchiura* the branchiæ should be limited to the tail-end of the body; but a consideration of the habits of the Tubificidæ seems to explain this. It is well known that the common *Tubifex* of our streams and rivers buries its head in the mud, while the tail waves freely about in the water; this appears also to be the way with other Tubificids. Now in *Limnodrilus* the hinder segments of the body are apt to have integumental capillaries, which render the aeration of the blood easier in those segments; there is thus the first step in the formation of a special breathing organ. In *Bothrioneuron* (see above) the hinder end of the body is furnished with an exceedingly rich integumental blood-plexus, which is a further step in the same direction. Finally, we have in *Branchiura Sowerbii* and in *Hesperodrilus branchiatus* the appearance of definite branchial organs. On the other hand, in *Chætobranchus Semperi*, Bourne's gilled Naid, which presumably wanders through the water and is not largely sessile, the branchiæ are at the head end and diminish towards the tail; the same is the case with *Alma nilotica*, whose nature, however, cannot yet be regarded as certain; it may be, as has been suggested by Eisig, a Capitellid. The branchiæ of *Dero* and of *Aulophorus vagans*, if this genus be allowed as distinct from *Dero*, are at the hinder end of the body.

In other features of its organization this *Hesperodrilus* conforms to the type of structure already described as characteristic of the genus *Hesperodrilus*, though there are naturally other points of difference.

2. Hesperodrilus niger, sp. n.

The most salient external character of this species is its deep black coloration. It is a largish worm, quite an inch in length, and of a considerable thickness. I regarded it at first as probably a *Lumbriculus*. It proved, however, in dissection to be undoubtedly a member of this genus.

Its chief distinguishing character is the dark pigmentation of the dorsal surface of the body; the pigment proved on an examination of sections to be chiefly located in the peritoneum lining the dorsal side of the cœlom, thence extending for a little way into the muscular layers of the body-wall and in the opposite direction along the septa. The internal characters, apart from differences of small importance, are those of the following species.

3. **Hesperodrilus albus**, sp. n.

This is a small and slender species of a white colour (when preserved); its general appearance is quite that of a *Tubifex*. In addition to the peculiar characters of the ventral setæ which I referred to as characteristic of the genus, this species shows another peculiarity in those organs which I believe to be unique in the Tubificidæ. The dorsal setæ do not commence upon the first setigerous segment, but upon the second; there is thus the commencement of what Prof. Lankester has termed "cephalization," so highly characteristic of many Naids. Vaillant, in his recently published account of the Oligochæta, has united the Tubificids and the Naids into one family; this species is a further proof of the justice of this course. Not only does *Hesperodrilus* show in this particular some resemblance to the Naids, but it also shows an approach to the Lumbriculidæ. It will be remembered that in *Phreatothrix* and in *Stylodrilus Vejdovskii* the first pair of nephridia extend through a considerable number of segments, though the funnel and the external pore are, as is the rule, upon consecutive segments; in *Hesperodrilus albus* we find exactly the same state of affairs. The first pair of nephridia are in the sixth segment; thence they extend back as far as the tenth, but the external aperture is upon the sixth. The proof of this was not entirely derived from a careful putting together of a series of consecutive sections, which might possibly lead to error; in one section the course of the tube through three segments was quite plainly visible. Another mark of distinction between the Tubificidæ and the Lumbriculidæ is thus broken down. I am disposed to unite Tubificidæ, Naidomorpha, and Lumbriculidæ into one large family.

The spermathecæ of this species are extraordinarily long; the genus as a whole is characterized by the possession of long spermathecæ, but the present species and the next one have unusually long sacs, which extend through five segments. Each sac is dilated at the blind end into an oval sac, in which

lie the spermatozoa; I could find no trace of spermatophores. The duct of the spermatheca leading from this sac is long and narrow; rather more than halfway down there is a slight swelling and a kind of trap formed by a sudden change in the height of the lining epithelium; the structure is very suggestive of the spermatheca of *Marionia sphagnetorum* recently described by Michaelsen *.

4. **Hesperodrilus pellucidus**, sp. n.

This species is very like the last, differing, however, in a few small points. Its colour when preserved is brownish, instead of an opaque white. The dorsal capilliform setæ are not so long and the spermiducal gland is a little different in form. In other respects it agrees entirely with *Hesperodrilus albus*.

I conclude with a definition of the genus and the species:—

HESPERODRILUS, gen. nov.

Dorsal setæ capilliform only; ventral setæ two to each bundle, one uncinate, the other simple. Male pores on segment xii., spermathecal pores on xiii. Spermiducal gland opening into protrusible penis, together with sperm-duct; no distinct "prostate." Spermathecæ long. No spermatophores (?).

(1) **Hesperodrilus branchiatus**, sp. n.

Dorsal setæ short and slender. Posterior thirteen segments with paired branchial processes.

(2) **Hesperodrilus niger**, sp. n.

Body strongly pigmented dorsally. Dorsal setæ short and slender.

(3) **Hesperodrilus albus**, sp. n.

Dorsal setæ do not commence until segment iii. Spermiducal gland communicates with penis by a narrow tube.

(4) **Hesperodrilus pellucidus**, sp. n.

Dorsal setæ do not commence until segment iii., slender. Spermiducal gland only separated by a short constriction from penis.

* Arch. f. mikr. Anat. xxxi. pl. xxiii. fig. 2 *c*.

XXIII.—*Diagnosis of a new Species of the Genus* Lepidolemur. By Dr. C. I. Forsyth Major.

Lepidolemur leucopus, sp. n.

Upperparts chiefly chinchilla-grey, with an indistinct median brownish stripe, stretching from the region of the neck to the root of the tail, in the proximity of which it becomes paler. Head above brown-grey, with a darker median stripe; cheeks and chin whitish. The ears encircled by a broad ring of whitish hair. Neck, shoulder, and upper parts of forearm pale rufous. Breast and belly greyish white; inner faces of fore and hind limbs and heels pure white. Tail greyish with rusty tinge, shorter than body (250 : 290 millim.).

Ears large, higher than broad, membranous.

Length of the upper molar and premolar series 17·5 millim.

Length of the lower molar and premolar series (*m.* 3–*p.* 2) 16 millim.

Hab. Fort Dauphin (S.E. Madagascar).

Type in the British Museum.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

November 8, 1893.—W. H. Hudleston, Esq., M.A., F.R.S., President, in the Chair.

The following communication was read:—

'Notes on the Occurrence of Mammoth-remains in the Yukon District of Canada and in Alaska.' By George M. Dawson, C.M.G., LL.D., F.R.S., F.G.S.

In this paper various recorded occurrences of Mammoth-remains are noted and discussed. The remains are abundant in, if not strictly confined to, the limits of a great unglaciated area in the North-western part of the North American continent; whilst within the area which was covered by the great ice-mass which the Author has described as the Cordilleran glacier, remains of the Mammoth are either entirely wanting or are very scarce. At the time of the existence of the Mammoth the North American and Asiatic land was continuous; for an elevation of the land sufficient to enable the Mammoth to reach those islands of the Bering Sea where these bones have been found would result in the obliteration of Bering Straits.

The bones occur, along the northern coast of Alaska, in a layer of clay resting on the somewhat impure 'ground-ice formation' which gives indications of stratification; and above the clay is a peaty layer. The Author considers this 'ground-ice' was formed as a deposit when more continental conditions prevailed, by snow-fall on

a region without the slopes necessary to produce moving glaciers. The Mammoth may be supposed to have passed between Asia and America at this time. At a later date, when Bering Straits were opened and the perennial accumulation of snow ceased on the lowlands, the clay was probably carried down from the highlands and deposited during the overflow of rivers. Over this land the Mammoth roamed, and wherever local areas of decay of ice arose bogs would be produced which served as veritable sink-traps. The Author considers it probable that the accumulation of 'ground-ice' was coincident with the second (and latest) epoch of maximum glaciation, which was followed by an important subsidence in British Columbia.

December 6, 1893.—W. H. Hudleston, Esq., M.A., F.R.S., President, in the Chair.

The following communication was read:—

'On a Variety of *Ammonites* (*Stephanoceras*) *subarmatus*, Young, from the Upper Lias of Whitby.' By Horace W. Monckton, Esq., F.L.S., F.G.S.

The Author describes an ammonite found by himself in 1874 near Sandsend, 3 miles north-west of Whitby. He thinks it was not actually *in situ*, but lying with a number of nodules on the floor of an old alum-pit, although he has no doubt that it is from the Alum Shale of the Upper Lias. A peculiar arrangement of the costæ as they cross the siphonal area distinguishes the specimen from other Whitby ammonites known to the Author. It bears a strong resemblance to a shell figured as *A. subarmatus* by D'Orbigny, 'Terr. Jurass.,' pl. lxxvii., but is unlike the figures of that species given by other authors.

MISCELLANEOUS.

On the Jaws of Hirudinea. By Jac. M. Croockewit.

Haycraft's discovery of a substance in the head of *Hirudo medicinalis*, which is able to prevent the coagulation of the blood, has had the effect of directing attention afresh to the jaws and to the so-called salivary glands of leeches.

I now venture to make a provisional communication of certain details of the results which I have obtained with reference to these organs in studying *Hirudo medicinalis* and *Aulastomum gulo*.

It is well known that in the head of *Hirudo* there is found a very large number of unicellular glands, the excretory ducts of which, in the shape of long, narrow, undulating tubes, partly run between the epithelial cells of the pharynx, and partly open on the free edges of the jaws. In *Aulastomum* the number of the glands is much smaller, and in this animal they open, if not exclusively, at any rate almost all upon the edges of the jaws. The secretion contains a

great multitude of small granules, which take a deep stain from hæmatoxylin, in consequence of which glands and excretory ducts are easily recognizable in preparations which are treated in this manner.

In *Hirudo* as well as in *Aulastomum* the orifices of the glands which open upon the jaws are found between the teeth.

The teeth have somewhat the shape of a $\wedge$, the apex of which is directed towards the surface. They may be readily isolated by means of liquor potassæ. In *Aulastomum* they are larger, and, as is well known, much fewer in number than in *Hirudo*. The teeth at the lower end of the arch of the jaw are not so well developed as those in the middle. Nevertheless the two somewhat stout processes, which are directed away from the pharynx, are wanting, so that the teeth are here represented by small conical structures. The teeth are entirely enclosed by the cuticle.

The clearest idea of these structures is afforded by serial sections through the jaws.

The leech is killed by being thrown into alcohol. The jaws are then dissected out, placed in alcohol containing picric acid, for the purpose of decalcifying the teeth and, after suitable preparation, embedded in paraffin. In the case of *Hirudo* it is then not difficult to divide the jaw into series of sections perpendicular to the plane of the jaw and perpendicular to its base. This may also be successfully carried out in the case of *Aulastomum*, although here, on account of the small size of the object, it is not so easy to hit upon the direction desired for the section when the jaw is enclosed in paraffin.

The terminal sections of the series do not show the details clearly. The section here passes obliquely through teeth and cuticle. At the level of the apex of the jaw, however, the transverse sections exhibit the condition of the teeth and cuticle distinctly. The cuticle, which clothes the epithelium of the jaw, increases greatly in thickness on the anterior and posterior surface of the jaw, so soon as it reaches the free margin, and runs out in a sharp edge towards the pharyngeal cavity. Between the cuticle of the anterior and that of the posterior surface a cleft-shaped space is left, and in this space the excretory ducts of the glands open. Each time that a tooth is encountered, however, we find that this space is closed. The decalcified teeth stain well with hæmatoxylin, while the cuticle remains free from this colouring-matter. Consequently in the sections every part of a tooth may be clearly distinguished from the cuticle. The tips of the teeth do not project beyond the free edge of the cuticle.

If an entire jaw, which is best not stained, be made transparent by means of oil of cloves, and then mounted in Canada balsam with the free edge uppermost and a suitably supported cover-slip placed over it, the sharp edges of the cuticle of the anterior and posterior surfaces of the jaw can be observed quite distinctly as two fine lines. The slit which is left between them is found to be open and closed by a tooth in regular alternation.

The teeth are consequently to be regarded as an apparatus for the

support of the cutting cuticle. So soon as a wound is made by the jaw, it is impregnated by the secretion which streams out between the teeth, whereby in the vessels which are bitten into not only the coagulation of the blood, but also the conglutination of the vascular membranes (Blutplättchen) is prevented—at least in the case of *Hirudo medicinalis*.

I have not succeeded in demonstrating an anti-coagulating effect in the case of the extract from heads of *Aulastomum* hardened in alcohol. I have been able to convince myself that *Aulastomum* is able to inflict a skin-wound upon frogs and to suck blood; subsequent bleeding from the wound, however, I have not found. So far as I have seen, *Aulastomum* wounds the skin of only such frogs as are badly nourished and do not defend themselves vigorously, and then only on the toes of the posterior extremities. In the case of dead frogs, *Aulastomum* also fixes itself and sucks in the oral cavity, the pharynx, and deep in the throat.

I hope shortly to be able to publish a more detailed account of my results.—*Zoologischer Anzeiger*, xvi. Jahrg., no. 433, November 13, 1893, pp. 427–429.

Utrecht, October 1893.

Schneider's Pore and the Œsophageal Glands of Nematodes.

By Prof. Otto Hamann, of Göttingen.

Since the investigations of Schneider the œsophagus and its glands in parasitic Nematodes have not been subjected to a renewed and more minute examination, and the subject was left with the brief allusion to a capilliform canal, which this investigator had observed in the œsophagus of *Ascaris megalocephala*. In his 'Monographie der Nematoden' (pp. 191 & 192) in dealing with this species Schneider alludes to a canal, which is stated to open on the dorsal side of the internal œsophageal wall and which could be traced for a short distance. Whether this canal extends deeper into the substance of the œsophagus is a question which he leaves undecided. Up to the present I have discovered the pore with its canal in a large number of Adriatic Ascaridæ and Strongylidæ, and in *Lecanocephalus*. I propose to give a short description of it as found in the latter form. Schneider's pore is situated a short distance below the lips on the dorsal side of the internal wall of the œsophagus, and constitutes a communication between the œsophageal lumen and an organ which lies in the œsophageal wall. The pore leads into a capilliform, membranous, hyaline canal, which at first runs at right angles, and then bends round and passes backwards parallel to the longitudinal axis of the œsophagus. The canal is surrounded by a granular substance, which offers a marked contrast to the basal substance of the œsophagus. It never lies free, but even at its hinder end, where it has become more and more slender, the canal is enclosed in this substance. It can be followed throughout the entire length of the œsophagus almost as far as the sphincter appa-

ratus, which is present in all Nematodes and divides the œsophagus from the mesenteron. At the end of this organ stellate cells are found, which probably have an excretory function.

In Ascaridæ and *Lecanocephalus* a cæcum is described, which is said to project backwards at the point where the œsophagus passes into the mesenteron, while a diverticulum of the intestine extends forwards. As is shown by transverse sections, the structure in question is not a cæcum, but a solid organ, which represents a projection of the œsophageal wall on the ventral side. A cavity opening into the lumen of the œsophagus is not found in its centre. With reference to the complicated structure of this organ, I will here only make the following observations. This gland, for such it undoubtedly is, is composed of cells, which are traversed by a capilliform intracellular tubule. In transverse sections the gland exhibits a biscuit-shaped figure, and is divided into two halves by a central septum. In each half lie the perforated cells already mentioned, so that consequently two delicate tubules are present. Now it is possible to follow these canals and observe how they enter the œsophageal wall, from which, as I remarked, the gland is a projection, and open each by a pore into the lumen of the œsophagus a little distance above the point where the gland fuses with the œsophageal wall. The excretory organ of the lateral lines, as I have already described it in *Lecanocephalus* in a previous communication, is essentially constructed in precisely the same manner as this œsophageal gland, since it is composed of a number of perforated cells. In both cases the canal is intracellular in position.

If we take the position of the œsophageal gland into consideration, and reflect that it is situated near the commencement of the mesenteron, and is suspended in the cœlome, we shall find no difficulty in assuming that this organ absorbs excretory products from the cœlomic fluid.

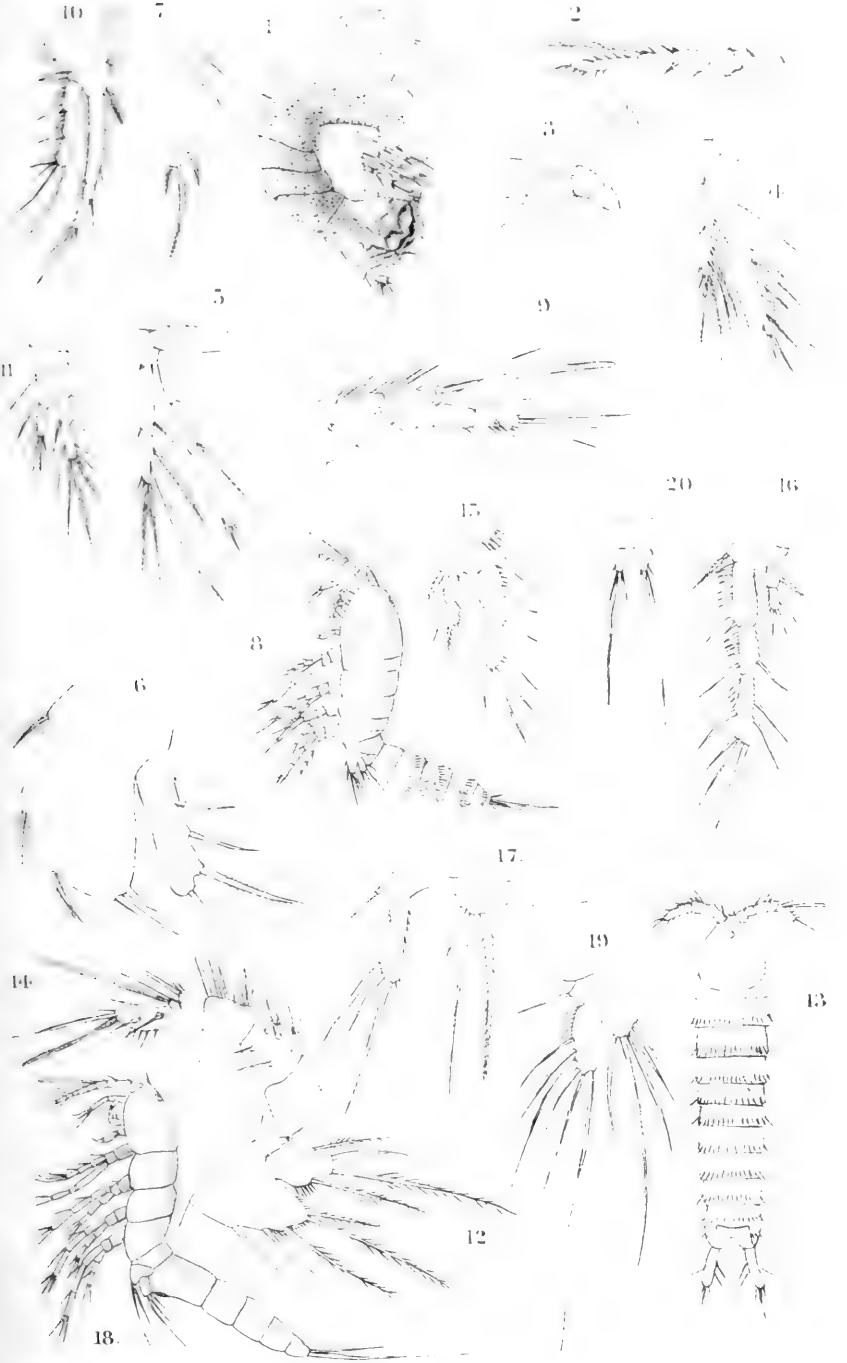
In the parasitic Nematodes, moreover, organs are found lying in the cœlome, which are in connexion with the lateral lines. *Lecanocephalus* possesses several peculiar organs measuring 4 mm. in diameter, which are distinguished by their digitate ramifications and enclose in their centre a disproportionately large nucleus. The digitate processes bear small pyriform structures, which attract attention on account of their strongly refractile granular substance and give rise to the conjecture that they may be homologous with the ciliate organs. A ciliation, however, I have so far never succeeded in discovering. These organs, which are in connexion with the lateral ridges by one end, are undoubtedly identical with the "fasciculate bodies" ("buschelförmigen Körpern") alluded to by Leuckart, Schneider, and others, in the case of *Ascaris megalocephala*, and situate in the neighbourhood of the excretory pore. The detailed description of these organs, as well as of those previously referred to, will be given in a monograph of the genus *Lecanocephalus* and allied forms which will shortly appear.—*Zoologischer Anzeiger*, xvi. Jahrg., no. 433, November 13, 1893, pp. 432–434.

Who first found Balanoglossus? By the Rev. Canon Norman, M.A., D.C.L., F.R.S., &c.

I find that with respect to Cavolini's figure I have lighted on a "mare's nest." Professor Jeffrey Bell has consulted that author's posthumous work, and tells me that "on p. 296 there is a description of Tav. ii. (marked in Atlas ii. and xiv.) thus: 'fig. 1, *Fissofora bijuga* . . . . gli ovari spirali *d*; fig. 4, ovario spirali;'" and that "at p. 342 the species is stated to be the *Agamolpsis* (sic) *Cavolinii* of Delle Chiaje" *. What Cavolini calls the "ovario spirali"—which I took to be a figure, natural size, of a *Balanoglossus*—is, in fact (using Hæckel's terms), the greatly magnified pedicle, cnidoband, and terminal filament of a tentillum of a Siphonophoridan. I have consulted all the chief works on the Siphonophoræ, but cannot meet with a figure which represents the anterior portion of a tentillum with such a collar and proboscis-like outline as is drawn by Cavolini; the figure most like on the whole, perhaps, is the illustration of the tentillum of *Forskalia tholoides*, Hæckel (Report 'Challenger' Siphonophoræ, 1888, pl. x. fig. 23), or that of *Stephanomia amphitridis*, Huxley ('Oceanic Hydrozoa,' 1859, pl. viii. fig. 8), where what he calls the "involucrum" must, I conclude, correspond with the collar-like portion of Cavolini's figure. In mistakingly supposing that Cavolini's figure was life-size and represented a *Balanoglossus*, the chief difficulty in the way of identification was the greatly produced and coiled termination: but it occurred to me that in life this part might be capable of greater elongation than had been represented in figures, and that, moreover, the old author might, in this respect, have drawn somewhat on his imagination. It is worth any one's while who is interested in *Balanoglossus* to look at this figure of Cavolini, and see the curious resemblance as regards the general form of this microscopic organ of a Siphonophoridan and the facies of a *Balanoglossus*.

Burnmoor Rectory,
Jan. 6, 1894.

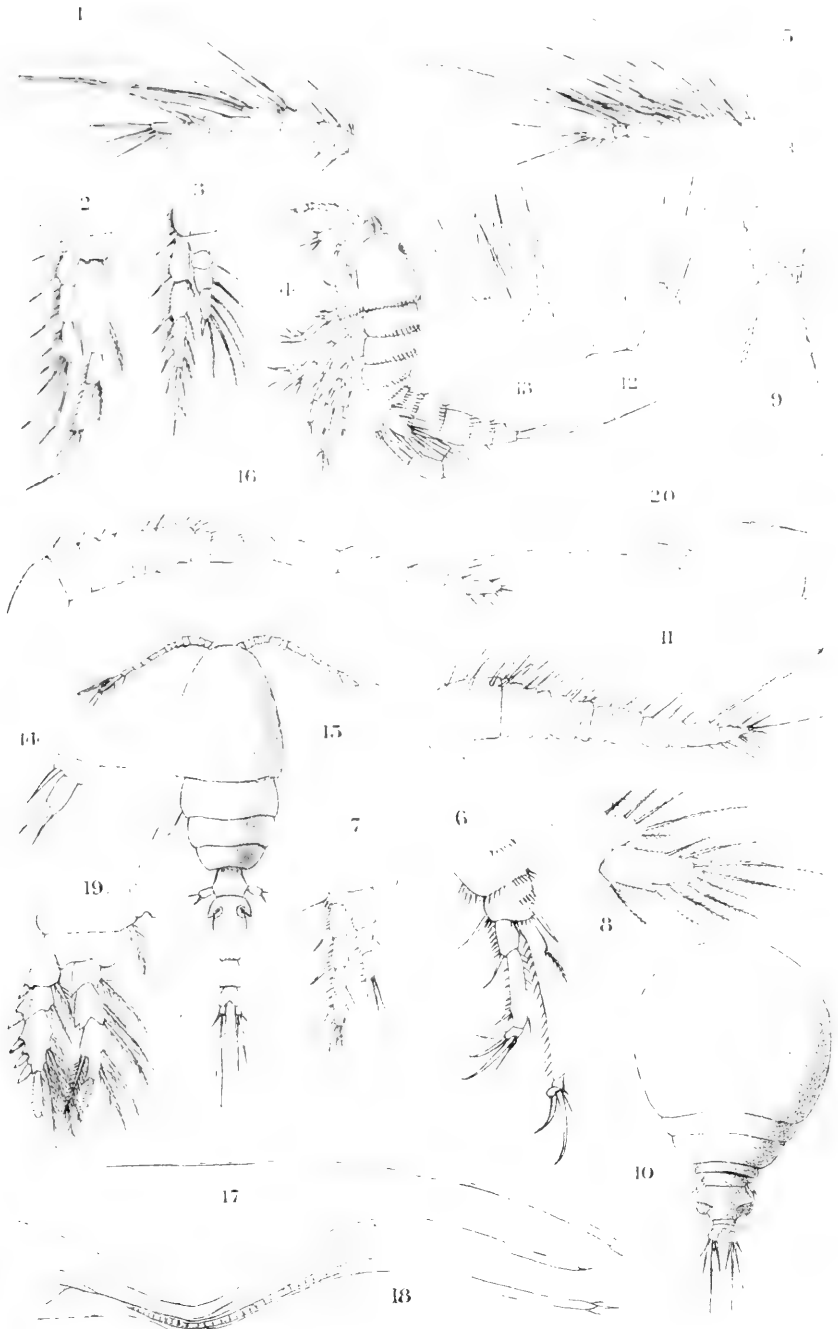
* On pl. clxxxi. of Chiaje, Anim. invert. Sicil. cit., are figures taken from Cavolini's figs., though not exact reproductions, fig. 4 (fig. 6 Chiaje) especially being much reduced in size, and thus not so much simulating *Balanoglossus*. I do not see any reference to these figures in the text. On the plate, fig. 3 (fig. 1, Cavolini) is called *Physsophora bijuga*; figs. 4–6 are not referred to. I may add that there is no reference in Hæckel's Bibliography or List of known Siphonophoræ (Report 'Challenger' Siphonophoræ) either to Cavolini or Chiaje's Sicilian work, nor is the name referred to in Carus, Fauu. Prod. Medit.



Andrew Scott del ad nat.

Mintern Bros. lith.

1–7. *Amymone nigrans, sp. n.*
8–12. *Stenhelia dispar, sp. n.*
13–17. *Cletodes irrasa, sp. n.*
18–20. *Ameira exilis, sp. n.*



Andrew Scott del ad nat. Mintern Bros. lith

1–3. Ameira exilis, sp.n. 4–9. Thalestris forficuloides, sp.n.
10–14. Dermatomyzon gibberum sp.n. 15–20. Acontiophorus elongatus, sp.n

THE ANNALS

AND

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[SIXTH SERIES.]

No. 75. MARCH 1894.

XXIV.—*On a Bifid Earthworm* (Lumbricus terrestris). By Henry C. Williamson, M.A., B.Sc., St. Andrews Marine Laboratory.

[Plate X.]

The *Lumbricus* described below belongs to Mr. Thomson Blackford, and was handed to me by Professor M'Intosh, to whom it had been courteously sent by Dr. Fulton, Superintendent of Scientific Investigations of the Fishery Board for Scotland.

The specimen is an earthworm in which the posterior half of the body is double. Each of the posterior portions has an anus. The recorded cases of bifurcation in the species of *Lumbricus* are few in number; and while that abnormality has been noticed not unfrequently in Polychæta, still comparatively few have been described. Professor E. A. Andrews, of Baltimore, U.S.A., published a list of the references made by different authors to bifurcation in Annelids in 'Nature,' vol. xlvii. no. 1214, Feb. 2nd, 1893. Mr. Robertson, of Oxford, gave the following description of a double earthworm in the 'Quarterly Microscopical Journal,' vol. vii. 1867:—

"The rings of the body presented the usual appearance from the first to the eighty-fifth, where the body divided into two symmetrical halves, each of which presented the usual appearance of the terminal part of an ordinary worm [Pl. X. figs. 8 and 9]. Each of these lateral appendages commenced

by distinct and separate rings applied to the eighty-fifth [in this respect it differs from the earthworm which is the subject of this article], and not by its bifurcation into two parts. A small triangular membranous space was thus left on the dorsal and ventral surfaces, between the junction of the three rings. It was found that the large vessels, the digestive tract, and nerve-cord divided at the eighty-fifth ring, and were symmetrically arranged in each of the lateral appendages. The generative organs were fully developed and quite normal."

Two abnormal earthworms are recorded by Professor F. Jeffrey Bell in the Ann. & Mag. Nat. Hist. 1885, vol. xvi. pp. 475–477. "In the first specimen the left hind branch was shorter than the right. Though the left branch looked like a bud it was not really so, since as time wore on the difference in size increased, and the left then was not only much the smaller, but also much the less active. There were at first no signs of a clitellum, but after two months there were apparent indications of a clitellum. A short time after that date it lost its tails, and soon after was found dead.

"1. It makes it quite certain that, like lizards with their tails, earthworms may reproduce bilaterally what is ordinarily only produced terminally. But this is only another way of saying that earthworms are subject to a well-known and widely diffused law.

"2. The fact that the clitellum only became apparent a few days before the loss of the hinder end is positive; but the events may or may not have any relation to one another. If they have, they only show that when the earthworm is reproducing parts of its body it is, *pro tanto*, comparable to a form reproducing itself asexually, a phenomenon which, so high in the scale of organization, is, we know, not compatible or contemporaneous with sexual reproduction.

"The second specimen belonged to the species *Lumbricus fœtidus*, and was dead when examined."

In 'The American Naturalist,' vol. xxvi. no. 309, 1892, a paper on "Bifurcated Annelids," by Professor Andrews, appeared. Prof. Andrews gives five instances of this abnormality in the species *Lumbricus terrestris*. Two of these are the specimens described by Robertson and Bell, the remaining three having been recorded by Dr. Horst, Asa Fitch, and Dwight Marsh. Prof. Andrews in this article says:—"Horst, in experimenting upon regeneration of lost parts in earthworms, found one, 100 millim. long, with two tails, each 25 millim. long and quite normally formed. This was alive when observed. Asa Fitch records finding in his garden in

New York State a live specimen about 3 inches long with the posterior end divided for nearly one fourth of its length. The appendages were equal, but each only about two thirds the normal thickness of the body anterior to them. Each appendage possessed a functional anus. The left appendage appears as a continuation of the body, three somites serving to form a gradual transition from the thicker trunk to the thinner appendage. The right appendage springs from the gaping suture between the trunk and the first of the three transitional left somites; where the origin of the right branch occurs there is a slight constriction not represented at all upon the left branch. The method of bifurcation seems thus similar to that recorded by Robertson.

"Dwight Marsh records a two-tailed earthworm found in Wisconsin. When alive both tails appear of equal importance, but in alcohol one division is markedly constricted where it joins the body and appears as a mere lateral branch. Each appendage has a branch of the intestine and of the nerve-trunk, as well as functional anus. In alcohol the specimen is only 34 millim. long, the tails each 12 millim."

Andrews further says that he only knows "of about twenty recorded cases of Annelids with bifid ends. The period at which these monstrosities arise is not well known, whether they were formed in the embryo or were formed in the maturer period of the individual's existence. Yet there is little support for the former supposition, while for the latter we have in two cases good evidence and in many others considerable presumption towards this conclusion. Granting for the present that these monstrosities have arisen in late life after the removal of parts of the main axis, or after injuries, we may next inquire how far the two new ends are of equal value, whether the two new parts are equal in origin (as in Robertson's specimen), or whether the one is to be regarded as a subordinate part or lateral outgrowth from the main trunk."

Dr. Cori * describes a bifid *Lumbriculus variegatus* which, in the mode of bifurcation, agrees to some extent with the *Lumbricus* here described. In the *Lumbriculus*, however, each of the three nerve-cords of the trunk—the left, median, and right—gives rise to two nerves which become the corresponding nerves in the two appendages.

The *Lumbricus* described in this article had the posterior portion of the body doubled. The two appendages had

* Sonderabdruck aus 'Lotus,' 1894, Neue Folge, Bd. xiv. p. 1–6, fig. 3.

each an anus, and to all appearances were exactly similar. The trunk and appendages were of nearly equal diameter (Pl. X. fig. 1). Bell does not say whether the specimen described by him had two ani or not. The right-hand appendage was perhaps a shade less in diameter than the left. In this respect this specimen differs from that described by Fitch, in which the posterior appendages were of the same thickness, but of less diameter than the anterior portion. It differs also from that described by Robertson (fig. 8), which appears from his drawing in that respect to agree with Fitch's specimen. When the worm was placed with the dorsum upwards (fig. 1) it was found that the anterior part marked AD, stretching from the prostomium to the fifty-fourth segment, where the bifurcation commenced, was $1\frac{7}{16}$ inch long, the left appendage, DB, $1\frac{3}{16}$ inch long, and the right appendage, D′C, $1\frac{9}{16}$ inch long. In the portion AD there were 54 annuli, in DB 122 annuli, and in D′C 109 annuli. The specimen when examined was in spirit and to some extent contracted. The dorsal line was visible in the anterior portion, in which it could be traced up as far as the nineteenth segment. It ran in a perfectly continuous line down the trunk and the left appendage to the anus (fig. 1). No trace of it could be made out in the right appendage. This is the first important difference between the two appendages, and leads one to suppose that the trunk and the left appendage form the complete worm, and that the right appendage, in which there is no trace of the dorsal line, is the extra portion. Fitch was led to the same conclusion in his specimen.

On examining the junction of the three parts it was seen that the right appendage D′C arose from the right lateral portion of the fifty-fourth segment (fig. 2). The origin of this appendage differs from that of the corresponding one in Robertson's specimen (fig. 8), neither does it occur by the bifurcation of the fifty-fourth segment. At its junction with the fifty-fourth segment the right appendage is constricted. A similar constriction was noticed in the right appendage of Fitch's specimen and also in one of the appendages of the earthworm recorded by Marsh. On dissection it was found that the dorsal blood-vessel was bifurcated, as also were the gut (fig. 3), the supra-neural vessel (fig. 5), and the nerve-cord (fig. 4). The typical double nerve-cord was present in the anterior and both posterior portions. There was no appreciable difference in diameter between the two posterior portions of the dorsal blood-vessel; the intestine in the right appendage was, however, a little less in diameter than that

in the left. The typhlosole was present in both appendages, as well as in the trunk. The gut was empty at the junction, which was the only spot at which it was opened. The double nerve-cord in the right was of less diameter than that in the left appendage. No difference was noticed in the thickness of the two posterior portions of the supra-neural vessel. The constriction that was noticed externally on the right appendage at its junction with the body of the worm was not distinctly made out on the intestine of the same at its junction with the main alimentary tract formed by that of the trunk and left appendage. Two rows of nephridia were made out on each of the appendages, no difference being found between any of them.

The structure of the blood-vessels and gut gave no indication as to which appendage might have been secondarily formed.

As regards the nervous system, there is a normal double cord in the trunk (fig. 4). The left cord (*a*) is continuous with that of the left appendage (*c*), and in a similar manner the right cord (*b*) forms the outer cord of the right appendage (*f*). The inner cords of each appendage (*d* and *e*) are confluent at the bifurcation and have no connexion with the cords of the trunk.

The *vesiculæ seminales*, the only portions of the reproductive organs present, were poorly developed. Three only of these were found, where normally there should be four pairs; one (vs_1, fig. 6), which was very small, on the left side of the tenth segment, and one on each side (vs_2 and vs_3, fig. 6) of the twelfth segment. Of the latter the left-hand one (vs_2) was much the larger. The fact that on the right side of the body the vesiculæ seminales were practically undeveloped gives ground for the supposition that the right appendage is the result of asexual reproduction. There is an entire absence of any clitellum; in this respect the specimen resembles that described by Bell. Robertson found in the worm described by him that the reproductive organs were well developed and normal. It would thus appear probable that asexual reproduction does not account for *all* cases of bifurcation in earthworms.

The method of bifurcation in this earthworm differs from that in the specimens recorded by Robertson and Fitch. As already mentioned, in Robertson's specimen each of the lateral appendages commenced by distinct and separate rings applied to the eighty-fifth segment. In the worm described by Fitch the right appendage arose from the gaping suture between the trunk and the first of the three transitional left

somites which are interposed between the trunk and its thin connexion. This specimen (Fitch's) differs from the one described here in that in the latter the left appendage is of the same diameter as the trunk, and the right appendage arises from the fifty-fourth segment, not from the suture between two segments. Fitch considered that in his specimen the left appendage was the continuation of the trunk, and this appears to be the case in the *Lumbricus* here described. The right appendage arises from the right side of the fifty-fourth segment (fig. 2). Segment 54 differs very much from the other segments both in shape and size. It is triangular in shape, the base being represented by the right side, where the right appendage joins the segment (fig. 2). The somite is of normal length on the left side, but on the right it has grown antero-posteriorly and is very much longer. The increase in length on the right side has caused the left appendage to be pushed to the left, so that the anterior and left posterior portions are not in the same straight line as they probably ought to be.

At what time in the life of the worm the extra tail was developed it is very difficult to tell. If it originated in the embryo we should expect that the two tails would be similar in every respect. They are not, however, identically equal. The mode of connexion between the trunk and the right appendage differs from that of the trunk and the left appendage. The right-hand appendage, moreover, is constricted at its junction with the anterior portion, while the left is not so. The dorsal line is not present in the right appendage. It is difficult to imagine how such an abnormality could have originated in the embryo. In such a case a division of each of the mesoblasts, neuroblasts, nephridioblasts, &c. must have been effected. It might appear possible that the two appendages had been formed by a median vertical longitudinal fission of the original worm. The division may be supposed to have extended from the anus forward to about the middle of the body dividing the gut, vessels, &c. equally and passing between the two nerve-cords. But the completeness of every organ in each appendage does not countenance that supposition; but, assuming that such a fission had taken place, it might probably have been going on at the time of the death of the earthworm. In this case there would have been at the fork a mass of embryonic cells, by their division giving rise to the left wall of the gut in the right appendage and the right wall of the gut in the left appendage, and similarly with the blood-vessels, nerves, and body-walls. The outer gut-walls of the two appendages

would in that case be the right and left walls of the original intestine. Two new rows of nephridia would be produced, one on the inner side of each appendage. The secondarily formed organs would probably differ slightly in structure from the corresponding original organs. No difference was noticed between the nephridia of one row and the nephridia of any of the other three rows in the appendages. Again, it would naturally be expected that the appendages would be symmetrically joined to the anterior trunk. This, however, is not the case. Lastly, the dorsal line, which is absent in the right appendage, would probably have been present in both appendages had this been a case of median fission. If the fission were supposed to have taken place a little to one side of the median line greater difficulties would be encountered. This is, then, apparently a case of budding, not of bifurcation. The right-hand appendage is a bud of segment 54, probably formed subsequently to the complete development of the original worm. The original worm is represented by ADB (fig. 1), and the right-hand appendage D′C (fig. 1) is an outgrowth from the right side of the somite and away from the middle line. The growth in diameter of the bud has caused the increase in size of the right side of the somite.

The third view is that the bifurcation may be the result of lateral budding. In many annelids longitudinal budding is common, and in the Syllidæ lateral budding also regularly takes place. These buds give rise to new individuals. It is impossible to tell whether the bud under consideration might have given rise to a new individual, or whether, like the bud described by Bell, it might have been absorbed if the *Lumbricus* had lived. Bell does not mention whether or not the bud was provided with an anus. If it had no anus, the two buds are not comparable. Claparède was of opinion that the budding in a *Serpula* examined by him might have been caused by a lesion, and M'Intosh, in reference to *Syllis ramosa*, considered that budding may take place at any point in consequence of lesion at that point. If it is taken for granted that at one time this earthworm existed in a normal condition, viz. that the anterior trunk and the left appendage made up the normal *Lumbricus*, and that the right appendage was developed some time after, the origin of the right-hand appendage might be explained thus:—Assuming that segment 54 had in some manner been cut or pierced (the wound extending into the interior of the intestine), some of the earth passing through the intestine during the process of alimentation may have been diverted through this opening

by the resistance offered by the earth in the posterior portion of the intestine, that is, the portion of the intestine lying between the opening and the anus. The cells surrounding the wound would become active, and a healing process would be set up. It is probable that the earth would tend to find its way through this opening in preference to passing through the rest of the intestine, and so the wound would not readily be closed. From the continued activity of the cells in the attempt to heal the wound, a process would gradually be formed. The main mass of the earth would probably continue to pass through this opening until the process became almost as long as the portion of the body between the point of lesion and the original anus, that is, until an equal resistance was offered at the fork to the passage of the earth along both branches of the intestine. The quantity of earth would then be equally divided between the two appendages, half of it passing along each. From the fact that the right-hand appendage is the shorter of the two, it might be supposed that a greater proportion of the earth would still pass along it, owing to its offering less resistance; but the greater length of the left appendage is compensated by the fact that its inclination to the trunk is less than the inclination of the new appendage to the same. The new appendage having now much less work to do than previously, the active cells at its posterior end would be enabled to narrow the opening and form an anus.

None of the explanations offered above are really satisfactory. It is probable that this earthworm existed as a normal *Lumbricus*, before the right-hand appendage was developed. The cause of the budding must be left undecided. There is doubtless some connexion between the fact that the reproductive organs are so undeveloped and the presence of the lateral bud. Whether the reproductive organs were from the first undeveloped, and the bud represents an attempt at asexual reproduction, or the reproductive organs atrophied in later life owing to the budding process, can only be a matter for conjecture. An interesting question suggests itself. How did this worm manage to move through the earth? It was alive when dug up. It would have no difficulty in moving about on the surface, but it certainly could not have readily burrowed in the ground. It therefore probably lived on the surface or amongst soft soil and decaying vegetable-matter close to the surface.

My best thanks are due to Professor M'Intosh, Dr. Fulton of Edinburgh, and Mr. A. T. Masterman, B.A. Cantab., University of St. Andrews, for valuable assistance and advice.

EXPLANATION OF PLATE X.

Fig. 1. Bifid earthworm, natural size, in spirit.
Fig. 2. Enlarged drawing of segments 54 &c., showing the bifurcation.
Fig. 3 shows the bifid condition of the dorsal vessel and gut.
Fig. 4. Drawing showing the relation of the nerve-cords in the two appendages and anterior trunk to each other.
Fig. 5. Bifid supraneural vessel lying above the nerve-cords.
Fig. 6. Drawing showing position of the vesiculæ seminales.
Fig. 7 shows bifid nature of dorsal vessel, gut, supraneural vessel, and nerve-cord. The gut has been drawn to one side to expose the nerve-cord.
Figs. 8 & 9. Copies of Robertson's drawings of earthworm described by him.

Explanation of letters used.

a. Left nerve-cord in anterior trunk.
b. Right nerve-cord in anterior trunk.
c. Left nerve-cord in left appendage.
d. Right nerve-cord in left appendage.
e. Left nerve-cord in right appendage.
f. Right nerve-cord in right appendage.
at. Anterior trunk.
dv. Dorsal vessel.
g. Gut.
h. Heart.
la. Left appendage.
nc. Nerve-cord.
ra. Right appendage.
s. Septum.
su. Supraneural vessel.
vs. Vesicula seminalis.

XXV.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.*—Series II., No. 1. *On the Results of Deep-sea Dredging during the Season* 1890–91 (*continued*). By A. Alcock, M.B., Surgeon-Captain I.M.S., Superintendent of the Indian Museum.

[Continued from vol. xi. p. 172.]

Of the species to be described in the sequel some have already been figured in the "Illustrations of the Zoology of H.M. I.M.S. 'Investigator,' Crustaceans," part i., published in 1892, and some in part ii. of the same publication, which I hope will be issued early this year. All the new species not yet figured will, I hope, appear in part iii. of the 'Illustrations,' which is now in preparation and may be expected early next year (1895).

Family **Nematocarcinidæ**.

NEMATOCARCINUS, A. Milne-Edwards.

58. *Nematocarcinus gracilis*, Spence Bate.

Nematocarcinus gracilis, Spence Bate, 'Challenger' Macrura, p. 815, pl. cxxxii. fig. 8.

Several specimens from Station 120, 240 to 276 fathoms.

59. *Nematocarcinus paucidentatus*, Spence Bate.

Nematocarcinus paucidentatus, Spence Bate, 'Challenger' Macrura, p. 816, pl. cxxxii. fig. 9.

Two ovigerous females from Station 115, 188 to 220 fathoms. The colour in life was pink, the eggs being light blue.

60. *Nematocarcinus tenuirostris*, Spence Bate.

Nematocarcinus tenuirostris, Spence Bate, 'Challenger' Macrura, p. 817, pl. xxxii. fig. 10.

A large male from Station 112, 561 fathoms. Colour in life bright orange-pink.

ASTACIDEA.

Family **Homaridæ**.

NEPHROPS, Leach.

61. *Nephrops andamanicus*, Wood-Mason.

Nephrops andamanicus, Wood-Mason, Illustrations of the Zoology of H.M. I.M.S. 'Investigator,' Crustacea, pl. iv.

The integument, though thin, is strong and firm, and dorsally is everywhere on the body finely granular and slightly pubescent.

The carapace measured to the tip of the rostrum is about half an eye-length short of half the total length, the rostrum measured from the orbital plate constituting about one third of this measurement. The rostrum is broad and concave above and ends in a compressed spine, at the base of which on the under surface is a similar spine, and on each lateral margin another large spine; behind the last the lateral margins of the rostrum extend backwards almost to the cervical groove, each as a ridge formed of three great trenchant procumbent

spines decreasing in size from before backwards; in the concavity between these ridges is a faint median ridge running up to the terminal spine of the rostrum. Behind the cervical groove the cardiac region is traversed by a broad ridge surmounted by a double row of spinelets, which diminish in size from before backwards, the whole being an evident continuation of the rostrum.

The under surface of the true rostrum behind the single inferior spine is furnished with a fringe of long setæ, which is continued round the orbital margin on each side.

Laterally on the level of the antennæ the frontal region is occupied by a great trenchant wing-like spine, the point of which surpasses the base of the antennary scale and reaches almost to the anterior limit of the eyes; between this spine and the postrostral ridge on each side are three small spinules disposed in a triangle. On the hepatic region, which is very distinctly delimited, are two spines, a large one ventrally and a small one dorsally. The cardiac and branchial regions are very distinctly demarcated from the gastric and hepatic, the two first forming a section of a much larger cylinder than the two second. The cardiac region is traversed by the already described continuation of the rostrum, and is bounded on each side by a granular or finely spinate ridge. The branchial regions are traversed fore and aft by two similar ridges, one almost parallel with that last described, the other following the curve of the thickened and grooved branchiostegal margin. All these ridges end anteriorly in minute spines.

The abdominal somites appear to correspond at all points with those of *Nephrops Thomsoni*, Spence Bate, their terga being sculptured in the same way, and the sixth somite and telson being quite similar in spinature.

The eyes are reniform and of huge size, their major diameter being nearly half the length of the rostrum; the peduncles are very short.

The peduncles of the antennules are shorter than the rostrum; the first joint viewed from above is spoon-shaped, the bowl forming the floor of the orbit, and the distal end has an inconspicuous spine below; the second and third joints are subcylindrical and are of nearly equal length, not much more than one third of the first; distally all three joints are thickly ringed with long cilia; the inner flagellum is more slender and considerably longer than the outer, the length of the former being three times that of the peduncle; in the male the outer flagellum has a row of fine setæ in its distal half below.

The stout peduncle of the antennæ reaches almost to the point of the rostrum; the antennal scale is broadly petal-shaped and is closely fringed with long setæ on its inner and front margins; its outer margin does not end in a spine; the second joint has the outer margin sharp, ending in front in a spine, while the third, fourth, and fifth joints have the inner margin sharp and fringed with setæ; the flagellum is nearly one half longer than the entire animal.

The mouth-parts present nothing remarkable.

The chelipeds are equal and uniform in the female and in small males, and even in large males the preponderance of one side (the right in two specimens) is but slight; their entire length is very nearly half the total length of the animal: the basipodite is fused with the ischiopodite, which is smooth, with a faintly granular ridge on the obtuse inner margin: the meropodite is more than twice the length of the ischiopodite and is triangular in transverse section; the inner surface is smooth, the outer surfaces are slightly granular; the upper and lower borders are sharp and sharply spinate and end in front each in a great spine; the outer border is rounded and is produced in front into a long blunt spine: the carpus is more than half the length of the meropodite and is prismatic in shape, with the angles more sharply granular than the surfaces; three of its angular borders—the two inner and the outer—end in large spines, the last having a second large spine at its proximal end: the entire propodite is at least twice the greatest length of the meropodite, the "finger" constituting about half of the total length of this joint; the "palm" of the propodite has the usual prismatic form, with the angles salient and strongly spinate and the surfaces between the angles smooth or faintly crenulate, but never pubescent; its "finger" portion has a sharply granular surface and bears internally a row of teeth, of which one near the proximal end is conspicuously large, standing between two thick rows of setæ: the dactylopodite is equal and similar to the finger of the propodite, except that (1) its surface distally is rather less granular, (2) instead of one large tooth near the base there are several, and (3) the setæ do not flank the teeth except quite at the proximal end of the joint, but form a long brush all along the under surface of the dactylus.

Of the remaining thoracic legs, all of which are slender and cylindrical, the longest is the fourth pair, which are not quite two thirds the length of the first pair, and the shortest are the fifth, while the second and third are chelate.

The branchial formula is—

Somite.	Podobranchiæ.	Arthro-branchiæ.	Pleuro-branchiæ.
VIII.	1 (rudimentary)	0	0
IX.	1	2	0
X.	1	2	0
XI.	1	2	1
XII.	1	2	1
XIII.	1	2	1
XIV.	0	0	1
	5 (6)	10	4

The first pair of abdominal appendages in the male is modified precisely in the same way as it is in *Nephrops Thomsoni*, Spence Bate; the second and succeeding pairs are also as in *N. Thomsoni*.

Colours in life: dorsum yellowish pink; venter pink in the female, white in the male; chelipeds banded pink and yellow in the female, pink and white in the male. The eggs in an advanced stage of development are dark blue.

Several males of all sizes and ovigerous females from Station 115, 188 to 220 fathoms.

This species has been so beautifully figured under the direction of the late Professor Wood-Mason that it is unnecessary to give a table of dimensions.

The species is undoubtedly very closely related to *N. Thomsoni*, Spence Bate, of which it may prove to be only a variety.

One striking character, as compared with *N. norwegicus*, L., and *N. japonicus*, Can., is the very distinct delimitation of the head from the thorax, distinct though it is in those species.

The Ova and Embryos of Nephrops andamanicus.

The ova of these specimens measure about 3 millim. in their greater diameter, and are of a dark blue colour.

They have been so long immersed in strong spirit, and are consequently so brittle, that, no matter how treated, they do not lend themselves to a satisfactory examination. All the eggs that I have examined contain embryos in an advanced stage of development, but have still abundant food-yolk. The embryos have a globular cephalothorax and a long and distinctly segmented abdomen which ends in a great fan-shaped "tail." All the appendages are present, including those of the abdomen, the latter having the same form as they have in the adult, and those which form the swimmeret

being very distinct beneath the lobes of the above-mentioned "tail." The abdominal somites are quite unarmed.

It would appear from these observations that the young of *Nephrops andamanicus* is hatched in a form not essentially different from that of the adult, and not considerably divergent from that of the larva of *Nephrops norvegicus* figured by Professor Sars.

Nephropsis, Wood-Mason.

62. *Nephropsis Stewarti*, Wood-Mason.

Nephropsis Stewarti, Wood-Mason, J. A. S. B. 1873, vol. xlii. pt. ii. p. 39, and Ann. & Mag. Nat. Hist. ser. 4, vol. xii. 1873, p. 59; A. Milne-Edwards, Ann. Sci. Nat., Zool. 5e sér. t. xix. 7, pl. xx. figs. 1–3.

Several fine specimens from Station 115, 188 to 220 fathoms, including an ovigerous female, the eggs of which still consist almost entirely of food-yolk. The eggs of this species are very much smaller and more numerous than those of *Nephrops Carpenteri*, W.-M., briefly described in P. A. S. B. 1885, p. 72.

63. *Nephropsis atlantica*, Norman.

Nephropsis atlantica, Norman, Proc. Roy. Soc. Edinb. 1881–82, vol. xi. p. 684; Wood-Mason and Alcock, Ann. & Mag. Nat. Hist. ser. 6, vol. vii. 1891, p. 198, fig. 4.

I refer to this species a young male from Station 114, 922 fathoms, which differs from the specimens taken in the Laccadive Sea only in having the third and fourth abdominal pleuræ, as well as the second, armed in front with a spine.

Family **Eryontidæ**.

Willemoesia, Grote.

64. *Willemoesia forceps*, A. Milne-Edwards.

Willmoesia forceps, A. Milne-Edwards, Bull. Mus. Comp. Zool. vol. viii. p. 64.

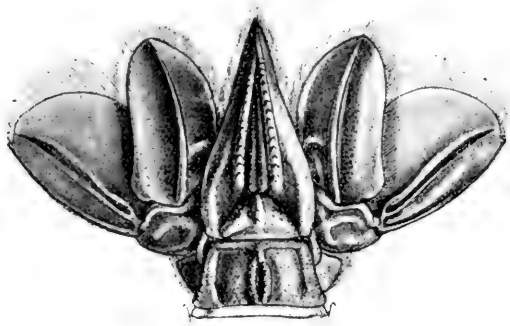
Specimens from Stations 117 and 118, 1748 and 1803 fathoms.

The late Professor Wood-Mason had noted that "in the male the olfactory branch of the antennules is much thicker than it is in the female." In the Introduction to this paper (Ann. & Mag. Nat. Hist., July 1891, p. 16) this species was stated to be luminous, in mistake for a species of *Pentacheles* (*P. phosphorus*).

PENTACHELES, Spence Bate.

The Indian species of this genus have for the most part the typical peculiarities of shape, spinature, setosity, &c., and I have not therefore mentioned these in the specific descriptions. The species, seven in number, fall into two groups, the one characterized, like *P. obscura*, Spence Bate, by having the carapace uniformly spiny or granular or carious and thickly furry, and the abdominal terga and pleuræ often granular or spicular; the other, like *P. lævis*, Spence Bate, having the carapace, except for certain definitely placed large spines, almost or quite smooth, and the abdominal terga and pleuræ also quite smooth as to the surface.

In all of our species in which both males and females have been examined the olfactory flagellum of the antennules is stouter and much longer in the male. The telson of all these species appears quite plainly to be made up by the concrescence of a somite and its appendages. This is apparent on either aspect, but is more plainly manifest on the dorsal aspect, where the anterior fourth or so is seen to represent a tergum carinated like all the other terga, the rest of the telson being formed by the fully extended and adducted appendages.



Sixth somite and telson of *Pentacheles Hextii*.

A tapering groove which traverses the telson in the middle line appears to represent the line of concrescence of the appendages of opposite sides; and on either side of this two longitudinal slightly convergent crests appear to represent the lines along which in each appendage the exopodite has fused with the endopodite.

Synopsis of the Indian Species of Pentacheles.

I. Carapace with the entire surface, including the median carina, spinate or sharply granular, independently of the usual definitely placed large spines; the lateral borders with 20 to 30 serrations; the posterior border narrow. [The ophthalmic notches shallow, or, if deep, divided into two regions, the anterior of which forms a shallow notch. Antennulary scale variable, usually much larger than the antennal scale.

1. Abdominal terga and pleuræ with the surface more or less granular; all the terga including the telson more or less carinated. [Antennulary scale very large.]

a. Both terga and pleuræ with the surface markedly and closely granular and with the edges closely and sharply spinate; the carinæ of the terga from the second to the fifth inclusive culminating in large procumbent spines. Antennulary scale about twice the size of the antennal scale . . . . . *P. Hextii.*

b. Terga and pleuræ with the surface slightly and more or less distantly granular, and with the edges quite smooth; the carinæ of the terga with the crests eroded, but never forming procumbent spines. Antennulary scale at least four times as large as the antennal scale. First pair of abdominal appendages of the female extremely small.

α. Carapace hump-backed; granulation of abdominal terga and pleuræ conspicuous . . . . . *P. gibba.*

β. Carapace of the usual form; granulation of the abdominal terga and pleuræ inconspicuous. *P. Carpenteri.*

2. Abdominal terga and pleuræ with the surface smooth or finely pitted and the margins quite smooth; only the first five terga carinated. [Antennulary scale diminutive, almost obsolete.] . . *P. Beaumontii.*

II. Carapace with the entire surface, including the median carina, quite or nearly smooth, except for the usual definitely placed large spines; the lateral borders with fewer than 20 serrations; the posterior border broad. [The ophthalmic notches usually deep. Abdominal terga and pleuræ smooth or slightly pitted as to the surface, the pleuræ with the edges denticulate. Antennulary scale, when viewed from the under surface, hardly larger than the antennal scale.]

1. Dorsal sublateral ridges distinct and markedly spinate throughout; frontal margin with a spine on each side of each ophthalmic notch; median carina behind the cervical groove with three pairs of spines; the carinæ of all the abdominal terga are distinct, and when they culminate in spines these increase in size gradually from before backwards as usual.

   a. Ophthalmic notches rather shallow; the carinæ of the first five abdominal terga end in procumbent spines .... *P. andamanensis.*

   b. Ophthalmic notches deep; the carinæ of the first four abdominal terga only end in procumbent spines..... *P. phosphorus.*

2. Dorsal sublateral ridges indistinct and smooth or only very faintly denticulate; frontal margin devoid of spines except the usual rostral pair; median carina behind the cervical groove with only two pairs of spines; the carinæ of the abdominal terga often indistinct, except that of the fifth, which ends in a procumbent spine of such enormous size that its point overhangs the front edge of the fourth tergum ..... *P. cerata.*

65. *Pentacheles gibba* *, sp. n.

Pentacheles, sp. remarkable for its hunch-backed thorax, Wood-Mason, Admin. Rep. Marine Survey of India for 1890–91, p. 19.

The carapace, which is inflated, elevated, and humped in front, is everywhere thin, spiny granular or carious, and thickly setose, and its greatest breadth, which is just behind the cervical groove, is not much more than half its greatest (lateral) length; the median carina ends in a double rostral spine and has its crest irregularly serrated or eroded throughout, in addition to which there is a row of 4 large spines, of which the second may be double, between the rostral spine and the cervical groove, and 10 or 11 spines or double spines between the cervical groove and the posterior smooth, narrowly-moulded edge of the carapace; the frontal margin is finely eroded; the spines of the lateral margins are concealed in setæ of great length, they number about 25 on each side, of which 5 are found in front of the hepatic groove, 3 between the hepatic and cervical grooves, and about 17 behind the cervical groove; the usual dorsal sublateral (branchiostegal) crests are quite wanting, but ventrally the branchial regions are traversed fore and aft by the usual finely serrated ridges. The abdominal terga have the surface rough and spiny and the setæ on the posterior margin remarkably long and close-set; all, including the telson in its front part, are carinated, the edge of the carina in all being irregularly and obtusely denticulated; a broad shallow groove traverses the terga obliquely outwards and backwards on each side of the carina.

The pleuræ have the surface spiny and the setose margin smoothly moulded. The edge of the telson is finely spinate.

The orbital notches are broad and shallow, with the inner edge eroded; the optic peduncles have each a small scrobiculate spine at the frontal level.

The basal joint of the antennules has a single spine at its antero-external angle, and its scale is 4 or 5 times larger than the antennal scale, both scales ending obtusely. All 5 pairs of thoracic legs are chelate (in the female).

The great chelipeds have the usual form and just exceed the body in length; the compressed meropodite has both edges distantly and very finely serrated, the upper edge bearing a single terminal spine; the prismatic carpopodite has a similar

* This species is figured in "Illustrations of the Zoology of the Royal Indian Marine Steamer 'Investigator,' Crustacea," pt. ii. (pl. viii.), to be issued early this year.

terminal spine on the lower edge; the propodite has the lower edge of the "palm" serrated, the upper edge having a terminal spine; the dactylopodite, like the opposed "finger" of the propodite, has the usual fine fringe of setæ; the chelæ of the fifth pair of legs are not quite perfect, owing to the shortness of the pollex.

The first pair of abdominal appendages (in the female) are almost rudimentary.

Colour in the fresh state bright pink.

Two females from Station 114, 922 fathoms.

The largest specimen measures 56 millim. in the mid-dorsal line from the front edge of the carapace to the tip of the telson.

The characteristic features of this species are—(1) the hump-backed carapace, and (2) the thin scabrous integument.

66. *Pentacheles Carpenteri*, sp. n.

Carapace thin, granular, and spicular beneath a very close fine fur; its greatest breadth, which is in the posterior third, is two thirds its greatest length; the median carina is crested by a double row of very fine granulation, and bears—(1) a double rostral spine, (2) three spines (of which the first two form a pair) in the middle of the gastric region, and (3) behind the cervical groove a very irregular series of 6 or 7 spines, some of which may be double; the frontal margin is most conspicuously excised between the orbital notches, and is finely granular but without any large spines except the rostral spine; the posterior margin is narrow and smooth; the spinature of the lateral margins is irregular and is concealed by very long setæ, the spines number 4 to 6 in front of the hepatic groove, 3 between this and the cervical groove, and over 20 behind the cervical groove; two conspicuous spines, one behind the other, stand on a faint ridge that delimits the gastric region on each side; the dorsal sublateral (branchiostegal) crests are sinuous, but hardly visible even on a denuded carapace.

The abdominal terga and pleuræ are faintly and distantly pustulate; all the terga except the sixth are strongly carinated, the high crests of the carinæ being strongly emarginate or bicuspid, but never forming spines; a few tiny denticles at the posterior edge of the sixth tergum are all that represents a carina; the crest of the anterior part of the telson forms an upstanding spine. The setose margin of the pleuræ is smoothly moulded.

The orbital notches are broad in front, triangular, and very

shallow, with the inner edge finely granular; the ophthalmic peduncles have each a small scrobiculate spine at the frontal level.

The basal joint of the antennules, which is very large, has a single spine at the antero-external angle, its scale is about four times larger than the antennal scale, both ending in spines.

All five pairs of legs are perfectly chelate (in the female).

The great chelipeds are not quite equal in length to the body, and in armature are similar to those of *P. gibba*, the meropodite being finely and distantly serrated on both edges and the propodite having the lower edge of the palm serrated.

The first pair of abdominal appendages are relatively very small, in the female.

A female from the Bay of Bengal, Carpenter's Ridge, 1370 to 1540 fathoms; it measures 87 millim. from rostrum to tip of telson in the mid-dorsal line.

The characteristic feature of this species is the remarkable concavity of the frontal margin between the ophthalmic notches and the consequent shallowness of the latter.

67. *Pentacheles Beaumontii**, sp. n.

Carapace finely but distinctly granular; its greatest breadth, just behind the middle, is three fourths the greatest length; the median carina is surmounted by a double row of fine granulation and bears—(1) a double rostral spine, and (2) four spines (of which the middle two form a pair) in the front part of the gastric region, these being the only large spines present; the frontal margin has both the inner and the outer angle of the orbital notches produced into large spines, but is otherwise, except for the rostral spines, quite smooth; the smooth posterior margin (which, as usual, is formed by the last thoracic tergum) is peculiar in being nearly straight; the lateral margins are peculiar in having the spines of almost equal size throughout, these numbering on each side 23 or 24, namely 7 or 8+3 in front of the cervical groove and 13 behind it; the dorsal sublateral (branchiostegal) ridges are sinuous, very faint, especially in front, and faintly denticulate, while of the two usual ridges that traverse the branchial regions on the ventral aspect the most dorsad on each side is apparent only in front of the cervical groove.

The abdominal terga have the surface smooth or pitted;

* This species is figured in "Illustrations of the Zoology of the Royal Indian Marine Steamer 'Investigator,' Crustacea," pt. ii. (pl. viii.), to be issued early this year.

the first five are carinated, the carinæ of the first three culminating in procumbent spines, that of the fourth not being produced and that of the fifth forming a simple cusp; the sixth tergum has no vestige of a carina, but the telson in its front part has a retrorse spine; a shallow groove traverses the terga obliquely backwards on each side of the carina from the second to the fifth. The abdominal pleuræ have the surface smooth and the setose margin smoothly moulded; all but the sixth have a not very prominent midrib.

The ophthalmic notches are shallow, with smooth edges, and their peduncles bear each a strong spine at the frontal level. The basal joint of the antennules has a single spine at the antero-external angle; the antennulary scale is peculiar in being very much shorter than the antennal scale; the former is truncated on a level with the rest of the joint, the latter has the usual form and ends in a spine.

All five pairs of thoracic legs are chelate. The great chelipeds much exceed the body in length; the meropodite, besides the usual terminal claw, has both its edges serrated, the lower edge very conspicuously so, four or five of its serrations in the proximal half forming large spines; the carpopodite has two terminal spines, one above, the other below; the propodite in its palmar portion has both edges strongly serrated, the serrations of the upper edge forming distinct spines.

(In the male) the "pollex" of the fifth pair of legs is much shorter than the dactylus. The first pair of abdominal appendages in the male has the usual spoon-shape.

A single male from off Colombo, 675 fathoms, measures 79 millim. from rostrum to tip of telson in the median line.

The characteristic features of this species are:—(1) the great breadth of the carapace posteriorly, (2) the diminutive size of the antennulary scale, (3) the deficient spinature of the median carina of the carapace, (4) the great length of the chelipeds.

68. *Pentacheles Hextii*, sp. n.

Carapace uniformly and thickly setose and covered everywhere with spines and spiny granules; its greatest breadth, which is in its posterior third, is less than two thirds of its greatest length; the median carina ends in a single rostral spine, between which and the cervical groove is a close series of spinules, five or six of which are large, while between the cervical groove and the spiny posterior border of the carapace is a double row of close-set sharp serrations; the frontal margin is serrated throughout, and there is also a spine at

the inner angle of each orbital notch; the lateral margins are spinate and very thickly setose, the spines numbering about 31, namely 8+5 in front of the cervical groove and about 18 behind it; the border of the cervical groove is strongly spinate and the gastric region is delimited on each side by a row of four large spines; the dorsal sublateral crests are quite straight and parallel with the lateral margins, each crest having about eighteen strong serrations, and the usual ventral branchial ridges are sharply serrated.

The abdominal terga, like the pleuræ, have the surface more or less covered with bead-like granules or globules and setose, the edges of most of the terga being spinate and of the pleuræ coarsely toothed; all the terga, including the telson in its anterior part, are carinated, the carina of the first being indistinct, those of the second to the fifth inclusive culminating in large procumbent spines, that of the sixth being longitudinally grooved or double, with the edges beaded, and that of the telson being obtusely dentate; the pleuræ are traversed each by a salient beaded midrib.

The orbital notches are very deep and are quite peculiar in that the edges, which are rough throughout and strongly spinate in all but the front half of their inner edge, meet across the ophthalmic peduncle so as to completely divide each notch into two parts, namely into a shallow notch in front, behind which the posterior portion of the ophthalmic peduncle is completely isolated; the ophthalmic peduncles have each a strong blunt spine at the frontal level.

The basal joint of the antennules has two spines at its antero-external angle, and the scale is a good deal longer than the antennal scale, both ending in spines.

All five pairs of thoracic legs are perfectly chelate in the female, but in the male the dactylus of the fifth pair is much longer than the pollex.

The length of the great chelipeds is less by half the length of the telson than that of the body; the meropodite has both edges spinate, the upper most markedly so; the carpus has the upper edge faintly serrate and has two terminal spines, one above, the other below, and the propodite in its palmar portion has both edges spinate.

The first pair of abdominal appendages have the usual forms and modifications of shape in both sexes—in the male spoon-shaped, in the female uniramous and setose.

Colour in life pink.

Three males and a female from Station 115, 188 to 220 fathoms.

The measurements from rostrum to tip of telson in the

middle line are, for the female 97 millim., for the largest male 80 millim.

The characters of this species are:—(1) the extremely spiny nature of the integument, and (2) the peculiar formation of the ophthalmic notches, which superficially are divided into two portions by the meeting of the edges across the ophthalmic peduncle.

69. *Pentacheles andamanensis*, sp. n.

Carapace with few distant spinules; its greatest breadth, which is in front of the cervical groove, is two thirds its greatest length; the median carina ends in a double rostral spine, between which and the cervical groove is a row of four spines, of which the penultimate is double, and between the cervical groove and the broad posterior margin are three pairs of spines; the frontal margin is smooth, with a spine on the inner side of each orbital notch; the lateral margins are spinate and sparsely setose, the spines numbering 5+3 in front of the cervical groove and 6 behind it; the gastric region is bounded on each side by a sinuous row of 6 large spines, and the cardiac region by an oblique spiny ridge; the branchial regions are traversed dorsally by a very slightly sinuous five-toothed sublateral ridge, and ventrally by the two usual serrated ridges.

The abdominal terga are smooth, all including the front part of the telson are carinated, the carinæ of the first five culminating in procumbent spines, that of the sixth being double with beaded edges, and that of the telson being simple; the first five terga are obliquely and faintly grooved on each side of the median carina. The pleuræ are smooth, with the setose margin denticulated; all are strengthened by a salient midrib.

The orbital notches are broad, smooth-edged, rather shallow; the ophthalmic peduncles have a strong spine at the frontal level.

The basal joint of the antennules has two spines at the antero-external angle; its scale is hardly larger than the antennal scale, the former ending in a spine, the latter obtusely pointed.

All five pairs of thoracic limbs are chelate (in the female); the great chelipeds are less in length than the body by three fourths the length of the telson; the meropodite has both edges smooth, except for two spines near its proximal end and one terminally on the upper edge; the carpopodite has a terminal spine of the usual claw-like shape above; the edges

of the propodite are smooth, except for a subterminal tubercle on the upper edge.

Colour in life bright pink.

A female from Station 108, 1043 fathoms, measures 50 millim. from rostrum to tip of telson in the median line.

70. *Pentacheles phosphorus* *, sp. n.

Carapace above nearly smooth, pubescent, especially at the lateral margins and below; its greatest breadth, which is just in front of the cervical groove, is more than two thirds of its greatest length; the median carina ends in a double rostral spine, between which and the cervical groove is a line of four spines, of which the penultimate is double, and behind the cervical groove are three pairs of spines, the last pair standing rather wide apart from each other on a distinct bifurcation of the carina; the frontal margin is smooth, except for a single spine at the inner angle of each orbital notch; the posterior margin is broad; the lateral margins are setose and spinate, the spines numbering 6 (very rarely 7) + 3 (rarely 4) in front of the cervical groove and 6 or 7 behind it; the gastric region is bounded on each side by a sinuous row of six large spines, and the cardiac region by an oblique, low, denticulate ridge; the branchial regions are traversed dorsally by a perfectly straight seven-toothed sublateral ridge, and ventrally by the two usual serrated crests.

The abdominal terga are smooth, all, including the anterior part of the telson, are strongly carinated, the carinæ of the first four culminating in procumbent spines, that of the fifth being, like that of the telson, simple, and that of the sixth being double, with the edges crenulated; the terga from the second to the fifth inclusive are obliquely and very deeply cleft on each side of the median carina. The abdominal pleuræ have the surface smooth and the setose margin denticulate; each is strengthened by a very salient midrib.

The orbital notches are broad and deep, smooth-edged, and broadly rounded behind; the ophthalmic peduncles have a small tubercle at the frontal level.

The basal joint of the antennules has a single spine at the antero-external angle; its scale is not very much larger than the antennal scale, both ending in very sharp spines.

All five pairs of thoracic limbs are chelate. The great chelipeds are longer than the body; the meropodite has in

* This species is figured in "Illustrations of the Zoology of the Royal Indian Marine Steamer 'Investigator,' Crustacea," pt. ii. (plate viii.), to be issued early this year.

its proximal half two or three large spines on the upper margin and one or two smaller ones on the lower, distally it is finely serrated below and bears above the usual subterminal claw; the carpopodite has two subterminal claws, one above, the other below; the propodite in its palmar portion is finely serrated below and has a subterminal spine, or two, above. In the male the fifth pair of thoracic legs are not quite perfectly chelate owing to the shortness of the pollex.

The first pair of abdominal appendages in both sexes have the usual shapes and modifications, namely spoon-shaped in the male and uniramous and setose in the female.

Colour in life uniform bright pink.

Numerous specimens of both sexes from Stations 112 and 116, 561 and 405 fathoms. The largest female measures 119 millim. in the middle line from the rostrum to the tip of the telson; the males are smaller. One of the large females was luminous at two points between the basal joints of the last pair of thoracic legs, where there is a glandular organ very like that found in the females of the common species of *Penæus*. In the introduction to this paper (Ann. & Mag. Nat. Hist., July 1891, p. 16) this species was confused with *Willemoesia forceps*, A. M.-Edw., which was therefore wrongly stated to be luminous.

Pentacheles phosphorus has been also dredged in the Andaman Sea at 375 and 500 fathoms; in the Bay of Bengal, off the Kistna Delta, at 678 fathoms; in the Gulf of Manár at 675 fathoms; and in the Laccadive Sea at 740 fathoms. It is by far the commonest of the Indian species of the genus.

71. *Pentacheles cerata* *, sp. n.

Pentacheles, sp. "distinguished by the huge spine which springs forwards from the middle of the fifth abdominal tergum," Wood-Mason, Admin. Rep. Marine Survey of India, 1890-91, p. 19.

Carapace remarkably smooth, slightly pubescent, especially towards the margins; its greatest breadth, which is just in advance of the cervical groove, is less than two thirds of its greatest length; the median carina ends in a double rostral spine, between which and the cervical groove is a line of four spines, the penultimate one being double; immediately behind the cervical groove is a pair of spines, and at the hinder edge of the carapace another larger and more widely separated pair; the frontal margin is perfectly smooth; the

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lateral margins are slightly setose and spinate or serrate; there are 6 + 2 spines in front of the cervical groove, and 3 succeeded by some not very distinct serrations behind it; within the cervical groove the gastric region is delimited on each side by a single spine; the dorsal sublateral (branchiostegal) ridges are sinuous, the anterior half being smooth and very faint, the posterior half being more distinct and slightly serrate.

The abdominal terga are smooth; the first is very inconspicuously carinated, the second, third, and fourth are indistinctly carinated, except in front, where there is a small procumbent spine on each, but the fifth has a very strong carina, which culminates in a monstrous spine reaching beyond the anterior margin of the fourth; the sixth tergum has a simple double carina; the anterior part of the telson is also carinated. The pleuræ are smooth, their setose margin is very faintly and distantly denticulated.

The orbital notches are narrow, very deep, nearly the same width throughout, and smooth-edged; the ophthalmic peduncles are perfectly smooth. The basal joint of the antennules has two spines at the antero-external angle; its scale is not much larger than the antennal scale, both ending in spines.

All five pairs of thoracic legs are chelate (in the female). The great chelipeds exceed the body in length; the meropodite is perfectly smooth, except for a subterminal tubercle on the upper edge; the carpopodite has two distinct subterminal spines, one above, the other below; the propodite is smooth, except for a subterminal spine above.

The first pair of abdominal appendages have the usual form in the female.

An ovigerous female from Station 114, 922 fathoms, measures 79 millim. in the middle line from rostrum to tip of telson.

The characteristic feature of this species is the huge spine on the fifth abdominal tergum.

Family **Parapaguridæ**.

Parapagurus, S. I. Smith.

72. *Parapagurus abyssorum*, A. Milne-Edwards, Henderson.

Parapagurus abyssorum, A. Milne-Edwards, MS.; Henderson, 'Challenger' Anomura, p. 87, pl. ix. fig. 2.

This species has been frequently dredged in the Bay of Bengal between 1644 and 1997 fathoms.

In colour in the fresh state it varies from pure pink to salmon-red.

It sometimes occurs in clean *Dentalium* shells, but usually inhabits the shell of a *Trochus* which is incrusted usually with a species of *Epizoanthus*, but sometimes with a solitary species of Actiniid.

73. ?*Parapagurus monstrosus*, sp. n.

The well-calcified anterior portion of the carapace is convex, smooth, and polished, with the gastric region and the hepatic regions sharply circumscribed by deep incisions; the frontal margin is sinuous and at the sides is carried far in advance of the inconspicuous, broadly rounded, faintly carinated rostrum, these lateral projections reaching almost to the level of the distal end of the basal joint of the antennæ; the posterior portion of the carapace is extremely thin, but is quite appreciably and uniformly calcified; its surface is smooth and bears some long scattered hairs.

The eye-stalks are short and stout, less than one third the length of the carapace, and gradually increase in diameter towards the expanded corneæ; dorsally they are crested by a line of long hairs; the ophthalmic scales are acute. The antennulary peduncles exceed the eye-stalks by the whole length of the terminal joint. The antennal peduncles are but slightly longer than the eye-stalks; their basal joint is expanded and has the usual strong spine at the antero-external angle; the antennal acicle is doubly curved, with the inner margin setose and strongly serrated; its point reaches just beyond the origin of the flagellum; the last is not far short of twice the length of the body.

The chelipeds are most remarkably unequal, the right exceeding the left in bulk many times and in length by somewhat more than its dactylopodite; both are pubescent above, and the right is sharply granular above and slightly so below. In the right cheliped the meropodite and carpopodite are also pubescent below, and the margins of the latter, like those of the propodite and like the upper margin of the dactylopodite, are closely and sharply serrated. The left cheliped is hardly more massive than the corresponding portion of the second or third leg, and is smooth throughout. In the second and third legs the upper borders of the merus, carpus, and propus are crenulate or bluntly serrate, and, like the upper border of the long sinuous dactylus, hairy.

The gill-elements have the form of small filaments, similar in shape to, but smaller and far more delicate than, those of *Parapagurus abyssorum*.

In the male the first pair of abdominal legs are small, curved, rigid rods; the second pair are well developed, and the third, fourth, and fifth, which are long and delicate, are present on the left side only. The female has not been dredged.

Several specimens were taken at Station 120 in 240 fathoms, living in dead shells of a small *Natica*.

A large male measures about 19 millim. in length.

Pylocheles, A. Milne-Edwards.

74. *Pylocheles scorpio*, sp. n.

The form of the body is long and slender, the cephalothorax being almost cylindrical. The carapace is long and narrow, its greatest length being more than twice its greatest breadth; the portion in front of the cervical groove is strongly calcified and is smooth and polished, while the portion behind the cervical groove is much less strongly calcified dorsally, where it is also pitted and striated, and laterally is quite membranous; the thickened and moulded frontal margin is remarkably excavated behind the eye-stalks, a small rostrum projecting into the excavation; the lateral projections of the branchial regions are not visible from above.

The abdomen is long and narrow, its length, which is nearly twice that of the carapace, being four times its greatest breadth, all the somites being distinct and symmetrical. The abdominal terga after the first are rectangular plates, with the margins thickened and strongly setose, and the surface pitted and hairy; the terga of the first and sixth somites, of the telson, and of the fifth somite in the middle of its posterior third are considerably the more strongly calcified.

The long eye-stalks taper acutely from a broad base to the small bead-like unpigmented cornea; their dorsal surface is thorny and hairy towards the edges, and their length is less than that of the antennulary peduncles by rather more than the terminal joint of the latter.

The antennulary peduncles when moderately extended measure more than half the carapace in length; in the female the upper flagellum tapers to a lash from a stout inflated base, and is nearly as long as the peduncle, while the lower flagellum is a fine short filament.

The antennary peduncle exceeds the eye-stalks by rather more than half the length of its terminal joint; the basal joint has the front edge serrated; the acicle is thorny and hairy, and its point reaches just beyond the level of the

corneæ; the flagellum (in the female) is about half the length of the body and is fringed with long hairs.

The chelipeds are equal, their length being about equal to that of the abdomen and their upper surface being hairy throughout; the ischium and merus, which together make up nearly half their total length, meet together from opposite sides in a perfectly straight line across the mouth-parts, the line of apposition being closely and sharply toothed. Except for this line of teeth and for a few hardly distinguishable roughnesses on the upper border of the short carpus and of the long cylindrical propodite the surface of the chelipeds is smooth, the propodite being also highly polished.

The second and third thoracic legs are not much longer than the chelipeds; the propodite in both is subcylindrical and a little more than twice the length of the dactylopodite, and in both all the joints are smooth, with the margins hairy.

The fourth and fifth legs are subchelate, the cheliform parts are swollen and hairy, and the propodites have the usual beaded patch.

The abdominal appendages (in the female) conform to the type; the appendages of the penultimate segment have the dorsal surface of both exopodite and endopodite covered with a pavement of bead-like granules arranged in close rows, resembling a stridulating organ.

Colour in the fresh state dull chalky red.

A female 28 millim. long was dredged at Station 116 in 405 fathoms.

[To be continued.]

XXVI.—*Descriptions of new Freshwater Fishes from Borneo.*

By G. A. Boulenger.

Liocassis inornatus.

Depth of body 7 times in total length, length of head 4 times. Head $1\frac{1}{2}$ as long as broad. Snout broad, rounded, scarcely projecting beyond the mouth; occipital region naked, rugose; occipital process nearly twice as long as broad, reaching the basal shield of the dorsal spine; diameter of eye 9 times in length of head; interorbital width 3 times; barbels slender, the maxillary reaching the opercle. Vomerine teeth in a curved uninterrupted band, without posterior median process. Dorsal I 7; spine feebly serrated behind,

$\frac{3}{5}$ length of head. Adipose fin $1\frac{2}{3}$ times as long as dorsal, a little shorter than its distance from the latter. Anal 16. Pectoral spine $\frac{2}{3}$ length of head, strongly serrated on the inner edge. Uniform dark brown.

Total length 145 millim.

Senah, Sarawak (*Everett*). A single specimen.

Liocassis saravacensis.

Depth of body $4\frac{1}{2}$ to 5 times in total length, length of head 4 times. Head $1\frac{1}{2}$ as long as broad; snout rounded, strongly projecting beyond the mouth; head covered with skin; occipital process not reaching the basal shield of the dorsal spine; diameter of eye 7 times in length of head, interorbital width 4 times; barbels very short, the maxillary reaching the eye. Vomerine teeth in a curved uninterrupted band, without posterior median process. Dorsal I 6; spine strongly serrated behind, $\frac{2}{3}$ length of head. Adipose fin nearly twice as long as dorsal, a little longer than its distance from the latter. Anal 14–15. Pectoral spine $\frac{3}{5}$ length of head, strongly serrated on the inner edge. Dark brown, with some large pale brown spots on the sides, and a pale brown bar across the nape; dorsal whitish, with a blackish band in its upper half; adipose fin with a broad whitish edge; ventrals, anal, and caudal whitish.

Total length 150 millim.

Senah, Sarawak (*Everett*). Two specimens.

Akysis major.

Depth of body $4\frac{1}{4}$ to $4\frac{2}{3}$ times in total length, length of head $3\frac{2}{3}$ to 4 times. Head $\frac{1}{5}$ or $\frac{1}{6}$ longer than broad; eyes very small, 3 or 4 diameters apart, their anterior border equally distant from the anterior and the posterior extremity of the head; interorbital width $3\frac{1}{2}$ times in length of head; nasal barbel extending hardly halfway from the eye, maxillary a little beyond base of pectoral, outer mandibular not quite to base of pectoral. Caudal peduncle $1\frac{1}{3}$ to $1\frac{1}{2}$ as long as deep. Dorsal I 6; spine strong, not denticulate, $\frac{1}{2}$ to $\frac{3}{5}$ length of head. Adipose fin as long as dorsal, half as long as its distance from the latter. Anal 11–12. Pectoral spine $\frac{2}{3}$ length of head, strongly serrated on the inner edge. Caudal forked. Dark brown above, whitish beneath; dorsal, pectoral, and adipose fins blackish brown, with a white border; ventrals and anal white, with one or two black bars; caudal blackish brown or black and white, the lobes constantly tipped with white.

Total length 130 millim.

Senah and Tagora River, Sarawak (*Everett*); Baram River, Sarawak (*Hose*). Several specimens.

The following Siluroids, not previously recorded from Borneo, are represented in the collections recently received from Messrs. Everett, Hose, and E. Bartlett:—

Hemisilurus scleronema, Blkr. Baram River (*Hose*).
Macrones planiceps, C. & V. Bongon, N. Borneo (*Everett*).
Liocassis Mœschii, Blgr. Poeh, Sarawak (*Everett*).
—— *pœcilopterus*, C. & V. Bongon and Merabeh, N. Borneo (*Everett*).
Batrachocephalus mino, Ham. Buch. Sarawak (*Bartlett*).

Crossochilus vittatus.

Depth of body equal to length of head, 5 to $5\frac{1}{2}$ times in total length. Snout rounded, much projecting beyond the mouth, nearly twice as long as diameter of eye, which is 4 to $4\frac{1}{2}$ times in length of head; interorbital width $\frac{1}{2}$ length of head, width of mouth $\frac{1}{3}$. Upper lip fringed; barbels four, maxillary minute, rostral a little shorter than the eye. Dorsal II 8, originating a little nearer end of snout than base of caudal. Anal II 5. Pectoral as long as or a little longer than the head, the distance between its extremity and the base of the ventrals $\frac{1}{3}$ to $\frac{2}{5}$ its length. Base of ventral below middle of dorsal. Caudal deeply forked. Scales $28–29\ \frac{3\frac{1}{2}}{4\frac{1}{2}}$; 2 scales between lateral line and base of ventral. Male with a large horny conical tubercle on each side of the snout. Dark olive-brown above, with a lateral blackish stripe occupying the scales of the lateral line and one half of each of the adjoining series, separated from the dark colour of the back by a light, metallic, iridescent streak; dorsal fin with a blackish median band and a broad whitish border; caudal greyish, with a blackish line within the upper and lower edges, which are white; lower parts white; pectorals and ventrals grey.

Total length 100 millim.

Senah, Poeh, and Tagora River, Sarawak (*Everett*). Numerous specimens.

Barbus strigatus.

Section *Barbodes*, Blkr. Depth of body $2\frac{3}{5}$ times in total length; length of head $4\frac{1}{2}$ times. Snout rounded, not prominent, as long as diameter of eye, which is $3\frac{1}{2}$ times in

length of head; interorbital width $2\frac{3}{4}$ times in length of head; rostral barbel slightly longer than diameter of eye, $\frac{3}{4}$ length of maxillary barbel. Dorsal III 8; spine strong, $\frac{3}{4}$ length of head, serræ strong, 19; the spine opposite to inner ventral ray and equally distant from end of snout and caudal fin. Anal III 5, longest ray $\frac{4}{5}$ length of head. Scales $29\frac{6}{4}$; 3 scales between lateral line and base of ventral. Grey above, silvery beneath, with seven blackish longitudinal streaks running between two series of scales; pectorals blackish above.

Total length 140 millim.

Bongon, N. Borneo (*Everett*). A single specimen.

Barbus pentazona.

Section *Barbodes*, Blkr. Depth of body $2\frac{2}{5}$ times in total length; length of head $3\frac{1}{2}$ times. Snout rounded, not prominent, longer than diameter of eye, which is 3 times in length of head and nearly equals interorbital width; rostral barbel $\frac{3}{4}$ diameter of eye, maxillary barbel $1\frac{1}{2}$. Dorsal III 8; spine strong, $\frac{2}{3}$ length of head, with 18 to 20 strong serræ; the spine opposite to inner ventral ray and equally distant from end of snout and caudal fin. Anal III 5, longest ray $\frac{2}{3}$ length of head. Scales $22\frac{5\frac{1}{2}}{4\frac{1}{2}}$; 3 scales between lateral line and base of ventral. Brown above, yellowish beneath, with 5 black bands completely encircling the body—the first behind the pectoral, the second from the anterior dorsal rays to behind the ventrals, the third above the anal, the fourth and fifth on the caudal peduncle.

Total length 45 millim.

Baram, Sarawak (*Hose*). Three specimens.

Barbus Everetti.

Section *Barbodes*, Blkr. Depth of body $2\frac{2}{3}$ to 3 times in total length; length of head $3\frac{2}{3}$ to 4 times. Snout rounded, not prominent, as long as diameter of eye, which is $3\frac{1}{2}$ to $3\frac{2}{3}$ times in length of head; interorbital width $2\frac{1}{2}$ to $2\frac{2}{3}$ times in length of head; rostral barbel $1\frac{2}{3}$ to twice as long as diameter of eye, a little shorter than maxillary barbel. Dorsal III 8; spine rather feeble, with 17 to 22 serræ, its stiff portion about half length of head, opposite to first ventral ray, and equally distant from end of snout and caudal fin. Anal III 5, longest ray about $\frac{3}{5}$ length of head. Scales $22–25\frac{3\frac{1}{2}}{4\frac{1}{2}}$; 2 scales between lateral line and base of ventral. Brown above,

yellowish beneath; a black bar across the nape, a short black streak on each side of the anterior part of the body, and five round black spots on each side, two above the lateral line and two below above the ventral and anal, the fifth on the lateral line a little in front of the base of the caudal; dorsal and anal tipped with blackish.

Total length 90 millim.

Poeh, Sarawak (*Everett*). Several specimens.

Leptobarbus melanotænia.

Depth of body 4 times in total length; length of head $3\frac{1}{2}$ times. Snout rounded, much flattened, not prominent, as long as or a little longer than diameter of eye, which is 4 to $4\frac{1}{2}$ times in length of head; interorbital width $\frac{1}{2}$ length of head; mouth extending to below anterior border of eye; rostral barbel once and two thirds, maxillary barbel twice as long as diameter of eye. Dorsal III 7; third ray $\frac{2}{3}$ length of head, slightly in advance of first ventral ray, and equally distant from end of snout and caudal fin. Anal III 5, longest ray $\frac{3}{5}$ length of head. Scales 36–38 $\frac{5\frac{1}{2}}{4\frac{1}{2}}$; 2 scales between lateral line and base of ventral. Grey above, white beneath, the two colours separated by a black lateral stripe running along the lower half of the series of scales above the lateral line, and continued on the gill-cover; a black vertical bar on the posterior border of the gill-opening.

Total length 130 millim.

Bongon, N. Borneo (*Everett*). Two specimens.

Rasbora calliura.

Depth of body equal to length of head, 4 times in total length. Snout as long as diameter of eye, $3\frac{1}{2}$ times in length of head; interorbital width 3 times in length of head; no barbels. Dorsal II 7, originating halfway between end of snout and base of caudal fin, nearer to base of ventrals than to origin of anal fin. Anal II 5. Pectoral $\frac{3}{4}$ length of head, not reaching ventral. Scales 27–28 $\frac{4\frac{1}{2}}{2\frac{1}{2}}$; 1 scale between lateral line and base of ventral. Caudal lobes much elongate. Silvery, greyish on the back, the dorsal and lateral scales with a blackish edge; caudal lobes black at the end.

Total length 145 millim.

Senah, Sarawak (*Everett*). Six specimens.

NEMATABRAMIS, gen. nov.

Body much compressed, with trenchant ventral edge.

Scales moderate; lateral line abruptly bent downwards behind the pectoral fin and running close to the lower profile of the body. Mouth directed upwards, moderately large; upper jaw protractile; a long maxillary barbel; gill-membranes united across isthmus; gill-rakers short; pseudobranchiæ present. Pharyngeal teeth hooked, in two series (5.4—4.5). Dorsal fin moderately elongate, opposite to but shorter than anal fin. Pectorals elongate, falcate; ventrals well developed; caudal forked.

Nematabramis Everetti.

Depth of body $3\frac{1}{4}$ to $3\frac{1}{3}$ times in total length, length of head $4\frac{1}{2}$ times. Upper profile of head and nape slightly concave; snout a little longer than diameter of eye, which is 4 times in length of head; interorbital width $2\frac{1}{2}$ times in length of head; maxillary barbel $1\frac{1}{2}$ to twice as long as head. Dorsal II 9–12, originating twice as far from end of snout as from base of caudal. Anal III 16–18. Pectoral $1\frac{1}{3}$ as long as head, extending beyond base of ventral; latter a little nearer end of snout than base of caudal. Scales 35–37 $\frac{7\frac{1}{2}}{2}$. Colour pale, with a silvery lateral stripe.

Total length 110 millim.

Bongon and Merabeh, N. Borneo; Baram River, Sarawak (*Everett*). Five specimens.

Nemachilus olivaceus.

Depth of body $5\frac{3}{4}$ to $6\frac{1}{3}$ times in total length, length of head $4\frac{1}{2}$ to $4\frac{3}{4}$ times. Eye $\frac{3}{5}$ length of snout, $\frac{3}{5}$ interorbital width, $\frac{1}{5}$ length of head; head naked; maxillary and outer rostral barbels extending to middle of operculum. Depth of caudal peduncle $\frac{2}{3}$ to $\frac{3}{4}$ depth of body, equal to the distance between the anal and the caudal fins. Dorsal II 8, originating above the base of the ventrals, and slightly nearer the end of the snout than the base of the caudal. Pectorals $\frac{3}{4}$ length of head, as long as ventrals, which reach the vent. Anal II 5, halfway between dorsal and caudal. Caudal feebly notched. Body entirely covered with imbricate scales, of which there are about 30 between dorsal and ventral fins. Olive above, with or without traces of 17 darker bars across the back, yellowish beneath; fins grey or greyish, without spots.

Total length 80 millim.

Bongon, N. Borneo (*Everett*). Five specimens.

Nemachilus saravacensis.

Depth of body 5¼ to 6 times in total length, length of head 4⅓ to 4¾ times. Eye ⅔ to ¾ length of snout, a little less than interorbital width, ¼ length of head; head naked; maxillary and outer rostral barbels extending to middle of operculum. Depth of caudal peduncle ⅔ depth of body, equal to the distance between the anal and the caudal fins. Dorsal II 8–9; originating slightly in advance of the base of the ventrals, and at equal distance from the end of the snout and the base of the caudal. Pectorals as long as the head, longer than the ventrals, which do not reach the vent. Anal II 5, halfway between dorsal and caudal. Caudal deeply notched. Body entirely covered with imbricate scales, of which there are about 30 between dorsal and ventral fins. Yellowish, with 13 to 15 brown bars across the back, and a series of brown spots or vertical bars on each side; a black vertical streak below the eye; dorsal and caudal fins with small brown spots; usually a round black spot at the base of the anterior dorsal rays.

Total length 55 millim.

Senah, Sarawak (*Everett*). Four specimens.

Specimens previously received from Marquis Doria have been referred (Cat. Fish. vii. p. 350) to *N. fasciatus*, which differs, apart from coloration, in the dorsal fin being formed of a greater number of rays and originating above the inner ventral rays.

Acanthophthalmus borneensis.

Depth of body 8 to 9 times in total length, length of head 6½ to 7 times. Eye very small; suborbital spine very strong; barbels short. Dorsal 7–8, its distance from the caudal about ¼ the total length. Anal 6–7, its distance from the caudal ⅙ to ⅐ the total length. Ventrals halfway between the head and the caudal fin. Caudal fin crescentically notched. Scales minute. Body colourless; three black annular bands on the head—the first on the snout, the second passing through the eyes, the third across the occiput and covering the opercles; dorsal and caudal fins black at the base.

Total length 50 millim.

Baram River, Sarawak (*Hose*). Several specimens.

This and the two preceding species are of special interest as the first Cobitines described from Borneo. *Homaloptera* is also represented in Mr. Everett's Sarawak collection by two species previously known from Burma, viz. *H. bilineata*, Blyth, and *H.* (*Helgia*) *modesta*, Vinciguerra.

XXVII.—*Descriptions of Three new* Lycænidæ *from New Guinea.* By Hamilton H. Druce, F.Z.S., F.E.S.

The following descriptions are taken from specimens captured by Mr. William Doherty at Humboldt Bay, North New Guinea, and which are now in Messrs. Godman and Salvin's collection.

Pseudonotis, gen. nov.

Allied to *Thysonotis*. Differs from that genus by the costal nervure being free its entire length and by the subcostal nervure emitting three branches only in place of four, the first of which is emitted rather beyond the middle of the cell, the second slightly more than halfway between the first and third, the third arising at the end of the cell and reaching the margin considerably before the apex. Legs and palpi more slender and not so densely hairy. Eyes smooth.

Type *Myrina antipha*, Hew.

Hewitson, when describing his *Myrina antipha* and *Myrina ancharia* (Ill. Diurn. Lep. Suppl. pp. 7, 8, 1873), remarked that it was not satisfactory to him to place them in the genus *Myrina*, but that he had done so because the Felders had included in it their *Myrina danis* and *Myrina Lorquinii*.

There are, I believe, four described species in the genus, viz.:—*P. antipha*, Hew., from Aru Island; *P. ancharia*, Hew., from Waigiou; *P. Lorquinii*, Feld., from Aru Island and Gilolo; and the species described below as *P. Humboldti*.

Myrina danis, Feld., cannot, in my opinion, be placed in this genus as, besides possessing two tails and a distinct lobe to anal angle, it presents a somewhat different arrangement of the nervules in the fore wing, the costal nervure and the first subcostal nervule being bent towards each other and running side by side for some short distance. The palpi, as pointed out by Dr. Felder, are different, the third joint being longer and the second shorter; the eyes also are hairy.

It is closely allied to *Hypolycæna*.

Pseudonotis Humboldti, sp. n.

Allied to *P. ancharia*, Hew.

♂. Upperside: blue more extensive, especially in the hind wing, where it reaches almost to the marginal row of lunules, white patch on costal margin more restricted centrally.

Underside: costal margin of fore wing not brown-bordered as in other species, outer marginal border wider at angle and

brown border of hind wing better defined. In some specimens the disks in fore wing are dusted with white.

♀. Upperside brown-bordered, with a semicircular white band common to both wings, commencing just inside and rather before the middle of the costal margin, and reaching the anal margin of hind wings; broadest about the median nervules of fore wing; bases brown, thickly dusted with shining light blue scales. Outer marginal row of black spots larger than in male and bordered inwardly with more distinct shining blue crescent-shaped lunules.

Underside as in male, but lunules larger and more distinct.

Expanse, ♂ $1\frac{1}{2}$, ♀ $1\frac{7}{10}$ inch.

Hab. Humboldt Bay; New Guinea (*Hagge-Grub*). Mus. Staud.

The indentation on the outer margin of hind wing is scarcely discernible in this form.

The female described is from a specimen in Dr. Staudinger's collection, and is, perhaps, exceptionally large.

Taken by Mr. Doherty in September and October.

Epimastidia pilumna, sp. n.

♂. Allied to *E. inops*, Feld. Upperside cærulean blue, narrowly edged with blackish brown; costal third of hind wing greyish brown, except along the costal margin, which is pure white; three more or less distinct black spots towards the anal angle, adjoining the black border, that between the first and second median nervules being the most distinct.

Underside: costal margin of fore wing rather more broadly bordered than in *E. inops*, and with a narrow greyish line partly closing the cell; outer marginal border consisting of lunules as in that species, but larger and more distinct. Hind wing with the inner band broader and the lunules and spots much larger, so that the white band between the brown border and the inner row of black lunules is reduced to a line of white crescent-shaped markings bordering the large black lunules. On the inner edge of the brown band, about the middle of the wing, is a slightly irregular line of faint grey markings indistinctly edged with white. The three lower black spots in the marginal series are more or less suffused with light shining blue scales.

♀. Upperside much as in *E. inops* ♀, but the bases of both wings strongly suffused with greenish blue.

Underside as in male, except that the inner margin of fore wing is white, not brownish grey as in that sex.

Expanse, ♂ ♀ $1\frac{7}{10}$ inch.

Hab. Humboldt Bay (September and October).

Arhopala leo, sp. n.

Alied to *A. hercules*, Hew.

♂. Upperside a more brilliant and bluer shade of purple.

Underside light shining silvery emerald-green, with bands and spots arranged as in *A. hercules*, but the two spots in the cell of the fore wing, the one under the costal nervure, and the two within the cell of the hind wing deep black with whitish rings; the band on both wings is also bordered with whitish, and the spots and markings on the upper part of the anal margin of the hind wing are either very minute or have entirely disappeared.

♀. Upperside differs considerably from *A. hercules* ♀ by the more violaceous and much more extensive blue colour, the outer margin of the fore wing being narrowly and that of the hind wing very narrowly brown. There is also no trace of the distinct brown mark which closes the cell of the hind wing of *A. hercules* ♀.

Underside as in male, but slightly duller.

The lobe in both sexes is less produced than in *A. hercules*.

Expanse, ♂ $2\frac{4}{10}$, ♀ $2\frac{1}{2}$ inches.

Hab. Humboldt Bay (September and October).

Distinguished from its ally by its smaller size, altogether different female, and by the wings of both sexes being more transparent, and so enabling the spots and bands on the underside to be seen through on the upperside, and by the light colour of the underside.

M. Kirsch (MT. Mus. Dresd. i. p. 127, 1877), in describing two specimens received from Ansus, which he refers to *A. hercules*, Hew., states that the female was unknown to Hewitson and Felder and that it is bright brown on the upperside without a trace of violet-blue; but it does not appear clear whether that remark applies to a specimen from Ansus or Java. I have not seen a specimen from Java or Makassar (whence the type was derived), but have before me several females from Minahassa which have the blue on the disks very distinct and are much like Felder's figure of *A. araxes* ♀. Dr. Staudinger (Exot. Tagf. p. 280), who is of opinion that Boisduval's locality, "Java," is incorrect, describes the form found in Waigiou under the name *herculina*, and states that it has two forms of female, one nearly all blue on the upperside, the other with no blue at all. Messrs. Godman and Salvin's collection contains both sexes from Waigiou, the female having the blue on the upperside quite as extensive as *A. leo* ♀, but of a decided violet shade; and I think it probable that those female specimens

which are entirely black on the upperside should be referred to males which have yet to be discovered. *A. herculina* is probably intermediate between *A. leo* and *A. tyrannus*, Feld.

XXVIII.—*On the* Elateridæ *of Japan.*

By G. Lewis, F.L.S.

[Continued from p. 201.]

Athous jactatus, sp. n.

♂. Niger, griseo-pubescens; thorace parallelo, nigro; elytris ferrugineo-brunneis, sutura fusca; antennis nigris; pedibus fusco-brunneis.
L. 7–8½ mill.

Black, shining, with grey pubescence; the head rather coarsely punctate, depressed between the antennæ; the thorax somewhat parallel at the sides, feebly canaliculate in the middle, punctuation much smaller than that of the head, hind angles concolorous, short and blunt; the scutellum fuscous; the elytra rusty brown, punctate-striate, interstices little convex and punctulate; the antennæ rather slender, black; the legs dusky brown, knees, ends of tarsi, and claws paler. There is one example with the basal joint of the antennæ red, elytra dark brown, and legs pale.

There is a close resemblance in this species to *A. difficilis*, Duf., but the thoracic hind angles are not red and the elytral sutures are dark. The general form also is more parallel. I took a large number of specimens, but no female; the female of *A. difficilis* is also unknown, so that the female of each species is probably very sluggish.

Hab. Nara. In abundance at the end of June.

Athous inornatus, sp. n.

Obscure brunneus, subnitidus, griseo-pubescens; thorace post angulos rufo; elytris pedibusque pallide brunneis.
L. ♀ 10½, ♂ 7½ mill.

♂. Dull brown, with griseous pubescence; the head rather closely punctured, little rugose; the thorax pitchy brown, with a broad reddish area behind the anterior angle, rather more finely punctured than the head, not very convex,

hind angles little acute, sometimes a little turned outwards, carina well-marked, marginal rim raised as much as the carina; the scutellum dark brown; the elytra testaceous or pale brown, finely punctate-striate, interstices punctulate and finely rugose; the antennæ brownish, with the base of each joint paler; the legs pale.

Female much more robust, with much larger punctuation on head and thorax; thorax convex, with elytra widening out behind the middle. Sometimes the females are wholly dark brown.

Hab. Junsai and Sapporo. Twelve examples.

Athous undosus, sp. n.

Ater, opacus, dense cinereo-pubescens; antennis inconspicue serratis; elytris brunneis, fasciis tribus flexuosis.
L. 18 mill.

Black, rather opaque, with ashy-grey pubescence; the head densely punctured, forehead triangularly impressed; the thorax very closely punctured, punctures on the disk larger (some ocellate) than those of the head, median channel short, commencing in the middle and not extending to the base, hind angles markedly turned outwards, without a carina; the scutellum rather long, obscurely sculptured, minutely incised behind; the elytra dull brown, with intervals free of pubescence which assume the appearance of fasciæ, viz. a large lobe-shaped space at the base on interstices 2 to 5, and behind it a zigzag fascia on interstices 1 to 8, behind the middle is a broader fascia, which extends across the whole of the elytron, punctate-striate, striæ narrow but rather deep, interstices convex and rugosely punctulate; the antennæ and legs concolorous with the head and thorax.

Resembles the European *A. undulatus*, De Geer.

Hab. Nikko. Taken not far from the summit of Niohozan, where snow remained in patches in June.

Corymbites, Latreille.

I have an example of a species belonging to Candèze's first section of the genus, taken by Mr. Fenton in Yezo, but the specimen is not in good condition.

Corymbites daimio, sp. n.

Niger, nitidus, nigro-pubescens; thorace subconvexo, leviter canaliculato; elytris flavis, macula scutellari alterisque duabus pedibusque nigris.
L. 10–11 mill.

Densely black, shining, pubescence black on the head and thorax, fulvous on the elytra; the head rather closely punctulate; the thorax lightly punctulate, median channel feeble or sometimes absent; the elytra striate-punctate, interstices little rugose and finely punctulate, yellow, with five black spots, scutellar spot dehiscent behind; two black dorsal spots, somewhat circular in outline, usually partly covering the third interstice and spreading to the eighth, sometimes much smaller; the two apical spots are shaped like the apex of an elytron, separated from each other and the apex and outside edge usually by the width of two or three interstices. The antennæ and legs densely black.

♂. Antennæ strongly pectinate, lateral thoracic margins narrowly elevated.

C. vernalis, Hentz, and *C. Bœberi*, Germ., are similar species to this.

Hab. Yuyama, Chiuzenji, and Sapporo. Not rare.

Corymbites tessellatus, L.

Candèze introduced the name of this species to the Japanese list (Mém. Ac. Belg. 1864, p. 53), and Schönfeldt has the name in his Catalogue; but in 1873 Candèze (Mém. Liège, p. 25) says it was given in error.

Corymbites orientalis, Cand.

Corymbites orientalis, Cand. Elat. Nouv. iv. 1889, p. 114.

This species is like *C. pruinosus*; it measures 15 mill. and the thorax has the hind angles slender and strongly outturned.

Hab. "Japan" (*Candèze*). I have an example from Chiuzenji and another from Nikko.

Corymbites ærosus.

Athous ærosus, Lew. Ent. Month. Mag. 1879, p. 157.

This species is somewhat like *C. modestus*, but it is much narrower, less convex, thoracic angles not straight, yet only feebly turned outwards; the elytra wholly æneous; the antennæ entirely black, the legs red and tarsi infuscate. Originally I introduced this in error as an *Athous*.

Hab. Kii and Chiuzenji. Three examples.

Corymbites modestus, sp. n.

Fusco-æneus, subnitidus, dense griseo-pubescens; thorace angulis posticis subrectis; elytris marginibus anguste rufescentibus; antennis (basi excepta) infuscatis, pedibus rufis.
L. 10½ mill.

Dusky æneous, with close grey pubescence; the head rather coarsely and rather densely punctured; the thorax densely punctured at sides, disk rather less closely, closer in female, hind angles obtuse and almost straight; the elytra punctate-striate, interstices rather flat, finely and sparsely punctulate, exterior margins narrowly and somewhat obscurely red; the antennæ, three basal joints reddish, others nearly black; the legs wholly red.

Very similar to *C. metallicus*, Payk., but larger; elytra relatively longer and hind angles of thorax straighter.

Hab. Fukahori and Nikko. Two examples only.

Corymbites selectus, Cand.

Corymbites selectus, Cand. Mém. Acad. Belg. 1864, p. 53.

I only obtained two examples of this species; one measures 14 millim., the other 17 millim. It is the only large species known from Japan in which the thorax is very densely punctured on the sides and disk in both sexes; the thorax is rendered opaque by the punctuation.

Hab. Sapporo.

Corymbites fulvipennis, sp. n.

Æneo-fuscus, subnitidus, fulvo-pubescens; elytris fulvo-rufis; antennis nigris, pedibus infuscatis vel testaceis.
L. ♂ 12½, ♀ 17 mill.

Brassy fuscous, somewhat shining, pubescence fulvous; the head coarsely and closely punctured, with a raised V-shaped smooth surface between the eyes; thorax, in the male parallel laterally, canaliculate in the middle, in the female much broader, convex on disk, very feebly canaliculate at the base, densely punctulate in both sexes, in the female punctures finer on disk; the scutellum rather small and narrow; the elytra yellowish red, striate-punctate, striæ lightly impressed, interstices flat and sparsely punctured; the antennæ black; the legs black or testaceous.

Resembles an American species, *C. volitans*, Esch.

Hab. Miyanoshita. Two examples from a decaying *Ginkgo biloba*.

Corymbites prænobilis, sp. n.

Elongatus, purpureo-æneus, nitidus, griseo- vel fulvo-pubescens; thorace lateribus dense, in medio tenuiter, punctatis; elytris punctato-striatis, interstitiis subrugosis, punctulatis.
L. 19–22 mill.

Bronzy, with a purple tint, shining, pubescence grey or fulvous; the head deeply, not closely punctured, punctures round, elevated in front of the eyes; the thorax visibly canaliculate longitudinally, much more closely punctured at the sides than on the head, disk finely and sparsely punctulate; the scutellum finely and closely punctulate; the elytra rather more metallic than the thorax, punctate-striate, interstices finely rugose and punctulate, striæ nearest the suture fine; the antennæ and legs infuscate, tibiæ little paler.

To be placed next to *C. serrifer*, Cand., a species found at Kobé and Nikko.

Hab. Idzu, Yokohama, and Yuyama. There are specimens also in the British Museum.

Corymbites hypocrita, sp. n.

Fusco-niger, nitidus, griseo-pubescens; elytris subobsolete striatis; antennis nigris, pedibus infuscatis.
L. 10 mill.

Dusky black, shining, with grey pubescence; the head, surface uneven, rather densely punctate; the thorax widest in the middle, less coarsely and more sparingly punctured than the head, hind angles carinate, somewhat acute and turned outwards (in this respect like *C. pruinosus*, Motsch.), thoracic lateral rim well-marked; the elytra, striæ very fine, in some lights obliterated by the punctuation of the interstices, interstices finely and somewhat thickly punctulate; the antennæ rather long, not serrate, third joint shorter than the fourth and more than twice as long as the second, coloured like the body; the legs not quite so dark.

Superficially this species looks like an *Athous*.

Hab. Nikko. Two examples.

Corymbites notabilis, Cand.

Corymbites notabilis, Cand. Mém. Liège, 1873, p. 25.

I have an example which is obscurely brassy above, not brown. The punctures on the thoracic disk of all the specimens are fine and sparse; Candèze's description of the punctuation applies to the sides only.

Hab. Nagasaki, Kumamoto, and Yuyama.

Corymbites (*Selatosomus*) *puncticollis*, Motsch.

Corymbites (*Selatosomus*) *puncticollis*, Motsch. Bull. Mosc. 1866, p. 167.

This species is similar to *C. æneus*, L., but it is much larger, and the thorax is densely punctulate on the disk in the female and scarcely less so in the male. Some examples are highly metallic, bright green or coppery.

Hab. Chiuzenji and Sapporo. Taken abundantly in both places.

Corymbites onerosus, sp. n.

Corymbites tristis, Cand., Horn, Tr. Am. Phil. Soc. x. p. 288.

Infuscatus, subnitidus, fulvo-pubescens; elytris testaceis, nigro-vittatis, ultra medium subdilatatis; antennis nigris vel obscure brunneis.

L. ♂ 11, ♀ 14 mill.

Dusky brown, little shining, pubescence fulvous; the head little coarsely and somewhat unevenly punctate, angles close to the antennæ raised and smooth; the thorax evenly, thickly, not coarsely punctate, convex on disk, widest in the middle, hind angles carinate, not acute, slightly turned outwards; the elytra testaceous, sutural interstice blackish, second dark for nearly half the elytral length; from the humeral angle to one third of the elytra interstices 5 to 7 are darkly marked, the marking extending beyond the middle on the sixth interstice, and it then widens out over interstice 5, and on interstices 8 and 9 the dark colouring approaches the apex, the striæ are scarcely or very feebly punctured. In one specimen the elytral markings join in the middle of the dorsum, not unlike the markings in *C. cruciatus*, L. The antennæ and legs are dull brown. In an example, which I consider is the male, the antennæ are much longer, each joint being one third longer, more lax, and all black, and the lateral rim of the thorax is raised and the hind angles acute, with the disk feebly convex.

This species is very similar to *C. tristis*, Cand., but differs in the thoracic canaliculation being absent, punctuation of the thorax less coarse, and the punctuation of the second and third striæ is scarcely visible. I have examined Candèze's type of *C. tristis* in the Janson collection; it is a female, and it appears that the male was unknown at the date of Candèze's Monograph. In the Janson collection there are also two examples of *C. onerosus* from Japan, both females, and they are labelled *C. tristis*, Cand.

Hab. Oyama, Tokio, Shimabara, Oyayama, and (♂?) Yuyama.

Corymbites pacatus, sp. n.

Obscure nigro-brunneus, parum nitidus, griseo-pubescens; elytris flavo-testaceis, nigro-vittatis, ultra medium subdilatatis; antennis nigris, tibiis brunneis.
L. $6\frac{1}{2}$–$9\frac{1}{2}$ mill.

Dull blackish brown, with grey pubescence; the head rather closely and coarsely punctate; the thorax widest in middle, hind angles rather acute, moderately turned outwards, little convex on disk; the elytra pale, with dark markings, sutural interstice dark (also scutellum), humeral angle on interstices 5 to 7 dark, near the middle interstices 5 to 7 dark and on interstices 8 to 9 the marking extends to the apices (the markings are a little variable), striæ punctate, interstices little rugose and punctulate; the antennæ black, rather long; the legs, thighs infuscate or obscure brown, tibiæ and tarsi reddish brown. Female unknown.

This species somewhat resembles a very small specimen of *C. onerosus*.

Hab. Tokio. Taken by Mr. Fenton in some numbers, and I am indebted to him for three male examples.

Corymbites vagepictus, sp. n.

Obscure nigro-brunneus, subopacus, griseo-pubescens; thorace dense punctato; elytris obscure trifasciatis, ultra medium subdilatatis; antennis pedibusque brunneis.
L. 7–$7\frac{1}{2}$ mill.

Dull blackish brown, head and thorax densely pubescent; the head rather flat between the eyes, densely punctured; the thorax rather convex in female, densely punctured in both sexes, widest in the middle, hind angles not very acute, moderately turned outwards; the elytra dull brown, with three pale fasciæ not well defined, that at the base chiefly occupies the third and fourth interstices, that before the middle the third, fourth, fifth, and seventh, and before the apex there is one similar to the last; the fasciæ vary in breadth, and sometimes the outer elytral margin is pale; the antennæ are longer in the male than the female, but not nearly so lax or so long as in those of *C. pacatus*, brown, and the bases of the articulations sometimes paler; the legs obscure brown.

Hab. Kumamoto. Both sexes taken abundantly on the 25th April, 1881, from the flowers of a dog-rose.

Corymbites mundulus, Lew.

Corymbites mundulus, Lew. Ent. Month. Mag. 1879, p. 157.

Piceus, nitidus, griseo-pubescens; thorace sparse et tenuiter punctulato: elytris punctato-striatis, interstitiis subtiliter punctulatis, marginibus externis rufescentibus; antennis (basi excepta) infuscatis; pedibus obscure rufis.
L. 7–8 mill.

The type of this species has an æneous tinge, but in a series of eighteen specimens I do not observe another with this colour. There is one example also with the antennæ wholly red.

Hab. Yokohama, Kii, Miyanoshita, Oyama, Oyayama, and Hagi (*Hiller*).

Corymbites gratus, sp. n.

Angustatus, parallelus, obscure æneus, opacus; thorace creberrime ocellato-punctato, canaliculato, angulis posticis haud carinatis; elytris densissime rugoso-punctatis; antennis nigris; pedibus rufis, tarsis infuscatis.
L. 11–12 mill.

Narrow, parallel at sides, obscurely æneous, opaque; the head densely punctate, punctures ocellate, frontal carina smooth; the thorax punctured like the head, with broad median channel, posterior angles turned outwards, somewhat acute in male, rather obtuse in female; the scutellum densely punctured like the elytral interstices; the elytra punctate-striate, striæ finely cut, interstices densely punctured and transversely rugose; the antennæ serrate, joints longest in male, otherwise differing little in the sexes, black; the legs, thighs, and tibiæ clear red, tarsi dusky.

This and the five following species are narrow and form a section in the genus distinct from the others from Japan.

Hab. Ichiuchi, Chiuzenji, Subashiri, Miyanoshita, and Junsai.

Corymbites ferrugineipennis, sp. n.

Angustatus, parallelus, obscure æneus, opacus; thorace creberrime ocellato-punctato, angulis posticis haud carinatis; elytris ferrugineis; tibiis rufis.
L. 9½–10 mill.

Form like that of *C. gratus* and the head and thorax similarly punctate; the thorax less deeply channelled; the elytra rusty red and much less densely punctulate and rugose;

the antennæ much shorter in male; the legs red, thighs sometimes dusky, tarsi infuscate.

If the antennæ of the male were longer and more lax this species might be taken for a variety of *C. gratus* with red wing-cases.

Hab. Nikko and Chiuzenji. Four examples.

Corymbites rubripennis, sp. n.

C. ferrugineipenni simillimus, antennis magis longioribus; thorace haud carinato; elytris rubris.

L. 9½ mill.

Narrow, parallel, obscure æneous, opaque; the head little rugose, very closely ocellate-punctate, frontal carinæ semicircular; the thorax punctured like the head, widely flattened in the middle, hind angles a little broad and relatively obtuse, little turned outwards, the basal carina being markedly absent; the elytra bright red, punctate-striate, interstices densely rugose and punctulate; the antennæ serrate, rather long; the legs, tibiæ red, thighs and tarsi infuscate.

Hab. Higo. One male example.

Corymbites chlamydatus, sp. n.

Angustatus, parallelus, æneus, subnitidus; capite grosse et creberrime ocellato-punctato; thorace a basi conspicue carinato; elytris rufis, interstitiis punctulatis haud rugosis; antennis nigris; pedibus rufis.

L. 12 mill.

Narrow, parallel, brassy, somewhat shining; the head very closely and coarsely punctured, punctures ocellate; the thorax densely punctate, the punctures round and deep, not pressed together nor ocellate on the disk, hind angles very distinctly carinate, somewhat acute and rather turning outwards; the elytra bright red, punctate-striate, interstices little convex, punctulate, feebly rugose; the antennæ black, articulations somewhat long and lax; the legs red, tarsi dusky.

Differs from the other five narrow species of this series in having a carina at the thoracic angle and the interstices of the elytra being simply punctulate.

Hab. Yuyama. One male example.

Corymbites concolor, sp. n.

Angustatus, parallelus, obscure cæruleo-niger; capite thoraceque creberrime ocellato-punctatis; elytris punctato-striatis, interstitiis rugosis; antennis nigris; pedibus infuscatis.

L. 7¾–8 mill.

Narrow, parallel, black, with dull bluish tinge; the head very closely ocellate-punctate; the thorax also extremely closely punctured, median channel feeble, hind angles obtuse, without a carina, slightly turning outwards; the elytra punctate-striate, interstices very rugose, the rugosities obliterating the punctures; the antennæ slender, lax, black; the legs dusky, with the knees and tibiæ paler.

Hab. Yuyama. Two male examples.

Corymbites obscuripes, sp. n.

Angustatus, parallelus, brunneo-æneus, opacus; thorace creberrime ocellato-punctato, angulis divaricatis, haud carinatis; elytris subbrunneis, interstitiis rugosis; antennis subelongatis, nigris; pedibus obscure brunneis.

L. 8 mill.

Narrow, very similar (except in colour) to *C. ferrugineipennis*. The head and thorax obscurely æneous, very densely punctate, punctures ocellate, hind angles of latter distinctly turning outwards, without a carina, median canaliculation feeble, angles brownish; the elytra brown, with a brassy tinge, interstices punctulate and rugose, striæ punctate, fine and even; the antennæ black, rather long, serrate, and joints lax, especially in male.

Hab. Miyanoshita. Four specimens.

Ludius niponensis, sp. n.

Latus, niger, nitidus, pube nigra; thorace confertim punctato, linea in medio lævi; elytris tenuiter striatis, interstitiis confertim punctatis; antennis pedibusque nigris.

L. 20–22 mill.

Broad and robust, black, three basal joints of antenna sometimes pitchy red, palpi and claws pale; the head somewhat uneven, coarsely punctured, with an impression more or less distinct between the eyes; the thorax narrowest in front, rounded off behind the anterior angles, then slightly and gradually widening to the base, closely and evenly punctured, with narrow smooth line down the centre; the scutellum oblong, depressed anteriorly, sculptured like the interstices of the elytra; the elytra, striæ uniformly not deeply impressed nor visibly punctate, interstices closely punctured, with a somewhat imbricated surface sculpture, and slightly convex, base excavated round the scutellum.

The prosternal notch in the posterior process of the keel is very conspicuous. The species is more robust than *L. abruptus*,

Say, but otherwise very similar to it; the latter, however, has no smooth median line on the thorax.

Hab. Nikko and Sapporo. Three examples only.

Ludius Candezei, sp. n.

Ellipticus, elongatus, niger, pube brunnea; fronte utrinque antice angulato; thorace carinis posticis obliquis; elytris tenuiter striatis, interstitiis punctulatis; antennis pedibusque piceo-nigris. L. 24 mill.

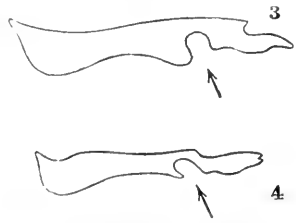
Elliptical, elongate, black, with brown pubescence; antennæ and legs pitchy red; the head oblique at the sides before the eyes, truncate before the epistoma, punctate, punctures rather small and somewhat closely set; the thorax narrowest in front, gradually widening to base, very feebly sinuous before the angles, carinæ well raised and oblique, thus leaving anteriorly a wide interstice, excavated transversely at base; the scutellum distinctly convex but nearly vertical; the elytra elongate, gradually narrowing to apex, feebly striate, interstices punctulate and somewhat finely rugose; the prosternal posterior process is very long and the notch is close to the tip; the antennæ, terminal joint constricted, third joint one third longer than the second.

I have only seen one example of this curious species. The form of the forehead and the oblique direction of the thoracic carinæ, the convex scutellum, and the length of the prosternal process are very peculiar. I have much pleasure in naming it after Dr. M. E. Candèze, the author of the 'Monograph on the Elateridæ' and of the first memoir on the Japanese species.

Hab. Nagasaki.

Ludius Sieboldii, Cand.

Ludius Sieboldii, Cand. Mém. Liège, 1873, p. 27.



In this species the prosternal notch is not quite so conspicuous as in *L. ferrugineus*, L., but it is well-marked (see fig. 3, ↑, coxal cavity).

Hab. Nagasaki, Kobé, and Sapporo. Twenty examples.

Crigmus plebejus.

Ludius plebejus, Cand. Mém. Liège, 1873, p. 28.

Dr. Candèze included *Crigmus* in *Ludius*; but the form of the posterior prosternal process in *Ludius* (type *L. ferrugineus*, L.) will not permit this. In *Crigmus* (type *C. hepaticus*, Germ.) the prosternal process descends immediately behind the coxæ, and in *Ludius* it extends horizontally for about half the distance and is then abruptly notched and continued on a lower plane, and this is the case in all true *Ludii*. In *Crigmus* also the terminal joint of the antennæ is not contracted at the apex, and in *C. junior* and *linteatus* it is very elongate. *C. plebejus* is very similar to *C. hepaticus*, especially in the elytral sculpture.

Hab. Nagasaki, Ashiwo, and Sapporo.

Crigmus junior.

Ludius junior, Cand. Mém. Liège, 1873, p. 27.

I give a figure showing the outline of the prosternal keel viewed sideways (fig. 4, †, coxal cavity). The great length of the antennæ in the male is a distinctive character in this species.

Hab. Yuyama, Ichiuchi, Kashiwagi, and Sapporo.

Crigmus linteatus.

Ludius linteatus, Cand. Mém. Liège, 1873, p. 28.

Hab. Kobé. Two examples found on Maiyasan in 1871.

Sericus sericarius, Motsch.

Dolerosoma?, Motsch. Bull. Mosc. 1866, p. 166.

The author says this species is similar to *D. humeralis*, Motsch., but larger; the elytral striæ are crenulate; it measures 8 millim. I have not seen any insect which answers to the description he gives, unless it is *Silesis musculus*, Cand.

[To be continued.]

XXIX.—*A Month on the Trondhjem Fiord.*

By the Rev. Canon Norman, M.A., D.C.L., F.R.S., &c.

[Continued from p. 164.]

[Plate XII.]

[The reader is requested to make the following corrections in the preceding Table of Distribution :—

P. 162, *for* Heteromysis *read* Hemimysis.
„ *for* Chiromysis *read* Heteromysis.
P. 163. The S in column 14 should be opposite *Eudorella truncatula* instead of *E. emarginata*.
P. 164, column 13. Put N instead of ? opposite *Campylaspis costata*.]

This Table of Distribution of the Higher Crustacea of Norway contains one hundred and seventy-eight species. The distribution of these species may be summed up as follows :—

Species which occur both to the north and to the south of Norway	30
Species known only to the north of Norway	19
Species known only to the south of Norway	104
Species here recorded only as Norwegian	25
	178

But of these last twenty-five species *Bythocaris Payeri*, Heller, has a wide distribution in the great depths of the cold area of the North Atlantic, and *Euphausia pellucida*, Dana, is an oceanic form with world-wide distribution ; and although this species is not marked in the Mediterranean column, it should have been so, since *Euphausia Mülleri*, Claus, is a synonym.

Deducting these two species, we have twenty-three remaining which are as yet unknown beyond the Norwegian seas.

Of the 178 Norwegian species, 121 are known in British seas and 57 reach the Mediterranean, while 44 occur on the N.E. coast of North America. A study of the table will show that the species common to Norway and N.E. America are, with the exception of *Carcinus mœnas*, *Eupagurus Bernhardus*, and *Crangon vulgaris*, either Arctic or deep-water forms.

The Isopoda of Norway differ in general character from those of the British sea by the fact that the family Sphæromidæ is only represented by the single species *Limnoria lignorum*; this family is altogether unknown in the Arctic seas, and in Denmark only two forms occur, *Limnoria lignorum* and *Sphæroma rugicauda*. On the other hand, the

families Tanaidæ, Munnidæ, and Munnopsidæ are largely represented in Norway; the first of these has been little studied in our own seas, while the two latter families are lovers of a soft muddy bottom and, for the most part, of a considerable depth of water, conditions rarely met with on or off our coasts; but there can be no doubt that our fauna will hereafter be enriched by many additions in these three interesting groups.

The Norwegian seas are very rich in Amphipoda, and here again many groups are more largely represented than in British seas on account of the greater depth of water and the nature of the bottom of the fiords; but there can be no question that the much larger number of Amphipods known in Norway as compared with the British fauna is due in no small degree to the fact that the Norwegian Amphipoda have been more thoroughly studied than the British. The following is a comparative statement of the number of Amphipoda at present known in Norway, Denmark, Britain, and the Mediterranean; the species of Norway are from Sars and Boeck, those of Denmark are taken from Meinert's works, those of Britain are from my own computation (including some unrecorded species), those of the Mediterranean are on the authority of Claus, Della Valle, and Mayer.

	Norway.	Denmark.	Britain.	Mediterranean.
Hyperina	9	1	10	21
Gammarina ..	333	107	214	106
Caprellina....	17 (?)	5	12	16
	359	113	236	143

When we pass to the consideration of the Entomostraca, we find that these, with the exception of one group, have been more studied and are better known in the British fauna and in that of the Mediterranean than in Scandinavia. With respect to Copepoda of the latter country the only papers we have are those of Boeck, published many years ago. The Ostracoda of the Norwegian seas have, however, been worked at both by Professor G. O. Sars and myself. One hundred and eighteen species of marine Ostracoda are now known from that coast * and one hundred and forty-six from our own †.

* Norman (A. M.), "Notes on the Marine Crustacea Ostracoda of Norway," Ann. & Mag. Nat. Hist. ser. 6, vol. vii. 1891, p. 108.

† Norman and Brady, "Mon. Marine and Freshwater Ostracoda of the North Atlantic and North-western Europe," Section I., Podocopa, Trans. Roy. Dublin Soc. ser. 2, vol. iv. 1889, p. 63. To the species of Podocopa there enumerated are added those of the other sections of the group.

Brachyura.

1. *Portunus depurator*, Linn.

One small specimen, Trondhjem.

Anomura.

2. *Eupagurus pubescens*, Kröyer.

Trondhjem and Rödberg.

3. *Galathea strigosa*, Linn.

Two young examples, Laminarian zone, Rödberg.
Professor M. Sars found this species as far north as the North Cape ('Oversigt over de i den Norsk-arctiske Region forekommende Krebsdyr,' 1858).

4. *Galathodes tridentatus*, Esmark.

? 1852. *Galathea serricornis*, Lovén, Œfv. Vet.-Akad. p. 22 (? junior).
1856. *Galathea tridentata*, Esmark, Skand. Naturf. Möte, p. 239.
1882. *Galathodes tridentata*, G. O. Sars, "Oversigt af Norges Crustaceer, I.," Vidensk.-Selsk. Forhand. Christ. p. 43 (separate copy), pl. i. fig. 3.

On the precipices at Rödberg down to 300 fathoms, as well as in similar localities in Kors and Hardanger Fiords.
This species would seem to feed on *Lophohelia prolifera*. It is usually found clinging to that coral or met with in its immediate neighbourhood.

Macrura.

5. *Calocaris Macandreæ*, Bell.

In 150–300 fathoms, Trondhjem and Rödberg; also Oster Fiord, near Bergen, 400 fathoms, and off Batalden, near Florö, 200–300 fathoms.

6. *Cheraphilus nanus*, Kröyer.

Trondhjem, 150 fathoms.
This is *Crangon bispinosus*, Westwood.

7. *Pontophilus*, sp.

I did not find any mature specimen of this genus, but an example occurred in the postlarval stage (see G. O. Sars, "Bidrag til Kundskaben om Decapodernes Forvandlinger, III. Fam. Crangonidæ," Archiv f. Mathem. og Naturv. 1890, pl. iv. figs. 19, 20), in which the telson and second leg are as

figured by Sars, while the carapace has two dorsal spines, a rostrum as long as the eye, and traces of lateral carinæ.

8. *Spirontocaris polaris*, Sabine.

1824. *Alpheus polaris*, Sabine, Supp. to Appendix of Parry's Voyage, p. 238, pl. ii. figs. 5–8.
1843. *Hippolyte polaris*, Kröyer, Monog. Fremst. af Hippolyte's Nordiske Arter, p. 324, pl. iii. figs. 78–81, pl. iv. fig. 82, ♀.
1843. *Hippolyte borealis*, id. ibid. p. 330, pl. iii. figs. 74–77, ♂.
1835. *Hippolyte borealis*, Owen, in Append. Ross's Second Voyage, p. 84, pl. B. fig. 3, ♂.
1867. *Hippolyte cultellata*, Norman, "Report Exploring Coasts of Hebrides," Brit. Assoc. Report, 1866, p. 200.
1869. *Hippolyte cultellata*, Norman, "Last Report Dredging Shetland," Brit. Assoc. Report, 1868, p. 265.
1879. *Hippolyte polaris*, S. I. Smith, "Stalk-eyed Crustaceans Atlantic Coast of N. America," Trans. Connect. Acad. vol. v. p. 80, pl. xi. figs. 1–4.

Trondhjem and Rödberg, 40–300 fathoms. I have the species also in my collection from Hardanger Fiord, off Lervig, and in Stoksund; Norddals Fiord, Florö; Svolvær, Lofoten Islands; Varanger and Bog Fiords, East Finmark; from the Minch and off Shetland: all dredged by myself. Also from Greenland ('*Valorous*' *Exped.*); lat. 60° 14′ N., long. 4° 30′ W., 290 fathoms ('*Porcupine*,' 1869, Stat. 78); and off Halifax, N.E. America (*S. I. Smith*).

9. *Spirontocaris securifrons*, Norman.

Trondhjem, 150 fathoms.

This is a much more common species than *S. spinus*, Sow. In British seas the latter is very rare; the former I have from Northumberland and Durham coasts, Shetland, the Minch, Loch Fyne, Firth of Clyde, &c. in our own seas; from most of the fiords in which I have dredged in West Norway and Finmark; also from Tromsö (*I. Sparre Schneider*), and off Salem, Massachusetts Bay, 90 fathoms (*S. I. Smith*).

10. *Spirontocaris pusiola*, Kröyer.

Rödberg, 3–10 fathoms.

11. *Bythocaris simplicirostris*, G. O. Sars. (Pl. XII. fig. 1.)

1869. *Bythocaris simplicirostris*, G. O. Sars, "Nye Dybvandscrustaceer fra Lofoten" (Vidensk.-Selsk. Forhand. Christ. 1869), p. 5 (separate copy).

For generic characters see G. O. Sars, 'Den Norske Nordhavs Exped. Crustaceer,' 1885, p. 26. Five species of the

genus have been described—*B. Panschii*, Bucholz *, *B. Payeri*, Heller †, *B. leucopis*, G. O. Sars ‡, and *B. nana*, S. I. Smith § ; and the present species, which is the type of the genus.

Bythocaris simplicirostris appears to be extremely rare. I dredged two specimens in 250–300 fathoms, Rödberg. Sars described the species from a single female dredged in 250 fathoms, Lofoten Islands. Two mutilated examples were taken by the Norwegian North-Atlantic Expedition, one between Finmark and Bear Island in 191 fathoms, the other west of Spitzbergen in 416 fathoms.

B. simplicirostris is distinguished from the more recently described species by the following characters :—

Carapace with only a very slight central carina, suddenly terminated anteriorly in a notch and armed with a spine. Frontal area considerably projecting ; middle spine-process (rostrum) subulate, round, smooth, acute, extending forwards to beyond the middle of the basal joint of the antennules, and longer than the long eyes ; the flanking lateral spine-processes acute and well-developed, about one third the length of the central. Eyes well developed, on long peduncles, when laterally projected extending beyond the sides of the carapace. Scale of antennæ of great size, as long as the entire carapace and three times as long as its own greatest breadth ; apically well rounded and greatly overtopping the spine-process of the outer margin. Telson slightly emarginate at the extremity.

12. *Cryptocheles pygmæa*, G. O. Sars. (Pl. XII. figs. 2–5.)

1869. *Cryptocheles pygmæa*, G. O. Sars, "Nye Dybvandscrustaceer fra Lofoten" (Videnskr.-Selsk. Forhand.), p. 6 (separate copy).

Rödberg, on the precipices, in 150–250 fathoms. I have also dredged it in 200 fathoms near Lervig, on the Hardanger Fiord. Sars's types were from the Lofoten Islands in 120–300 fathoms ; he has also procured it at Hesthammer, in the Hardanger Fiord, in 100–150 fathoms, and it was dredged by the Norwegian North-Atlantic Expedition at the mouth of the Sogne Fiord, in 200 fathoms. It has as yet only been found on the Norwegian coast.

* *Hippolyte Panschii*, Bucholz, Die zweite Deutsche Nordpolarfahrt, 1869 und 1870, vol. ii. 1874, p. 277, pl. i. fig. 1.

† *Hippolyte Payeri*, Heller, Crustaceen, Pycnogoniden, und Tunicaten Œsterr.-Ungar. Nordpol-Exped. p. 2, pl. i. figs. 1–4.

‡ *Bythocaris leucopis*, G. O. Sars, Den Norske Nordhavs-Exped. 1876–78, Crustacea, I., 1885, p. 27, pl. iii. figs. 1–26.

§ *Bythocaris nana*, S. I. Smith, "Report Decapod Crustacea 'Albatross,' 1884," Annual Rep. Comm. Fish and Fisheries, 1885, p. 56 (separate copy), pl. xii. fig. 2.

This is probably the smallest Macruran known, measuring only about 13 millim. long.

Outer maxillipeds (fig. 4) strongly developed, with a small palp at the base, last joint longer than penultimate, on the anterior side furnished with semiverticils of setæ, extremity terminating in a very strong triangular spine, at the base of which is projected to about one third of its length a dentated lobe. First feet very short (fig. 5), hand greatly elongated, nearly twice the length of the wrist, attenuated distally, the finger and thumb extremely small and weak. Second feet slender and weak; wrist longer than the anterior portion of limb, composed of seven articulations; hand very minute and the chela so small that it can only be seen when the limb is mounted and microscopically examined. Remaining feet simple. The front portion of the carapace is dorsally keeled and spined, spines about four; rostrum (fig. 3) about half as long as the carapace, nearly horizontal, narrow, above with "8–12" spines, beneath unarmed, except sometimes a small tooth at the apex. No spine over the eye, but three minute spines below. Antennal scale elongated, rhomboidal, with a spine about the middle of the outer margin. Epimera of first three segments of pleon very large in the female, especially the second. Telson shorter than uropods, elongated-ovate, with numerous spines on the sides, distally truncate, and furnished with six spines. "Branchiæ utrinque 5 structura singulari, laminas formantes ovatas in superficie modo exteriore plicas 4–7 ut rudimenta foliolorum præbentes; branchia posterior ceteris major et forma subreniformi" (*G. O. Sars*).

Both *Bythocaris* and *Cryptocheles* have only a few ova, and these are very large; and G. O. Sars has recorded that in these genera the young issue from the egg with the full complement of limbs, and do not undergo any metamorphosis subsequently. Thus these genera differ from all shallow-water Macrura. In most deep-water Macrura the eggs are few and large, and it is probable therefore that the development is similar in character to that of *Bythocaris* and *Cryptocheles*. [Notes by Prof. S. I. Smith on the large size of the eggs of abyssal Crustacea will be found in papers printed in Ann. & Mag. Nat. Hist. ser. 5, vol. xiv. 1884, p. 183; "Report Decapod Crustacea 'Albatross' Dredgings, 1884," in Ann. Rep. Comm. Fish and Fisheries, 1885 (1886), p. 13 (separate copy); Ann. & Mag. Nat. Hist., ser. 5, vol. xvii. 1886, p. 197.]

13. *Pandalus brevirostris*, Rathke.

Rödberg, 150 fathoms.

Two specimens, both presenting peculiarities. One is more slender in form than usual and has the rostrum less deep and much longer, equal to twice the length of the eye; it bears ten teeth above, of which six are articulated on the carapace and two are situated beyond the extremity of the eye; there is usually a cilium in front of each tooth of the carapace, but in this specimen it is absent; there are three teeth on the underside of the rostrum of larger size than usual. The second specimen has the rostrum somewhat shorter, with eight teeth above of which five are on the carapace, and four below, the two proximal of which are of good size and at some distance from the extremity.

14. *Caridion Gordoni*, Bate.

Rödberg, 150 fathoms.

15. *Pasiphæa tarda*, Kröyer.

1845. *Pasiphae tarda*, Kröyer, Naturhist. Tidsk. Anden Rækkes, vol. i. p. 453.
1844? *Pasiphæa tarda*, Kröyer, Voyage en Skandinavie &c. pl. vi. figs. A, B, *a–o* *.
1868. *Pasiphae norvegica*, M. Sars, Bidrag til Kunds. om Christianiafjordens Fauna, p. 42, pls. iv. and v. figs. 65–90.
1882. *Pasiphae tarda*, G. O. Sars, "Overs. af Norges Crustaceer, I." (Vidensk.-Selsk. Forhand. Christ.), p. 42 (separate copy).

A single specimen off Rödberg in about 300 fathoms.

The chief points which distinguish this species from *P. sivado*, our British species, are that the telson is cleft at the extremity and that there is no spine over its base on the hinder margin of the preceding segment. The segments are also strongly keeled dorsally.

Both *P. sivado* and *P. tarda* are usually found in depths exceeding 80 fathoms; but on one occasion, about forty years ago, I found the former in enormous quantities in stake-nets which had been set between tide-marks at Clevedon, Somerset; and these could not have temporarily come out of deep water, since the whole of the Bristol Channel is shallow.

Mysidea.

Descriptions and admirable figures of the following Schizopods will be found in G. O. Sars's "Monog. over de ved Norges Kyster forekommende Mysider," and descriptions of such as are found in Britain in my paper on British Mysidæ in Ann. & Mag. Nat. Hist. ser. vi. vol. x. 1892.

* The generic name in the Voyage en Scand. is spelt *Pasiphæa*, and this is the spelling of Savigny, who instituted the genus.

16. *Boreomysis tridens*, G. O. Sars.

In 3–300 fathoms, Trondhjem and Rödberg. Some young examples were taken among *Laminariæ* in very shallow water, but close at hand there was a precipice descending to 250 fathoms.

17. *Erythrops microphthalma*, G. O. Sars.

A single specimen off Trondhjem, in 150 fathoms.

18. *Parerythrops abyssicola*, G. O. Sars.

In considerable numbers, Rödberg, 250–300 fathoms.

19. *Mysidopsis didelphys*, Norman.

Trondhjem, between Munkholmen and the harbour.

20. *Pseudomma roseum*, G. O. Sars.

Among *Lophohelia* and Alcyonarians on the precipices and on the bottom of the fiord, Rödberg.

21. *Pseudomma affine*, G. O. Sars.

One only, 250–300 fathoms, Rödberg.

22. *Mysideis insignis*, G. O. Sars.

Rödberg, 150 fathoms, one only.

23. *Hemimysis abyssicola*, G. O. Sars.

Rödberg, 250–300 fathoms, abundant.

24. *Macromysis inermis*, Rathke.

Trondhjem and Rödberg, 3–5 fathoms.

25. *Schistomysis ornata*, G. O. Sars.

Rödberg, 3–5 fathoms.

Cumacea.

I do not in the following list give reference to such species as are described in G. O. Sars's paper "Om den aberrannte Krebsdyrgruppe Cumacea og den Norske Arter" (Vidensk.-Selsk. Forhand. 1864) except when other papers contain figures of the species.

26. *Lamprops fasciata*, G. O. Sars.

One specimen in 1 fathom, west bay at Trondhjem.

27. *Hemilamprops rosea*, Norman.

1863. *Vaunthompsonia rosea*, Norman, Trans. Tyneside Nat. Field-Club, vol. v. p. 251, pl. xiii. figs. 1–3, ♀.
1863. *Cyrianassa elegans*, id. ibid. p. 275, pl. xiv. figs. 1–6, ♂.

Specimens here and there in 15–150 fathoms, Trondhjem and Rödberg.

28. *Hemilamprops cristata*, G. O. Sars.

1869. *Lamprops cristata*, G. O. Sars, "Nye Dybvandscrustaceer fra Lofoten" (Vidensk.-Selsk. Forhand.), p. 13 (separate copy).

Four specimens, 150–300 fathoms, Trondhjem and Rödberg.

29. *Leucon nasicus*, Kröyer.

Leucon nasica, Kröyer, Voyage en Skand. &c. pl. iii. fig. 3, *a–o*.

In 20–150 fathoms, Trondhjem and Rödberg.

30. *Leucon pallidus*, G. O. Sars.

Rödberg, 40–300 fathoms.

31. *Leucon acutirostris*, G. O. Sars.

Rödberg, 150–300 fathoms.

32. *Eudorella truncatula*, Bate.

1856. *Eudora truncatula*, Bate, "On British Diastylidæ," Ann. & Mag. Nat. Hist. ser. 2, vol. xvii. p. 457, pl. xiv. fig. 3.
1871. *Eudorella truncatula*, G. O. Sars, "Besk. af 'Josephines' Exped. fundne Cumaceer," Kong. Svenska Vetensk.-Akad. Hand. vol. ix. pl. xviii. fig. 99.

Rödberg and Trondhjem, 20–300 fathoms.

33. *Eudorella emarginata*, Kröyer.

1844? *Leucon emarginatus*, Kröyer, Voyage en Scand. &c. pl. v. fig. 2, ♀.
1863. *Cyrianassa ciliata*, Norman, Trans. Tyneside Nat. Field-Club, vol. v. p. 273, pl. xiii. figs. 4–9, ♂.
1871. *Eudorella emarginata*, G. O. Sars, "Besk. af 'Josephines' Exped. fundne Cumaceer," Kong. Svenska Vetensk.-Akad. Hand. vol. ix. pl. xvii. fig. 98.

Common, 40–300 fathoms, Trondhjem and Rödberg.

34. *Eudorella hirsuta*, G. O. Sars.

1869. *Eudora hirsuta*, G. O. Sars, Undersögelser over Christianiafjordens Dybvandsfauna, p. 43.
1871. *Eudorella hirsuta*, G. O. Sars, "Besk. af 'Josephines' Exped. fundne Cumaceer," Kong. Svenska Vetensk.-Akad. Hand. vol. ix. pl. xvii. fig. 100.

A single specimen, Rödberg, 250–300 fathoms.

35. *Diastylis lucifer*, Kröyer.

Cuma lucifera, Kröyer, Voyage en Skand. &c. pl. iii. fig. 3.

Very abundant at Trondhjem in 20–150 fathoms; also at Rödberg, sparingly, in 40–70 fathoms.

36. *Diastylis cornutus*, A. Boeck.

1863. *Cuma cornuta*, A. Boeck, "Vidensk.-Selsk. Forhand. p. 190" (*fide* G. O. Sars; I have not this paper).
1865. *Diastylis bicornis*, Bate, Ann. & Mag. Nat. Hist. ser. iii. vol. xv. p. 84, pl. i. fig. 2.
186(4?)*. *Diastylis bispinosa*, G. O. Sars (*nec* Stimpson), Aberr. Krebsdyrgruppe Cumacea, p. 39.

In 150 fathoms at Trondhjem and 250–300 fathoms at Rödberg.

37. *Diastylis echinatus*, Bate.

1865. *Diastylis echinata*, Bate, Ann. & Mag. Nat. Hist. ser. 3, vol. xv. p. 81, pl. i. fig. 1.

Two specimens, Rödberg, 250–300 fathoms. I have also taken it in three places in the Hardanger Fiord, in 100–180 fathoms; and I have a specimen from 550 fathoms in the Faroe Channel.

38. *Diastylis serratus*, G. O. Sars.

Rödberg, 70–300 fathoms, the specimens for the most part very young. I have also taken it at Drobak, in the Christiania Fiord; off Lervig, in the Hardanger Fiord; and at Florö.

39. *Diastylis tumidus*, Lilljeborg.

Trondhjem, in 20–70 fathoms. I have also dredged it in several places near Florö, in 70–250 fathoms.

40. *Diastylis biplicatus*, G. O. Sars.

Diastylis lamellata, Norman, "Report Dredging Hebrides," Brit. Assoc. Rep. 1866 (1867), p. 200.

Trondhjem, between Munkholmen and the land. I have also taken it at Drobak; in Oster Fiord, north of Bergen; and off Lervig, in the Hardanger Fiord. It has a great range in depth from 20 to 1230 fathoms, at which last depth it was taken by the 'Porcupine' Exped., 1869.

* This paper bears date 1864; but as it quotes Bates's paper published in 1865, it must have been published later.

41. *Diastylis resimus*, Kröyer.

1844? *Cuma resima*, Kröyer, Voyage en Scand. &c., pl. iii. fig. 1; Naturhist. Tidsk. Anden Række, vol. ii. 1846, pp. 165 and 206.
1882. *Diastylis resimus*, G. O. Sars, "Oversigt af Norges Crustaceer, I.," Vidensk.-Selsk. Forhand. Christ. p. 58 (separate copy).

In abundance at Trondhjem, between Munkholmen and the land, and in other places, 20–70 fathoms. I have also found it in profusion in shallow water, 3–5 fathoms, at Vadsö, and in Bog and Klosterely Fiords, Sydvaranger. Sars also found it "i stor Mængde" at Vadsö, in 6–10 fathoms, and also at Christiansund. It is remarkable that this *Diastylis*, originally described from specimens procured by Capt. Holboll in Greenland, should be the latest addition to our knowledge of the Cumacean fauna of the Norwegian coast, and not recorded again till about thirty-six years after its first discovery. The circumstance of its not having been found is the more remarkable since the species is an inhabitant of shallow water and is gregarious and most abundant where it occurs, and that it is now known to range from the borders of Russia (Sydvaranger) to Denmark. In form it is utterly different from any other species of the genus, being at once distinguished by its upturned rostrum, in which respect a counterpart may be found in *Eudorellopsis deformis*, Kröyer.

42. *Diastylis rugosus*, G. O. Sars.

1879. *Diastylis rugosa*, G. O. Sars, "Nye Bidrag til kunds. om Middelhavets Invertebratfauna, II. Middelhavets Cumaceer," Archiv. for Math. og Naturvidenskab. vols. iii. and iv. p. 98, pls. xxxiv.–xxxviii.

Two specimens, Trondhjem, 20–40 fathoms. I have also dredged it at Drobak and in the Hardanger Fiord; off Valentia, Ireland; and procured it at Naples.

43. *Leptostylis ampullaceus*, Lilljeborg.

Rödberg, in 250–300 fathoms. This is a rare species which I have also taken at Drobak (Sars's locality); and I am indebted to Prof. Lilljeborg for specimens from Kullen, Sweden.

44. *Campylaspis costata*, G. O. Sars. (Pl. XII. fig. 9.)

1864. *Campylaspis costata*, G. O. Sars, "Aberrante Krebsdyrgruppe Cumacea," Vid.-Selskab. Forhand. p. 79.

Carapace sculptured, with three oblique subcrescentic crests on each side; the lowest commencing at the anterior extremity of the lateral border, runs nearly parallel with that border until it arches over the back near the dorsal margin;

after pursuing rather more than half its length, it sends out a branch, which ascends thence nearly perpendicularly over the back; in front of this lowest and divided crest are the two remaining crests, which are flexuous, oblique, and subcrescentic, the lower meeting the front margin at the base and the other a little above the summit of the rostrum. For description of limbs see Sars.

Trondhjem and Rödberg, 70–150 fathoms. In 1879 I dredged it in 80–100 fathoms in Stoksund, which is near the mouth of the Hardanger Fiord; and in 1878 at Drobak.

It is also a member of the British fauna, having been dredged by Mr. T. Scott at Rothesay, in the Firth of Clyde, and by myself off Little Cumbrae in 1885.

45. *Campylaspis verrucosa*, G. O. Sars. (Pl. XII. fig. 8.)

1866. *Campylaspis verrucosa*, G. O. Sars, Beret. om en i Somm. 1865 foretagen Zool. Reise ved Kysterne af Christianias og Christiansands Stifter, p. 24.

Carapace without crests or ribs; beset all over with conspicuous irregularly disposed tubercles. The whole animal is speckled with deep brown or black, and on the carapace there is usually one such dark speck on each tubercle.

Rödberg, 100–300 fathoms; also in 1879 in 80–100 fathoms, in the Hardanger Fiord.

46. *Campylaspis horrida*, G. O. Sars. (Pl. XII. figs. 6, 7.)

1869. *Campylaspis horrida*, G. O. Sars, "Nye Dybvandscrustaceer fra Lofoten," Vidensk.-Selsk. Forhand. p. 18 (separate copy).

Carapace very large, but less tumid than usual; surface very uneven; a little within the lateral margin runs a plain crest or plica, which overhangs the inward sweep of the sides below it; above this is a longitudinal waved crest, and above this again the whole surface is tuberculated; there are also a few tubercles in the space between the waved and the plain crest.

One specimen only, Rödberg, in 250–300 fathoms.

For descriptions of the limbs of the three foregoing species Sars's papers can be consulted. As they have not hitherto been figured, I give illustrations of these interesting Cumaceans.

Isopoda.

47. *Paranthura tenuis*, G. O. Sars.

1872. *Paranthura tenuis*, G. O. Sars, "Bid. til Kunds. om Dyrelivet paa vore Hafbanken," Vidensk.-Selsk. Forhand. p. 89.

1886. *Paranthura tenuis*, Norman and Stebbing, "Isopoda of 'Lightning,' 'Porcupine,' and 'Valorous' Expeditions," Trans. Linn. Soc. vol. xii. p. 191, pl. xxvii. fig. 1.

Rödberg, 250–300 fathoms.

48. *Anceus maxillaris*, Montagu.

Found down to 100 fathoms.

49. *Æga ventrosa*, M. Sars.

1858. *Æga ventrosa*, M. Sars, "Overs. af de i den norske-arct. Region forekom. Krebsdyr," Vidensk.-Selsk. Forhand. Christ. 1858, p. 156.
1879. *Æga ventrosa*, Schiödte and Meinert, "Symb. ad Monog. Cymothoarum, I. Ægidæ," Naturhist. Tidss. 3 Række, vol. xii. p. 375, pl. ix. figs. 7, 8.

Four specimens, among Alcyonarians and corals on the precipices at Rödberg. This species is only as yet known on the Norwegian coast. The type was taken in Öxfjord, Finmark, and though rare—Schiödte and Meinert record twelve specimens in all—it has been found in several places thence to the Christiania Fiord. I may add to recorded habitats near Lervig, in the Hardanger Fiord, where I took two specimens in 1879.

50. *Idotea marina*, Linné.

= *I. tricuspidata*, Desmarest, = *I. pelagica*, Leach, = *Oniscus balthicus*, Pallas, = *Stenosoma irrorata*, Say, = *Idotea Basteri*, Audouin, = *Idotea variegata*, Roux.

Rödberg. I have this species from Sicily, from the Adriatic, and from all parts of the British coast; West Norway generally, and up to Vadsö, East Finmark, and from the N.E. American coast.

It is subject to great variation as regards the form of the telson:—

a. The sides slope away without any angulation to a considerably produced central point. This is a common state in the young, but is sometimes preserved to full maturity.

b. The telson is markedly angled at that part whence the sides begin to slope away to the produced apex.

c. The angles just spoken of are produced into more or less acute points, which, however, are much shorter than the central apex. This is typical *I. tricuspidata*, Desmarest.

d. The extremity is very broad, somewhat produced and widely rounded at the sides, with a small central point, which is scarcely, if at at all, longer than the lateral lobes. All the specimens I have seen from the Mediterranean, that is from Sicily and the Adriatic, are referable to this variety or, possibly, species. It is a form which I have never seen in the north, and is *I. Basteri*, Roux.

Miers, in his "Revision of the Idoteidæ" (Journ. Linn. Soc. vol. xvi. 1881, p. 31), has considered the North-east American *Idotea* described by Harger under the name *Idotea*

phosphorea * to be a variety of *I. marina*. In this I think he was mistaken. Neither Harger nor Miers alludes to what I consider the most important specific character. The manner in which the lateral lobes of the thoracic segments are distinctly separated from the epimera is important; but the form of the epimera themselves is quite different from what it is in *I. marina*—instead of being of subequal depth throughout, each is markedly narrow in front and gradually widens backward, and thus has a wedge-shaped form (Harger's figures distinctly show this to be the case: compare fig. 27, *I. phosphorea*, Harger, with fig. 24, *I. irrorata*, Harger, = *I. marina*). The specimens I have examined are types received from Harger taken in the Bay of Fundy, and they have been compared with *I. marina* from European localities as well as with specimens of the same species received from Vineyard Sound, N.E. America (from Harger as "*I. irrorata*").

51. *Astacilla longicornis*, Sowerby.

Two small females with pouches carrying eggs, Trondhjem. The most northern locality from which I have this species is Tromsö (*I. Sparre Schneider*).

52. *Janira maculata*, Leach.

Rödberg, 40–70 fathoms.

This is *Henopomus muticus*, Kröyer ('Voyage en Skand. &c.' pl. xxx. figs. 1 *a–n*).

53. *Pleurogonium rubicundum*, G. O. Sars.

Pleuracantha rubicunda, G. O. Sars, "Om en Anomal Gruppe af Isopoder," Vidensk.-Selsk. Forhand. Christ. 1863, p. 16 (separate copy).

Pleurogonium rubicundum, G. O. Sars, "Unders. over Hardangerf. Fauna, I. Crustaceer," Vidensk.-Selsk. Forhand. 1871, p. 30 (separate copy).

In 40 and 150 fathoms, Trondhjem and Rödberg. I have to thank Prof. G. O. Sars for specimens from Finmark, and I have myself taken the species at Vadsö, Finmark. It is also a British species, since I dredged it in 1888, in company with my friend Mr. D. Robertson †, in 20–25 fathoms off Fairland Point, Cumbrae, in the Firth of Clyde.

* Harger, "Report Marine Isopoda of New England," Report U.S. Comm. Fish and Fisheries, 1878, pt. 6, p. 347, pl. v. figs. 27–29.

† I may record here another species taken at the same time in company with *Pleurogonium rubicundum*, belonging to the same family and also new to the British fauna, *Paramunna bilobata*, G. O. Sars.

The genus *Leptaspidia*, Bate and Westw., is, I think, unquestionably a synonym of *Pleurogonium*.

54. *Macrostylis spinifer*, G. O. Sars.

Macrostylis spinifer, G. O. Sars, "Om Anom. Gruppe af Isopoder," Vidensk.-Selsk. Forhand. 1863, p. 15 (separate copy).
Vana longiremis, Meinert, Vidensk. Udbytte 'Hauchs' Togter, III. Crustacea Malacostraca, 1890, p. 195, pl. ii. figs. 63–73.

Two or three specimens of this curious little species in 40–70 fathoms, Rödberg. I also have received specimens from Denmark (Copenhagen Museum as "*Vana longiremis*").

55. *Ischnosoma bispinosum*, G. O. Sars.

Ischnosoma bispinosum, G. O. Sars, Beret. om en i Somm. 1865 foretagen Zool. Reise ved Kyst. af Christianias og Christiansands Stifter, 1866, p. 34.

Three specimens from the greatest depths at Rödberg. Also in my collection from Christiania Fiord, given me by G. O. Sars, who has also procured it at Lofoten and in the Hardanger Fiord.

56. *Eugerda tenuimana*, G. O. Sars.

Desmosoma tenuimanum, G. O. Sars, Beret. om en i Somm. 1865 foretagen Zool. Reise ved Kyst. af Christianias og Christiansands Stifter, 1866, p. 33.
Eugerda globiceps, Meinert, Vidensk. Udbytte 'Hauchs' Togter, III. Crustacea Malacostraca, 1890, p. 194, pl. ii. figs. 53–62.

Rödberg, 70–200 fathoms.

I have been able to compare my specimens with types of *Eugerda globiceps* received from the Copenhagen Museum. There seems sufficient grounds for removing Sars's species from the genus *Desmosoma*, on account of the mandibles being destitute of a palp, the filiform character of the first feet, and the biramose caudal appendages.

57. *Munnopsis typica*, M. Sars.

Munnopsis typica, M. Sars, Beret. om en i Somm. 1859 Zool. Reise ved Kysten af Romsdals Amt. 1860, p. 10.
Munnopsis typica, M. Sars, "Besk. af en ny Stægt og Art af Isopoder," Vidensk.-Selsk. Forhand. 1860, p. 84.
Munnopsis typica, M. Sars, Bidrag til Kunds. om Christianiafj. Fauna, 1868, p. 70, pls. vi., vii.
Munnopsis typica, H. J. Hansen, Dijmphna-Togtets zool.-bot. Udbytte, 1887, p. 196, pl. xx. figs. 2–2 *e*.
Munnopsis typica, H. J. Hansen, Oversigt over det vestlige Grönlands Fauna af Malakos. Hafskrebsdyr, 1887, p. 195 (no description).

Rödberg, 250–300 fathoms. I also have it from Varanger Fiord, East Finmark, 150 fathoms (*A. M. N.*); off Hare Island, Disco, Greenland, 85 fathoms ('*Valorous*,' 1875); Faroe Channel, 540 fathoms ('*Knight Errant*,' Stat. 8); Faroe Channel, 640 fathoms ('*Triton*,' Stat. 8); West Greenland (*Prof. d'Arcy Thompson*).

58. *Ilyarachna hirticeps*, G. O. Sars.

Ilyarachna hirticeps, G. O. Sars, "Nye Dybdvandscrustaceer fra Lofoten," Vidensk.-Selsk. Forhand. 1869, p. 23 (separate copy).

Rödberg, 250–300 fathoms.

In this species the leading character is "Segmentorum thoracicorum 4 priorum margines anteriores in cristas subtiliter crenulatas elevati." Among the specimens occurring at Rödberg are some in which this crenation is almost wholly absent. I have also taken this species in the Varanger Fiord, East Finmark, and have one of the original specimens procured by the describer at the Lofoten Islands.

59. *Eurycope cornuta*, G. O. Sars.

Eurycope cornuta, G. O. Sars, "Om en Anomal Gruppe af Isopoder," Vidensk.-Selsk. Forhand. 1863, p. 5 (separate copy).

Rödberg, 250–300 fathoms. Also Christiania Fiord (*G. O. Sars, in Mus. Nor.*).

60. *Eurycope producta*, G. O. Sars.

Eurycope producta, G. O. Sars, Beret. Somm. 1865 Zool. Reise ved Kysterne af Christianias og Christiansands Stifter, 1866, p. 32.

Antennules having the basal joint broad and produced on each side into triangular lobes, which embrace the second joint between them; the inner of these lobes very long and reaching forward to the length of the fourth joint; rostrum having the base equal in breadth to about one fourth of that of the cephalic segment, deeply concave and bent downwards at the extremity, which is emarginate in the centre, rounded on each side, and bearing on the outer margin 6 to 8 tooth-like serrations; the rostrum is subequal in length to the long triangular lobe of the first joint of the antennules. The three anterior segments of the posterior portion of the body are distinctly separate and articulated, and are slightly grooved in the central dorsal line. Length of antennæ about 2½ that of the body; length of latter 3 millim., of former 8 millim.

There are two species with which *E. producta* might be confounded; from *E. furcata* and *E. latirostris* the distinctly separated segments which precede the last will at once distinguish it, as well as the character of the basal joint of the antennules and the exact structure of the rostrum.

Rödberg, on the precipices among Alcyonarians, in about 150 fathoms.

Sars described the species from a single specimen, which was scarcely more than half the length of those found by me; and as in that description there is no allusion made to the structure of the antennules, I should have failed to recognize the species had it not been that I had the advantage of direct comparison with specimens kindly given me by Prof. G. O. Sars, and obtained by him in West Norway.

[To be continued.]

EXPLANATION OF PLATE XII.

Fig. 1. *Bythocaris simplicirostris*, G. O. Sars. Dorsal view of anterior portion of carapace, enlarged.
Fig. 2. *Cryptocheles pygmæa*, G. O. Sars. Enlarged about three diameters.
Fig. 3. Ditto. Rostrum.
Fig. 4. Ditto. Outer maxilliped.
Fig. 5. Ditto. First foot.
Fig. 6. *Campylaspis horrida*, G. O. Sars, ♀. Enlarged.
Fig. 7. Ditto. Dorsal view of carapace.
Fig. 8. *Campylaspis verrucosa*, G. O. Sars, ♂. Enlarged.
Fig. 9. *Campylaspis costata*, G. O. Sars, ♂. Enlarged.

XXX.—*New Coleoptera from the Australian Region.*

By Chas. O. Waterhouse.

Lucanidæ.

Eurytrachelus Wickhami, sp. n.

Niger, sat nitidus: mandibulis porrectis perparum curvatis, convexis, ante apicem dente valido armatis, medio denticulatis; capite magno, subtiliter granulato, pone oculos bituberculato rugoso; thorace lato, lateribus leviter arcuatis.
Long. (mandib. incl.) 25 lin.

Hab. Queensland.

Formerly I regarded this as a variety of *E. arfakianus*,

Lansb. I am now, however, convinced that it is a distinct species. It is relatively rather narrower; the mandibles are convex, *i. e.* the ridge which bears the teeth is not dorsal as in *arfakianus*, but internal in the ordinary way; the large subapical tooth is more removed from the apex, and there are three or four small teeth rather behind the middle. The head has the same peculiar notch behind the eye, leaving two small tubercles, but the surface round the eye is merely rugose instead of being wrinkled. The thorax is more convex, more obliquely narrowed posteriorly, with the sides, especially anteriorly, distinctly arcuate. The mentum is more broadly truncate anteriorly.

In describing *E. arfakianus*, M. Lansberge has not, I think, laid stress enough on the differences in the mandibles in specimens of this species. In *Odontolabis*, dimorphism is common, but I do not remember any quite similar case in the *Dorcini*.

In *E. arfakianus*, var. *maximus*, the mandibles are rather straight, simple, except a large tooth near the apex.

In the var. *minor* the mandibles have a large subbasal tooth, and besides the subapical one there are one or two smaller teeth between the large teeth.

This appears to me to be a distinct case of dimorphism, and not a question of large and small examples. The Museum specimens measure:—

Var. *maximus*: 18 to 26 lines (mandib. incl.).

Var. *minor*: 19 to 24 lines (mandib. incl.).

These would correspond to what Dr. Leuthner calls telodont and amphiodont forms.

Cetoniidæ.

Pœcilopharis femorata, sp. n.

Oblonga, depressa, nitidissima, cyaneo-viridis: capite subtiliter punctulato, fronte punctis nonnullis sparsa; thorace lævi, latera versus punctis nonnullis sparsis; elytris lævibus, lineis tribus punctorum vix conspicuis, lateribus pone medium transversim striatis; pedibus obscure rubro-purpureis, femoribus obscure rubris.

Long. 10 lin.

Hab. Doreh (New Guinea).

Besides the difference in colour, this differs from *P. Whitei* in being rather narrower, the head is much more finely punctured, with only a few larger punctures on the forehead. The

thorax has only a few lunate punctures towards the sides. The elytra have only three not very distinct lines of punctures at the base, not extending beyond the middle; at the apical margin are the usual transverse striolæ. The transverse striolæ of the pygidium are finer and closer. The femora are dull red, the tibiæ and tarsi obscure reddish purple.

Buprestidæ.

Belionota Saundersii, sp. n.

Ænea, elytris purpureo-æneis: scutello subtillissime punctulato; corpore subtus læte aureo-viridi, ad latera brunneo-æneo, hic et illic cupreo tincto, segmento apicali cyaneo.
Long. 9½ lin.

Hab. N. Australia, Cape York.

This species is very like *B. fallaciosa* in general form (even narrower than that species usually is), but is easily distinguished by the extremely finely punctured scutellum and different coloration. The thorax has the punctuation very fine, rather closer than in *B. fallaciosa*, with less smooth space in the middle of the base. The elytra are bronze, obscurely tinted with brownish purple, with a steel-blue shade at the apex. The body beneath is very bright golden green, brownish æneous at the sides; the segments are bordered with dark steel-blue, and the greater part of the apical segment is of the same colour; in some examples the blue colour ascends somewhat in the median channel.

Belionota Woodfordi, sp. n.

Nigro-ænea: thorace igneo-cuprea, medio purpureo suffuso; scutello purpurascenti, subtiliter punctulato; corpore subtus aureo-viridi, ad latera cyaneo purpurascenti.
Long. 11–12½ lin.

Hab. Fauro I., Solomon Islands (*C. M. Woodford, Esq.*).

This is very close to *B. prasina*, but is, I think, sufficiently different in its coloration to merit a distinctive name.

Cleridæ.

Natalis.

Many species of this genus have been described from time to time, most authors comparing their species with "*N. porcatus*, Fabr." What these authors consider *porcatus*, F. to

be it is difficult to determine. Fabricius gives the locality as Van Diemen's Land; and the specimens in this Museum are all so marked except one labelled New Holland, which generally means West Australia. It is the longest, narrowest species known to me, with the disk of the thorax closely and finely punctured. It is not unlikely this is *N. cribricollis* of Spinola's Monograph; certainly his *N. porcatus* is not the Fabrician species. The Rev. T. Blackburn has given a synopsis of the species of the genus (Tr. Roy. Soc. of S. Austr. xiii. 1890, p 126), and the one he refers to *N. porcatus* is evidently not the Fabrician species, as he places it in the section "Disc of the prothorax not closely and evenly punctured." The specimens named *N. porcatus* in White's Catalogue are probably *porcatus* of Spinola (the type was not then in the Museum), and I am inclined to think they are the *N. Marstersii*, Casteln., but it all depends on what this author considered the Fabrician species.

Natalis Blackburni, sp. n.

Picea: capite creberrime subtiliter punctato, punctis nonnullis majoribus mixtis; thorace disco subtiliter obsolete punctulato, lateribus sat rugulosis; elytris postice modice dilatatis, costatis, costis alternis pone medium evanescentibus.

Long. 12, lat. elytr. $3\frac{3}{4}$ lin.

Hab. Swan River.

The head is closely and rather finely punctured, with a few much larger punctures interspersed. The antennæ are long, the apical joint elongate-ovate, moderately narrowed at the apex, the tenth joint as broad as long, the ninth scarcely as broad as long, very obliquely narrowed towards the base. The thorax is as long as broad, not very much flattened on the disk, a little broader at the widest part than in front, the disk very finely, rather closely, but indistinctly punctured; the sides rugulose, but not strongly as in many of the species. The elytra have the punctures large and transverse at the base, gradually diminishing in size posteriorly, being comparatively fine at the apex; the costæ are narrow and equal at the base, the alternate ones disappearing rather before the middle, leaving the others separated by dull flat spaces. The intermediate tibiæ are curved. The abdomen has a finely punctured patch in the middle of the second, third, and fourth segments, clothed with golden pubescence, the patch on the fourth segment a little broader than long. Posterior tarsi very long.

The upper surface of the insect is finely pilose, with some erect hairs scattered over the surface.

Natalis lata, sp. n.

Lata, depressa, ferrugineo-picea: capite confertim subtiliter punctulato, punctis majoribus crebre mixtis, fronte rugulosa; thorace medio depresso, parce subtiliter punctulato, lateribus fortiter vermiculosis; elytris brevioribus, postice modice dilatatis, basi crasse cancellato-punctatis, post medium subtilius punctulatis, costatis, costis 4ª, 6ª, et 8ª solum apice attingentibus.
Long. 11, lat. elytr. 3½ lin.

Hab. Moreton Bay (*Diggles*).

This is a comparatively short broad species. The head is finely punctured, but the large punctures are also very numerous and moderately close together; the upper part, especially above the eyes, is rugulose. The antennæ are long, the apical joint is oblong-ovate in general outline, but is doubly angular on each side; the tenth joint is a trifle broader than long, not very much narrowed at the base, the ninth joint is similar but a little longer. The thorax is as broad as long, distinctly broader at the widest part than in front; the disk is impressed, with very fine scattered punctures, with larger punctures here and there; the sides very strongly vermiculate. The elytra are short as compared with most species; at the base the punctures are very large and square, changing very abruptly just beyond the middle to rounder and smaller punctures, which become very small at the apex; the costæ are very narrow at the base, equal, but beyond the middle the first, second, third, fifth, and seventh disappear; the apex of the elytra is of a lighter brown colour. The intermediate tibiæ are rather short and nearly straight. The posterior tarsi are very short. The abdomen has the middle portion of the second and third segments densely and finely punctured, with a band of golden pubescence, more particularly along the posterior margin.

I cannot reconcile either of these species with any described by Mr. Blackburn.

Natalis lævis, sp. n.

Fusca, nitida, pube brevissima sordide flava obsolete marmorata: thorace medio subtilissime parce punctulato, lateribus late fortiter vermiculatis; elytris latera versus subtiliter striato-punctatis, postice costis vix elevatis notatis.
Long. 22, lat. elytr. 6¼ lin.

Hab. New Guinea.

In form this species presents nothing unusual, but its large size and smooth elytra at once distinguish it from all the described species. The antennæ are very long, the apical joint is elongate-ovate, obliquely truncate at the apex; the tenth joint is a little longer than broad, much narrowed at the base; the ninth joint is about one third longer than broad, obliquely narrowed to the base. The head is finely punctured, but with large punctures intermixed. The thorax is about as broad as long, obliquely narrowed in front, shining, deeply impressed in the middle; extremely delicately and not very closely punctured; the sides strongly vermiculose; the rugosity extending considerably on to the disk. The elytra are extremely finely and closely punctured where there is the fine pubescence, but there are bare smooth spots at intervals; the lines of punctures are only distinct at the sides, and the punctures are small; each elytron has three not very conspicuous costæ, the first commencing behind the middle, the next a little longer, the third almost entire, commencing below the shoulder. The intermediate tibiæ are slightly curved. The abdomen is shining and finely punctured; the third segment has a very small inconspicuous pubescent patch in the middle.

XXXI.—*On the Characters of a new Genus and Six new Species of Longicorn Coleoptera from New Guinea.* By C. J. Gahan, M.A.

Prionidæ.

Osphryon hirticollis, sp. n.

Nigro-fuscus; capite thoraceque supra subtusque sat dense fulvo-villosis; prothorace utrinque trispinoso; elytris dense punctulatis, sordide flavo-testaceis, sutura et margine exteriore angustissime piceis, apicibus utrisque bidentatis; antennis totis nigro-fuscis, (♂) corpore longitudine fere æqualibus, (♀) medium elytrorum paullo superantibus; segmento quinto abdominis (♂) fortiter, (♀) leviter emarginato.

Long., ♂ 37–40, ♀ 50 mm.

Hab. Doreh and Arfak.

Dark brown. Elytra yellowish testaceous, but in places exhibiting a darker tint; along the suture and the outer margin very narrowly piceous. Prothorax with three distinct spines on each side, of which the posterior is longest (on one

side of one male specimen there is an additional small spine, between the anterior and postmedian spine, in a position corresponding to that occupied by the second of the four spines in *Osphryon adustus*, Pasc.). The head and thorax are clothed both above and below with a rather dense tawny brown pubescence, which is longer on the underside, especially on the hind breast. The scutellum is dark brown. The elytra are rather thickly punctulate, and in places, especially towards the base in the female, are rather strongly coriaceous or subrugose; at the apex each is rounded externally, but towards the suture is truncate, with a distinct tooth or small spine at each angle of the truncature. The fifth ventral segment of the male abdomen is rather strongly emarginate behind, and part of the sixth segment projects beyond it. In the female the fifth segment is also emarginate, but not so strongly as in the male.

This species differs from *O. adustus*, Pasc., in some minor structural characters, such as having only three spines on each side of the prothorax and in having two small spines at the apex of each elytron; but in general form and in the sculpture and relative proportions of the joints of the antennæ there is such close agreement as to justify me in considering the two species congeneric. The genus was placed by Pascoe amongst the Derobrachides, and, in my view, rightly so. Lansberge, in his list of Malayan Prionidæ, ranks it with the Closterides. The two groups have, however, closer affinities than Lacordaire's arrangement seems to suggest.

Osphryon Forbesi, sp. n.

♂. Fuscus, supra opacus; prothorace antice posticeque pilis fulvis fimbriato, lateraliter utrinque quadrispinoso, supra minute sparseque granulato et bituberculato, tuberculis haud fortiter elevatis, obtusis, crebre subreticulatim punctatis; elytris opacis, minutissime sat sparseque granulatis, utrisque ad apicem bidentatis; antennis quam corpore paullo longioribus, articulis 1°, 2°, et tertii basi fortiter denseque punctatis, ceteris minutissime porosis et opacis, articulis a tertio ad decimum apice extus dentatis et intus subspinoso-productis.

Long. 43 mm.

Hab. New Guinea (*H. O. Forbes*).

Dark brown, almost entirely dull and opaque above. The head with a sparse fulvous pubescence. The prothorax is fringed anteriorly and at the base with fulvous hairs; the two anterior spines at each side are connate at their base, and

so likewise are the two posterior spines; the disk bears two feebly raised humps which are strongly and closely punctured. The elytra are devoid of pubescence, but under the lens are seen to bear numerous minute granules which seem to correspond to the setigerous punctures of *O. adustus*, Pasc. The underside of the thorax has a fulvous pubescence. The abdomen is glossy, sparsely punctured and almost impubescent; the fifth ventral segment of the male is feebly emarginate (almost truncate) behind. The antennæ are slightly longer than the body; the first two joints and the base of the third are thickly and strongly punctured; the third (except at the base) and the remaining joints are very minutely and closely punctulate and opaque; some feeble or obsoletely raised lines are to be seen on nearly all these joints; each joint from the third to the tenth is acutely angular or toothed on the outer side at the apex, and is produced into a distinct dentate or spinous process on the inner side. These characters of the antennæ would almost justify the separation of this species into a distinct genus; but in other respects it agrees very well with the remaining two species of *Osphryon*.

Gnathonyx, gen. nov.

♂. Capite lato, magno; oculis supra distantibus; mandibulis sat magnis, valde curvatis, spatium transverse ellipticum circumscribentibus, a basi ad apicem gradatim acuminatis. Antennis medium elytrorum attingentibus, articulo primo brevi, crasso, tertio primo longitudine æquali, quarto quam tertio paullo breviore, quinto ad undecimum longitudine gradatim crescentibus. Prothorace transverso, quam capite vix latiore, margine laterali medio vix conspicua, antice posticeque sat distincta et dentata. Elytris parallelis, apicibus rotundatis. Prosterno dense punctato, processu intercoxali plano. Episternis metathoracis postice late truncatis. Tibiis anticis mediisque spinosis, femoribus omnibus subtus denticulatis. Segmentis 1° ad 4^{um} abdominis utrinque profunde foveatis; segmento 5° apice subrotundatis.

This genus is especially characterized by the strongly curved mandibles, destitute of teeth, simple at tip, and enclosing a transversely elliptical space, and by the large deep fovea on each side of each of the first four abdominal segments in the male. The presence of spines on the tibiæ and of similar but much smaller spines on the underside of the distal halves of the femora leads me to provisionally place it in the group of the Remphanides, though I believe that less

importance should be attached to this character than is given to it in Lacordaire's system.

Gnathonyx piceipennis, sp. n.

Niger; elytris piceo-fuscis, capite grosse confertimque punctato, occipite minute granulato; pronoto rude subreticulatim punctato, area mediana subcordata sparsim punctata, nitida; scutello nitido, impunctato, postice rotundato; elytris coriaceis; prosterno dense punctato; pedibus nigro-fuscis, sparsim punctatis; articulo primo antennarum dense punctato, tertio ad decimum sparse punctatis et subtus strigoso-opacis, undecimo omnino strigoso-opaco.
Long. 58, lat. 19 mm.

Hab. Doreh.

Analophus niger, sp. n.

♂. Niger; capitis fronte fortiter minus dense punctata, medio longitudinaliter sulcata, occipite dense confluenter punctato, interstitiis granuliformis; disco pronoti nigro-polito, sparse punctato, medio breviter sulcato et versus basin utrinque foveolato, lateribus subinæqualibus, fortiter densiusque punctatis, et ad angulos anticos confertissime sed minus fortiter punctatis; prosterno opaco, confertissime punctato; elytris nigris nitidis, sat dense punctatis et subcoriaceis, versus basin levioribus sparsiusque punctatis, apicibus rotundatis; pectore dense fulvo-villoso; abdomine pedibusque fusco-castaneis, nitidis, sparse punctatis.
Long. 28–30 mm.

Hab. Mount Arfak.

Head broad, with the eyes widely separated above; from the narrow transverse excavation at the base a very distinct median groove passes upwards for a short distance on the front, and is thence continued backwards as a narrower and less distinct impression. The punctures are less thickly placed on the front of the head, but are closely crowded and confluent on the sides and hinder part, so that the interspaces appear as small shining granules. The pronotum is slightly emarginate in front; its lateral edges are but slightly prominent as feeble carinæ, which are strongly deflexed towards the middle of their length; the central area of the disk is very glossy and but sparsely punctured, and bears a short median groove and two foveæ placed posteriorly one on each side; towards the sides the pronotum is somewhat uneven and is strongly and rather thickly punctured, while close to the anterior angles it is very closely but less strongly punctured, as is the whole surface of the prosternum. The elytra are rather thickly punctured and slightly coriaceous, except

towards the base, where they are smoother and more sparsely punctured; each bears three very feebly raised and indistinct lines.

This species is smaller and narrower than *A. parallelus*, Waterh., from which it may be easily distinguished by its colour, by the difference in the punctuation of the lateral parts of the pronotum, and the greater deflexion of the lateral ridge towards the outer angle of the anterior acetabulum.

Lamiidæ.

Haplohammus longipennis, sp. n.

Nigro-fuscus, pube grisea sat dense obtectus, capitis fronte verticeque sparse punctatis; prothoracis dorso subinæquali, medio sat dense punctato; elytris elongatis, dense punctatis, postice angustatis, apicibus late truncatis, extus valde spinosis.
Long. 27–36 mm.

Hab. Mount Arfak.

Dark brown, with a short close greyish pubescence. Head distinctly but rather sparsely punctured in front, and with a few sparsely scattered punctures on the upperside. Prothorax slightly uneven above, rather thickly punctured in the middle. Scutellum with a fulvous pubescence. Elytra elongated, thickly punctured, narrowing gradually behind, and each at the apex broadly truncate, with a strong spine at the outer angle. Antennæ in the male more than twice the length of the body, the scape rather strongly thickened towards the apex, where the cicatrice has a prominent rim on the anterior side, but no limiting edge on the posterior side; the third joint is twice as long as the first, the fourth shorter than the third.

Potemnemus tuberifer, sp. n.

Nigro-fuscus, pube brevi fulvo-brunnea obtectus; antennis basi pedibusque punctis nigris glabris dense maculatis; prothoracis dorso haud tuberculato, linea medio-longitudinali fulva, et ad medium maculam glabram circumscribente; elytris dorso planis, postice sat valde declivis, utrisque ad basin tubere magno rotundo dense nigro-granulato, instructis; lateribus verticalibus utrisque supra carinatis et spinoso-granulatis, apicibus oblique truncatis, extus spinosis, intus dentatis.
Long. 35 mm.

Hab. Mount Arfak.

This species may be easily distinguished from those of this genus hitherto described by the presence of a large rounded hump, thickly studded with black shining granules, at the

base of each elytron. It also departs somewhat from the characters of the more typical members of the genus in having the disk of the prothorax smooth; but in almost all its remaining characters, especially in the form of the elytra and the distribution of the spinous tubercles on the sides and disk of the elytra (the basal hump excepted), it has the closest relation with *P. scabrosus*, Oliv.

XXXII.—*Diagnosis of a new* Pteropus *from the Admiralty Islands.* By Oldfield Thomas.

Pteropus admiralitatum, sp. n.

Most closely allied to *Pt. hypomelanus*, Temm., but distinguished by its smaller size, much smaller ears, uniformly coloured chest and abdomen, and woollier fur; crown pale grey ("olive grey" of Ridgway *); nape fulvous ("cinnamon"); back brown ("Prout's brown"), mixed with whitish. Below, the neck shows an indistinct fulvous collar; but all the rest of the under surface, the chin, throat, abdomen, and the sides of body are a uniform brown (between "sepia" and "clove-brown"), thickly mixed with silvery white or yellowish hairs. In *Pt. hypomelanus* the centre of the abdomen is always lighter than the sides of the body.

Skull and teeth as in *Pt. hypomelanus*, except for their smaller size.

Dimensions of the type (skin B.M. 80. 11. 24. 4) :—

Head and body (c.) 180 millim.; forearm 121 (=4·75 in.); ear 17·5.

The ear of a spirit-specimen measures 19 millim. (from notch); and the forearms of the three other specimens in the collection are 126, 120, and 118 respectively in length.

Hab. Admiralty Islands. Coll. H.M.S. 'Challenger.'

Four specimens of this species were obtained in March 1875.

* 'Nomenclature of Colours,' 1886. The extreme difficulty of matching the uniform colours of a colour-plate and the grizzled and broken colours of an animal are so great that these determinations must be looked upon as merely approximate; but it would nevertheless be of great help to other workers if all describers would use some such standard of colours as is provided by Ridgway's valuable work.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

January 10, 1894.—W. H. Hudleston, Esq., M.A., F.R.S., President, in the Chair.

The following communication was read:—

'On the Rhætic and some Liassic Ostracoda of Britain.' By Prof. T. Rupert Jones, F.R.S., F.G.S.

In this paper the published observations on the occurrence of these Microzoa in the Rhætic and Lower Liassic strata of England, chiefly in Gloucestershire and Somerset, by the Rev. P. B. Brodie, H. E. Strickland, C. Moore, and others, are first of all recorded; and the various notices of the so-called '*Cypris liassica*' in various palæontological works are considered. Numerous specimens submitted by the Rev. P. B. Brodie, the Rev. H. H. Winwood, and Mr. E. Wilson, and some few examined in the Geological Society's collection, have been studied, with the result of determining, it is hoped satisfactorily, the characters and alliances of *Darwinula liassica* (Brodie) and of six or seven other species found in the same and the associated series of strata. The *Darwinula globosa* (Duff), from Linksfield, Morayshire, is also critically re-examined as one of this interesting series of Rhætic Ostracoda. The other species belong for the most part to *Cytheridea*; thus most of them probably lived in brackish or estuarine waters.

January 24, 1894.—W. H. Hudleston, Esq., M.A., F.R.S., President, in the Chair.

The following communications were read:—

1 'The Ossiferous Fissures in the Valley of the Shode, near Ightham, Kent.' By W. J. Lewis Abbott, Esq., F.G.S.

The fissures occur in a promontory of Kentish Rag between two tributaries of the Shode. There are four fissures in this promontory, striking at right angles to the valley. Details of the physiography of the area in which the fissures occur are given in the paper. Three of the fissures have obviously been in contact with the surface, and from these the bones appear to have been dissolved out. The fourth does not reach the top of the Rag, and further is sealed by an aragonite-lined chamber with stalactitic floor and ceiling. This fissure is from 2 to 6 feet wide and about 80 feet deep, and is filled with a heterogeneous collection such as constitutes the flotsam and jetsam of streams, along with materials derived from the rock in which the fissures occur. Several thousand bones were found, also 12 species of aquatic and land shells, an entomostracan, *Chara* and other vegetable remains have been procured.

The Author gives reasons for concluding that the fissures have

never been reopened since they were first closed by the materials introduced into them by the river, and that all the contained fossils belong to one and the same geological period. He points to the discovery of species not before found in Pleistocene beds as only a repetition of what has occurred in other sections he has worked, and remarks also that the increase of species is corroborative of a suggestion of Mr. C. Reid that the more we discover of the smaller creatures of this and the preceding age, the more they approximate to those of our own times. Even if we were to exclude from the lists all the species not previously found fossil elsewhere, we still have an extensive assemblage of the older Pleistocene forms, which must have lived during the filling of the fissures, and this therefore fixes the filling operation as having occurred in Pleistocene times.

2. 'The Vertebrate Fauna collected by Mr. Lewis Abbott from the Fissure near Ightham, Kent.' By E. T. Newton, Esq., F.R.S., F.G.S.

The vertebrate remains collected by Mr. Lewis Abbott are passed in review, and as far as possible specifically identified: they represent mammals, birds, reptiles, and amphibians; but no fishes have been found. In all, 48 different forms have been recognized; 3 or perhaps 4 are extinct; 11 are extinct in Britain, but are still living elsewhere; 21 are living in Britain, but are known to be Pleistocene or Forest-bed forms; and 12 are species now living in Britain which have not hitherto been recognized in Pleistocene or older deposits.

Among the more important species found in this fissure, but extinct in Britain, may be noticed, besides *Elephas primigenius*, *Rhinoceros antiquitatis*, and *Hyæna*, the *Ursus arctos*, *Canis lagopus*, *Myodes torquatus*, *Myodes lemmus*, *Microtus gregalis*, *M. ratticeps*, *Lagomys pusillus*, *Spermophilus*, and *Cervus tarandus*. The name of *Mustela robusta* is proposed for some limb-bones intermediate between the Polecat and Marten, and the remains of an extremely small Weasel are noticed as a variety of *Mustela vulgaris*. Although the large number of living species gives a recent aspect to this series of remains, the evidence, it is believed, points rather to their being all of Pleistocene age, and most nearly allied to the fauna of British caves.

MISCELLANEOUS.

On the Embryology of the Cumacea.

By P. Butschinsky, of the University of Odessa.

The segmentation of the ova in *Iphinoë maotica*, Sowin., is of the centro-lecithal type. All the segmentation-nuclei, which in the centre of the ovum are surrounded by radiating aggregations of

protoplasm, travel towards the surface, and a uniform blastoderm is finally constituted *.

The rudiment of the future germinal streak now becomes recognizable on the ventral surface of the ovum in the shape of a thickening of the blastoderm, and three separate thickenings may be remarked in the extent of this rudiment; these are the paired anterior optic lobes and an unpaired posterior thickening, which gives rise by the process of multiplication to a large number of cells (meso-endoderm). This internal mass of cells becomes further differentiated into three rudiments:—(1) The yolk-cells, which migrate into the yolk, (2) the endoderm- and (3) the mesoderm-cells.

The proctodæum is formed earlier than the rudiment of the stomodæum and has the appearance of a very long tube. Both of these structures originate as invaginations of the ectoderm. The mid-gut is built up from the cell-material of the endoderm. As the cells of the endoderm multiply they arrange themselves so as to form an epithelium. The liver develops very early on the ventral surface of the endodermal furrow, and forms in the anterior portion of the latter two lateral tubes, which are composed of large cells. These rudiments are paired and present the appearance of folds, which are open upon the dorsal side; their edges grow together, and two hepatic sacs are formed from them, each of which becomes divided into two secondary hepatic sacs in consequence of a longitudinal invagination.

The entire central nervous system originates as a thickening of the ectoderm at the period of the formation of the anterior appendages. In the early stages it takes the shape of paired ectodermal thickenings; these gradually coalesce and give rise to an unpaired cord, from which the 18–19 ganglia are subsequently formed.

The unpaired eye develops from two separate thickenings of the hypodermis of the foremost optic lobes, and undergoes a complicated metamorphosis.

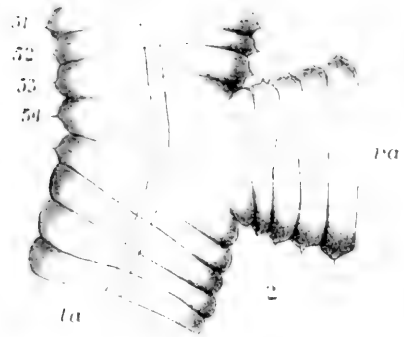
The earliest rudiment of the heart takes the shape of a compact collection of mesoderm-cells on the dorsal side, in which the cavity subsequently appears.

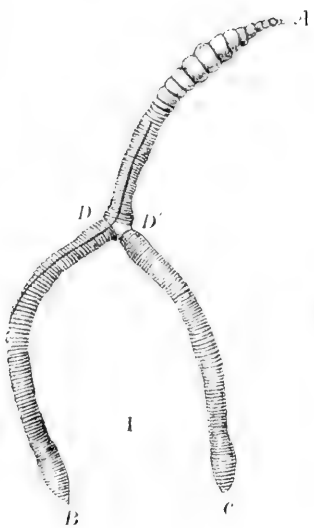
The genital organs also develop at the same time; these appear as a paired mesodermal rudiment situated above the intestinal canal.

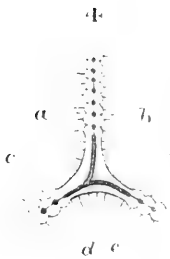
The dorsal organ arises very early on the dorsal side as an oval aggregation of ectoderm-cells; it persists for a long time, and disappears after all the organs of the animal are formed.

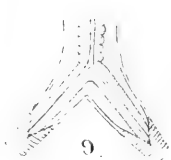
A complete memoir of mine upon the embryology of the Cumacea, accompanied by three plates, will be published in the 'Mémoires de la Société des Naturalistes de la Nouvelle-Russie à Odessa.'—*Zoologischer Anzeiger*, xvi. Jahrg., no. 430, October 2, 1893, pp. 386, 387.

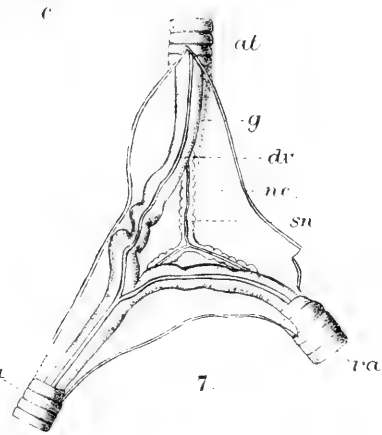
* I observed this in *Parapodopsis cornuta* and *Gebia litoralis*.











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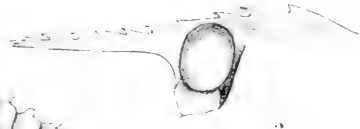

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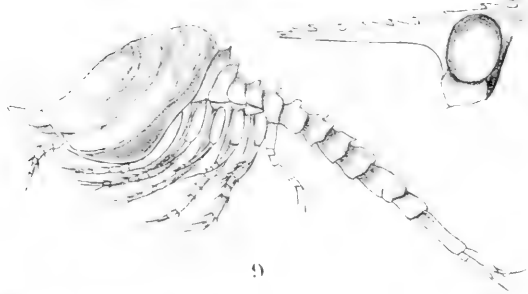

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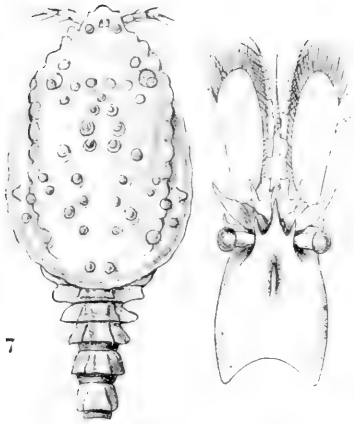

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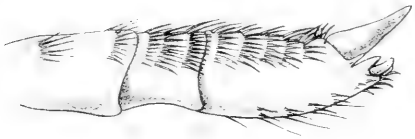

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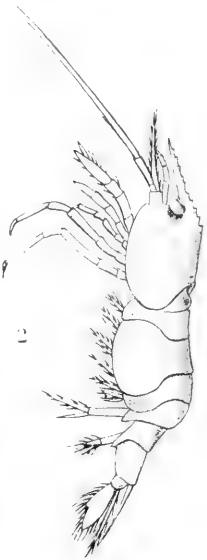

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A. Scott del.

Mintern Bros. lith.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 76. APRIL 1894.

XXXIII.—*A Contribution to the Osteology of the Head of* Hatteria*. By Friedrich Siebenrock, Assistant in the Imperial and Royal Natural History Museum in Vienna.

[Plate XIV.]

The present memoir contains a precise description of the interorbital septum, the anterior cartilagino-membranous cranial wall, and of the paroccipital, which is present in *Hatteria* alone among Saurians.

In addition to this there follows a detailed account of the several cranial bones, especially with reference to the bony auditory structures contained within them. These are distinguished by the presence of the fossa cochlearis of the basi-occipital, the junction of the orificium ampullæ canalis semicircularis frontalis and the orificium canalis semicircularis horizontalis in the posterior ampullary chamber of the paroccipital, the absence of the foramen nervi acustici, ramus cochlearis, the absence of the foramen canalis Vidiani anterius in the fossa hypophyseos, and by the remarkable structure of the superior margins of the paroccipital and of the otosphenoid.

Finally, it will be shown that the parietal is paired even

* Translated from the 'Sitzungsberichten der kaiserl. Akademie der Wissenschaften in Wien, Mathem.-naturw. Classe,' Bd. cii. Abth. i., June 1893, pp. 250–268: from a separate impression, communicated by the Author.

in the adult, a point which was hitherto in doubt; while there will also be appended further communications upon the subject of the dentition of the vomer.

I.

The **interorbital septum** and the **anterior cranial wall** of *Hatteria* were represented by Günther* and Brühl† as homogeneous cartilaginous structures, without further allusion being made to them in the text of their papers. If, however, these parts be examined more closely in a carefully prepared *Hatteria*-head, it is found that neither the interorbital septum nor the anterior cranial wall are uniformly developed, but that in both cartilaginous structures occur, just as they are met with in the majority of Saurians with a distinct interorbital septum.

In the interorbital septum of *Hatteria* the anterior and upper edges are sinuous, while the lower one is straight. The posterior edge is notched and forms the anterior boundary of the optic foramen. In the majority of lizards the interorbital septum is membranous, and in it is embedded the cartilaginous plate which has developed from the two lower trabeculæ ("unteren Schädelbalken"). In *Hatteria*, however, the entire interorbital septum is cartilaginous, with the exception of an oval fenestra at the upper margin, which is covered by a membrane. But since the cartilaginous plate in the interorbital septum in the case of the other lizards represents the presphenoid, in *Hatteria* the entire interorbital septum must receive the same interpretation.

A much greater degree of complication is presented by the cartilaginous structures in the anterior cranial wall, with regard to which Günther writes (*loc. cit.* p. 5):—"A crescentic space between alisphenoid and columella remains cartilaginous; and the fore part of the cranial cavity is closed by fibro-cartilaginous membrane without a trace of ossification." It is perfectly correct that a bony orbitosphenoid is not present in *Hatteria*, but in its stead we find a cartilaginous one, which exhibits the same arrangement as in all other lizards. It is remarked by Baur‡, in a note upon *Sphenodon—Hatteria*, that the alisphenoid-orbitosphenoid is

* A. Günther, "A Contribution to the Anatomy of *Hatteria*," Phil. Trans. Roy. Soc. Lond. 1867.

† C. B. Brühl, 'Zootomie aller Thierclassen,' Taf. 148 and 149, with explanation.

‡ G. Baur, "Osteologische Notizen über Reptilien (Fortsetzung vi.)," Zool. Anzeiger, xii. Jahrg., 1889, p. 45.

cartilaginous and is closely applied to the epipterygoid-columella, but no further details are given. The presence of an orbitosphenoid in *Hatteria* is likewise pointed out by Cope *, though it would follow from the author's statement that the structure in question is bony and not cartilaginous: for upon page 189 he writes that in the membranous cranial wall in lizards an ossification occurs, upon which he bestows the provisional designation "postoptic," and does not term it the alisphenoid, like Parker, since, according to his view, the epipterygoid-columella is the real alisphenoid. Coming to *Hatteria*, he then proceeds to say:—"In the Rhynchocephalian genus *Sphenodon* these two elements [*i. e.* the postoptic and epipterygoid] coexist with an orbitosphenoid, lying between the optic and trigeminal foramina. The two together may be homologous with the mammalian alisphenoid." I am not of this opinion, since the orbitosphenoid is in the case of *Hatteria* precisely as in that of the other lizards, if it occurs at all, without any connexion with the epipterygoid-columella, and remains in a cartilaginous state throughout life. It is semilunar in shape, and forms with the posterior notched edge of the presphenoid, with which it is united above and below, an oval hole, the optic foramen, for the exit of the optic nerve.

From the upper third of the posterior edge of the orbitosphenoid a stout cartilaginous process projects backwards and somewhat upwards, and then divides into two thinner rami. Of these the uppermost and shorter has an anterior and upward direction; it runs to the first postfrontal and unites with the upper trabecula. The lower and considerably longer ramus trends downwards and backwards, and runs almost parallel with the lower portion of the cartilaginous orbitosphenoid; it unites with the processus anterior inferior of the otosphenoid and with the processus alaris of the basisphenoid.

It follows from what has just been stated that the orbitosphenoid is not embedded in the anterior cranial wall in complete isolation, but is in intimate connexion with the bony sphenoid group and with the roofing bones of the head.

The anterior cranial wall, which is cartilaginous in *Hatteria*, is fixed to the crista cranii frontalis, and passes forwards in the shape of a narrower canal to the olfactory cavity; where, however, it expands once more in an aliform manner, since it reaches down on each side on the inner edge of the prefrontal as far as the anterior extremity of the palatine, and thus forms the optic-nasal septum. The groove itself

* E. Cope, "The Osteology of the Lacertilia" (reprinted May 10, 1892, from Proc. Amer. Phil. Soc. vol. xxx.).

serves for the reception of the olfactory nerves, and consists in *Hatteria* of tough cartilaginous tissue, while in the majority of lizards it merely remains in a membranous condition.

II.

The **bony cranium** consists, as in all lizards, of the occipital and sphenoid groups of bones. The latter [*sic*!—former?], again, is composed of the basioccipital, supraoccipital, and the two pleuroccipitals which lie between these. All four occipitals enclose the occipital foramen, an oval aperture with a greater vertical than transverse diameter, on the lower circumference of which the unusually large occipital condyle is developed as a semilunar tubercle. In *Hatteria* this is formed in a conspicuous degree from the basioccipital, while the two pleuroccipitals take a much smaller share in it, in contrary fashion therefore to what we find in the chamæleons, in which the partes condyloideæ of the pleuroccipitals are much larger than the pars condyloidea of the basioccipital. In adult individuals the four occipital elements are indistinguishably fused together, while in specimens which are still young they remain separated by sutures, precisely as in the case of the rest of the Lacertilia. Now in young specimens we find that the pleuroccipital is composed of two bones, which are separated one from another by a suture. The one bone with its pars condyloidea is connected in the shape of a semicircle with the basioccipital below, constitutes the lateral margin of the occipital foramen, and unites above with the supraoccipital. From the middle of its external circumference a short pointed process projects almost horizontally outwards. This bone is manifestly, according to position and function, the pleuroccipital—exoccipital of Owen and Huxley. Before this there lies a bone, which unites with the otosphenoid in front, with the supraoccipital above, and with the basioccipital below. Its posterior surface is convex and its anterior concave, with which it forms the posterior wall of the bony labyrinth. The processus paroticus projects outwards and backwards. I consider this bone as the paroccipital, exoccipital of Brühl, and opisthotic of English authors. Günther also describes (*loc. cit.*) a paroccipital, which, however, cannot be quite identical with that discovered by me. According to this author the paroccipital is superimposed upon the processus paroticus merely in order to strengthen it, without taking part in the formation of the auditory apparatus. Günther writes:—"It [namely the processus paroticus] is strengthened by a paroccipital, which covers nearly

the entire side of the process and is united with the occipital part by only partly distinct sutures." The paroccipital described by me forms the posterior wall of the labyrinth and sends the processus paroticus outwards. It is consequently a bone of considerable importance, separated by a suture from the pleuroccipital. Only on the posterior surface of the paroccipital does the suture between it and the pleuroccipital remain indistinct at a spot which is of quite small extent, so that here the two bones appear to be united by synostosis. It may be that the specimens which I examined were not sufficiently young in order to show the complete separation of the bones in question. I was able, nevertheless, in the crania of three individuals to perceive distinctly the suture between paroccipital and pleuroccipital, which separates the two bones one from another with the exception of a small space, so that the possibility of a merely individual separation of these two bones seems to be excluded.

I imagine that Günther probably identified the paroccipital correctly, but the sutures in the specimen investigated by him were no longer sufficiently distinct to enable him to recognize the precise limits of the bone in question. He says, moreover, in a note (*loc. cit.* p. 2):—"The sutures between these bones [namely between supraoccipital and exoccipital] are so indistinct that they could not be represented in the drawing." It is the more remarkable that Brühl (*loc. cit.*) did not perceive the division between the paroccipital and pleuroccipital, since nevertheless he figures and describes the head of a young individual in which all the sutures between the several bones of the occipital and sphenoid groups were still distinctly visible. He assumes an attitude of vigorous opposition to Günther's alleged paroccipital:—"The pleuroccipital . . . . . is, as I must maintain in opposition to an absolutely incorrect statement on the part of Günther (*loc. cit.* p. 596), the only lateral element of the occipital segment in *Hatteria*; no other element, no exoccipital [*mihi*, paroc., *Owen*, opisth. of English authors] exists at all. Günther's statement that a paroccipital of Owen [exoccipital, *mihi*] is to be found in *Hatteria* is based upon an extremely superficial inspection, erroneously conducted upon entire preparations (!), which, however, was not supported by any more precise investigation (disarticulation! the only anatomical method which is here conclusive)." As is evident from my description, Brühl was entirely in the wrong in disputing Günther's statement; the paroccipital is present in young individuals, so that consequently *Hatteria*, like the Chelonians, exhibits six occipital elements, namely:—1 basioccipital, 1 supraoccipital,

2 pleuroccipitals, and 2 paroccipitals. On account of this remarkable fact *Hatteria* approaches the Chelonians and recedes further from the Lacertilians.

It may not be without interest to give a separate representation and description of the individual bones of the cranium of *Hatteria*, specially with a view to the acquisition of a more precise knowledge of the bony auditory structures contained within them. Günther (*loc. cit.*) did not figure the cranium or its individual bones, and Brühl, although he gave a representation of the cranium from below and behind, paid less attention to the auditory apparatus than to the demonstration of the absence of a paroccipital as alleged to exist by Günther.

The **basioccipital** is an almost quadrangular and somewhat bulky bone. Its upper surface is concave, while its under convex surface is swollen at the two lateral margins and with the basisphenoid forms the two very powerfully developed tubercula sphenooccipitalia. These are always characterized by an epiphysis.

Behind the tubercula sphenooccipitalia lies the very large pars condyloidea, which forms the posterior border of the basioccipital, at the two angles of which are situated the points of attachment for the pleuroccipitals. The anterior border is almost straight; it serves to unite the bone with the basisphenoid, which, with its two posterior processes, which are separated by a triangular notch, lies upon the under surface of the basioccipital and reaches to the tubercula sphenooccipitalia. In this manner there arises in relief upon the under surface of the basioccipital a triangular protuberance. The two lateral borders of the basioccipital unite posteriorly at the pars condyloidea with the pleuroccipitals, in the middle and anteriorly with the paroccipital and the otosphenoid. Each lateral border of the basioccipital exhibits indeed in front of the pars condyloidea a somewhat deep indentation, the incisura venæ jugularis, which, with a similar indentation constituted by the paroccipital and pleuroccipital, is completed to form the foramen jugulare. In front of this incisura venæ jugularis the lateral border towards the anterior angle is transformed into a deep pit, the posterior margin of which unites with the paroccipital and the anterior with the basisphenoid, while its outer and inner margins serve to support the membranes which fill up the space between the three bones already mentioned and the otosphenoid. This pit closes the bony cochlea below. It was shown by me that it also occurs in *Brookesia superciliaris**, where I designated it the fossa cochlearis. It has an oblique situation in a

* F. Siebenrock, "Das Skelet von *Brookesia superciliaris*, Kuhl,"

direction from outside inwards, and to its lower circumference is attached the tuberculum sphenooccipitale.

The **pleuroccipital**, which in young individuals is separated by a suture from the paroccipital, constitutes a simple bony arch. Its lower end is swollen to form the pars condyloidea, while the upper shovel-shaped end runs out into two pointed processes; by means of these it is attached to the hinder surface of the paroccipital and to the supraoccipital. The inner margin of the arch forms the lateral boundary of the occipital foramen, from which the paroccipital is entirely excluded. The external margin of the arch, which is much shorter than the internal one, forms the upper and posterior limit of the foramen jugulare, and contains from above downwards the foramen nervi hypoglossi, the foramen nervi vagi, and the foramen nervi glossopharyngei. The last two nerve-exits are frequently united into one externally, but internally they always remain separate.

In the representation of the occipital region of a young *Hatteria* Fritsch * has figured the pleuroccipitals alone as the lateral limiting bones of the foramen occipitale, but he adds no explanation as to whether in his specimen the pleuroccipitals were separated from the paroccipitals, or whether he had omitted the latter merely for the sake of simplifying the figure. Otherwise the outlines of the pleuroccipitals as reproduced by this author are perfectly true to nature.

The **supraoccipital** is an unusually broad bony arch, which extends from the occipital foramen as far as the anterior end of the processus anterior superior of the otosphenoid. Upon the upper curved surface there arises in a sagittal direction a low crest, the crista occipitalis, which produces the immovable connexion with the parietal. Underneath the supraoccipital constitutes a sagittal groove, which at its hinder end is contracted by the inner walls of the vestibular portion and at the lower margin of which in front lies the orificium externum of the aqueductus vestibuli. The posterior border has a semicircular excavation and forms the upper boundary of the occipital foramen. The two posterior and obliquely truncated angles are expanded in the shape of hollows, and constitute on each side the roof of the vestibular chamber; they unite with the pleuroccipital and paroccipital. The lateral borders come into contact with the otosphenoids, while the free anterior margin exhibits three projections, produced by two indenta-

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Sitzgsber. k. Akad. Wiss. Wien, Math.-naturw. Classe, Bd. cii. Abth. i., 1893, p. 76.

* Dr. A. Fritsch, "Fauna der Gaskohle und der Kalksteine der Permformation Böhmens," Bd. 2, Prag, 1889, p. 58.

tions. On the inner wall of the roof of the vestibular portion lies the inosculation of the commissure of the canalis semicircularis frontalis and the canalis semicircularis sagittalis, and in front of this at the lower margin of the inner wall the orificium internum of the aqueductus vestibuli. At the upper external margin of the vestibular portion the foramen canalis semicircularis frontalis is visible, while the foramen canalis semicircularis sagittalis lies away towards the middle of the lateral border of the supraoccipital at a distance from the vestibular portion. This aperture is otherwise usually found in lizards at the anterior circumference of the vestibular portion. On the upper surface of the supraoccipital neither canal is noticeably visible; the sagittal canal stands out on the inner surface pretty distinctly.

The **paroccipital**, which in young individuals constitutes an independent bone, has some similarity to a spoon, for it is strongly arched and sends off outwards a long process, the processus paroticus. The paroccipital forms the posterior wall of the bony labyrinth, and unites with the otosphenoid in front, with the supraoccipital above, and with the basioccipital below. To the posterior wall is attached the upper end of the pleuroccipital, while the lower end of this, which as pars condyloidea unites with the basioccipital, forms with the posterior wall of the paroccipital the incisura venæ jugularis and is completed with the basioccipital to form the foramen jugulare. From the anterior external border, which is excavated in the shape of a semicircle and forms the incisura foraminis vestibuli, arises the processus paroticus. This is long, strongly compressed, hollowed out in the shape of a groove in front for the accommodation of the columella auris, and directed horizontally and somewhat backwards. The anterior excavated surface of the paroccipital forms the hinder portion of the vestibulum. It is divided into the outer portion, which extends in the shape of a crescent from above downwards, and the inner, smaller, but very deep portion, the posterior ampullary chamber, which forms an oval pit and at the bottom contains two holes, the orificium ampullæ canalis semicircularis frontalis above and more towards the rear, and the orificium canalis semicircularis horizontalis below and more towards the front. The vestibulum in *Hatteria* consequently possesses one hole less than in the majority of lizards, in which the two orifices just mentioned, divided by a septum, open into the vestibulum, while in *Hatteria* they fuse together into one large oval hole. At the upper margin of the vestibular cavity, to which the supraoccipital is attached behind and the otosphenoid in front, we find posteriorly the foramen

canalis semicircularis frontalis and anteriorly the foramen canalis semicircularis horizontalis.

These two foramina are connected together by a cleft or fissura (Pl. XIV. fig. 5, *x*), which divides the upper margin longitudinally into an upper and lower half. The cleft at this spot has arisen through the approximation of the outer and inner lamellæ of the vestibular wall. In addition to this the long transverse cleft in front of the foramen canalis semicircularis frontalis is also connected by a short cleft, running at right angles to it, with the oval pit, the inosculation of the orificium ampullæ canalis semicircularis frontalis and the orificium canalis semicircularis horizontalis. In no other living lizard is this remarkable phenomenon to be observed. The lower border of the paroccipital exhibits externally an aliform prolongation, and appears, with its lower portion at least, to form the posterior wall of the cochlea, which is bounded below by the very strongly developed fossa cochlearis of the basioccipital, while externally it is enclosed by the cartilaginous plate which extends between the paroccipital, otosphenoid, and basioccipital.

The **basisphenoid** consists of the body, which constitutes a trapeziform plate of bone, and of the two alary processes. The upper concave surface exhibits a median division into two halves by means of a sagittal furrow. This was previously remarked by Baur, who expressed the conjecture (*loc. cit.*) that the basisphenoid arises from two lateral halves. On both sides of this furrow in the anterior third lie two foramina, the orifices of two short canals for branches of the internal carotid. The straight posterior border of the basisphenoid unites with the anterior border of the basioccipital. Beneath it there project backwards two triangular processes, which attach themselves to the under surface of the basioccipital and with their ends help to form the tubercula sphenooccipitalia. The anterior border, which as dorsum ephippii overhangs the fossa hypophyseos, is deeply indented, so that its two angles become transformed into the processus alares. The two lateral borders converge towards the front and serve to connect the bone with the otosphenoids.

From the anterior portion of the under surface of the basisphenoid arise the processus pterygoidei. They are moderately long, inclined somewhat forwards, and diverging at the ends, on the outer sides of which lie the articular surfaces for connexion with the pterygoids.

Between the processus pterygoidei arise the fairly long cylindrical processes for the inferior trabeculæ; they are separated by a furrow, which ends posteriorly in the shape of

a pit. In the latter lies on both sides the foramen caroticum internum. The cylindrical processes form the floor of the fossa hypophyseos, in the roof of which on each side, consequently at the base of the processus alares, is situated the foramen for a branch of the internal carotid, which opens into the cranial cavity on the upper surface of the basisphenoid by the hole already mentioned. On the under surface of the basisphenoid between the processus pterygoidei arises the parasphenoid; this extends forwards below the cylindrical processes as a narrow dagger-like bone. Its free portion is somewhat longer than the body of the basisphenoid. Fritsch (*loc. cit.*) and Baur (*loc. cit.*) have expressed the conjecture that the parasphenoid, forming the entire under portion of the basisphenoid together with the processes which project backwards, in very young individuals admits of being separated from the basisphenoid as an independent bone, I thoroughly concur in this view, since on the underside of the basisphenoid it is possible to trace almost the entire outline of the parasphenoid; only, in my opinion, Fritsch is mistaken in believing that the processes for attachment to the pterygoids also belong to the parasphenoid. It has been shown by Parker* that the basisphenoid is formed by the union of three ossifications, the lateral ones of which are the processus pterygoidei. Moreover the parasphenoidal plate is separated from the base of the processus pterygoideus by a cleft, so that as a matter of fact no connexion exists between the bony parts in question. In this cleft lies the posterior foramen caroticum internum.

In the lizards we find in the fossa hypophyseos three pairs of apertures: in front on both sides of the cylindrical processes the foramen canalis Vidiani anterius, behind at the bottom of the fossa the foramen caroticum internum, and at the side and above the foramen for a branch of the internal carotid. *Hatteria*, however, like the Chelonians, possesses only two pairs of apertures in the fossa hypophyseos, since the foramen canalis Vidiani anterius is absent. Here we have a further character in which *Hatteria* recedes from the lizards and approaches the Chelonians in the structure of the head.

The **otosphenoid** is a quadrangular bone, the upper angles and the inferior anterior angle of which are produced into processes, while the inferior posterior angle remains blunt. The upper border unites with the supraoccipital; its posterior end is produced into a moderately long, triangular, pointed process, the processus posterior, which is applied like a scale

* W. K. Parker and G. J. Bettany, 'The Morphology of the Skull' (London, 1877): German translation by B. Vetter, 1879.

to the anterior surface of the processus paroticus, and forms the upper margin of the sulcus columellæ auditus.

The anterior end of the upper border is likewise produced into a process, the processus anterior superior, which in the other lizards remains very short and serves for the attachment of the upper trabecula.

The lower border unites with the basisphenoid; its anterior end is elongated in the shape of a shovel and forms the processus anterior inferior, which is united with the processus alaris of the basisphenoid. The anterior end of the bone serves for the attachment of the lower cartilaginous branch of the orbitosphenoid. The posterior truncated end of the lower border unites with the plate of cartilage which extends between the otosphenoid, basisphenoid, paroccipital, and basioccipital. The posterior free border of the otosphenoid, together with the paroccipital, encloses the very large foramen vestibuli seu ovale. On the anterior free border we find a crest which is quite small, indicating the ala otosphenoidea, below which is situated the incisura otosphenoidea for the exit of the fifth nerve (trigeminus).

The external surface of the otosphenoid is strongly convex. Upon it may be seen standing out in relief in front and above the canalis semicircularis sagittalis running towards the middle, and the canalis semicircularis horizontalis running in the same direction from the base of the processus posterior superior. Towards the lower border, behind the origin of the processus anterior inferior, we find an indication of a very short crista otosphenoidea, behind which lies the foramen nervis facialis.

The inner surface forms the anterior vestibular cavity, and for this purpose is strongly excavated. It consists of the posterior portion, the actual vestibulum, and of the anterior, much smaller, but very deep portion, the anterior ampullary cavity. Into this there opens quite at the bottom, as a transversely oval hole, the orificium ampullæ canalis semicircularis sagittalis, the orificium ampullæ canalis semicircularis horizontalis above, and below, the oval foramen nervi acustici. A distinct crista cochlearis separates the vestibulum from the semicanalis seu canalis lymphaticus which lies below it, and which does not run horizontally as in the other lizards, but obliquely downwards and backwards from in front and above. This forms the upper portion of the cochlea, the outer and inner walls of which are constituted by the two plates of cartilage, which fill up externally and internally the gaps between the occipital and sphenoid bones, as we find is similarly the case in the Chelonians. Of the foramen nervi

acustici for the ramus cochlearis, which in the other lizards leads into the cochlea, we find no trace whatever in *Hatteria*. On the upper border of the otosphenoid are situated two holes, the foramen canalis semicircularis sagittalis in front and the foramen canalis semicircularis horizontalis behind at the base of the processus posterior. In this case the two holes themselves are not connected by a cleft, as we find them to be in the paroccipital, but each hole (Pl. XIV. fig. 10, x' and x'') is in connexion with the anterior ampullary cavity, so that it looks as if the holes and their canals have arisen as a result of the laying together piece by piece of the walls of the vestibulum, a condition which is seen in *Hatteria* alone, as was pointed out above in the case of the paroccipital.

On the inside of the otosphenoid, behind the incisura otosphenoidea and in front of the anterior vestibular wall, lies an oval pit, which contains the foramen nervi acustici above and the much smaller foramen nervi facialis below.

I have observed in many lizard skulls that the basioccipital remains longest separate from the rest of the occipital bones.

In *Hatteria* the converse appears to be the case, for here the basioccipital is always already united by synostosis with the two pleuroccipitals, when the remaining bones are still distinctly divided by sutures.

In the case of the sphenoid bones at first merely the processus anterior inferior of the otosphenoid coalesces with the processus alaris of the basisphenoid, while the two bones behind the crista otosphenoidea still continue separated by a distinct suture.

III.

The **parietal** of *Hatteria* is described by Günther (*loc. cit.* p. 2) as follows:—"The parietal bone is very narrow and elevated into a strong mesial crest, which, although appearing simple in an individual of advanced age, evidently consisted of two lateral halves in youth," &c. In opposition to this Brühl writes (*loc. cit.*):—"The parietal, which even in younger skulls already appears unpaired, although it may well be paired in the embryo," &c. Five *Hatteria* skulls disarticulated by me have yielded the result that the parietal remains paired not merely in youth, but throughout life. In the case of a skull, too, in which all the sutures of the bony cranium had already completely disappeared, a proof that the specimen was certainly already adult, the parietal fell of itself into two halves after careful maceration. These are united in *Hatteria* by synchondrosis, and not, as in the Asca-

labota, by a simple suture. The inner surfaces, which are elevated into the paired crest, are very broad, but perfectly flat, and are firmly united together by the cartilaginous tissue which is embedded between them. The large parietal foramen, which is always of an oval shape, is in all the nine *Hatteria* skulls which I have examined formed by the two halves of the parietal alone, and the frontals contribute in not the slightest degree to its limitation. The processus parietales are fairly long, it is true, but do not reach the processus parotieus of the parietal any more than in the case of the majority of lizards, but attach themselves to the outer and inner surface of the superior posterior process of the supratemporal. Each processus parietalis is indeed divided into a longer posterior and a shorter anterior lamina, between which the lower border of the posterior superior process of the supratemporal is wedged in.

IV.

The Vomer.—Baur* was the first to announce the interesting fact that he had found in a young *Hatteria* a distinctly developed tooth in the centre of each half of the vomer. A communication was subsequently published by Howes† as to further cases of the dentition of the vomer in *Hatteria*. Out of nine specimens he found that the vomer was toothed in four cases, while five were toothless. Of the former, three possessed a tooth on each half of the vomer, while in the case of the fourth specimen a tooth was developed upon the right half of the vomer alone. These teeth, however, had not broken through the mucous membrane of the palate, as Howes was able to convince himself in the case of two individuals, but their tips were covered by it, so that they were not visible in the cavity of the mouth:—"its apex was exposed, but it could not in any sense be said to project into the cavity of the mouth." And with regard to the second example he writes:—"In the other specimen the insignificant vestiges of the teeth, which were present, lay wholly beneath the mucous membrane, which completely covered their apices."

Among the nine *Hatteria* skulls examined by me I found teeth upon the vomer in only one, while the remaining eight exhibit no trace of such a dentition. In the toothed specimen the right half of the vomer possesses two teeth, the left, on

* G. Baur, "Osteologische Notizen über Reptilien, I. Rhynchocephalia," Zool. Anzeiger, ix. Jahrg., 1886, p. 685.

† G. B. Howes, Proc. Zool. Soc. Lond. 1890, part iii. p. 358.

the contrary, only one tooth, but the spot where a second was situated can still be distinctly seen. The teeth are fairly long, with conical points, covered with enamel, and with the tips of a dark colour and curved inwards. The dark colour of their tips, apart from the considerable length of the teeth themselves, allows us to conclude that they had broken through the mucous membrane of the palate and projected into the cavity of the mouth.

It is certainly very remarkable that relatively few specimens possess the vomerine teeth. Baur (*loc. cit.*) has expressed the conjecture that they only exist in young specimens and disappear in old age. Howes, however, has observed the vomerine teeth in an old specimen—"in a senile old male"—and, further, found that all the four individuals which possessed these teeth were demonstrably males. This last observation appears not to be without interest, and there is perhaps more probability in the idea that only the males possess the vomerine teeth than in Baur's conjecture that they are only present during youth. In two of the specimens which I examined I found no trace of teeth upon the vomer, although, to judge by their size and the separation of all their cranial bones, they were still fairly young, while another, adult, individual possessed the vomerine teeth in the manner already stated. Unfortunately I was unable to determine the sex of this specimen, since the internal organs were missing.

EXPLANATION OF PLATE XIV.

Fig. 1. Vomer from below.
Fig. 2. Interorbital septum and anterior cranial wall.
Fig. 3. Bony cranium from behind, with the omission of the right paroccipital.
Fig. 4. Supraoccipital from below.
Fig. 5. Right paroccipital from in front and within.
Fig. 6. Basisphenoid from in front.
Fig. 7. Basisphenoid from above.
Fig. 8. Basisphenoid from below.
Fig. 9. Basioccipital from above.
Fig. 10. Otosphenoid from the inside.
Fig. 11. Parietals from above.

Explanation of the Letters.

a.o. Ala otosphenoidea.
a.v. Aquæductus vestibuli.
b.o. Basioccipital.
b.s. Basisphenoid.
c. Columella.
cms. Commissure.
c.o. Canalis olfactorius.
c.oc. Condylus occipitalis.
c.s.o. Crista supraoccipitalis.
d.d. Dentes dextri.
d.e. Dorsum ephippii.
d.s. Dens sinister.
f. Frontal.
f.c. Fossa cochlearis.

f.ca. Foramen caroticum internum.
f.ca'. Foramen for a branch of the internal carotid.
fe. Fenestra.
f.hy. Fossa hypophyseos.
f.j. Foramen jugulare internum.
f.l. Foramen lacrymale.
f.oc. Foramen occipitale.
fo.f. Foramen canalis semicircularis frontalis.
fo.h. Foramen canalis semicircularis horizontalis.
fo.s. Foramen canalis semicircularis sagittalis.
f.p. Foramen parietale.
h.a. Posterior ampullary chamber.
i.j. Incisura venæ jugularis.
i.ot. Incisura otosphenoidea.
i.v Incisura foraminis vestibuli.
j. Jugal.
m. Maxilla.
n. Nasal.
o.a.s. Orificium ampullæ canalis semicircularis sagittalis.
o.c.h. Orificium canalis semicircularis horizontalis.
or.s. Orbitosphenoid.
o.s. Otosphenoid.
p. Parietal.
p.a.i. Processus anterior inferior.
p.al. Processus alaris.
pa.o. Paroccipital.
pa.s. Parasphenoid.
p.a.s. Processus anterior superior.
p.c. Pars condyloidea.
p.f. 1. First postfrontal.
p.f. 2. Second postfrontal.
p.m. Premaxilla.
p.o. Pleuroccipital.
p.p. Processus paroticus.
p.p.s. Processus posterior superior.
p.pt. Processus pterygoideus.
pr.f. Prefrontal.
pr.p. Processus parietalis.
pr.s. Presphenoid.
r.a. Ramus ascendens.
r.d. Ramus descendens.
s.c.a. Sulcus columellæ auditus.
s.l. Semicanalis lymphaticus.
s.o. Supraoccipital.
u.c. Inferior cylindrical processes.
v. Vestibulum.
v.a. Anterior ampullary cavity.
x. Cleft between *fo.f.* and *fo.h.*
x'. Cleft between *fo.s.* and *v.a.*
x''. Cleft between *fo.h.* and *v.a.*
II. Foramen opticum.
VII. Foramen nervi facialis.
VIII. Foramen nervi acustici.

XXXIV.—*On the* Elateridæ *of Japan.*

By G. Lewis, F.L.S.

[Continued from p. 266.]

Agriotes longicollis, sp. n.

Infuscatus, subopacus, fulvo-pubescens; elytris brunneo-testaceis, interstitiis planis, rugosis, striis tenuiter impressis; antennis pedibusque infuscatis.

L. 13 mill.

Elongate, dusky brown, somewhat opaque, with tawny pubescence; the head closely, rather coarsely and roughly punctate, frontal carina oblique laterally and well elevated; the thorax closely and evenly punctate, elongate, rounded off anteriorly, sides parallel in the middle, widening out a little before the posterior angles, angles rather acute; the scutellum obscurely punctulate, little pointed behind; the elytra testa-

ceous, narrowly dusky at the apices, striæ fine, interstices flat, 2 to 5 rather wide, all evenly and finely rugose; the antennæ infuscate, rather long, with rather lax joints; the legs also infuscate; the thorax and antennæ are shorter in the female.

This species has the facies of a very large specimen of *A. sericeus*, Cand., but it is apparently nearer to *A. pilosus*, Panz.

Hab. Nikko. Four examples.

Agriotes persimilis, sp. n.

Infuscatus, subopacus, fulvo-pubescens; elytris brunneis, sutura infuscata; antennis pedibusque brunneis.
L. $12\frac{1}{4}$ mill.

This species is more robust than the last, with the thorax shorter, scutellum wider and less pointed behind, elytral suture infuscate, and legs and antennæ reddish brown. The frontal carina also is much less conspicuous and is not notably oblique at the sides. If I did not know the female of *A. longicollis* I should with some hesitation consider this to belong to it. The species, however, were found more than 500 miles apart.

Hab. Junsai. One example.

Agriotes sericeus, Cand.

Agriotes sericeus, Cand. Ann. Belg. 1878, p. 189.
Agriotes sericans, Lew. Ent. Month. Mag. 1879, p. 157.

Hab. Subashiri and Wada-toge. Abundant.

Agriotes sepes, Lew.

Agriotes sepes, Lew. Ent. Month. Mag. 1879, p. 157.

Elongatus, niger, fulvo-pubescens; thorace creberrime punctato, punctis obscure ocellatis, angulis inconspicue carinatis; antennis valde serratis; pedibus rufis.
L. 9 mill.

Elongate, black, with fulvous pubescence; the head coarsely and very closely punctate; the thorax also closely punctate, punctures minutely ocellate, posterior angles little acute, turning outwards, with the carina scarcely visible; the elytra punctate-striate, interstices finely punctulate and transversely rugose; the antennæ, articulations rather long and lax, distinctly serrate (male), three basal joints red, others darker; the legs wholly reddish brown.

This species is similar to *A. exulatus*, Cand., but it is larger and more robust, antennæ serrate, and the carina at the base of the thorax scarcely perceptible.

Hab. Kii. I have only seen one example.

Note.—In *Agriotes exulatus*, Cand., the thoracic carina is well-marked. I found it in abundance under dead leaves at a rather high elevation near Nagasaki in March.

Agriotes elegantulus, sp. n.

Fusco-brunneus, nitidus, fulvo-pubescens; thorace angulis posticis haud carinatis; elytris punctato-striatis, interstitiis punctulatis, obscure rugosis; antennis pedibusque pallidis.

L. 5½ mill.

Rather dark brown, shining, pubescent; the head rather uneven, not very closely punctured; the thorax parallel at the sides until well before the hind angles, hind angles not carinate, long, rather acute, and turning outwards, surface finely, evenly, and not thickly punctulate; the scutellum relatively large, finely punctulate; the elytra punctate-striate, striæ fine, interstices sparsely punctulate, obscurely rugose; the antennæ and legs pale.

Hab. Fukushima. Two examples.

Agriotes helvolus, Cand.

Agriotes helvolus, Cand. Mém. Liège, 1873, p. 30.

The head in this species is sometimes black.

Hab. Nagasaki, Kobé, Hakone, and Junsai.

Agriotes ogurœ, sp. n.

Obscure brunneus, parum nitidus, griseo-pubescens; capite thoraceque dense punctatis; elytris punctato-striatis, interstitiis conspicue scabris; antennis pedibusque pallide brunneis.

L. 7¼ mill.

Dusky brown, with griseous pubescence; the head strongly punctured, with a faint median impression; the thorax densely punctured, punctures finer than those of the head, convex, infuscate on the disk, margins reddish brown, hind angles slightly turned outwards and carinate; the scutellum reddish brown, obscurely punctulate; the elytra punctate-striate, markedly scabrous, reddish brown, but distinctly darker on interstices 2, 3, 4, 5; the antennæ and legs concolorous, pale brown.

Smaller and narrower than *A. marginipennis*, Luc.; the thorax less parallel, posterior angles longer and turning outwards, and the asperity of the elytral interstices more conspicuous.

Hab. Kioto, at the Ogura lakes.

Agriotes palustris, sp. n.

Brevis, obscure brunneus, griseo-pubescens; thorace sparse punctulato, punctis parvis et grossis intermixtis; elytris punctato-striatis, interstitiis vage rugosis; antennis pedibusque brunneis.
L. 5 mill.

Short, rather robust, obscure brown, pubescence grey; the head rather closely and irregularly punctate; the thorax arched anteriorly, straight at the sides, hind angles with same direction, convex and punctate, punctures close laterally, but somewhat sparse on the disk, where the punctures are of various sizes, many fine, with a number of large ones between them; the elytra punctate-striate, interstices feebly rugose; the antennæ and legs dull palish brown.

Hab. Tokio, Nikko, Ogura lake, and Sakai.

Agonischius obscuripes, Cand.

Agonischius obscuripes, Cand. Mon. Elat. iv. p. 420, pl. v. fig. 5; Mém. Liège, 1873, p. 31.

Hab. Kagoshima. There are two examples in the Janson collection from Central Japan. According to Candèze it is found also in China, on the Himalayan Mountains and Cochin China.

Sericosomus viridis, sp. n.

Viridis vel aureo-viridis, metallicus; capite thoraceque dense punctatis; antennis (basi excepta) nigris; pedibus læte rufis.
L. 6–8 mill.

Bright metallic green or golden green, scarcely pubescent; the head densely punctured, usually with a round frontal impression between the eyes; the thorax narrowest anteriorly, gradually widening to base, angles continuing in same direction, wholly punctate like the head, with a short median channel before the scutellum; the scutellum obtusely pointed behind, punctulate; the elytra rather deeply punctate-striate, interstices convex and rugosely punctulate; the antennæ, three basal joints clear red, the rest black; the legs also clear red.

Hab. Hitoyoshi, Oyama, and Miyanoshita. At the last

place taken abundantly in May from the flowers of *Viburnum* and *Spiræa*.

Glyphonyx illepidus, Cand.

Glyphonyx illepidus, Cand. Mém. Liège, 1873, p. 31.

The frontal stria of this species is, as Candèze states, ∧-shaped, and there is a variety with the elytra testaceous, which is introduced as a new species by Schönfeldt in the last supplement of his Catalogue as *G. bicolor*, Cand., *in litt.*

Hab. Nataksugawa, Tsumago, Fukushima, Hosokute, and Shinkano; also in Higo.

Silesis musculus, Cand.

Silesis musculus, Cand. Mém. Liège, 1873, p. 31.

There is a variety of this species also (var. *flavipennis*) with pale elytra which I think is *Agriotes ferruginipennis*, Motsch., 1866. Motschulsky's name for an *Agriotes* is preoccupied by Leconte in 1861, so Candèze's name will remain in either case.

Hab. Hakone, Fukui, Tsumago, Numata, and other places on the Nakasendo.

Silesis scabripennis, sp. n.

Ellipticus, nigro-brunneus, subnitidus, fulvo-pubescens; thorace antice rufo-marginato; elytris punctato-striatis, interstitiis granulatis, opacis; antennis pedibusque brunneo-rufis.
L. $6\frac{1}{2}$ mill.

Elliptical, dark brown, somewhat shining, pubescence tawny; the head not very closely punctulate; the thorax sparingly punctured on the disk, narrowly rufous on the anterior margin, hind angles a little acute, turning a little outwards; the elytra obscurely brown at the base, darker posteriorly, punctate-striate, interstices markedly rugose and opaque; the antennæ and legs reddish brown.

The sculpture of the interstices separates this species at once from *S. musculus*, Cand.; it is also narrower and more elliptical, thorax but little convex, and the scutellum less pointed behind.

Hab. Yuyama. One example.

Adrastus patagiatus, sp. n.

Niger, nitidus, griseo-pubescens; antennis basi testaceis, articulo

tertio secundo æquali ; elytris testaceis, sutura infuscata ; pedibus testaceis.
L. $4\frac{1}{2}$–6 mill.

Black, shining, with griseous pubescence ; the head clearly, not very closely punctured ; the thorax much more finely punctured, infuscate, usually with a narrow margin anteriorly and at the sides, including the posterior angles, reddish ; the elytra punctate-striate, striæ rather fine, especially that next the suture, interstices flat, sparsely punctulate, interstices 1 and 2 wholly infuscate, 3 and 4 dark at base, 3 dark behind the middle, outer margin dusky about the middle or, in a variety, wholly dark ; the antennæ reddish at base, other articulations darker ; the legs wholly testaceous or reddish brown in the dark varieties.

This species varies in colour, sometimes the thorax and elytra are wholly infuscate. It is similar to *A. pallens*, F., in having the second and third joints equal and to *A. limbatus*, F., in general appearance ; the outer margin of the elytra in most of the specimens is narrowly infuscate in the middle only.

Hab. Chiuzenji, Hakone, Wada-toge, and Junsai.

Lepturoides (*Campylus*) *versicolor*, sp. n.

♂. Elongatus, colore variabilis ; capite grosse ocellato-punctato, fronte triangulariter excavata ; thorace rufo-brunneo, in medio canaliculato, ocellato-punctato ; elytris testaceis, punctato-striatis, interstitiis transversim rugosis, tibiis infuscatis.
♀ tota nigra.
L. 14–15 mill.

Elongate, male variable in colour, female black, with knees and claws only pale. The head rather uneven, with large ocellate punctures, forehead behind the carina triangularly excavated ; the thorax punctured like the head, median channel not wide, but well-marked, emarginate before the hind angles, which last turn outwards almost at right angles to the sides (this is a varying character) ; the scutellum punctulate, not carinate ; the elytra punctate-striate, obscurely punctulate near the base, interstices are then transversely rugose to the apex, the rugosities apparently crossing the striæ. The male : head black, thorax varying from black to reddish brown ; elytra usually testaceous, sometimes black, or with the suture and outer margins black ; legs equally variable, but the tibiæ usually infuscate. The antennæ black in both sexes.

Hab. Chiuzenji. Seventeen specimens, taken in June.

Lepturoides (*Campylus*) *miniatus*, Cand.

Campylus (*Lepturoides*) *miniatus*, Cand. Notes Leyd. Mus. 1885, vii. p. 121.

This species does not vary much in colour; there are generally two red spots on the head, but sometimes these are absent. The scutellum is distinctly carinate.

L. 9–15½ mill.

Hab. Nikko, Miyanoshita, Subashiri, Ichiuchi, and Oyayama. Rather common in forests in May.

Lepturoides (*Campylus*) *scutellaris*, sp. n.

Lepturoidi miniato simillimus sed minor; elytris obscure rufis; scutello valde carinato.

L. 10 mill.

This species is intermediate between *L. miniatus* and *oculatus*, but most like the first. The head punctate, punctures deep, rather close, but irregular, coloured like the head of *L. oculatus*, without the two spots seen in *L. miniatus*; the thorax blackish, with four nodules and margin reddish brown; the scutellum very strongly carinate, carina arched in outline, and well raised above the level of the elytra; the elytra dull red, punctate-striate, punctures very deep, interstices convex and rugose; the antennæ and legs black.

The scutellum in this species is as curiously formed as that in *Athous subcyaneus*, Motsch., of this series.

Hab. Oyayama. Two female examples.

Lepturoides (*Campylus*) *oculatus*, sp. n.

Infuscatus, subnitidus, pilosus; oculis prominulis; elytris coccineis profunde punctato-striatis, interstitiis rugosis; antennis pedibusque nigris.

L. 8–9 mill.

Infuscate, rather shining, with fulvous hairs on the head and thorax, bright red hairs on the elytra; the head, frontal carina between the antennæ and a small space behind testaceous, punctate (in male not densely, in female densely), excavated behind the frontal carina, eyes small in the female, very prominent in the male; the thorax canaliculate in the middle, with two nodules on each side of the channel, nodules most conspicuous in the female, lateral margins testaceous, sometimes there are pale markings near the nodules; the scutellum punctate, carinate; the elytra bright red, punctate-striate, punctures very deep and similar to those of *L. miniatus*,

interstices flattish, quite flat in male, less so in female, rugose; the antennæ and legs infuscate, claws pale; in two specimens there is a sutural dusky band, not, however, well-marked.

There are no spots on the head of this species like those of *L. miniatus*, Cand., but in facies it resembles small examples of it. In this and the two previous species the anterior trochanters are pale.

Hab. Miyanoshita and Subashiri. Nine examples.

Note.—Since the second part of the paper was printed I have received a new species of *Limonius* from Herr von Schönfeldt, viz. :—

Limonius eximius, sp. n.

Capite thoraceque viridi-aureis, sparse cinereo-pubescentibus; scutello perspicue carinato; elytris obscure purpureo-tinctis, interstitiis punctatis; antennis nigris; pedibus infuscatis.
L. $6\frac{4}{5}$ mill.

Greenish golden on the head and thorax, metallic, with ashy pubescence; the head punctate, punctures somewhat deep, not closely set, frontal carina well-marked, with the edge feebly sinuous, forehead conspicuously impressed, impression extending backwards triangularly between the eyes; the thorax narrowest anteriorly, punctured less deeply than the head, especially on the disk, hind angles obtuse; the scutellum coarsely and roughly punctured laterally, with a median smooth carina; the elytra dark bronze, with a purple tint, punctate-striate, interstices very feebly transversely rugose, almost flat and punctate; the antennæ black, joints 2 and 3 small and equal, 4 to 10 triangularly dilated on the inner edge; the legs, tibiæ, and tarsi infuscate, femora obscurely brown.

This species in general facies resembles *L. ignicollis*, Lew. The frontal impression is similar, but the thorax is more finely punctured and less narrowed anteriorly, the scutellum is less wide but similarly punctate and carinate, the elytral interstices are not conspicuously rugose, but distinctly punctate only; the antennæ also are less dilated. The type examples of both species are males. The two species mentioned above, with *L. approximans*, Lew., and *L. aurifer*, Cand. (from N. America), appear to form a small group in the genus; all have a more or less distinct scutellar carina.

Hab. Main island (*Herr Roesing*).

List of Species.

Adelocera Müklinii, *Cand.*
—— antennata.
—— parallela.
Lacon cordicollis, *Cand.*
—— binodulus, *Motsch.*
—— fuliginosus, *Cand.*
—— quadrinodatus.
—— scrofa, *Cand.*
—— tumens, *Cand.*
—— brunneus.
—— difficilis.
trifasciatus, Cand.
Meristhus niponensis.
—— scobinula, *Cand.*
Alaus berus, *Cand.*
—— pini.
Tetrigus Lewisii, *Cand.*
grandis, Lew.
Pectocera Fortunei, *Cand.*
Heteroderus agnatus, *Cand.*, 1891 (Æolus, *Cand.*, 1873).
Anchastus aquilus, *Cand.*
—— mus.
—— rufipes.
Elater niponicus.
—— optabilis.
—— orientalis.
—— fagi.
—— convexicollis.
—— scutellaris.
—— rubridorsus, *Lew.*
—— ainu.
—— chlamydatus.
—— montanus.
—— puniceus, *Lew.*
—— miles.
—— canalicollis.
—— hypogastricus, *Cand.*
—— nigroventris.
—— vestitus.
—— tenuistriatus.
—— rufipes.
—— carbunculus, *Lew.*
—— bicarinatus, *Cand.*
—— rugipennis.
—— parvulus.
—— pauxillus.
—— gracilipes.
Megapenthes opacus, *Cand.*
—— bicarinatus.
—— higonius.
—— insidiosus.
Megapenthes fujisanus.
—— bifoveolatus.
—— cariniceps.
—— gracilis, *Cand.*
—— pallidus.
—— insignitus.
—— versipellis.
—— ornatus.
Melanoxanthus pictipennis.
—— similis.
Hypolithus saxatilis.
—— expansicornis.
—— fluviatilis.
Cryptohypnus rivalis.
—— cruciatus, *Cand.*
—— quadrillum, *Cand.*
—— optatus.
—— interstinctus.
—— tutus.
—— modestus.
—— humeralis, *Cand.*
—— curatus, *Cand.*
—— insulsus, *Cand.*
—— telluris, *Lew.*
—— luteipes, *Cand.*
—— difficilis.
—— albipilis, *Cand.*
—— atomarius.
—— ellipticus, *Cand.*
—— ovalis, *Cand.*
—— carinicollis.
—— minutissimus, *Germ.*
—— cinefactus.
—— agilis.
Cardiophorus pinguis.
—— niponicus.
—— opacus.
—— pullatus, *Cand.*
—— sequens, *Cand.*
—— pauper, *Cand.*
—— rameus, *Lew.*
—— nothus, *Cand.*
—— adjutor, *Cand.*
—— ferrugineus.
sobrinus, Cand.
Melanotopsis cete, *Cand.*
amussitatus, Cand.
—— restrictus, *Cand.*
Melanotus longipennis.
—— legatus, *Cand.*
—— spernendus, *Cand*
—— annosus, *Cand.*

Melanotus correctus, *Cand.*
—— ocellato-punctatus.
—— senilis, *Cand.*
—— erythropygus, *Cand.*
—— invectitius, *Cand.*, ♂.
Fortnumi, Cand., ♀.
—— caudex, *Lew.*
—— seniculus, *Cand.*
Limonius niponensis.
—— montivagus.
—— marginipennis.
—— brunneus.
—— marginicollis.
—— vittatus, *Cand.*
—— imitans.
—— rufipennis.
—— atricolor, *Lew.*
—— ignicollis.
—— eximius.
—— approximans.
Athous umbratilis.
—— subcyaneus, *Motsch.*
—— secessus, *Cand.*
—— sinuatus.
—— virens, *Cand.*
var. *brunneipennis.*
—— sanguinicollis, *Friv.*
—— desertor, *Cand.*
—— comes.
—— suturalis.
—— porrecticollis.
—— singularis.
—— jactatus.
—— inornatus.
—— undosus.
Corymbites daimio.
—— pruinosus, *Motsch.*
—— orientalis, *Cand.*
—— ærosus (Athous), *Lew.*
—— modestus.
—— selectus, *Cand.*
—— fulvipennis.
—— prænobilis.
—— serrifer, *Cand.*
—— hypocrita.
Corymbites notabilis, *Cand.*
—— puncticollis, *Motsch.*
—— onerosus.
—— pacatus.
—— vagepictus.
—— mundulus, *Lew.*
—— puerilis, *Cand.*
—— gratus.
—— ferrugineipennis.
—— rubripennis.
—— chlamydatus.
—— concolor.
—— obscuripes.
Ludius niponensis.
—— Candezei.
—— Sieboldii, *Cand.*
Crigmus plebejus, *Cand.*
—— junior, *Cand.*
—— linteatus, *Cand.*
Sericus (Dolerosoma?) sericarius, *Motsch.*
Agriotes longicollis.
—— persimilis.
—— sericeus, *Cand.*
sericans, Lew.
—— sepes, *Lew.*
—— exulatus, *Cand.*
—— elegantulus.
—— helvolus, *Cand.*
—— oguræ.
—— leucophæatus, *Cand.*
—— palustris.
Agonischius obscuripes, *Cand.*
Sericosomus viridis.
Glyphonyx illepidus, *Cand.*
var. *bicolor*, Cand.
Silesis musculus, *Cand.*
var. *flavipennis.*
—— scabripennis.
Adrastus patagiatus.
Lepturoides (Campylus) versicolor.
—— (——) miniatus, *Cand.*
—— (——) scutellaris.
—— (——) oculatus.

XXXV.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., late commanding.*—Series II., No. 1. *On the Results of the Deep-sea Dredging during the Season* 1890–91 (*continued*). By A. Alcock, M.B., Surgeon-Captain I.M.S., Superintendent of the Indian Museum.

[Continued from p. 245.

Family Galatheidæ.

Munida, Leach.

75. *Munida militaris*, Henderson, var. nov. *andamanica*.

The length of the carapace is very little more than its greatest breadth. The uptilted rostrum is a good deal more than half the length of the carapace and more than double the length of the slightly divergent supraorbital spines; it extends backwards as a faint carination of the front half of the gastric region. The anterior border of the carapace on either side of the rostrum is convex and slightly oblique; the posterior border is smooth; the lateral borders are armed with 7 (2+3+2) spines. The transverse ridges are strongly developed and finely and faintly beaded, and are thickly fringed with setæ, some of which at regular distant intervals are long. The gastric area is armed in front with a convex row of spines, of which only two, namely those in the immediate rear of the supraorbital spines, are conspicuous, while of the others the outermost one on each side is the largest and stands far back.

A small spinelet is present on each side immediately behind the bifurcation of the cervical groove. The cardiac area is usually well defined by a zigzag incision.

The abdominal terga have the transverse ridges well developed and setose; the second only is armed, having on its anterior margin a row of 8 distant spinelets.

The eyes are large, the major diameter of the moderately flattened corneal region being between one third and one fourth the length of the carapace; conspicuous setæ fringe the corneal region, and the pigmentation of the latter varies from slate-grey to cinnamon-brown.

The spines of the basal joint of the antennulary peduncles are long and needle-like.

The antennal peduncles are smooth; the basal joint has its

antero-internal angle produced into a spine which is not visible from above, and the second joint has both its anterior angles produced into long sharp spines; the flagellum is about three times the length of the body.

Of the external maxillipeds the ischium has its inner edge finely, sharply, and very regularly toothed throughout, and the meropodite has two large spines on its inner edge.

The thoracic legs are comparatively short and stout. The chelipeds when fully extended only just exceed the fully extended body in length without the rostrum in the male, and in the female only just equal the body without the rostrum, and from the ischium outwards they are hairy and granular; the prismatic meropodite has the upper edge throughout and the inner (lower) edge in its distal half spiny, and ends above in two huge spines, the inner edge and the granular outer edge ending in smaller spines; the carpus has spines in two rows on its upper and outer surface and two or three obliquely placed spinules on its inner surface; the propodite in the upper and outer surface of its palmar portion has three rows of spines; the fingers are rather longer than the palm and are closely and evenly toothed, the immobile finger having usually a large spine near the middle of its outer edge and terminating in a pair of large spines, between which the tip of the dactylopodite closes.

Of the second, third, and fourth thoracic legs the upper (anterior) edge is closely fringed with long hairs from the base of the ischium to the tip of the claw; in all the merus and the carpus have the upper (anterior) edge strongly spined, and the merus, propus, and dactylus have the posterior edge serrate or spinulate.

The branchial formula conforms to type.

This subspecies has often been dredged in the Andaman Sea, and appears to be gregarious. On the present occasion several specimens of both sexes were dredged at Station 115, 188–220 fath.

The largest male measures 54 millim. and the largest female 56 millim. from the tip of the rostrum to the end of the telson.

Colours in life: cephalothoracic region and appendages pink, abdominal region white.

The characters are quite constant throughout a large series of individuals of both sexes.

76. *Munida squamosa*, Henderson, var. nov. *prolixa*.

The length and the greatest breadth of the carapace are nearly the same. The almost horizontal rostrum is one

third the length of the carapace, and the orbital spines, which are slightly inclined upwards, are two thirds the length of the rostrum,—all three being very distinctly squamous. The anterior margin of the carapace on either side of the rostrum is concave and without any obliquity; the posterior margin has a pair of spines, one on either side of the middle line; the lateral margins are armed each with five spines. The gastric area is very distinctly delimited and is armed in front with two (and only two) spines, which stand immediately behind the supraorbitals and are about a third the length of these. The cardiac area also is very distinctly defined, and is surmounted centrally by a large spine and flanked on each side, just behind the bifurcation of the cervical groove, by a similar spine. The transverse ridges are well developed and are strongly and sharply beaded and thickly and very finely setose.

The abdominal terga also are most beautifully sculptured with similar ridges, transverse and concentric; the second, third, and fourth terga are armed on their anterior margin each with four distant spines, the middle pair of which are large and conspicuous, and the fourth also has in its hinder portion and in the middle line a single spine.

The eyes are large, their major diameter being more than one fourth the length of the carapace, and the eye-stalks on the upper surface have several setose squames; the corneal region is compressed and closely fringed with setæ at base.

The spines on the basal joint of the antennules are not large, only the outer terminal spine and the anterior of the two marginal spines being of noticeable size.

The antennal peduncles are scaly; the basal joint has a small tubercle at its internal angle, and the second and the third joints have each a spine in the same situation; the flagellum is very little longer than the chelipeds.

The external maxillipeds are very hairy and have the exposed surface of the ischium and merus scaly, the former joint being serrated, up to a large terminal spine, along the inner edge, and the latter having a similar spine near the middle of the inner edge.

The thoracic legs are long, slender, and most remarkably squamous, the scales being fringed with fine setæ. The chelipeds, which are relatively both stouter and longer in the male, are in that sex one third of their own extent longer than the body with the rostrum, being also a little unequal; the merus, which is almost square in transverse section, has three regular rows of spines on its upper and inner face; and the carpus and propodite, which are almost cylindrical,

have each two irregular rows of spines on the inner face, the propodite also having two or three spines on the outer aspect; the fingers are about two thirds the length of the palm and are finely toothed, the immobile finger having a second series of 5 or 6 large teeth and ending in a pair of claw-like spines, between which the tip of the dactylus shuts.

Of the second, third, and fourth thoracic legs the merus has both edges spiny, the anterior the more markedly so; the carpus has the anterior edge spiny, the posterior edge having only a single terminal spine; the propodite has the posterior edge distantly spinulate; and the dactylus has the anterior edge crenulate.

The first abdominal appendages are absent in the male.

Colour in life dull red.

Dredged at Station 115, 188–220 fath.

The largest male measures 42 millim. and the largest female 41 millim. from the tip of the rostrum to the end of the telson.

The spermatozoa of this form, which I have had an opportunity of examining in a specimen lately sent from the 'Investigator,' are remarkable for their size, but still more for their form. As teased out from a piece of the sperm-tube they consist of an elongate oval head which gradually tapers to a long lash-like tail. They have, in fact, much the appearance of flagellate spermatozoa of gigantic size, only the end of the flagellum is truncated and split into two little lips, and the head is connected at its front end by means of a short twisted filament with a sucker-like plate. In structure the head and the tail throughout its whole extent are alike, consisting of a granular core, which stains deeply with carmine, and an outer clear structureless envelope, which remains unstained.

77. *Munida tricarinata*, sp. n.

Belonging to the group *Munida granulata*, *scabra*, and *proxima*, Henderson, and *Munida obesa*, Faxon.

The length of the carapace and the greatest breadth are equal. The entire carapace is covered with spinelets arranged in longitudinal and transverse rows. The rostrum is less than one fourth the length of the rest of the carapace and not very much longer than the supraorbital spines; it is continued backwards to the after border of the carapace, first as a sharply spinulate carination of the front half of the gastric region, then as a row of 3 close-set spines traversing the posterior half of the gastric region, then as a row of 3 more distant spines traversing the cardiac region, and terminates

as a large spine on the posterior margin of the carapace. On either side of this rostral series of spines the orbital spine also is continued backwards as a gently divergent series of rather smaller spines, so that the carapace is dorsally traversed by three sharply spinate carinæ. The anterior margin on either side of the rostrum is concave, without any obliquity; the posterior margin is raised and closely spinate throughout; on the lateral margins the spinature is hardly to be distinguished from the general spinature of the surface, the antero-lateral spine alone being large.

Abdominal terga with the transverse and concentric ridges well developed; the first tergum is remarkably broadly exposed and has the entire surface sharply rugose; the second and third have their anterior edge and their principal transverse ridge spinate, two of the spines in every case, namely those on either side of the middle line, being large; the fourth has the anterior edge only armed in an exactly similar manner.

The eyes are large—the major diameter one fourth the length of the carapace—and much compressed; the corneal region is remarkably narrow and the setæ that fringe its basal margin overlap the eye in front; in addition to these setæ there are three half-rings of setæ on the eye-stalks.

The basal joint of the antennal peduncle has its antero-internal angle produced into a great serrated hairy spine about half as long as the carapace, the spines of the two sides converging in front of the eyes; the antennal flagellum is not much more than two thirds the length of the body with the rostrum.

The external maxillipeds are very hairy, and the merus has a strong spine on the inner edge near the proximal end.

The chelipeds (in the female) are one half longer than the body with the rostrum, are slender and cylindrical, and are remarkable for the great length of the carpus, which is equal in length to the palm of the propodite or more than two thirds the length of the meropodite; all the joints are sharply squamous, the scales on the meropodite, and to a less extent on the carpus (except on the under surface of these joints), forming spines; the fingers are rather more than two thirds the length of the palm, the opposed edges are finely and closely serrated, the immobile finger having also a second series of distant large teeth and ending in a pair of claws between which the tip of the dactylus closes.

The second, third, and fourth legs have the merus and carpus strongly spinate along both edges, the propus finely

serrate on the posterior edge, and the dactylus crenate on the front edge.

An ovigerous female from the Andaman Sea, 112 fath. : length 29 millim. from tip of rostrum to end of telson.

78. *Munida microps*, sp. n.

Very closely related to *M. microphthalma*, A. M.-Edw.

The breadth of the carapace is barely three fourths of the length (without the rostrum). The rostrum, which is strongly upcurved and is indistinctly serrated at tip, is considerably more than half the length of the carapace and considerably more than double the length of the divergent supraorbital spines; it extends backwards as a faint carination of the anterior third of the gastric region. The frontal border on either side of the rostrum is convex and slightly oblique; the posterior border is raised but unarmed; the lateral margins are armed with 7 (2+3+2) spines. The transverse ridges are strongly developed, smooth, and thickly fringed with short setæ. The tumid gastric area bears in front a convex row of spines, only two of which, namely those which stand immediately behind the supraorbital spines, are conspicuous, the outermost spine on each side being placed far back on a level with the centre of the hepatic region. The cardiac area is well defined and is bounded on each side by a spine standing immediately behind the bifurcation of the cervical groove. A spinule or two are found within the area enclosed by the bifurcation of the cervical groove.

Abdominal terga each with one or two smooth setose ridges; the second tergum only is armed, having 6 to 8 spines on its front edge.

The eyes are small, with the cinnamon-coloured corneal region hardly compressed and little dilated, its major diameter being about one eighth the length of the carapace.

The spines of the basal joint of the antennulary peduncle are long and needle-like.

The antennal peduncles are smooth; the basal joint has its internal angle produced into a stout spine, which, however, is not visible from above, and the second joint has both its anterior angles produced into long acicles; the flagellum is of great length.

The external maxillipeds are slender, almost smooth, and but slightly hairy; the inner edge of the ischium is sharply toothed throughout and the inner edge of the merus near the proximal end bears a very prominent spine.

The thoracic legs are slender, smooth or very faintly

squamous, and very slightly hairy. The chelipeds in the male—in which sex they are not quite symmetrical—exceed the length of the fully extended body, measured with the rostrum, by rather more than a carapace length, and in the female by half a carapace length; the merus and carpus and the propus in its palmar portion are covered with large thorns; the fingers, which do not quite equal the palm in length, are evenly and finely toothed, and the immobile finger has also several distant spines along its outer margin, and at the base of the terminal claw a pair of small teeth, between which the tip of the dactylus closes.

Of the second, third, and fourth thoracic legs the merus has both its margins and the carpus its front margin thorny, the posterior margin of the carpus having only a long terminal spine, while the propus and dactylus have their posterior edge serrated for a series of minute articulating spinules.

The first pair of abdominal legs in the male have the usual development.

Colour in life milky pink.

Several males and females from Station 112, 561 fathoms.

The largest male measures 45 millim., and the largest female 43 millim., from the tip of the rostrum to the end of the telson.

This species has also been dredged off Colombo in 675 fathoms. It appears to be gregarious.

I have to separate provisionally from this species, as illustrating a variety, two large males which only differ from the above type in the nature of the chelipeds:—

79. *Munida microps*, var. *lasiocheles*, nov.

Differs from *M. microps* only in the structure of the chelipeds, which (in the male) are markedly unequal, one (the right in one individual, the left in the other) exceeding its fellow by nearly the whole length of the dactylus.

The chelipeds are very densely furred, except on the short ischium, and are from nearly twice to two and a half times the length of the fully extended body measured with the rostrum; they are thorny, much as in *M. microps*, except that the thorns are relatively smaller, especially on the propus, and most of all on the propus of the larger cheliped, where they are almost entirely hidden in the thick fur. The fingers are not much more than half the length of the palm; and while in the smaller claw they are straight, closely apposed, and otherwise the same as in *M. microps*, in the

larger claw they are separated throughout, but especially at the base, where there is found on the dactylus a large truncated tubercle and on the immobile finger a corresponding excavation and bulging. The carpus of the shorter claw has a strong bend outwards.

Two males were dredged in the Andaman Sea, along with *M. microps*, at 480 fathoms. The largest measures 60 millim. from the tip of the rostrum to the end of the telson, and 175 millim. from the tip of the extended larger cheliped.

Munidopsis, Whiteaves.

80. *Munidopsis stylirostris*, Wood-Mason.

Munidopsis stylirostris, Wood-Mason, Ann. & Mag. Nat. Hist., Feb. 1891, p. 201.

The general surface of the body is finely pubescent dorsally.

The greatest breadth of the carapace is about three fourths of the greatest length (without the rostrum). The rostrum, which is styliform and strongly upcurved, is nearly two thirds of the carapace in length; the front margin of the carapace is slightly oblique, and is unarmed except for a strong spine at the antero-lateral angle, and the lateral margins, which are parallel throughout or even a little divergent anteriorly, are, except for the antero-lateral spine, either unarmed or only slightly rugose anteriorly; the posterior margin is raised, but is quite smooth; the tumid gastric region is marked by the presence of rugosities which anteriorly culminate in a pair of coarse spinelets, one on each side of the middle line.

The abdominal terga from the second to the fourth inclusive are transversely channelled, both margins of the channel being raised into finely ctenate crests.

The eye-stalks, which are very stout and very short, are not united, are freely movable, and are not prolonged beyond the globular corneæ.

The greatly inflated basal joint of the antennulary peduncles has the two external terminal spines very strong and long, projecting far beyond the eyes.

The antennary flagellum is not much longer than the chelipeds.

The external maxillipeds have the inner edge of the ischiopodite evenly toothed throughout and the lower edge of the meropodite furnished with two large unciform spines near the proximal end.

The thoracic legs, except the ischiopodite of the first pair, are almost devoid of hairs.

The chelipeds are robust and are not quite symmetrical on both sides, the longer one being about an eye-length shorter than the fully extended body (measured with the rostrum); their meropodite and carpopodite have each a terminal ring of four spines, the meropodite also having a series of distant spinelets along the upper margin in continuity with a terminal spine on the upper edge of the ischiopodite, and the last-named joint having also a terminal spine below; their fingers, which are barely equal in length to the inflated palm, are finely and evenly toothed up to the very tip, are capable of very complete apposition, and when shut form a pronounced spoon.

The second, third, and fourth thoracic legs are at least two thirds the length of the chelipeds, and have the meropodite and carpopodite granular (the former joint with a pair of terminal spines above, the latter with a single one), and the curved dactylopodite furnished on its posterior margin with a row of spines hardly smaller than the terminal claw.

The abdominal legs of the male, excepting the first and second pairs, are quite rudimentary.

The length of the largest male from the tip of the rostrum to the end of the telson is 45 millim.

Colours in life milky orange, fading to milk-white on the carapace and sternum; corneæ milky yellow.

Laccadive Sea (Stations 107 and 109), 738 fathoms.

81. *Munidopsis dasypus*, sp. n.

Nearest to *M. Sigsbei*, A. M.-Edw.

Body pubescent; thoracic legs densely covered with long hairs.

The greatest breadth of the carapace is about three fourths the greatest length. The rostrum, which is styliform, gently ascendant, and slightly curved at tip, is a little more than half the length of the carapace; the front margin of the carapace is markedly oblique and is unarmed, except for a small antero-lateral spine; the lateral margins are parallel, with a slight convergence in the anterior third, where there are two spinelets behind the antero-lateral spine; the posterior margin is raised and bears four strong spines in its middle third; the general surface of the carapace is smooth and polished anteriorly, and is marked posteriorly by slight transverse ripples.

The anterior abdominal terga have a faint naked transverse groove.

The eye-stalks, which are slender and comparatively long, are not prolonged beyond the globular corneæ, are not united, and are freely movable.

The inflated basal joint of the antennulary peduncle has only one of its spines, namely that at the antero-external angle, long.

The antennary flagellum is not much longer than the chelipeds (in the female).

The ischiopodite of the external maxillipeds has the inner edge evenly toothed and the lower edge prolonged distally into a huge spine, while the meropodite has two strong spines on the lower edge in the proximal half.

The thoracic legs, except the fifth pair, are thickly covered with long hairs. The chelipeds are long, slender, and slightly asymmetrical, the longer one exceeding the length of the fully extended body (with the rostrum) by the extent of the dactylopodite; their ischiopodite has two strong distal spines, one above, the other below, their meropodite two rows of spines along the upper and inner surface and a terminal ring of four spines, and the carpopodite has a terminal ring of three spines; the slender fingers, which are finely and evenly toothed to the very tip, slightly exceed the elongate palm in length.

The second, third, and fourth thoracic legs are relatively short, the second pair barely, and the others less than, half the length of the chelipeds; in all the meropodite and carpopodite have the anterior edge spinate, and the dactylopodite has the terminal claw but slightly curved and very much longer than the spines along the posterior edge.

An egg-laden female from Station 112, 561 fathoms, measures 44 millim. from the tip of the rostrum.

Colours in life uniform milky orange.

82. *Munidopsis scobina*, sp. n.

Nearest to *M. erinacea*, A. M.-Edw., *M. spinifera*, A. M.-Edw., and *M. Agassizii*, Faxon.

Body and appendages almost devoid of hairs, but with the spinature sharp and distinct.

The greatest breadth of the carapace is about six sevenths of its length. The rostrum, which is styliform and slightly recurved at tip, is not quite half the length of the carapace; the frontal border is very slightly oblique and, except for one or two small spinelets above the base of the antennæ, is

smooth; the lateral borders, which are convergent anteriorly, are from six- to ten-spined; the posterior border is raised and is surmounted by a series of about ten spines; the gastric region bears a pair of spines at the base of the rostrum and a row of spines along the middle line, and this row is continued along the cardiac region, some of the spines there being bifid or trifid; on the branchial regions are numerous sharp tubercles and spines.

The abdominal terga and pleuræ are glabrous; the second, third, and fourth terga are deeply channelled transversely, the edges of the channel forming sharp and very evenly spinate crests.

The eye-stalks are very short, free and freely movable, and not prolonged beyond the ovoid corneæ.

The basal joint of the antennulary peduncles has three large terminal spikes of nearly equal length.

The spines on the joints of the antennal peduncles are remarkably distinct and the flagellum is about twice as long as the body.

The ischiopodite of the external maxillipeds is evenly toothed along the inner edge and has a terminal spine on the lower edge, and the meropodite has two spines near the proximal end on the lower edge.

The thoracic legs are granular, or squamous, or spinate. The chelipeds are somewhat longer, but hardly stouter, than the second, third, and fourth legs, and in the male they are somewhat longer and in the female somewhat shorter than the fully extended body (with the rostrum); all their joints except the first and last are more or less thorny; the fingers are long, slender, and finely toothed, being in the male a little longer than, and in the female about the same length as, the palm.

The second, third, and fourth legs have the anterior edge of the ischiopodite and carpus thorny and the teeth on the posterior edge of the dactylopodite small.

The abdominal legs of all but the first two pairs are rudimentary in the male; those of the first pair are absent in the female.

Length of the male 40 millim., of the female 42 millim. (measured from the tip of the rostrum).

Dredged at Station 120, 240 fathoms.

83. *Munidopsis subsquamosa*, Henderson, var. nov. *pallida*.

The carapace to the very tip of the rostrum is covered with

hairy squames arranged in transverse series; its greatest breadth is about six sevenths of its length. The rostrum, the length of which is about two fifths that of the carapace, is broad, being at its base nearly one third the breadth of the carapace, triangular, and strongly carinated, and upcurved and serrated at tip; the frontal border is in the same convex curve with the anterior portion of the lateral borders, it bears on each side two strong spines, and there is also a strong antero-lateral spine, and the lateral borders are armed in addition with three or two spinules; the posterior border is raised and quite smooth; the gastric and cardiac regions are well defined, the former having a pair of spines on the middle line in front.

The abdominal terga and pleuræ are squamous and hairy, but are not spinate; the second, third, and fourth terga are grooved transversely.

The eye-stalks, which are short and stout, are united with one another at base and are almost immobile, each is prolonged beyond the cornea into a stout spine, which projects obliquely from beneath the base of the rostrum, to which, at first sight, it appears to belong.

The basal joint of the antennulary peduncles is stout, but not inflated; of the two external terminal spines only one—the lower—is large and conspicuous.

The antennary flagellum is three times as long as the cheliped.

The external maxillipeds are short and slender, the ischium having the inner border finely ctenate and the meropodite having the lower border irregularly crenulate.

The thoracic legs are granular, or squamous, or spinulate, and moderately hairy.

The chelipeds are shorter and not very much stouter than the second, third, and fourth legs, their length being considerably less than half that of the body (with the rostrum); in the male they are slightly asymmetrical; the meropodite and carpus have each a terminal ring of spinelets, and the fingers, which are longer than the inflated palm, are coarse, and are excavated *en cuillère* at tip, being closely crenulate round both edges of the spoon-shaped tips, but not toothed in the proximal half.

The second, third, and fourth thoracic legs have the joints remarkably prismatic and the carpus and propodite strongly fluted; in all the anterior border of the meropodite and carpopodite is spinate, and the teeth on the posterior border of the long dactylopodite are small.

The abdominal legs, except the first two pairs, are rudimentary in the male.

Length 59 millim., measured from the tip of the rostrum.

Colour in life brilliant white.

Dredged at Station 118, 1803 fathoms.

The variety differs from the typical form in having only two gastric spines, in having the rostrum broader, in having the cardiac area more distinctly delimited, and in the strongly fluted fifth and sixth joints of the second to fourth thoracic legs.

Elasmonotus, A. Milne-Edwards.

84. *Elasmonotus cylindrophthalmus*, sp. n.

Nearest to *Elasmonotus longimanus*, A. M.-Edw., and to *Elasmonotus carinipes*, Faxon.

The carapace is quadrangular, with the antero-lateral angles simply rounded and the surface and borders perfectly smooth, the greatest breadth being about three fourths of its length. The rostrum is triangular, flat, and horizontal, with the extreme tip slightly upturned; the frontal margin, which is faintly lobed on either side of the rostrum, meets the lateral margins, which are almost parallel, at right angles; the raised posterior margin is smooth; two deep grooves, one of which crosses the cardiac region, pass across the carapace transversely.

The abdominal terga and pleurae are perfectly smooth; the terga, from the second to the fourth, are transversely grooved, the edges of the groove being salient but smooth; in the case of the fourth tergum the posterior edge of the groove forms a strongly convex eminence.

The eye-stalks, which are slender and extremely short, are free and freely movable; the corneæ are remarkably long and cylindrical, their length being about two thirds that of the rostrum.

The basal joint of the antennulary peduncles has two external terminal spines, these being the only spines found upon the animal.

The antennal peduncles are long and slender, the antero-external angle of each of the second to fourth joints forming a tooth.

The external maxillipeds are long and slender, the ischium having the inner edge finely toothed, and the meropodite having two small tubercles on its lower edge near the proximal end.

The thoracic legs are perfectly smooth and hardly pubes-

cent. The chelipeds are long—one half longer than the body and more than three times as long as the other legs,—slender, and cylindrical; the fingers, which are not two thirds the length of the palm, are singular in being rather hairy.

The second to fourth thoracic legs are slender and extremely short, being not quite as long as the carapace (with the rostrum); they all have the meropodite strongly carinated along the anterior border and the dactylopodite (which has the usual spiny posterior border) short.

Colours in life milky red above, milk-white below.

An egg-laden female from Station 115, 188–220 fathoms, measures about 24 millim. from the tip of the rostrum.

[To be continued.]

XXXVI.—Corylophidæ *and* Trichopterygidæ *found in the West-Indian Islands.* By the Rev. A. Matthews.

I am indebted to the Committee of Natural History of the British Museum for the permission to examine and describe the insects which form the subject of this memoir; they were collected in the West-Indian Islands, chiefly in Grenada and St. Vincent, by Mr. H. H. Smith, to whom much credit is due for the careful manner in which they have been mounted and preserved, since almost every specimen has retained its full complement of limbs—a matter of no small difficulty and of somewhat rare occurrence.

Although the collection contains more than 1000 individuals, the number of species is comparatively small; very few examples of the smaller and more interesting kinds seem to have been found, while those of larger size are represented by immense series, in one case exceeding 500 specimens.

The prevailing character of both Corylophidæ and Trichopterygidæ inclines to the tropical American type and does not present any special peculiarities, except, perhaps, in *Throscidium invisibile*; for, although this insect has already been found in many tropical regions—in Ceylon, where it was discovered by Herr Nietner, in the Cape-Verd Islands by Mr. Wollaston, and in Central America by Mr. Champion—yet in all those localities it appears to be rare; the West-Indian Islands, however, seem to be its head-quarters, more than fifty specimens having been taken by Mr. Smith in Grenada and St. Vincent.

It is also remarkable that, notwithstanding the constant intercourse between these islands and Europe, only two European species are found in this large collection, both of which had previously been taken on the American continent.

The Trichopterygidæ form about three fourths of the whole collection, and, as it always happens when any fresh locality has been entomologically explored, the genus *Trichopteryx* contributes the usual amount of species, which it is very difficult to distinguish, but quite impossible to associate with each other. Indeed, this genus is the bane and vexation of describers, presenting as it does among its various components, when examined under a high magnifying-power, many unmistakable specific distinctions, persistent through a large series of individuals, but in a great measure unappreciable to casual observation. From my own experience, extending over a period of more than half a century, I feel convinced that there are few, if any, genera of Coleoptera more numerous in species than *Trichopteryx*, and not one represented by such myriads of individuals; they abound in every region of the world and in every conceivable locality except water, and even there are represented by the closely allied family of Hydroscaphidæ. Indeed, the study of *Trichopteryx* as a genus suggests to the mind an impression similar to that produced by observing on a moonless night a portion of the Via Lactea through a powerful telescope, for the further you penetrate into space the more bewildering is the multitude of stars brought into view. Thus, whenever the fauna of any fresh tract of country becomes explored, the species of *Trichopteryx* must go on indefinitely increasing in number. And it is to be feared that this fact, together with the minute size of the animals themselves, has much effect in deterring entomologists from the pursuit of this most interesting class of Coleoptera. But instead of altogether relinquishing the study in despair, it would be better to regard *Trichopteryx* as many regard *Homalota*—I mean as a genus of which a general knowledge is all that is really necessary, and, leaving the more obscure species to monographic describers, content themselves with the recognition of such as are more conspicuous. Thus in part ignoring *Trichopteryx*, they will find among the other genera of the same family abundant material for a study of the most interesting and absorbing nature, totally devoid of difficulty or confusion, embracing objects of very great beauty and engrossing interest, both from their perfect organization and curious habits of life.

I have been led to these remarks by the scepticism with which many regard the species of *Trichopteryx*. Col. Motsch-

ulsky, while I enjoyed the advantage of his correspondence, assured me that I should find those which he had separated to be true and genuine species when examined under a magnifying-power sufficiently high to render the superficial sculpture clearly visible; and this I found to be true in forty out of forty-two types which he had kindly sent. And I feel no hesitation in saying that any one who will take the same trouble will come to the same conclusion, and that opinions formed without such examination, and sometimes without any examination at all, can be of no real value.

Among the Corylophidæ *Sacium instabile* is a very pretty and interesting addition to its genus; like its congener *S. Oberthuri* it varies much in the disposition of the yellow markings on its elytra. The two species of *Arthrolips* are insignificant, but very distinct; they are each represented by a single example. *Sericoderus minutus* is a new and distinct species, and, what is very unusual in that confusing genus, easily recognized. *Rhypobius dissimilis* differs much in form from any of its congeners, but agrees with them entirely in its anatomy, especially in the elongate linear mandibles. I have already described *Orthoperus perpusillus* in the 'Biologia Centrali-Americana' from specimens taken in Nicaragua by Mr. E. Janson. It appears to be excessively abundant in the West-Indian Islands.

Corylophidæ.

List of Species.

Sacium instabile, sp. n.
Arthrolips innotabilis, sp. n.
—— nitidus, sp. n.
Sericoderus minutus, sp. n.
Corylophodes pusillus, sp. n.
Rhypobius dissimilis, sp. n.
Orthoperus perpusillus.

Sacium instabile, sp. n.

L. c. 1·50 mm. Oblongo-ovale, convexum, nitidulum, minute et confertim punctatum, pilis aureis denso vestitum, castaneum, fasciis duabus flavis undulatis, aut maculis quatuor sat rotundatis, in elytris notatum; antennis obscure, pedibus læte flavis.

This very distinct and pretty species was found by Mr. Smith rather plentifully in the island of Grenada.

Arthrolips innotabilis, sp. n.

L. c. 0·90 mm. Oblongo-ovalis, fuscus, breviter pubescens, convexus, minute et confertissime punctatus; pronoto magno; antennis perbrevibus atque pedibus læte flavis.

One specimen of this rather obscure and uninteresting species was found in Grenada. It is chiefly distinguished by its very short antennæ.

Arthrolips nitidus, sp. n.

L. c. 0·85 mm. Oblongo-ovalis, angustus, nitidissimus, minute et remote punctatus, haud pubescens, pallide castaneus; pronoto parvo; elytris longis; pedibus atque antennis flavis.

This species is distinguished from the preceding by its small thorax, long narrow elytra, and remote punctation. One specimen only was found near St. John's River in Grenada.

Sericoderus minutus, sp. n.

L. c. 0·70 mm. Subovatus, sat angustus, obscure flavus, aureo-pubescens; pronoto glabro, nitido; elytris postice attenuatis; pedibus obscure flavis; antennis sat brevibus, obscure flavis, clavis infuscatis articulo ultimo profunde excavato.

S. minutus is an unusually distinct species of this perplexing genus; it may be known from others by its small size and dusky colour, and seems to be exceedingly abundant in these islands.

Corylophodes pusillus, sp. n.

L. c. 0·75 mm. Hemisphæricus, nitidissimus, fere impunctatus, niger; pronoto plus minusve translucide testaceo; pedibus atque antennis sat brevibus, pallide flavis.

This small species may be recognized by its very shining smooth surface, black elytra, and more or less testaceous thorax. It seems to be rare, only eight specimens having been taken in Grenada and St. Vincent, of which several are immature and discoloured.

Rhypobius dissimilis, sp. n.

L. c. 0·75 mm. Ovatus, valde convexus, nitidissimus; pronoto impunctato, nigrescenti; elytris piceis; pronoto atque elytris marginatis; pedibus atque antennis læte flavescentibus.

R. dissimilis differs much in form from the more typical species of its genus; but since having dissected two individuals, and found no difference whatever from the normal character of the organs of the mouth, especially of the curious linear mandibles, nor in the relative proportion and disposition of the various parts of the external skeleton of the underside,

or in the number and relative size of the joints of the antennæ, I do not feel any hesitation in placing the present species in the genus *Rhypobius*. It was found not uncommonly both in Grenada and St. Vincent.

Orthoperus perpusillus, Matth.

Orthoperus perpusillus, Matth. Biol. Centr.-Americana, Col. ii. pt. 1, p. 124 (1887).

L. c. 0·50 mm. Ovatus, valde convexus, ater, impunctatus; pronoto sat magno; pedibus atque antennis piceis.

I described this species in the 'Biologia' from two examples taken by Mr. E. Janson in Nicaragua. It appears to abound in the West-Indian Islands, where it has been found in great profusion by Mr. Smith.

Trichopterygidæ.

List of Species.

Pteryx brunnea.
Trichopteryx lævicollis, sp. n.
—— occidentalis, sp. n.
—— depressa, sp. n.
—— Crotchii.
—— grenadensis, sp. n.
—— dubitata, sp. n.
Actinopteryx fucicola.
Smicrus filicornis.
Nephanes meridionalis.
Ptilium Smithsii, sp. n.
—— tropicum.
—— impressum, sp. n.
—— rufotestaceum, sp. n.
Ptenidium concinnum, sp. n.
Throscidium invisibile.

Pteryx brunnea, Le Conte.

Pteryx brunnea, Le Conte, Smiths. Misc. Coll. i. p. 62 (1866).

In the 'Trichopterygia Illustrata,' p. 162, I described this very interesting species from Dr. Le Conte's original and unique specimen. Since then no other example has ever occurred until Mr. Smith was fortunate enough to capture the subject of this note in the island of Grenada.

It may be known from the rest of the genus by its deep and almost variolose punctation.

Trichopteryx lævicollis, sp. n.

L. c. 0·80 mm. Subhemisphærica, postice attenuata; pronoto magno, nigro, nitidissimo, angulis posterioribus valde productis, rufescentibus; elytris rufescentibus, brevibus, multum attenuatis: pedibus atque antennis flavis.

A distinct and well-marked species. It may be known

from any other by its hemispheric form, large and very shining thorax, and short attenuated elytra.

It was found very plentifully in the islands of Grenada and St. Vincent.

Trichopteryx occidentalis, sp. n.

L. c. 0·80 mm. Ovata, convexa, lata, postice attenuata, pilis flavescentibus vestita; pronoto nigro, confertim tuberculato, angulis posterioribus valde productis, dilutioribus; elytris fuscis, attenuatis; antennis longis atque pedibus flavis.

If we may judge from the multitude of specimens (upwards of five hundred) collected by Mr. Smith, this species must abound in the utmost profusion in the West-Indian Islands. Although it varies much in size, which is probably a sexual difference, I cannot discover any valid specific distinctions throughout the whole of this immense series.

Trichopteryx depressa, sp. n.

L. c. 0·90 mm. Oblongo-ovalis, sat depressa, haud attenuata, piceo-nigra; pronoto magno, vix dilatato, tuberculis distinctis irregulariter dispositis, interstitiisque reticulatis ornato; elytris parallelis; antennis atque pedibus flavis.

T. depressa differs from the preceding species in its more depressed and parallel form and in its uniform black colour. It seems to be less common than either of the foregoing, but was found in the same localities.

Trichopteryx Crotchii, Matth.

Trichopteryx Crotchii, Matth. Ent. Month. Mag. vi. p. 248 (1865).

This species was first described by me from specimens taken by Mr. G. R. Crotch in the Canary Islands. Since then it has been found in many parts of America and now not uncommonly by Mr. Smith in the West-Indian Islands.

Trichopteryx grenadensis, sp. n.

L. c. 0·60 mm. Oblonga, brevis, lata, atra, modice tuberculata, sat depressa; pronoto atque elytris utrisque prope media dilatatis; elytris brevibus; antennis brevibus atque pedibus flavis.

Only two specimens of this well-marked species were found by Mr. Smith in Grenada. It belongs to a small group of the genus represented in Europe by *T. Edithia* and in Central

America by *T. bidilatata*, in which the thorax and elytra are separately dilated; from both of these *T. grenadensis* is distinguished by its small size and short broad form.

Trichopteryx dubitata, sp. n.

L. c. 0·87 mm. Elongata, angusta, convexa, pallide castanea, oculis nigris, aureo-pilosa; pronoto brevi; elytris perbrevibus, his atque pronoto ad media latissimis; antennis longis atque pedibus flavis.

It is doubtful whether the pale colour of this single specimen may not have been caused by immaturity; but whether this is or is not the case, its long narrow shape, short thorax and elytra, long antennæ, and stout legs sufficiently distinguish *T. dubitata* from the rest of its genus.

It is allied to *T. Edithia* and belongs to the same group. It was found in St. Vincent.

Actinopteryx fucicola, Allibert.

Actinopteryx fucicola, Allibert, Rev. Zool. p. 52 (1844).

Three specimens of this insect were found in Grenada by Mr. Smith, and it had previously been taken in the United States by Mr. G. R. Crotch.

A. fucicola is one of the most universally distributed species in existence; it occurs in many parts of Europe, Africa, and America, and although I have not seen any examples from Asia, yet as it is found on the European and African shores of the Mediterranean, there can be little doubt of its existence on the Asiatic coast. This species seems to contradict the common theory of the influence of climate on differentiation, since in my own collection there are specimens from Ireland, where it was first discovered by Mr. Haliday, many parts of England, France, Belgium, Italy, Algeria, Morocco, the Atlantic Islands, North America, and now from the West Indies, which all persistently adhere to the normal type.

Smicrus filicornis, Fairm. et Lab.

Smicrus filicornis, Fairm. et Lab. Fn. Fr. i. p. 330 (1854).

One specimen of this insect was found by Mr. Smith in Grenada. *S. filicornis* has long been known to inhabit both North and South America; in both these regions it was taken many years ago by Dr. Schaum, and has recently been often met with in the United States.

Nephanes meridionalis, Matth.

Nephanes meridionalis, Matth. Trich. Illust. p. 174 (1872).

I described this species in the above work from a single specimen received by M. Sallé from Guadaloupe; in the present collection there are five examples taken in Grenada.

Ptilium Smithsii, sp. n.

L. c. 0·50 mm. Subovatum, convexum, piceum, confertim tuberculatum, haud nitidum; pronoto ad latera rotundato; antennis longis, piceis; pedibus longis, flavis.

P. Smithsii resembles the European *P. Kunzei*, but may be distinguished from that species by the rounded sides of its thorax and elytra and much greater length of its antennæ and legs. Mr. Smith met with several specimens of this insect in Grenada and St. Vincent.

Ptilium tropicum, Matth.

Ptilium tropicum, Matth. Trans. Am. Ent. Soc. xi. p. 144.

Two examples of this exceedingly minute insect were found by Mr. Smith in Grenada. The species was first discovered by Mr. Champion in Central America, and is, with one exception, the smallest of its order.

Ptilium impressum, sp. n.

L. c. 0·63 mm. Elongato-ovale, modice convexum, confertim tuberculatum, rufo-testaceum; pronoto lateribus rotundatis, impressione profunda ovali ad medium atque alia utrinque ad basim notato; pedibus atque antennis brevibus, robustis, flavis.

P. impressum differs from the following species in the shape and sculpture of its thorax and in its short robust legs and antennæ.

One specimen found in St. Vincent.

Ptilium rufotestaceum, sp. n.

L. c. 0·50 mm. Elongato-ovatum, nitidulum, rufo-testaceum, confertissime tuberculatum, fere alutaceum; pronoto ad basim fortiter contracto et triangulariter impresso; antennis longis, gracilibus, atque pedibus læte flavis, oculis magnis, nigris.

This species is distinguished from the preceding by its long slender antennæ and by the sculpture of its thorax, which is strongly contracted at the base.

One specimen found in Grenada.

Ptenidium concinnum, sp. n.

L. c. 0·60 mm. Ovatum, postice attenuatum, nigrum, glabrum, nitidissimum; capite atque pronoto magnis; elytris parvis, angustatis; antennis longis, robustis, atque pedibus lætissime flavis.

Six specimens taken in Grenada and St. Vincent.

This is a very pretty and very distinct species, easily recognized by its shining black colour, attenuated elytra, and large and very bright yellow antennæ. It is very remarkable that no other species of this universally distributed genus should have been found in the West-Indian Islands.

Throscidium invisibile.

Trichopteryx invisibilis, Nietner, Ann. & Mag. Nat. Hist. n. s., xix. p. 378 (1856).

As I have already remarked in my preliminary observations, this very interesting and very peculiar insect seems to be distributed throughout the whole tropic zone, and in all those varied localities constantly to preserve one uniform type. The more or less ochreous tint usually seen in mounted specimens seems to have been produced by desiccation, for in the most recently captured of those which I have examined the life-colour appears to have been a very pale translucent green.

Gumley, Market Harborough,
January 1894.

XXXVII.—*List of Reptiles and Batrachians collected by Dr. J. Bohls near Asuncion, Paraguay**. By G. A. Boulenger.

REPTILES.

Lizards.

1. *Polychrus acutirostris*, Spix.

2. *Liocephalus caducus*, Cope.

Scartiscus caducus, Cope, 1862.
Liocephalus bolivianus, Boulenq. 1890.

* For contributions to the herpetological fauna of Paraguay, *cf.* Cope, Proc. Ac. Philad. 1862, p. 346, and Boettger, Zeitschr. f. Naturw. (4) iv. 1885, pp. 213 and 436.

3. *Tropidurus spinulosus*, Cope.

4. *Ophiodes intermedius*, sp. n.

Intermediate between *O. striatus* and *O. vertebralis*. Scales in 25 or 27 rows, as in the former. Interparietal not broader than the parietals, narrower than the frontal; three large chin-shields on each side in contact with the lower labials. Bronzy above; a fine black vertebral line; a dark brown stripe on each side, occupying one scale and two halves, between two fine black lines, bordered below by a narrower whitish stripe, which is again edged by a black line; dusky lines along the lateral series of scales; belly white; upper lip and loreal region with alternate black and white vertical bars.

From snout to vent 185 millim.; tail 245.

Several specimens.

5. *Tupinambis teguixin*, L.

6. *Centropyx viridistriga*, sp. n.

Vertex concave, bordered by two sinuous ridges beginning on the præfrontals and ending on the occipitals; four supraoculars, first and fourth small, first separated from second by a series of granules; median temporal scales minute, granular; first pair of chin-chields separated from each other by granular scales; gular scales granular, juxtaposed, the median larger, hexagonal, and keeled; collar strongly dentated, formed of 15 keeled scales. Dorsal scales rhomboidal, imbricate, keeled, the keels not forming continuous lines, gradually decreasing in size down the sides, which are covered with minute granules; the dorsal scales moderately large, as in *C. intermedius*. Ventral shields in 10 longitudinal and 35 transverse series. 6 longitudinal series of enlarged keeled brachial scales and 5 of antebrachials. 8 rows of large keeled femoral scales, separated from the femoral pores by very small scales; femoral pores 9 or 10. Præanal region with smooth scales and two large spines on each side (♂). Dark olive above and on the sides; a broad bright green vertebral stripe, extending from the forehead to the base of the tail; three white lines along each side, the upper from the loreal region to the base of the tail, passing on the lower eyelid and above the ear, the next from the upper lip to the base of the tail, passing under the ear, the third from axilla to groin; a black line runs along the upper labials; limbs pale olive; tail green; lower parts whitish, with a few small dark spots on the throat.

	millim.
Total length	250
Head	20
Width of head	9
Body	50
Fore limb	26
Hind limb	45
Tail	180

A single male specimen.

7. *Ameiva surinamensis*, Laur.

8. *Amphisbæna Bohlsii*, sp. n.

Præmaxillary teeth 5, maxillaries 4—4, mandibulars 7—7. Snout rounded, prominent. Rostral moderate, subtriangular, just visible from above; nasals large, shorter than the præfrontals, forming a suture; a pair of large præfrontals, the suture between them as long as that between the frontals and longer than that between the nasals; a pair of frontals, a pair of occipitals, and a pair of postoculars, subequal in size or occipitals largest; eye distinct through the ocular, which is in contact with the second and third labials; no præ- or suboculars; three upper labials, second and third largest; symphysial tetragonal, followed by a large octagonal chin-shield; three lower labials, second largest and followed by a large lateral chin-shield. 232 to 239 annuli on the body and 29 on the tail; on the middle of the body each annulus divided into 36 segments, 18 above and as many below the lateral line, which is distinct; dorsal and lateral segments longer than broad, the median ventrals once and a half to once and two thirds as broad as long. Anal shields 8. Præanal pores 6. Purplish above, whitish beneath, the dark colour forming lines on the anterior borders of the annuli on the sides of the belly and tail.

Length to vent 280 millim.; tail 42; diameter of body 10.

Two specimens.

9. *Amphisbæna Darwinii*, D. & B.

10. *Amphisbæna camura*, Cope.

Præmaxillary teeth 5, maxillaries 4—4, mandibulars 7—7. Snout rounded, prominent. Rostral moderate, subtriangular, just visible from above; nasals large, shorter than the præfrontals, forming a suture; a pair of large præfrontals, the suture between them as long as or longer than that between the frontals; latter one pair, or divided into an anterior and a

posterior pair, followed by small square shields; eye distinct through the ocular, which is in contact with the second or second and third upper labials; no præocular; two postoculars; a subocular sometimes present, detached from the third upper labial; four upper labials, fourth or third and fourth small; symphysial bell-shaped, followed by a heptagonal or heart-shaped chin-shield; three lower labials, second largest and followed by a large lateral chin-shield. 194 to 201 annuli on the body and 19 to 21 on the tail; on the middle of the body each annulus divided into 74 to 80 segments, 36 or 38 above and 38 or 40 below the lateral line, which is distinct; the segments all longer than broad. Anal shields 10 or 12. Præanal pores 4. Purplish brown above, whitish below; a yellowish-white band or collar across the occiput.

Length to vent 420 millim.; tail 40; diameter of body 19.

Several specimens.

11. *Lepidosternum latifrontale*, sp. n.

Præmaxillary teeth 3, maxillaries 2—2, mandibulars 4—4. Snout obtusely pointed, with sharp horizontal edge; rostral large, its posterior border concave and in contact with the frontal, which is very large, at least as broad as long, and entirely or partially fused with the supraocular; no præfrontals; a pair of large parietals, as broad as long or broader than long, sometimes followed by a pair of smaller occipitals; eye more or less distinct; two or three temporals; two upper labials, first largest; symphysial small, four-sided, broader than long, followed by a large chin-shield; lateral chin-shields very small; two lower labials, first very large. 236 to 263 annuli on the body and 13 to 17 on the tail; an annulus contains 56 to 64 segments, 26 to 30 dorsal and 30 to 36 ventral; the segments all longer than broad or the median ventrals as long as broad. Pectoral shields numerous, small, irregular, the largest considerably longer than broad. Præanal shields 6 or 8. Lateral line strongly, vertebral and ventral lines feebly marked. Colourless or pale purplish brown above.

Length to vent 320 millim.; tail 20; diameter of body 12.

Numerous specimens.

12. *Mabuia agilis*, Raddi.

13. *Mabuia aurata*, Gravh.

14. *Mabuia frenata*, Cope.

SNAKES.

15. *Typhlops reticulatus*, L.

16. *Glauconia albifrons*, Wagl.

17. *Drymobius bifossatus*, Raddi.

Coluber pantherinus, Schleg., nec Daud.

18. *Herpetodryas sexcarinatus*, Wagl.

19. *Leptophis liocercus*, Wied.

Bright green above and on the sides, with the margins and keels of the scales black; yellow beneath. Otherwise typical.

20. *Liophis pœcilogyrus*, Wied.

Opheomorphus doliatus, Cope; *Liophis subfasciatus*, Cope.

21. *Xenodon rhabdocephalus*, Wied.

22. *Aporophis lineatus*, L.

Aporophis dilepis, Cope.

23. *Aporophis coralliventris*, sp. n.

Rostral broader than deep, just visible from above; internasals broader than long, shorter than the præfrontals; frontal twice as long as broad, longer than its distance from the end of the snout, a little shorter than the parietals; loreal deeper than long; one præ- and two postoculars; temporals 1+2; eight upper labials, fourth and fifth entering the eye; five lower labials in contact with the anterior chin-shields, which are as long as the posterior. Scales in 17 rows. Ventrals 155; anal divided; subcaudals 71. Olive-brown above, darker along the five median rows of scales, bluish grey on the sides (three rows of scales); head without streaks or markings; upper lip white; throat and anterior ventral region white, rest of belly and tail coral-red, the shields edged with black.

Total length 300 millim.; tail 80.

A single male specimen. This was not obtained at Asuncion, like the rest of the collection, but on an island north of Concepcion, near San Salvador, North Paraguay.

24. *Rhadinæa fusca*, Cope.

Opheomorphus fuscus, Cope.

But for the statement "scales and head-plates without

black borders." I should have identified this form with Cope's *O. Merremii*, var. *semiaureus*.

25. *Rhadinæa genimaculata*, Bttgr.

Liophis genimaculata, Bttgr.

26. *Rhadinæa occipitalis*, Jan.

Enicognathus occipitalis, Jan; *Dromicus Wuchereri*, Gthr.; *Dromicus miolepis*, Bttgr.

27. *Oxyrhopus plumbeus*, Wied.

28. *Oxyrhopus petalarius*, L.

29. *Rhinostoma nasuum*, Wagl.

30. *Leptodira annulata*, L.

31. *Philodryas Schottii*, Schleg.

32. *Philodryas Olfersii*, Licht.

33. *Thamnodynastes Nattereri*, Mik.

34. *Homalocranium melanocephalum*, L.

35. *Apostolepis Dorbignyi*, D. & B.

36. *Elaps lemniscatus*, L.

37. *Leptognathus ventrimaculatus*, Blgr.

38. *Bothrops diporus*, Cope.

39. *Bothrops alternatus*, D. & B.

40. *Crotalus horridus*, L.

CROCODILES.

41. *Caiman sclerops*, Schn.

BATRACHIANS.

1. *Phryniscus nigricans*, Wiegm.

2. *Engystoma ovale*, Schn.

3. *Engystoma albopunctatum*, Bttgr.

4. *Engystoma Muelleri*, Bttgr.

5. *Pseudis paradoxa*, L.

The colour in life, Dr. Bohls informs me, is bright green. Male with an external gular vocal sac.

6. *Pseudis limellum*, Cope.

Male with an external gular vocal sac.

7. *Ceratophrys americana*, D. & B.

8. *Paludicola fuscomaculata*, Stdr.

9. *Paludicola gracilis*, Blgr.

Like the specimens mentioned by Boettger, differing from the types in the absence of the black lumbar spot.

10. *Leptodactylus bufonius*, sp. n.

Tongue subcircular, slightly nicked behind. Vomerine teeth in two long, slightly arched series behind the choanæ. Snout rounded, slightly prominent, longer than the diameter of the orbit; nostril nearer the tip of the snout than the eye; interorbital space narrower than the upper eyelid; tympanum two thirds the diameter of the eye. First finger much longer than second; toes rather short, not fringed; subarticular tubercles moderate; two small metatarsal tubercles; a slight tarsal fold. The tibio-tarsal articulation reaches the tympanum. Upper parts with flat smooth warts of unequal size; no glandular folds; a strong fold above the tympanum; a ventral discoidal fold. Olive above, with small darker spots; a series of lateral warts whitish; no streaks on the head; upper lip with vertical dark bars; limbs with dark cross bars; lower parts white.

From snout to vent 48 millim.

Four specimens.

11. *Leptodactylus ocellatus*, L.

12. *Leptodactylus caliginosus*, Gir.

Cystignathus podicipinus, Cope; *Leptodactylus ocellatus*, part., Bttgr.

13. *Bufo marinus*, L.

14. *Bufo granulosus*, Spix.

15. *Hyla Spegazzinii*, Blgr.

16. *Hyla granosa*, Blgr.

17. *Hyla venulosa*, Laur.

18. *Hyla nasica*, Cope.

19. *Hyla nana*, Blgr.

? *H. bracteator*, Bttgr., nec Hens.

20. *Phyllomedusa hypochondrialis*, Daud.

XXXVIII.—*On a new Species of* Phreatoicus *from Tasmania.*

By George M. Thomson, F.L.S., Corr. Mem. Roy. Soc. of Tasmania.

[Plate XI.]

The specimens described in the following paper were received from Mr. Augustus Simson, of Launceston, who collected them in the Great Lake, Tasmania. This lake lies at an elevation of about 3880 feet above sea-level. Mr. Simson was unfortunately unprovided at the time with suitable material or apparatus for preserving Crustacea; consequently the specimens were put away to dry, and reached me in a more or less mutilated condition.

In a paper on Tasmanian Crustacea* published in the last volume of the Proc. Roy. Soc. Tasm. p. 76, I mentioned having found among specimens taken on the summit of Mount Wellington a single example of *P. australis*, Chilton. There is little doubt that the specimen referred to was merely a young form of the present species. I find that the young of *P. tasmaniæ* resemble the adult form of *P. australis* in the comparative smoothness of the body and the shortness of the telson, while the adults are very distinct, their body being so characteristically spinose and the uropods so much longer.

The occurrence of the three forms of this peculiar genus in the three adjacent and yet widely separated regions of New Zealand, South-east Australia, and Tasmania is of great interest from a geographical point of view; but beyond recording the fact it is not safe as yet to generalize on it, as very little is known concerning the crustacean fresh-water fauna of any of these countries.

The following is a description of this very distinct form:—

Phreatoicus tasmaniæ, sp. n.

Surface of body in the adult specimens more or less covered with acute spines and tubercles, which, on the head and thoracic portion of the body, are particularly numerous on the dorsal surface, and are arranged in two or three rows crossing the segments from side to side. In the abdominal segments they are most abundant on the margins. The females are somewhat smaller and less spinose than the males,

* 'Papers and Proceedings of the Royal Society of Tasmania' for 1892, p. 45.

while in the young the spines and tubercles are almost wanting, there being only a few scattered hairs on the body, as in *P. australis*.

Eyes rounded and prominent, much larger than in the Australian species. First pair of antennæ with peduncle of three joints and a seven-jointed flagellum, the last joint minute. Second pair of antennæ and first pair of legs resembling the same organs in *P. australis*.

Last segment of abdomen ending in a long narrow telson, which is completely coalesced with it and which is furnished with a few spines on its upper surfaces and bears a small tuft of spines and setæ at its extremity.

All the legs are more or less spinose. Sixth and seventh pairs of legs long, reaching as far as or beyond the extremity of the pleon. Uropoda large, reaching beyond the pleon, margin spinose, rami unequal, as long as the peduncle and very acute.

Length of the largest male specimen a little over ½ inch.

Colour of dried specimens light brown or greyish.

In general form this species approximates to *P. australis*, and as the latter has been very fully described by my friend Dr. Chilton, I will make my description conform with his species.

Seen from above the front margin of the head is evenly concave, the rather prominent round eyes being very close to the front and separated by about half the width of the head from one another. These organs are relatively rather large and have from fifty to seventy lenses. Below the eyes is a groove running back nearly to the posterior margin of the cephalic segment, and serving to separate off a distinct, nearly rectangular, lateral lobe. The thoracic and abdominal segments and their epimera on the whole resemble those of the Australian species, only spines replace the setæ. In my dried specimens a spinous ridge occurs close to the anterior and posterior margin of each segment of the thorax. The telson also is a very prominent feature, being quite as long as the segment which bears it. In Pl. XI. fig. 1 the telson appears to be separated from the last abdominal segment by a very distinct articulation; this, however, is due only to the point of view, there being a slight prominence on each side of it, which hides the base in lateral view. In fig. 6 the complete coalescence of the telson with the segment which bears it is seen.

The first pair of antennæ reach to about the middle of the fourth joint of the peduncle of the second pair. The peduncle consists of three joints, of which the second and third are

subequal and are longer and more slender than the first. The flagellum is almost as long as the peduncle and consists of seven joints, the last being very minute.

The second antennæ resemble those of *P. australis*, the flagellum consisting of about twenty joints and somewhat exceeding the peduncle in length.

The upper and lower lips and mandibles appear to be very like those of *P. australis*. Both pairs of maxillæ appear also to approximate very closely to that species, only in the first pair the teeth are smooth in the dried specimens, while in the second pair all the setæ seem to be simple, not pectinate, as those on the first lobe are described by Dr. Chilton.

The maxillipeds differ slightly from those of the Australian form. The epipodites, which act together as a cover to the other mouth-organs, bear two or three long and a number of short spines on their margins. The plate on the basos which stands at right angles to the surface of the rest of the maxilliped, and projects beyond the base of the ischium, is very densely setose along its inner margin. I failed in most of my specimens to detect the three hooked spines which in *P. australis* serve, as Dr. Chilton considers, to keep the two maxillipeds together; but as I have found them in one, I think they must occur in all, only in the others they have probably been broken off, all the parts being in a very dry and brittle condition. The meros is long and slender and bears about seven long setæ at its apex. The rest of the limb is as in *P. australis*, except that there are no setæ on the outer margin of the dactylos, which is quite smooth.

The thoracic legs resemble those of the Australian species. Owing to the condition of my specimens I could not make out the structure of the pleopoda at all satisfactorily.

The uropoda are very strongly developed and reach considerably beyond the telson. The outer ramus is about as long as the basal portion, the inner ramus somewhat longer. The base seems to have a deep longitudinal groove on its upper surface and carries a double row of spines along each edge of this; the rami each bear two or three strong spines on their upper surface and one small seta-like spine near their acute apex.

EXPLANATION OF PLATE XI.

Phreatoicus tasmaniæ.

Fig. 1. Adult male, × 6.
Fig. 2. Head and first pair of antennæ as seen from above, × 26.
Fig. 3. Antenna of second pair, × 15.
Fig. 4. Maxilliped, × 26.
Fig. 5. First thoracic foot, × 20.
Fig. 6. Telson and uropod, × 12.

XXXIX.—*Descriptions of some new Species of Heterocera from Central America.* By Herbert Druce, F.L.S.

Fam. Sphingidæ.

Calliomma, Walk.

Calliomma Zurcheri, sp. n.

Primaries fawn-colour, shaded with olive-green along the costal margin and outer half of the wing; an olive-green band crosses the wing near the base from the costal to the inner margin, and a second band beyond the cell; a row of lunular-shaped olive-green markings extends across the wing from the middle of the inner margin to the apex; the anal angle is slightly irrorated with black scales; the fringe greenish fawn-colour: secondaries brownish black, crossed from near the apex to the anal angle by a wide fawn-coloured band, the outer margin bordered with olive-green, the fringe fawn-colour. Underside of both wings reddish brown, irrorated with black scales, the outer margins grey, the basal portion of the primaries brownish black. Head, collar, tegulæ, thorax, and abdomen fawn-colour shaded with olive-green; antennæ greyish brown.

Expanse 4 inches.

Hab. Costa Rica, Santa Clara Valley, 1200 feet (*F. A. Zurcher*).

A very distinct species, quite unlike any other known to me.

Fam. Agaristidæ.

Euthisanotia, Hübn.

Euthisanotia argentata, sp. n.

Primaries pale fawn-colour, greyish on the outer margin; a wide silvery-white band extends from the base to the apex, crossed by a fawn-coloured line at the end of the cell; the fringe greyish brown: secondaries yellow, broadly bordered from the apex to the anal angle with reddish fawn-colour; the marginal line black, the fringe white. Head and thorax greyish fawn-colour; abdomen pale yellow; antennæ and legs grey.

Expanse 2 inches.

Hab. Mexico, Orizaba (*Mus. Druce*); Guatemala, in the city (*Rodriguez*).

A poor specimen of this species from Santa Domingo is in the National Collection, with a label in Walker's handwriting "*Copusa argentata*," but I cannot find that it has been described.

Fam. **Uraniidæ.**

CORONIDIA, Westw.

Coronidia Beckeri, sp. n.

Female.—Primaries dull blackish brown, crossed from the costal to the inner margin by a number of fine waved black lines; a greyish spot on the costal margin near the apex; the fringe black: secondaries pale yellow; a waved black line crosses the wing below the middle from the costal to the inner margin, the outer margin bordered with fine waved blackish-brown lines. Head, antennæ, and thorax blackish brown, abdomen yellowish.

Expanse 2 inches.

Hab. Mexico, near Durango city (*Becker*).

Fam. **Zygænidæ.**

Subfam. *EUCHROMIINÆ.*

COSMOSOMA, Hübn.

Cosmosoma Zurcheri, sp. n.

Male.—Similar to *Cosmosoma hector*, but with the apical black border slightly wider, the first segment of the abdomen black, and the two anal segments black, spotted with bright dark blue on each side; tibia and tarsus yellow instead of black.—*Female* the same as the male.

Expanse $1\frac{1}{2}$ inch.

Hab. Costa Rica, Santa Clara Valley, 1200 feet (*Zurcher*).

This species is closely allied to *C. hector*, from which it is at once distinguished by the black anal segments of the abdomen.

Cosmosoma pudica, sp. n.

Female.—Primaries and secondaries hyaline, the veins, apex, outer and inner margin of both wings all black, the base of the primaries clothed with pale yellow hairs. Head, antennæ, and legs black, the collar, tegulæ, thorax, and abdomen pale yellow: a small white spot on each side of the thorax; the anal segment and the anus black.

Expanse $1\frac{3}{4}$ inch.

Hab. Costa Rica, Santa Clara Valley, 1200 feet (*Zurcher*).

Fam. **Arctiidæ.**

CYCNIA, Hübn.

Cycnia (?) *raspa*, sp. n.

Male.—Primaries creamy white, the costal margin shaded with yellow; four black lines cross the wing from the costal to the inner margin, the first three near the base, the fourth beyond the cell, the veins beyond the fourth line black; a short black streak at the end of the cell; the fringe yellow: secondaries uniformly pale yellow. Underside of both wings pale yellow, the black lines on the primaries the same as above. The head and thorax yellow, collar and tegulæ white, abdomen yellow; antennæ white, pectination black.—*Female* similar to the male, but larger.

Expanse, ♂ $1\frac{7}{10}$, ♀ $2\frac{1}{10}$ inches.

Hab. Mexico, Teapa in Tabasco (*H. H. Smith*).

IDALUS, Walk.

Idalus dares, sp. n.

Primaries and secondaries semihyaline white; primaries streaked with black at the base on the costal margin beyond the cell, and four rather long black streaks edged with fawn-colour below the cell, the fourth on the inner margin rather above the first three streaks; two black spots on the outer margin nearest the apex. Head, thorax, and tegulæ yellowish white; thorax white, with four very distinct black spots near the middle; abdomen above red, the sides, underside, anus, and a row of spots down the middle white; legs white, spotted with black.

Expanse $1\frac{3}{4}$ inch.

Hab. Costa Rica, Santa Clara Valley, 1200 feet (*Zurcher*).

Fam. **Laparidæ.**

COLOCASIA, Ochs.

Colocasia rhotana, sp. n.

Male.—Primaries grey, crossed about the middle from the costal to the inner margin by a wide broken black band, beyond which are two fine waved black lines, the marginal line black; the fringe grey: secondaries dark greyish black, the fringe white. Head and thorax grey; abdomen blackish grey; legs white, banded with black; antennæ brown.—*Female* almost identical with the male.

Expanse, ♂ $1\frac{1}{2}$, ♀ $1\frac{3}{4}$ inch.

Hab. Mexico, Orizaba (*Mus. Druce*) ; Jalapa (*M. Trujillo*) ; Guatemala, in the city (*Rodriguez*) ; Cahabon (*Champion*).

STILPNOTIA, Westw.

Stilpnotia (?) *dara*, sp. n.

Primaries and secondaries uniformly silky mouse-colour. Head and thorax yellowish brown, the thorax thickly clothed with long yellowish hairs; abdomen brown, banded with yellow ; antennæ yellowish brown.

Expanse $2\frac{1}{2}$ inches.

Hab. Mexico, Orizaba (*Mus. Druce*).

One specimen.

Fam. **Drepanulidæ.**

TROGOPTERA, Herr.-Schäff.

Trogoptera sao, sp. n.

Male.—Primaries and secondaries orange-brown, the costal margin of the primaries and a faint line crossing the wing from the costal to the inner margin pinkish brown. Antennæ, head, thorax, and abdomen yellowish brown.

Expanse $1\frac{3}{4}$ inch.

Hab. Costa Rica, Rio Susio (*Rogers*).

Trogoptera rumina, sp. n.

Male.—Primaries and secondaries citron-yellow ; primaries with two small spots close to the base on the costal margin, one close to the apex, and a streak at the anal angle all greyish white ; the anal angle is shaded with fawn-colour : secondaries crossed below the middle by an indistinct broken white line of small spots ; the inner margin and anal angle slightly shaded with pinkish fawn-colour ; the fringe greyish white. Head, thorax, and abdomen pale pinkish fawn-colour ; antennæ pale brown.

Expanse $1\frac{3}{10}$ inch.

Hab. Panama, Volcan de Chiriqui, 2000 to 3000 feet (*Champion*).

Fam. **Notodontidæ.**

PHYA, Druce.

Phya dela, sp. n.

Male.—Primaries pale fawn-colour, the costal margin from the base almost to the apex shaded with reddish brown, with

two small black streaks close to the apex; a wide reddish fawn-coloured band extends down the middle of the wing from the base to the outer margin; the anal angle shaded with dark reddish brown; the fringe pale fawn-colour: secondaries creamy white, slightly darker along the inner margin; a small brown spot at the anal angle; the fringe cream-colour. Underside of both wings creamy white, the costal margin of the primaries shaded with dark brown. Head, antennæ, and thorax dark reddish brown, the tegulæ dark grey; abdomen fawn-colour; legs reddish brown.

Expanse 2 inches.

Hab. Mexico, Orizaba (*Mus. Druce*); Jalapa (*M. Trujillo*).

Allied to *P. laciniosa*, H. Edwards, from which it is at once distinguished by the central reddish fawn-coloured band on the primaries.

Phya salona, sp. n.

Male.—Primaries pinkish fawn-colour, shaded with brown along the inner margin from the base to the anal angle; a submarginal black waved line extends from the apex along the outer margin almost to the anal angle, and then partly crosses the wing towards the base; the outer margin pale yellowish fawn-colour, with two very fine marginal black lines: secondaries white, the costal and inner margin fawn-colour. Antennæ, head, and thorax brownish fawn-colour; abdomen fawn-colour.

Expanse 2 inches.

Hab. Mexico, Coatepec (*Brooks*).

NOTODONTA, Ochs.

Notodonta (?) *dares*, sp. n.

Male.—Primaries dark blackish brown, the veins all darker; a narrow black streak extends from the base to the end of the cell: secondaries dark brown, the fringe pale brown. Head, thorax, and abdomen dark blackish brown, the collar and front of the tegulæ black; antennæ dark brown.

Expanse 2 inches.

Hab. Mexico, Orizaba (*Mus. Druce*).

Notodonta (?) *pythia*, sp. n.

Male.—Primaries fawn-colour, with a pinkish shade over the basal half of the wing, a mark on the costal margin near the base, a streak from the base extending partly across the wing, the veins, and a rather wide line above the anal angle all reddish brown; the fringe reddish fawn-colour: secondaries

pale greyish brown, the fringe fawn-colour. Head, collar, and tegulæ fawn-colour, thorax and abdomen dark brown, antennæ brown.—*Female* very similar to the male in marking, but very much paler in colour.

Expanse, ♂ $2\frac{1}{10}$, ♀ $2\frac{1}{2}$ inches.

Hab. Mexico, Orizaba (*Mus. Druce*).

Heterocampa, Doubl.

Heterocampa daona, sp. n.

Primaries greyish brown, shaded with pink at the base and partly along the costal margin; a greyish-white band crosses the wing about the middle, beyond which is an ill-defined eye-like spot: secondaries white, the inner and outer margins and fringe grey. Head, thorax, and abdomen greyish brown; antennæ brown.

Expanse 2 inches.

Hab. Mexico, Orizaba (*Mus. Druce*).

Heterocampa (?) *crossæa*, sp. n.

Male.—Primaries dark brown, palest near the anal angle, crossed from the costal to the inner margin beyond the middle by several narrow waved pale greyish-brown lines; the fringe pale brown: secondaries white, with a large dark brown square-shaped spot at the anal angle. Head and thorax brown, tegulæ pale greyish brown, abdomen greyish brown.

Expanse $1\frac{3}{4}$ inch.

Hab. Mexico, Orizaba (*Mus. Druce*).

Heterocampa sagana, sp. n.

Primaries from the base to the middle of the costal margin grey, the outer half of the wing fawn-colour, the inner margin and a large marking beyond the cell thickly irrorated with green scales; the fringe brown: secondaries uniformly pale reddish fawn-colour. Head, thorax, and tegulæ grey; abdomen fawn-colour, with a central black line from the base to the anus; antennæ dark brown.

Expanse $1\frac{1}{2}$ inch.

Hab. Mexico, Teapa in Tabasco (*H. H. Smith*).

Dasylophia, Pack.

Dasylophia? *danala*, sp. n.

Male.—Primaries dark brown, crossed from the costal to the inner margin by narrow waved black lines; a reddish-

brown spot at the end of the cell and a waved pale brown submarginal line extending from the apex to the anal angle; a marginal row of small black dots, those nearest the apex are the largest; fringe dark brown: secondaries blackish brown, the base, inner margin, and fringe pale yellow. Head, palpi, antennæ, and thorax dark brown; abdomen brown above, yellowish on the underside; legs yellow.—*Female* very similar to the male, but larger and with the base of the secondaries much darker.

Expanse, ♂ $2\frac{1}{10}$, ♀ $2\frac{3}{10}$ inches.

Hab. Costa Rica, Volcan de Irazu, 6000 to 7000 feet (*Rogers*); Panama, Volcan de Chiriqui, 2000 to 3000 feet (*Champion*).

This species is allied to *D. lignicolor*, Möschler.

Drymonia, Hübn.

Drymonia procas, sp. n.

Male.—Primaries pale fawn-colour; a wide pinkish-white band extends down the middle of the wing from the base to the costal margin; a silvery-white curved line extending from the base almost to the anal angle; the outer margin broadly bordered with pinkish white: secondaries white. Head, antennæ, and thorax fawn-colour; abdomen greyish white.

Expanse 2 inches.

Hab. Brazil, Cabo (*Forbes*).

Harpyia, Ochs.

Harpyia dandon, sp. n.

Male.—Primaries and secondaries white; primaries blotched with black along the costal margin, at the apex, and on the inner margin; the fringe alternately black and white. Head and collar yellow; antennæ and front of thorax black; thorax, side and underside of the abdomen, and anus white, the upperside of the abdomen black.

Expanse $1\frac{3}{4}$ inch.

Hab. Mexico, Jalapa (*M. Trujillo*).

Hatima, Walk.

Hatima deba, sp. n.

Primaries fawn-colour, shaded with reddish brown at the base and along the inner margin almost to the anal angle: secondaries pale brown; the fringe of both wings fawn-

colour. Head and thorax greyish brown; antennæ and legs brown; abdomen pale yellowish brown.

Expanse 1½ inch.

Hab. Mexico, Jalapa (*M. Trujillo*).

NYSTALEA.

Nystalea sabella, sp. n.

Primaries silvery grey, clouded with yellowish brown at the base and along the inner margin; an indistinct brown line crosses the wing beyond the middle from the costal to the inner margin, beyond which are two rows of small black dots; the fringe yellowish brown: secondaries greyish brown, palest at the base. Head, antennæ, and thorax pale brown; abdomen darker brown; legs yellowish brown.

Expanse 2½ inches.

Hab. Mexico, Orizaba (*Mus. Druce*).

Subfam. *Apamides*.

CELÆNA, Steph.

Celæna datis, sp. n.

Primaries greyish black, with a spot close to the base, two beyond the cell, and a marginal row of spots extending from the apex to the anal angle all reddish brown; the fringe alternately black and white: secondaries brownish hyaline, the veins and outer margin darker brown. Head, thorax, and abdomen dark greyish black, thickly irrorated with reddish-brown hairs.

Expanse 1 inch.

Hab. Mexico, Jalapa (*M. Trujillo*).

HYDRŒCIA, Guen.

Hydræcia pyrrha, sp. n.

Primaries dark reddish brown, irrorated with paler brown and greyish scales; a fine silvery-white streak at the end of the cell; the costal, outer, and inner margins narrowly edged with greyish white: secondaries pale brown, the veins and outer margin darker; fringe pale brown. Head, antennæ, thorax, and abdomen dark brown.

Expanse 1¼ inch.

Hab. Guatemala, near the city (*Rodriguez*).

PANAMERIA, Hübn.

Panameria rhea, sp. n.

Primaries dark brown, with a narrow submarginal grey line extending from the apex to the anal angle; the fringe dark brown: secondaries black, crossed about the middle from the costal margin almost to the inner margin with a wide orange-yellow band; the fringe yellowish brown. Head, thorax, and abdomen black.

Expanse 1 inch.

Hab. Mexico, near Durango city (*Becker*).

MAMESTRA.

Mamestra rhadata, sp. n.

Primaries very dark brown; a small spot in the cell and one at the end of the cell black; two fine waved black lines cross the wing from the costal to the inner margin, the first near the base, the second beyond the middle; a rather large reddish-brown spot close to the anal angle; the fringe dark brown: secondaries brown, whitish hyaline near the base. Head, thorax, and abdomen dark brown; antennæ and palpi brown.

Expanse 2 inches.

Hab. Mexico, Orizaba (*Mus. Druce*).

Fam. **Noctuidæ.**

AGROTIS.

Agrotis daunus, sp. n.

Primaries greenish stone-colour; three small black dots on the costal margin and a larger one close to the apex; a narrow dark brown line, edged with black on the inner side, crosses the wing beyond the middle from the costal to the inner margin just above the anal angle, a second narrow brown line crosses the wing nearer the base; the wing is clouded with dark brown on the inner margin; a marginal row of small black dots extends from the apex to the anal angle; the fringe alternately black and stone-colour: secondaries pearly white, the marginal line black; the inner margin and the fringe stone-colour. Head and collar brown; thorax stone-colour; abdomen brown; the anus pale brown.

Expanse 2¼ inches.

Hab. Mexico, Orizaba (*Mus. Druce*).

Very distinct, but allied to *A. semidolens*, Walker.

ANTACHARA, Butl.

Antachara (?) *superba*, sp. n.

Male.—Primaries pale pea-green, the costal margin with three small V-shaped dark brown spots, the largest about the middle; from the middle of the cell a wide reddish-brown marking extends to the outer margin and the apex; a silvery-white line partly crosses the wing about the middle; the fringe reddish brown: secondaries pearly white, the marginal line and fringe pale brown, the inner margin clothed with fawn-coloured hairs. Head, collar, and tegulæ pale pea-green; thorax, abdomen, and legs fawn-colour; antennæ and palpi dark brown.—*Female* very similar to the male, but not quite so distinctly marked.

Expanse, ♂ $2\frac{1}{10}$, ♀ $2\frac{3}{10}$ inches.

Hab. Costa Rica, Santa Clara Valley, 1200 feet (*F. A. Zurcher*); Ecuador, Sarayacu (*Buckley*).

Two males from Ecuador and a female from Costa Rica are all I have seen of this very distinct species.

Subfam. *ACONTIINÆ*.

ACONTIA, Ochs.

Acontia dela, sp. n.

Primaries bright orange-yellow, crossed from the costal to the inner margin with five narrow zigzag black lines; a pale yellow spot edged with black in the cell; the fringe alternately black and yellow: secondaries black, the fringe yellow and black. Underside of both wings blackish brown. Head and thorax dark yellow; abdomen, antennæ, and legs blackish brown.

Expanse $1\frac{1}{4}$ inch.

Hab. Mexico, near Durango city (*Becker*).

DACIRA, Walk.

Dacira roma, sp. n.

Primaries white, the base broadly black; a dentated black band crosses from the costal margin to the anal angle; the outer margin greyish: secondaries hyaline white. Head white; thorax reddish brown; abdomen greyish brown, the base white; antennæ black.

Expanse 1 inch.

Hab. Mexico, Jalapa (*M. Trujillo*); Guatemala, in the city (*Rodriguez*).

PLUSIA, Ochs.

Plusia roxana, sp. n.

Primaries pale greyish brown; a pale greyish streak extends from the base of the wing nearest the inner margin, below which is a reddish-brown spot; a greyish-white line crosses the wing from the apex to the inner margin; on the outer side of the line is a large triangular-shaped reddish-brown marking, the point of which just crosses the white line; the fringe pale brown: secondaries pale greyish brown, darkest round the outer margin; the fringe pale brown. Head, thorax, abdomen, and legs pale greyish brown; antennæ dark brown.

Expanse $1\frac{1}{2}$ inch.

Hab. Mexico, Jalapa (*M. Trujillo*).

TRISULODES, Butler.

Trisulodes pata, sp. n.

Primaries greyish brown, crossed from the costal to the inner margin by several waved black lines; a round grey spot in the cell, beyond which is a pale grey band, widest near the costal margin; a wide black streak near the anal angle; the fringe alternately black and grey: secondaries pale yellow, broadly bordered with dark blackish brown from the apex to the anal angle. Head and thorax dark grey; abdomen black.

Expanse 2 inches.

Hab. Guatemala, in the city (*Rodriguez*).

Fam. **Ophiusidæ.**

OPHIODES, Guen.

Ophiodes daona, sp. n.

Primaries pale yellowish fawn-colour, slightly irrorated with minute black specks; the fringe yellow: secondaries blackish grey, the fringe yellow. Head, thorax, and abdomen the same colour as the primaries; antennæ dark brown.

Expanse $2\frac{1}{4}$ inches.

Hab. Mexico, Orizaba (*Mus. Druce*).

Ophiodes raphia, sp. n.

Primaries pale greyish mouse-colour; a spot at the end of the cell and a row of small spots beyond crossing the wing

from the costal to the inner margin dark brown; three black spots close to the apex, the marginal line with black points: secondaries pale mouse-colour, almost white at the base; the fringe pale yellowish brown. Head, thorax, and abdomen greyish mouse-colour.

Expanse 2 inches.

Hab. Mexico, Orizaba (*Mus. Druce*).

HERMINODES, Guen.

Herminodes sabata, sp. n.

Primaries very pale fawn-colour; a small spot at the base, a dot in the cell, and a large comma-shaped marking at the end of the cell all reddish brown; a star-shaped brown spot near the base on the inner margin: secondaries blackish brown; the fringe of both wings pale fawn-colour. Head and thorax fawn-colour; abdomen and antennæ brown.

Expanse $2\frac{1}{4}$ inches.

Hab. Mexico, Orizaba (*Mus. Druce*).

XL.—*On Two new Chinese Rodents.*

By OLDFIELD THOMAS.

IN working out some mammal-skins recently presented to the British Museum by Mr. F. W. Styan the two following new forms prove to need description.

The first, a squirrel, is really Mr. Styan's own discovery, as he had long recognized it as distinct from the ordinary Chinese species *S. castaneoventris*, Gray, and had sent specimens of it to the Museum as long ago as 1886. Without better material I have not until now thought myself justified in describing it as new; but the specimens lately received prove the constancy of its characters so fully that I have no longer any hesitation in distinguishing it.

Sciurus Styani, sp. n.

Allied to, and in the upper view scarcely distinguishable from, *S. castaneoventris*, Gray, but with the coloured surface of the belly a peculiar reddish cream-colour ("pinkish buff" of Ridgway) instead of the rich rufous ("orange-rufous") of the older known form. This difference is extremely striking, and, as shown by the dates of the specimens before me, is not due to seasonal variation. Limbs and tail coloured as in the allied form.

Skull slightly smaller than that of *S. castaneoventris*, but not differing materially in shape.

Dimensions of the type (B. M. 86. 10. 28. 5), an adult female, in skin * :—

Head and body (c.) 219 millim., hind foot 47.

Skull: basal length 42·5; greatest breadth 28·5; nasals, length 14·7, interorbital breadth 15·1; palate, length 24·5; diastema 11·1; length of upper tooth-series ($\frac{p.4}{}$ to $\frac{m.3}{}$) 9·0.

Hab. Kiang-su province, extending south to Hang-chow.

Type from "between Shanghai and Hang-chow," probably Kahing, where some of the other specimens were collected. One individual also comes from the Lushan Hills, Kiu-Kiang.

Mr. Styan tells me that this species is very common in the flat mulberry districts of Southern Kiang-su, and does not overlap *S. castaneoventris*, which is only found south of the Hang-chow Gulf, in Che-Kiang and Fokien, and only occurs in the hills and not in the plains.

The two species differ therefore both in their habits and distribution. Nor has Mr. Styan ever seen any specimens that appeared to be intermediate between them.

The second species is a member of the genus *Lepus*.

In December 1866 Mr. Robert Swinhoe obtained in Chefoo, N. China, two skins of a hare which he at first supposed to be new, but afterwards, apparently misled by a wrongly labelled specimen in the Pekin Museum, referred to and fully described as *Lepus tolai*†, by which name it has become known to Chinese sportsmen. A comparison with undoubted specimens of *L. tolai*, however, shows that this Chefoo hare is really a quite different species, which therefore still requires a name; and I would propose for it, as only just to its discoverer, that of *Lepus Swinhoei*.

Taking as the type Swinhoe's Chefoo specimen, B. M. 70. 7. 18. 16, I may briefly say that externally it is at once distinguished from *L. tolai* by its far deeper and richer coloration, which is, both on back and sides, a handsome cinnamon or clay-colour (*Ridgway*), while *L. tolai* is approximately "cream-buff." The tail is also markedly longer, but agrees in colour, very black along the top, white on the sides and below. For further external details Mr. Swinhoe's description (p. 449) may be referred to.

The skull of *L. Swinhoei* is wholly different from that of

* Of a spirit-specimen (♀):—Head and body 197 millim.; tail without hairs 162; hind foot 48·7; ear 19.

† P. Z. S. 1870, pp. 431, 449, and 639.

L. tolai, having nothing of the peculiarly flat elongated muzzle and narrow pointed nasals of that species, and need not be further compared with it. It is characterized by a short, broad, and heavy muzzle, an arched and vaulted nasal region, and a rather narrow interorbital space (see measurements below). In some ways its nearest counterpart is that of my *Lepus coreanus* *; but that has less arched, shorter and (anteriorly) broader nasals, and a much broader interorbital space.

Measurements of the type, an adult skin:—

Head and body (c.) 500 millim.; tail without tuft 75; ears (contracted) 83; hind feet 110.

Skull: tip of nasals to lambda (back of parietal suture) 83; greatest breadth 40; nasals, length in middle line 32·5, greatest length 39·6; breadth anteriorly 14, posteriorly 19·5; interorbital breadth 17·7; intertemporal breadth 13·4; distance from postorbital notch to tip of nasals 55; height of nasal region, from palatal bridge to nasion, 24; diastema 25·3; length of palatine foramina 23·5, combined breadth of ditto 11; least breadth of palatal bridge 6·2; breadth of posterior nares opposite $\frac{m.^3}{}$ 9·5: lower jaw, back of condylar process to front of bone between incisors 66·6; lower diastema 18·7.

Hab. Chefoo, N. China. Coll. R. Swinhoe, Dec. 1866.

From *L. manchuricus*, Radde, as from *L. sinensis* and *L. coreanus*, this species is readily distinguishable by its long black and white tail, while its differential characters from *L. tolai* have been sufficiently noted above.

XLI.—*Preliminary Description of a new Goat of the Genus* Hemitragus, *from South-eastern Arabia.* By Oldfield Thomas.

Hemitragus Jayakari, sp. n.

Much smaller than *H. jemlaicus* or *hylocrius*. Fur harsh and shaggy, much elongated on the nape and withers, and also lengthened below the angle of the lower jaw and on the upper arms and thighs, the hairs on these two latter places hanging down so as to form a sort of ruff round the arms and legs. Hairs of upper surface from nose to tail directed backwards, not reversed forwards on nape as in the Thar.

General colour of body a pale sandy or brownish white,

* *Lepus sinensis coreanus*, Thos. Ann. & Mag. Nat. Hist. (6) ix. p. 146 (1892).

the lengthened hairs of the mane broadly tipped with black; upper surface of muzzle, sides of chin, and tail deep black, blackish markings also present on cheeks, back of ears, and on metacarpo- (and tarso-) phalangeal joints. Elsewhere the limbs are pale-coloured, while the belly is nearly white. Chest with a naked glandular patch. Knees naked and callous. No interdigital glands. Mammæ 2 *, as in *Capra* and in *Hemitragus hylocrius*.

Skull showing a closer relationship to that of *H. jemlaicus* than to that of *H. hylocrius*, but readily distinguished from it by its much smaller size, narrower and more convex forehead, broader and shorter nasals, which are expanded posteriorly so as to nearly fill up the prefrontal vacuities, and by the different direction of the parietal plane, which slants upwards at an angle of 45° instead of being nearly vertical.

Horns approximately of the same form and direction as those of *H. jemlaicus*, but rather longer in proportion, far slenderer (their basal circumference only 137 millim., as against 230 millim., both old males), and their surface, especially along the anterior angular ridge, smoother and less nodulose.

Dimensions of the type (B. M. 94. 3. 9. 11), an old male, measured in skin:—

Snout to root of tail (approximate) 1100 millim., tail about 25 or 30; hind foot, from heel to base of hoof, 191; ear from notch (measured when moistened) 100, its breadth 53.

Skull: gnathion to occiput 218; greatest breadth 109; nasals, length 61, greatest breadth 27; gnathion to orbit 133; forehead, breadth outside bases of horns 61; palate-length 113; length of upper molar series 59.

Horn: length round curve 295; greatest basal diameter 59, least ditto 29.

Hab. Jebel Taw †, S.E. Arabia.

Two adult male specimens of this striking novelty were collected by Dr. A. S. G. Jayakar on Nov. 7, 1892, and have been presented by him with a set of other mammals to the British Museum.

* At least in the male.

† I cannot find this mountain in any map available to me; but it is probably one of the constituent parts of the Jebel Akhdar range, just behind Muscat, which attains an altitude of nearly 10,000 feet.

XLII.—*On the Palawan Representative of* Tupaia ferruginea.

By Oldfield Thomas.

The British Museum has received from Mr. A. Everett some *Tupaia* skins from Palawan, and these, although apparently referable to the species *T. ferruginea*, Raff., are sufficiently different from *T. ferruginea typica* to demand subspecific separation. The Bornean representative of *T. ferruginea* has already * been found to be distinct from the typical Sumatran one; but, curiously enough, that from Palawan, an island very closely connected faunistically with Borneo, does not show any special approximation to the peculiar long-footed form there found.

Tupaia ferruginea palawanensis, subsp. n.

Similar in size, proportions, and general characters to the typical variety, not long-footed as in subsp. *longipes*. General colour above darker brown (bistre, *Ridgway*). Ears, fingers, and toes blackish. Tail bushy, the terminal halves of the hairs deep shining black, which makes the tail when viewed from above appear wholly of this colour; their basal halves, most visible from below, annulated with black and orange. Under surface yellowish olive (approximately "tawny olive" of Ridgway), brighter and clearer on the chest.

Skull very similar to that of Raffles's type specimen of *ferruginea*, but the muzzle is somewhat narrower, the orbits smaller, and the frontal profile more flattened.

Dimensions of the type, an adult skin, ♂ (B. M. 94. 2. 1. 3) :—

Head and body 208 millim., tail 177, hind foot 43·2.

Skull: basal length 47; greatest breadth 26·6; nasals, length 15·6, interorbital breadth 15, intertemporal breadth 16; palate, length 28·7, breadth outside $\frac{m.1}{}$ 16·3, inside $\frac{m.1}{}$ 8·4; front of $\frac{i.1}{}$ to back of $\frac{m.3}{}$ 28.

Hab. Palawan. Coll. A. Everett.

In a young specimen, apparently of the same subspecies, collected in Palawan by Mr. E. L. Moseley during the Steere expedition to the Philippines (B. M. 91. 11. 28. 1), the tail, so characteristically black in the adults, is finely freckled with orange above as well as below. There is also a very faint and inconspicuous amount of the same freckling in an adult female example.

* *T. ferruginea longipes*, Thos. Ann. & Mag. Nat. Hist. (6) xi. p. 343 (1893).

BIBLIOGRAPHICAL NOTICE.

Foraminifera from the Deep-sea Soundings obtained in 1874–1876 *by H.M.S. 'Gazelle.'* Described by Dr. Joseph George Egger, &c. 4to. 266 pages, with a Chart and 21 full pages of figures in the text. Munich, 1893. [*Foraminiferen aus Meeresgrundproben, u. s. w.* Abhandl. k. bayer. Akad. Wiss. II. Classe, xviii. Band, II. Abth. pp. 195–458.]

In this Memoir about 160 "Stations" whence the specimens were procured are enumerated, with particulars of their localities, nature of mineral materials, and relative proportion of minute organisms, especially the Foraminifera, pp. 6–23 (198–215). The line of occurrence of these places, the dates when obtained by the 'Gazelle,' and their depths are traceable on the block-map at page 5 (197),—from off Spain, down the Atlantic, round the Cape of Good Hope, across the Indian Ocean to South-west Australia, and then northwards to and through the Eastern Archipelago, down to New Zealand, thence away across the Pacific towards Cape Horn, then off to the South-east coast of South America, and lastly in the Mid-Atlantic, 3° 26′·7 S. lat., 25° 59′·2 W. long. (Paris), not far, W. by S., from Station "25."

Of the Foraminifera treated of at pages 6–248 (198–440) there are 493 species, of which only 44 are new, besides some new varieties. A Table of these Foraminifera, showing their localities and depths, is given at pages 249–261 (441–453); and their 1271 figures, printed by the Meisenbach-Riffarth photo-chemical zinc process, occupy 21 full pages in the text.

Although very closely crowded in these plates, rough in appearance and not so artistically neat and finished as in many modern illustrations of Foraminifera, yet the figures give very truthfully the characteristic features of these Microzoa; and, indeed, the closely packed condition gives the observer the advantage of a *coup d'œil*—recognizing at a glance the natural features of specific or generic groups—such as of *Biloculina* and *Spiroloculina* in plate 1, 54 figs., p. 26 (218); *Miliolina*, pl. 2, 86 figs., p. 35 (227); *Textularia* &c., pls. 6 and 7, 52 and 56 figs., pp. 76 and 85 (268 and 277); *Bulimina*, *Bolivina*, and *Virgulina*, pl. 8, 112 figs., p. 90 (282); *Polymorphina*, *Uvigerina*, and *Siphonogenerina*, 65 figs., p. 114 (306); *Lagena* &c., pl. 10, 101 figs., p. 128 (320); *Nodosaria* &c., pl. 11, 62 figs., p. 146 (338); *Cristellaria* &c., pl. 12, 42 figs., p. 157 (349); *Globigerina* &c., pl. 13, 83 figs., p. 164 (356); *Anomalina* &c., pl. 14, 42 figs., p. 185 (377); *Discorbina* and *Patellina*, pl. 15, 79 figs., p. 192 (384); *Truncatulina*, pl. 16, 64 figs., p. 206 (398); *Pulvinulina*, pl. 17, 45 figs., p. 214 (406). The specimens have been figured on an approximately proportional scale, and their actual dimensions are given with the descriptions in the text. An important drawback to the value of the illustrations is their small and cramped numbers of reference, always inconspicuous and sometimes difficult to decipher.

In the descriptions, as in the illustrations, economy of space has been very closely studied. All details of nomenclature that could at all be spared have been omitted, and only clues, as it were, are given to synonymy and the origin of names. H. B. Brady's 'Challenger' Report, 1884, is referred to throughout, with all the species except those that are new and some few others; the nomenclature being given very curtly and left to be worked out from the 'Challenger' Report, for by far the most part, and from the works of d'Orbigny, Reuss, Gümbel, Schwager, Silvestri, Moebius, Schlumberger, and a few other authors of species or genera occurring here and there in the Memoir, with bare reference only to monograph or memoir. Rhizopodists, however, have to be thankful to the Bavarian Academy for having printed and published this important monograph, though limiting the Author to so imperfect a method of nomenclature.

Dr. Egger especially acknowledges the kind help and counsel he has received from Dr. C. W. von Gümbel, of Munich, in the furtherance of his work *.

The distribution of Foraminifera, as indicated by the results of Dr. H. B. Brady's study of those brought home by the 'Challenger,' is throughout referred to in addition to Dr. Egger's determination of those obtained by the 'Gazelle;' and the long Table of the distribution of the species at pp. 249–261 (441–453), and particularly the notes on the eight zones of depth, at pp. 262–265 (454–457), supply important additions to our knowledge of the hydrographical and bathymetrical range of the Foraminifera. The long Table referred to gives the relative abundance or scarcity of the several species at a glance, owing to the relative abundance or sparseness of the figures in the columns carrying the numbers of the Stations. The eight zones, each taking 100 metres of depth, reaching to 6000 metres, with the several stations where they were met with successively enumerated, give the proportionate occurrence of individual Diatoms, Radiolarians, Ostracods, and Foraminifera for the Stations, and the numerical value of the species of the last for the zones of depth. Thus in the fifth zone (from 2000 to 2999 metres) there were 16 species of *Globigerina*, 11 *Pulvinulina*, 9 *Truncatulina*, 6 *Lagena*, 5 *Bolivina*, 4 *Discorbina*, and some others. In the 6th zone (3000 to 3999 metres), with a very great abundance of individuals, the number of species was relatively small—18 *Globigerina*, 13 *Lagena*, 11 *Pulvinulina*, 9 *Truncatulina*, 5 *Miliolina*, 4 *Biloculina*, with *Discorbina*, *Virgulina*, *Bolivina*, &c. In the 7th zone (4000 to 4999 metres) there were only 11 species of *Globigerina*, 9 *Pulvinulina*, 3 *Rotalina* (*Rotalia*), with *Lagena* and *Virgulina*. In the deepest (8th) zone (from 5000 to 6000 metres) the species were represented by 16 of *Globigerina* and 9 of *Pulvinulina*.

* The mineral and geological conditions of the Ocean-bed, as shown by the Soundings obtained by the 'Gazelle,' are fully treated of by Dr. von Gümbel, &c., &c., in the Second Part (Physics and Chemistry, 1888) of the "Forschungsreise S.M.S. 'Gazelle.'" 5 vols., 4to, Berlin, 1888–90.

Dr. Egger's views of the specific relationship of the Foraminifera are liberal. Following Brady for the most part, he fully recognizes that "varieties" are here little more than individual modifications of the "species," and that these, not widely separate one from another, often coalesce, leaving non-essential features as sufficient characteristics for convenience of grouping and registration. With all their capability of adapting themselves to varying conditions, and their consequent extreme plasticity of form, they yet possess a well-recognized fixity of type. Dr. Egger's abundant figures of individuals grouped by certain alliances of form and structure offer strong confirmation of this, and will be of great use both to the Student who wishes to become acquainted with this Protozoan series and to the more advanced Biologist who might wish to have at hand some comprehensive illustrations of typical Foraminifera.

This memoir is a very valuable addition to foregoing monographic descriptions of these interesting and cosmopolitan Protozoa. We are sure that the Author's having chosen to work on the lines of Brady's 'Challenger' Report will be of advantage in securing some uniformity in the treatment of the "genera" and "species" among the many would-be rhizopodists of to-day, who are bewildered with the almost endless varietal forms of the creatures themselves and with the complicated synonymy with which they have been overloaded.

MISCELLANEOUS.

On the Dates of Sowerby's 'Genera of Recent and Fossil Shells.'

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

Gentlemen,—Considerable trouble has been caused by the difficulty of fixing the dates of the separately published parts of this book: and a recent request from Mr. W. H. Dall, of Washington, for exact information has led me to investigate the matter. The book was published at intervals between 1822 and 1834(?); forty-two parts were issued, the contents of which have been given by R. B. Newton, who was the first to print a collation of "The Genera" in his Syst. List Edwards Collection (Catal. Brit. Mus.), 1891, p. 321. These contents were taken from a set of original wrappers, of which only two are dated, preserved in the Natural History Museum.

In the course of my research I have been delighted to find, through the courtesy of Mr. Harting and Mr. Kappel, the original MS. Donation Books of the Linnean Society between 1822 (end) and 1840, in a perfect condition. These manuscript records are priceless for bibliographic purposes, as they show every appearance of careful recording. Many periodicals have also been ransacked, particularly Férussac's 'Bulletin des Sciences Naturelles,' section ii., 1824–31, the 'Zoological Journal,' 1824–34, &c., by Mr. Newton, Mr. J. Saunders, and myself; but the evident exactness of the Donation Book of the Linnean Society permits its quotation as sufficient authority for those portions of the work it refers to.

['The Genera' was announced as a forthcoming work in the 'Annals of Philosophy,' Oct. 1821, p. 318.]

Parts 1–9.	1822.	Trans. Linn. Soc. xiii. (1822) p. 631.
10.	„	No record.
11.	„	Linn. Soc. Donation Book: received Jan. 1, 1823.
12.	1823.	„ „ „ Feb. 3, „
13.	„	„ „ „ Mar. 21, „
14.	„	„ „ „ Apr. 4, „
15.	„	„ „ „ June 3, „
16.	„	„ „ „ July 31, „
17.	„	„ „ „ Aug. 20, „
18.	„	„ „ „ Sept. 1, „
19.	„	„ „ „ Oct. 11, „
20.	„	„ „ „ Nov. 29, „
21.	„	„ „ „ Jan. 3, 1824.
22.	1824.	„ „ „ Mar. 27, „
23.	„	„ „ „ June 3, „
24.	„	No record (but reviewed in Zool. Journ., Jan. 1825, p. 573).
25.	1825.	Linn. Soc. Donation Book: received Mar. 30, 1825.
26.	„	„ „ „ Nov. 8, „
27.	1826.	„ „ „ Jan. 12, 1826.
28.	„	„ „ „ June 28, „
29.	1827.	„ „ „ Apr. 17, 1827.
30.	1828.	„ „ „ Apr. 11, 1828.
31.	„	„ „ „ Dec. 22, „ [Erroneously entered as part 33.]
32.	1831.	Linn. Soc. Donation Book: received Feb. 4, 1831.
33.	„	„ „ „ Mar. 2, „
34.	„	„ „ „ Apr. 4, „
35.	„	„ „ „ May 5, „
36.	1832.	„ „ „ Jan. 4, 1832. [Specified as "*London*, 1832."]
37.	„	Linn. Soc. Donation Book: received Mar. 19, 1832.
*38.	1832?	[This part contains *Placunanomia*, described in Proc. Zool. Soc. 1832, p. 28 (April †).]
*39.	1833?	[This part contains *Solenella*, described in Proc. Zool. Soc. 1832, p. 197 (March 1833).]
*40.	1833?	[This part contains *Cumingia*, described in Proc. Zool. Soc. 1833, p. 34 (May 1833).]
*41.	1834?	
*42.	1834?	[This part contains *Lottia*, described in Phil. Trans. 1833, p. 800 (read June 13th, published later in 1833).]

[N.B.—Mr. W. H. Dall writes to me (Feb. 14, 1894) as follows:—"No. 1 (first edition) was sent out in 1820 with a prospectus. A pause then ensued before it was decided by Sowerby to go on with it. Nos. 1 and 2 appeared, with a better printed text for No. 1, late in 1820, which subscribers were requested, on the cover, to use instead of that first issued."]

C. Davies Sherborn
(Index gen. et spec. anim.).

Natural-History Museum,
Cromwell Road, S.W.

* All received by Linn. Soc. May 11, 1837.

† See Proc. Zool. Soc. xxx. 1893, p. 436 (dates of 'Proceedings').

Contributions to the Knowledge of the Antennary Sense-Organs of Insects. By C. M. Child, of the Zoological Institute, Leipzig University.

After being occupied for some months in studying the larvæ and pupæ of *Mochlonyx* [*Corethra*] *culiciformis*, Deg., and *Corethra plumicornis*, F., in the laboratory of Privy Councillor Leuckart, my attention was directed to a singular organ at the base of the antenna in these insects. Upon further investigation it has been found that the structure in question is a highly developed sense-organ, an organ which, as I gradually learnt, is not only present in the Nematocera, but is also of fairly frequent, if not of universal, occurrence in the most widely different orders of insects.

The literature upon the subject I found to be very scanty, and for the most part out of date and incomplete. On account of its structure and position the organ was regarded by Johnston* as having an auditory function. Mayer† performed certain experiments with living gnats, which confirm rather than refute this view. Weismann‡ has studied the development of the organ, but leaves the question as to its function entirely undecided. Hurst§ gives a very inexact and partly incorrect description of the structure of the organ, and agrees with Johnston and Mayer in regarding it as auditory.

Moreover, as I convinced myself in the course of my investigations, the organ in question is possessed not only by the gnats, but also by all Diptera, so far as I have examined them. This general occurrence among the Diptera induced me to investigate other orders of insects, and here also I have found a similar structure in a corresponding position.

With reference to this a few words may be said as to the structure of the organ in the case of a common wasp (*Vespa vulgaris*), which perhaps may serve as an introduction to the knowledge of the other forms. In the wasp the structure lies in the small second joint of the antenna, through the middle of which run the main antennary nerve and a tracheal stem. At the end of the first joint the nerve gives off fibrils on all sides, which run obliquely towards the periphery of the second joint, there to enter into connexion with ganglion-cells. These ganglion-cells are also connected with long rod-like structures, which run as far as the arthrodial membrane between the second and third joints, where they apparently enter into small pores in the membrane and there end. Into each of these pores or small tubes enters a little group of these structures, which I will here term rodlets (Stäbchen).

* Johnston, "Auditory Apparatus of the *Culex* Mosquito," Journal of Microscopical Science (Old Series), vol. iii. 1855.

† Mayer, "Researches in Acoustics: Paper no. 5," 'Philosophical Magazine' for December 1874, p. 513.

‡ Weismann, "Die Metamorphose von *Corethra plumicornis*," Zeitschr. f. wiss. Zool. xvi. Bd.

§ Hurst, "The Pupal Stage of *Culex*," Inaug. Dissertat. Leipzig, 1890.—"On the Life-History and Development of a Gnat," Transactions of the Manchester Microscopical Society, 1890.—"The Post-embryonic Development of *Culex*," Proceedings of the Liverpool Biological Society, vol. iv.

Between the rodlets in their course towards the arthrodial membrane lie here and there small bodies, which contain chromatin; these are probably nuclei, but whether they belong to supporting cells or to other cells of a nervous nature is a question which for the present may be left undecided. On the outside of the antenna there is neither a sensory seta nor any other appendage corresponding to the ends of the rodlets, and the pores appear to be closed at their outer ends. In no other joint of the antenna of the wasp have I been able to find a trace of this structure or of one resembling it. I at first thought that perhaps some relation might exist between this organ and the rod-bearing sense-organs, or scolopophores, which (according to the statements of Graber, von Leydig, and others) occur in the antennæ. A closer investigation, however, proved this supposition to be erroneous.

In the genera *Melolontha* (Coleoptera), *Epinephele* (Lepidoptera), *Bombus* (Hymenoptera), *Pachyrhina*, *Tabanus*, *Syrphus*, *Helophilus*, *Musca*, *Sarcophaga* (Diptera), *Sialis*, *Panorpa*, *Phryganea* (Neuroptera), and *Libellula* (Pseudoneuroptera) the organ exhibits on the whole the same structure as in the case of the wasp.

Among the Hemiptera I have so far only examined the Homoptera. Here the organ is but slightly developed. The ganglion-cells and rodlets are present in small numbers, and are also situated at the end of the second joint, which is not materially different from the other joints.

Among the Orthoptera the genera *Periplaneta*, *Locusta*, and *Stenobothrus* have in the second joint of the antenna a structure which is provided with ganglion-cells and long fibre-like rodlets.

I have hitherto had no opportunity of examining the Thysanura.

The organ undergoes a further development in the Culicidæ and Chironomidæ (Diptera), in which, as is well known, the antennæ are different in the two sexes. At the base of the antenna is an almost spherical joint, which is larger in the male than in the female. Within this joint is a very complicated organ of a nervous nature, in the structure of which, especially in the case of the female, an unmistakable similarity to the organ above described is recognizable. In the female the rodlets, instead of entering into pores, terminate towards a plate of chitin, upon the centre of which stands the long antenna. The very large antennary nerve runs chiefly into the ganglion-cells of the organ, but gives off two relatively small cords, which run through the centre of the large joint into the other segments. The ganglion-cells pass without a sharp division into those of the brain. The rodlets are delicate and provided with small nuclei, which are rich in chromatin. In the male the structure is very complicated, and, moreover, different in the Culicidæ and Chironomidæ. It does not easily lend itself to description in a few words and without figures, but I would here remark that this form is also readily traceable to the general type.

The organogeny I have so far studied only in the Culicidæ and Chironomidæ. For the general development of the antennæ in these insects I would refer the reader to the papers of Weismann and Hurst, already quoted. I will merely add that the entire organ is formed from a fold at the base of the invaginated sac of hypodermis,

and that the differentiation of the rodlet- and ganglion-cells takes place very early.

With reference to the function of this organ in general I am firmly convinced that it does not belong to the category of the so-called olfactory organs of the antenna. I think that my investigations prove that the nerve-endings are situated in such a way that each movement of the distal portion of the antenna, whether in consequence of pressure or tension (Zerrung), must cause a stimulus to be imparted to them. As has been determined by numerous observations and experiments, many insects exhibit with their antennæ a reaction to sound.

It is true that in many instances these observations are not free from error; but in spite of this it appears to be very probable that, at any rate in the case of many insects, an auditory organ is connected with the antenna. In my opinion the organ which I have investigated may be the auditory organ in question. It was, moreover, years ago regarded as such in the case of the Nematocera.

The presence of an organ of this nature in the Orthoptera might perhaps tell against this view, since these insects besides these structures also possess others, the tympanic organs, which are usually regarded as an auditory apparatus. Nevertheless I will here merely recall the experiments of Graber*, who found that Orthoptera, even after the excision of the tympanic organs, were still sensitive to sound, and moreover exhibited the reaction with their antennæ, in certain cases also with the legs.

It appears to me that this organ, if susceptible to very small sound-movements, is also stimulated by coarser shocks, *e.g.* by contact of the antenna with a solid object; in short, that in this case there is no sharp distinction between auditory and tactile sensation.

Since it was impossible for me to foresee that the investigation would extend so far, I collected but little fresh material during the past summer, and was later on prevented from acquiring more in consequence of the advanced season of the year. I intend, however, to ascertain precisely the range of this organ, and to determine its function if possible by experiment. The results of these investigations I purpose to treat in greater detail in a subsequent paper.—*Zoologischer Anzeiger*, xvii. Jahrg., No. 439, February 5, 1894, pp. 35–38.

Researches on the Structure, Organization, and Classification of the Fossil Reptilia.—Part IX. Section 1. *On the Therosuchia.* By H. G. Seeley, F.R.S.

This paper discusses the classification of reputed Permian and Triassic Reptilia which have been referred to the Anomodontia as Theriodonts.

Lycosaurus, as the genus placed first on Sir R. Owen's list, is accepted as the type of the Theriodontia. The species *Lycosaurus*

* Graber, "Ueber die Tympanalsinnesorgane der Orthopteren," Denkschr. der k. Akad. zu Wien, nat.-wiss. Theil, 1876; and other papers.

curvimola is regarded as the type of the genus, being the only species in which its characters are fully shown. *Galesaurus planiceps*, which was the type of the Cynodontia, is probably distinct from *Nythosaurus larvatus*, and from Sir R. Owen's second type of *Galesaurus planiceps* of 1887, which is referred to as *Thrinaxodon liorhinus*. *Aelurosaurus felinus* agrees with *Galesaurus* in having a transverse development of bones of the palate, regarded as palatine and transverse, which abut toward the inner side of the lower jaw. The palate in this genus is found to be covered with groups of small teeth with conical crowns, which are unknown in *Lycosaurus*. The palate of *Lycosaurus curvimola* is found and described in the type specimen. It shows a transverse development of the palatine arch abutting against the lower jaw, behind which is a long compressed sphenoidal keel flanked by narrow pterygoid bones. The occipital condyles do not appear to be prominently developed in *Lycosaurus*. The genus is regarded as the type of a division of the Theriodontia, defined by having the molar teeth pointed and without cusps. A snout from Tamboer, named *Pristerognathus polyodon*, is referred to this group. It is characterized by six incisor teeth in each premaxillary bone and three incisor teeth in each ramus of the mandible, followed by canine teeth and small molars of Lycosaurian type.

Professor Cope's definition of the Theriodontia as distinguished from the Anomodontia by characters of the post-orbital arch is regarded as unsupported by evidence. The author would limit the Theriodontia to animals which conform to Sir R. Owen's original definition based on the dentition (1876), and have temporal vacuities and a small quadrate bone. It would then include the Lycosauria, with type *Lycosaurus curvimola*; the Cynodontia, with *Cynognathus crateronotus* (sp. n.) and *Thrinaxodon liorhinus* as types; and a group of South-African Reptiles named Gomphodontia, based upon new genera *Gomphognathus* and *Trirachodon*, which have the molar teeth with flattened cuspidate crowns more or less worn with use. The palate is formed on the type of *Lycosaurus* in these Theriodontia.

Gorgonops is closely allied to Theriodonts in its dentition (though no molar teeth are known). The skull is closed behind as in *Kistecephalus*, and the temporal vacuities are roofed. It appears to show a palate formed on the same plan as in Theriodontia so far as its transverse development is concerned, but it has not any hard palate extending above the posterior nares as in Theriodontia. It is regarded as the type of a distinct group, named Gorgonopsia.

The Parciasauria have the same transverse palatine arch, abutting against the lower jaw, but not developed downward to the same extent, as in Theriodontia. Its hard palate appears to be carried back behind the teeth, so that the posterior nares are further back than in the Theriodontia. It differs from the Theriodontia in the slight development of the coronoid process of the lower jaw, and in having the temporal vacuities roofed; and from the Gorgonopsia in having the skull open behind, and in having no canine teeth.

The Endothiodont type is believed to show the transverse descending palatal arch between the rami of the mandible. *Pristerodon* is regarded as possibly Endothiodont; and *Endothiodon uniseries* is

made the type of a genus *Esoterodon*. A small skull from Molteno Pass, *Cryptocynodon simus* (sp. n.), is regarded as an Endothiodont with imperfectly-developed canine teeth The Endothiodontia have no incisor teeth, have the hard palate imperfectly developed, and no coronoid process to the lower jaw.

Another South-African group is regarded as indicated by *Delphinognathus*, *Tapinocephalus*, and a new genus named *Dinocephalus*, which has the largest tusks known in any South-African genus, associated with small molars. In the typical genera the skull-bones are very thick and the temporal vacuities small. *Elurosaurus* is probably to be placed in this group. It is referred to as Dinocephalia.

Thus there is a series of groups of South-African Reptilia which appear to agree in having a palate which has some resemblances to Mammals but approximates to *Sphenodon*, Lizards, and Crocodiles. All these sub-orders are combined as the Therosuchia. In this order or group may be included the Deuterosauria from the Permian rocks of Russia.

The Deuterosauria is distinguished from the Theriodontia by having palato-nares which open by oval vacuities on a concave surface instead of behind a hard palate. The transverse palatine arch is not developed downward. The sphenoidal region is at an angle with the palate, and in the same plane with the occiput.

Finally, the names given by Professor Cope to allied American types are examined. It appears that the Theromora as hitherto used is a synonym of the Anomodontia, though it might be conveniently limited to the American types, which appear to be distinct from those of Africa and Europe. But it is not possible to use either that name or the names Pelycosauria or Cotylosauria till the characters of the groups they indicate are adequately defined by good characters.

The relation of the Therosuchia to other Anomodontia is shown in the following grouping :—

ANOMODONTIA.

- THEROSUCHIA.
  - Pareiasauria.
    - Procolophonia.
  - Gorgonopsia.
  - Dinocephalia.
  - Deuterosauria.
  - Theriodontia. { Lycosauria. / Cynodontia. / Gomphodontia. }
  - Endothiodontia.
  - [Theromora.]
- THEROCHELONIA.
  - Dicynodontia.
  - Kistecephalia.
- MESOSAURIA.

—*From the Proceedings of the Royal Society.* (Communicated by the Author.)


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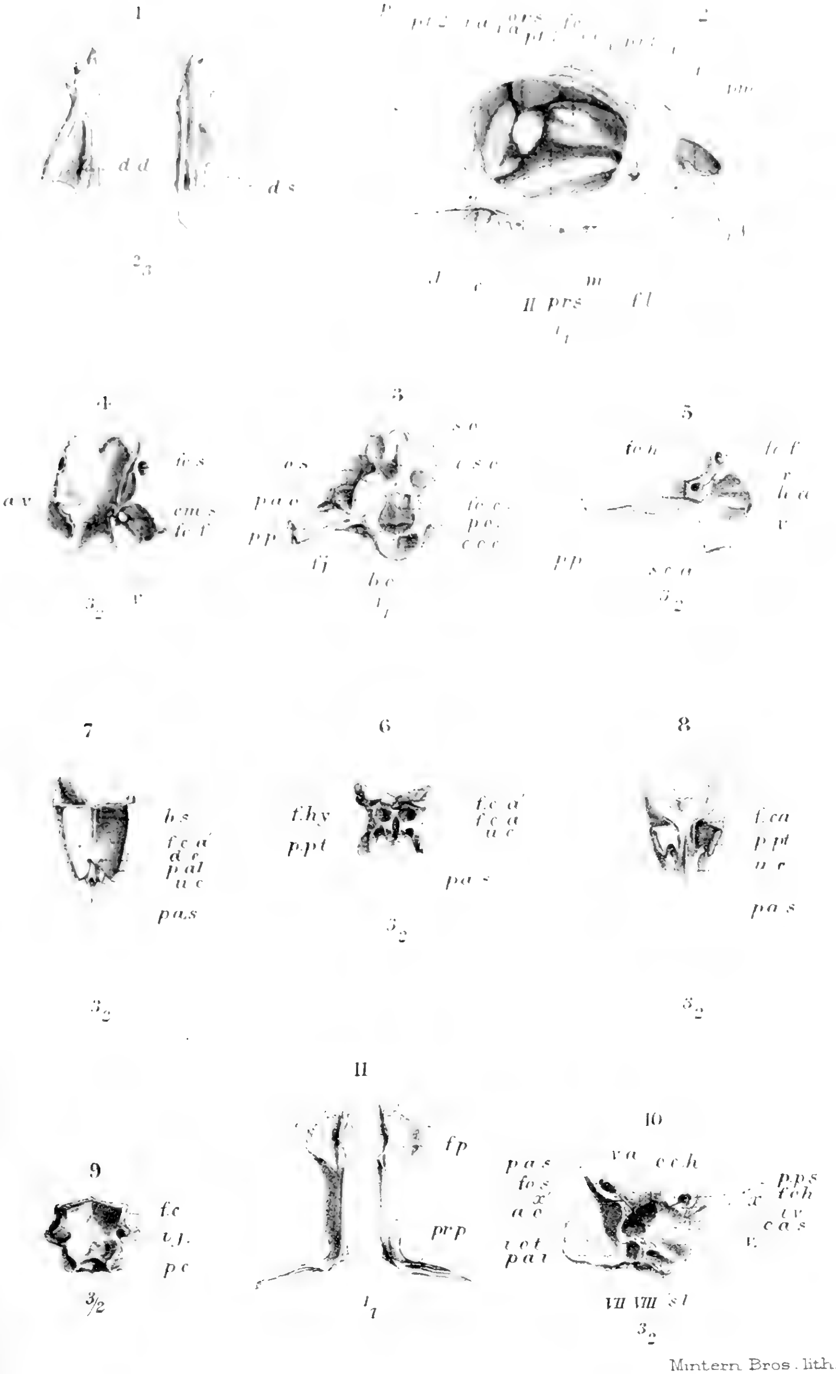

Mintern Bros. lith.

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XLIII.—*On the* Tenebrionidæ *of Japan*.

By G. Lewis, F.L.S.

[Plate XIII.]

On the 28th January, 1874, Marseul read a paper on the Heteromera of Japan before the Entomological Society of France, and after a lapse of rather over two years it was published in the 'Annales' of the Society. Marseul's material consisted chiefly of specimens gathered near Nagasaki and Hiogo, and contained about fifty species of Tenebrionidæ. Since 1876 a few isolated notices of new species have been published, which, with the new species here described, bring the number known from the Japanese islands to 125. As isolated notices of species are not always easy to find, I have given in the list of species at the end of this paper the date of the 'Zoological Record' in which notices of such species may be found. The Munich Catalogue serves up to 1870.

The collection of Coleoptera in the National Museum has been recently enriched by the addition of two important collections of Heteromerous beetles, one formed by Mr. F. Bates, the other by the late Mr. F. P. Pascoe. My visits to South Kensington have in a large measure made the task of determining the genera of my species an easy one; and when at times I have failed there, I have had the kindly assistance of Mr. C. G. Champion, who has lately written on

the Heteromera for the 'Biologia,' a work which involved an exhaustive research in the literature of the family. My own collection of Tenebrionidæ scarcely includes 500 species, and is insufficient to work upon, while my acquaintance with the family as a whole is very limited.

The European genera which are most remarkable in containing Japanese species are *Amarantha*, *Arrhenoplita*, *Corticeus*, *Platydema*, *Scaphidema*, and *Bolitophagus*; the last genus contains *B. reticulatus*, L., the only species not associated with commerce which has been found in Japan, Siberia, and the British Islands. The most salient feature of the species of this series is that so many belong to oriental, tropical, and subtropical genera, such as *Atasthalus*, *Byrsax*, *Ceropria*, *Hemicera*, *Setenis*, *Thydemus*, *Eucyrtus*, *Tetraphyllus*, *Basanus*, and *Ischnodactylus*; and I think this may be accounted for by the fact that the Coleopterous fauna of tropical Asia contains a very large proportion of Heteromerous beetles. This proportion consists, not, as in Europe, of genera such as *Helops*, *Pimelia*, *Blaps*, and *Asida*, each of which contains perhaps a hundred species, but of genera in which the species are limited in number, and therefore, taken as a whole, are species with great diversity of habit and capable as such of thriving under more varying conditions; and these in Japan, with its enormous forests, are exceedingly favourable to insect-life.

During the spring of 1882 I collected 1620 species of Coleoptera in Ceylon, of which 104 pertain to the Tenebrionidæ; this is in very much larger proportion to those found in Japan, which, at a rough calculation for the larger figure, are as 125 to 4500. But in 1881 I left the southern island of Kiushiu on the 3rd of June, before the heat of summer and heavy rains set in, and I missed seeing that year many of the subtropical species which emerged from the pupal state in July and August. Some of these species are *Hemicera zigzaga*, *Notiolesthus foveolatus*, *Thydemus purpurivittatus*, *Strongylium japanum* and *Marseuli*, and I think that there can be but little doubt that if a collection of Coleoptera were made in the provinces of Higo and Satzuma during and after the rainy season, the discovery of novelties of this subtropical class would be considerable. But lest it should be supposed that the tropical element is a very strong one, a glance at the list of species will show that the tropical genera, such as *Eucyrtus*, are represented by only one small species, while in the tropics the species of *Eucyrtus* are very numerous.

Phellopsis suberea, Lew. (Pl. XIII. fig. 1.)

Phellopsis suberea, Lew. Ent. xx. 1887, p. 219.

Hab. Yuyama and Chiuzenji. Found on a boletus attached to a large deciduous oak. Twenty specimens.

Blaps japonensis, Mars.

Leptocolena japonensis, Allard, Ann. Soc. Ent. Fr. (5) x. 1880, p. 320; ibid. 1882, p. 133, fig. 125.

The type of this species is in the Bates collection in the British Museum; Marseul placed the species in *Blaps*, and in 1880 Allard founded a subgenus to receive it; but his name has not been accepted by European entomologists.

Hab. "Japan" (*Bates*). I did not meet with it.

MICROPEDINUS, gen. nov.

The characters of this genus are for the most part the same as those of *Cabirus*, Mulsant, and the two small species for which it is established resemble somewhat *C. minutissimus*, Muls. The distinctive differences of *Micropedinus* are that the forehead is not emarginate anteriorly, as in *Pedinus* and *Opatrum*; the elytra are punctate, not striate, and in the male the tarsi on the anterior and intermediate tibiæ are transverse and very wide, the second and third joints being the widest. The tarsi in the female are as wide as those of the male of *C. minutissimus*, Muls. If European entomologists do not consider these characteristics sufficient to found a genus on, my name will serve for *Cabirus*, as Mulsant's name was occupied by Hübner in Lepidoptera as early as 1816.

Micropedinus algæ, sp. n.

Piceus vel niger, parum nitidus, supra punctatus; elytris haud striatis; antennis pedibusque dilutioribus.
L. $4\frac{3}{4}$–$5\frac{1}{4}$ mill.

Piceous or nearly black, somewhat shining; the head and thorax very distinctly punctate, punctures dense at the sides, rather less closely set on the disks; the scutellum is transverse and rounded off posteriorly at the sides; the elytra, bases punctured like the disk of the thorax, but on the middle of the dorsum to the apices the punctures gradually become

less distinct and less circular in outline, and each bears a single grey hair between the punctures, the surface is microscopically granulate; the legs, tibiæ in both sexes are dilated after the manner of a *Pedinus*, but the male has the second and third joints of the tarsi on the anterior and intermediate feet very wide and transverse, as stated above.

Hab. Kobé. Abundant under seaweeds on the sandy sea-coast.

Micropedinus pallidipennis, sp. n.

M. algæ simillimus, sed piceus vel brunneus; elytris pallidis, ♀ tibiis anticis haud dilatatis.
L. $3\frac{3}{4}$–4 mill.

This species is extremely similar to the last, but it is smaller, and the elytra are generally pale in colour. Sometimes the whole insect is of a light brown colour, but there is a variety in which the dorsal area is dark. Structurally it differs from *M. algæ* in the antennæ being shorter with the articulations more compressed, in the thorax being less transverse, and, above all, in the anterior tibiæ in the female not being dilated near the tarsi.

Hab. Kobé. Associated with *M. algæ*.

Opatrum expansicolle, sp. n.

Nigrum, opacum, supra granulatum; thorace lato, marginibus explanatis; elytris tenuiter punctato-striatis.
L. 11–$11\frac{1}{2}$ mill.

Dull black, opaque, granulate; the head widened and thickened before the eyes, emarginate anteriorly; the thorax explanate laterally, edge rounded off from the anterior angle nearly to the base, posterior angles slightly turned outwards; the elytra, striæ when visible fine and punctate, in many examples the striæ are obsolete, interstices granulate like the head and thorax; the antennæ, two basal joints pitchy red.

This species differs from all in this series in the shape of the thorax.

Hab. Kiga, Kobé, Arima, and on Maiyasan.

Opatrum orarium, sp. n.

Atrum, opacum, oblongo-ovatum, granulatum; capite securiformi, ante oculos angulato; elytris obsolete striatis.
L. 10 mill.

Densely black, opaque, oblong-oval, granulate above; the head emarginate anteriorly, angles before the eyes prominent, giving the head a hatchet-shaped outline; the thorax transverse, wholly arched at the sides from one angle to the other, bisinuate at base; the elytra obsoletely striate; the antennæ and legs black, claws palish.

The shape of the head is a distinctive character in this species; otherwise it is very similar to, but larger than, *O. japanum*, Motsch.

Hab. Kobé. One example.

Opatrum persimile, sp. n.

O. japano simillimum, sed thorace post caput semicirculari et tibiis anticis dilatato-compressis.

L. 9 mill.

This species is extremely like *O. japanum*, Motsch., but the surface-sculpture is not so coarse, the thorax has a semicircular outline behind the head, and the posterior angles are small and slightly turned outwards and more acute; the anterior tibiæ are gradually widened from the base, a little thickened on the inner surface, and emarginate at the tarsal end between the point of the insertion of the tarsus and the outer edge. In *O. japanum* and all the other species of this series the tarsal end of the fore tibia is cut out on the outer edge; in this species it is not.

Hab. Miyanoshita or Odawara.

Opatrum coriaceum, Motsch.

In the male the hind tibiæ are denticulate on the inner edge, like those of *O. recticolle*.

Hab. Yokohama (very common on the beach), Odawara, and Kiga.

Opatrum recticolle, Motsch.

Opatrum sexuale, Mars.

There is a remarkable sexual character in this species not noticed by Marseul; the hind tibiæ for two thirds of their length are obtusely denticulate on the inner edge.

Hab. Kobé, Sannohe, Shirakawa, and in countless multitudes on the plain of Fujisan in the early days of May.

Opatrum villigerum (Blanch.).

Opatrum villigerum, Blanch. Voy. Pôle-Sud, iv. p. 154, t. x. fig. 15.
Mesomorphus villiger, Miedel, Deutsch. ent. Zeitschr. 1880, p. 40; Fairm. Ann. Soc. Ent. Belg. 1894, p. 20.

This species was originally described from Australia, where Mr. J. J. Walker has also recently found it. I have met with it in Ceylon.

Hab. Kobé. I found three examples on the sandy sea-beach.

Idisia ornata, Pasc.

Pascoe records this species from Mantchuria, but I think this locality should be received with caution, as the captor, Dr. Adams, did not label his captures, to say the least, systematically, and he collected during the same voyage on the west coast of Japan.

Hab. Enoshima and Niigata. Abundant on the sand-hills.

Phaleria Riederi (Fald.).

Diaperis Riederi, Fald. Bull. Mosc. 1833, p. 57, t. iii. fig. 8; Lew. Ent. 1893, p. 151 (for synonomy see list).

Phaleria subhumeralis, Mars.

Hab. Hakodate. Abundant on the sand-hills surrounding the harbour.

Epiphaleria, gen. nov.

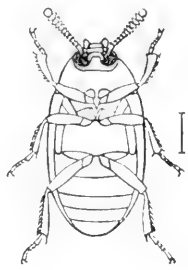
I propose this genus to receive some eastern species that it does not seem desirable to retain in *Phaleria*. The species differ from *Phaleria* (type *P. cadaverina*, F.) in having a small head, large eyes, which approach each other on the underside of the head; the mesosternum is a broad plate, as broad in the middle as half its width, widely separating the posterior and intermediate coxæ; the second and third joints of the tarsi in the males are scarcely dilated and the fifth joint of the antenna is nearly as large as the sixth. The outline of the body is an elongate oval. The underside of the type, *E. atriceps*, is given in woodcut, fig. 1. *Phaleria pusilla*, Boh., from Hong Kong, belongs to this genus, and there are two species found in Ceylon.

Epiphaleria atriceps, sp. n. (Woodcut fig. 1.)

Elongato-ovata, testacea, capite nigro subtilissime punctulato; thorace elytrisque nigro-ornatis.
L. 4–4½ mill.

Elongate-ovate, testaceous, shining; the whole of the upper surface is seen under the microscope to have a fine and clear mosaic-like sculpture; the head black, with an extremely fine punctuation; the thorax, disk dark brown, with a linear fovea well marked opposite the fourth elytral stria; the scutellum triangular, wide at the base; the elytra finely punctate-striate, interstices flat, punctulate like the head, dorsal area dark brown, the pattern on interstices 3 and 5 is prolonged posteriorly in most examples; the antennæ, legs, and mouth-organs testaceous.

Fig. 1.



Hab. Enoshima and Niigata. Under seaweed.

[*Note.*—The following species is common on the sea-beach at Colombo and Galle, in Ceylon :—

Epiphaleria pallida, sp. n.

Oblong, testaceous, eyes alone black; the head clearly punctulate; the thorax with an extremely fine punctuation and linear fovea similar to that of *E. atriceps*; the elytra punctate-striate, striæ near the suture finest, interstices impunctate; the abdominal segments are slightly infuscate; the antennæ and legs concolorous. The mosaic-like sculpture is only seen under the microscope on the thorax.
L. 6–6½ mill.]

Trachyscelis sabuleti, sp. n.

Piceus, nitidus, supra lævis; thorace rufo-piceo; antennis testaceis; pedibus brunneis.
L. 3–3¼ mill.

Piceous, shining, smooth above, hairy beneath; the head and thorax impunctate; the scutellum microscopically strigose, somewhat triangular but bulging out laterally; the elytra clearly and evenly punctate-striate, interstices with a

few transverse lines at rather wide intervals, sutural interstice sometimes reddish; the antennæ are much paler than the legs.

I think the form of the scutellum may be a good specific character in this species. It is similar to *T. tenuistriatus*, Fairm., but it is smaller, narrower, and the dorsal striæ are better defined, and it also resembles the European *T. aphodioides*, Germ.

Hab. Enoshima. Occurs under seaweed on sandy shores.

Bolitophagus felix, sp. n. (Pl. XIII. fig. 2.)

Oblongus, subparallelus, picco-brunneus, subnitidus; capite securiformi, angulis utrinque valde productis; thorace post oculos emarginato; elytris costatis, costis multo interruptis.
L. 9–10 mill.

Oblong, somewhat parallel at the sides, dark brown; the head securiform, remarkably angulate outside the eyes, rugosely punctate, with transverse crescent-shaped line before the eyes; the thorax channelled in the middle, disk tuberculate on either side and rugosely punctate, lateral margins explanate, transversely rugose, edges feebly crenate, strongly emarginate behind each eye; the elytra, lateral margin narrowly elevated, edges uneven, striate-punctate, interstices with broken costæ, third costa strongest and least interrupted; the antennæ reddish brown; the legs darker, tibiæ carinate and angulate before the tarsi.

Hab. Nagasaki. Found in April in a small boletus, *Polyporus lucidus*, Fr., a species of wide distribution in the northern hemisphere, growing on *Pinus massomana*, S. & Z. (Kuro-matzu). The boletus gives out a strong pungent smell in early summer, and may be discovered by it; the beetles scoop out the centre and live in the hollow in companies of six or eight. *Trogosita japonica*, Reit., was found associated with it in the *Polyporus*.

Bolitophagus pannosus, sp. n.

B. interrupto similis, sed brevior et latior; antennis rufo-brunneis.
L. 4½ mill.

Oblong-oval, black, opaque, rugosely sculptured; the head somewhat transverse, anterior edge narrowly and feebly raised, angulate before the eyes; the thorax with a narrow median granulate channel, and the disks on either side of it tuberculate, lateral margin explanate, edges crenate; the elytra, sutural interstice with a feeble row of tubercles, second inter-

stice tubercles larger, third carinate at the base, tuberculate posteriorly, 4 to 6 similarly tuberculate, between the tubercles are numerous small nodules which apparently represent the striæ; the antennæ dull reddish brown, joints 8 to 10 markedly transverse; the legs darker, tibiæ carinate, tarsi reddish.

This species resembles *B. interruptus*, Ill., in the sculpture of the elytra, but it is much shorter and relatively broader and the joints of the antennæ are much more transverse and less lax.

Hab. Oyayama. One example, April 26th, 1881.

Atasthalus, Pasc.

Atasthalus, Pasc. Ann. & Mag. Nat. Hist. 1871, viii. p. 348.

Type *A. spectrum*, Pasc.

This genus resembles *Bolitophagus* more than *Bolitoxenus*. In the first the eleventh joint of the antenna is free of the tenth, in *Atasthalus* the tenth joint is incised to admit the base of the terminal joint. In *Bolitoxenus*, type *B. gibber*, Motsch., the articulations of the antenna are more compressed and the prosternum has a keel. In the Munich Catalogue, p. 1946, the genus *Bolitoxenus* includes *B. testudinarius*, Motsch., and *B. tuberculifer*, Motsch.; these two species belong to the genus *Byrsax*, in fact the last name is only a synonym of *Byrsax horridus*, Ol. *Bolitoxenus bifurcus*, Pasc., should be placed in *Bolitonœus*.

Atasthalus dentifrons, sp. n. (Pl. XIII. fig. 3.)

Oblongus, subparallelus, niger vel nigro-brunneus, opacus; fronte margine 4-dentata; thorace cornibus duobus validis, parum brevibus, rectis.
L. 9½–12 mill.

Oblong, rather parallel, black or dull blackish brown; the head, frontal margin reflexed and with two prominent teeth in the middle and two others less conspicuous over the bases of the antennæ; the thorax, lateral edge lirate, surface very rough with frequent tubercles, with two robust median horns, long enough to cover the base of the antennæ from view when seen from above, tips covered with golden or reddish hairs; the elytra parallel at sides, rough, with a few polished tubercles on what are apparently the third and fifth interstices; the striæ are represented by irregular punctures; the antennæ and legs dull brown, tibiæ carinate, not narrowed near the tarsi; the last segment of the abdomen is rugose,

not punctate. The female differs in the head being wider, the frontal dentation merely remaining in outline, and the thorax has coarse and rugose protuberances without hair in the place of horns. In some small males the thoracic horns almost disappear, but a nodule with red hairs indicates their places.

Hab. Hakone and Nikko. Common in boleti on beeches in May.

Atasthalus bellicosus, sp. n. (Pl. XIII. fig. 4.)

Breviter ovalis, nigro-brunneus, rugose sculpturatus; fronte haud dentata; thorace cornibus duobus elongatis subparallelis vel parum obliquis.
L. 7–9 mill.

Shortly oval, dull blackish brown; the head rugose, punctate, frontal margin arched in outline, edge roughened, not dentate; the thorax lirate and arched at the sides, surface rough with frequent tubercles, two median horns, sometimes parallel to each other, sometimes obliquely turning inwards, projecting in well-developed specimens half their length beyond the head, apices with tufts of red hairs; the elytra with tubercles on the third and fifth interstices well marked and not irregular, seventh interstice with tubercles less defined, between the tubercles are irregular rows of punctures; the antennæ and legs dull brown, tibiæ carinate, narrowed near the tarsi; the last segment of the abdomen is coarsely punctate. The female is similar to the male, except that the thoracic horns are represented by large protuberances. Some examples are densely squamous.

A small variety or species, *A. incurvatus*, occurs very commonly, in which the horns of the male are short and incurved; if they touched a circular space would be enclosed.

Hab. Miyanoshita, Hakone, Chiuzenji, Nikko, and Nishimura. Occurs, like the last species, in large boleti, but is apparently more widely distributed.

[*Note.—Atasthalus taprobanæ*, sp. n. I obtained a species very similar indeed to *A. bellicosus* in Ceylon; but the male may be known by the frontal carina being raised and denticulate, the ocular ridge being more prominent, the punctuation under the thoracic horns is distinct, and the horns are more than half as long again. The female has the thoracic protuberances wider apart, more erect, and more regularly covered with tubercles. There are specimens in the Bates collection taken by Nietner.

Hab. Wackwaller, near Galle. I found three examples in a boletus.]

Bolitonæus, gen. nov.

Type *B. mergæ.*

I propose this genus to receive some small species which vary in size from about 4 to 6 mill.; most of its characters are those common to *Atasthalus*; the antennæ have seven rather short and sometimes robust (*B. mergæ*) moniliform joints, sometimes the joints are much more slender (*4-dentatus*), eighth to tenth more or less transverse, eleventh with the base somewhat embedded in the tenth; the maxillary palpi slender, terminal joint rather long; the eyes, ocular ridge ceases abruptly in the middle of the eye-disk, the ridge when viewed from above gives the eye the appearance of having a small tubercle in its centre. The prosternum is depressed posteriorly and the mesosternum somewhat short. *Bolitophagus vacca*, Motsch., *Heledona nasalis*, Pasc., and *Bolitotherus* 4-*dentatus*, Cand., should be placed in this genus. The type of *Bolitotherus* (*Phellidius*, Lec.), Candèze, is an American species, *B. cornutus*, F., which has an antenna of ten joints only; but Candèze also included in it *B.* 4-*dentatus*, which has eleven joints to these organs. Pascoe's note (Ann. & Mag. Nat. Hist. 1871, viii. p. 348) regarding *Bolitotherus* may be cancelled, as the note was written, as he informed me, under the impression that *B. cornutus*, F., was, as indicated in the Munich Catalogue, a Ceylonese insect.

Bolitonæus mergæ, sp. n. (Pl. XIII. fig. 5.)

Oblongus, parum cylindricus, obscure brunneus; thorace marginibus crenato, ♂ cornibus duobus horizontalibus ad apicem dense rufo-hirtis.

L. 4–4½ mill.

Oblong, dull brown or blackish brown, opaque; the head very rugose, frontal margin roughened on the edge, with a small denticle near the antenna in well-developed males; the thorax rough, nodulous, laterally crenate, with two median horizontal horns, reaching in fine examples beyond the head by half their length, incurved from their bases, apices densely clothed with reddish hair; the elytra, interstices rugose, with eight or ten rows of small nodules on each wing-case, but this sculpture suffers much from abrasion and is often obsolete. The antennæ rather stout, seventh and eighth joints rather transverse, ninth, tenth, and eleventh forming a club; the

tibiæ carinate and scarcely narrowed near the tarsi. In small males the thoracic armature is very short and stout, and this form admits of the eyes being seen from above outside the horns; in the large individuals the horns intervene. In the females the horns are absent, but the anterior part of the thorax is gibbous.

B. 4-dentatus, Cand., differs from the above in having more slender antennæ, with two conspicuous frontal denticulations on the anterior edge, and in having the tibiæ very markedly narrowed from the middle to the tarsal end.

Hab. Yuyama. A large boletus was found full of specimens in all stages on the 11th May, 1881.

Byrsax niponicus, sp. n.

Ovalis, supra parum convexus, fuscus, rugose sculpturatus, nodulosus; antennis ferrugineis; pedibus brunneis; ♂ capite cornibus duobus elongatis erectis; thorace explanato.
L. 5–6½ mill.

Oval, rather convex above; the male—head rugose, with two long slender horns, diverging upwards from their bases, slightly turning in at their tips, forehead depressed between the horns, the thorax laterally explanate, edges lirate, broadest just before the base, rough and nodulose; the elytra rough and nodulose, very similar to those figured for *Atasthalus bellicosus*; the female—head rugose, not depressed, lateral edges of the thorax more strongly lirate and much more widened out before the base; in both sexes the anterior and intermediate tibiæ are slightly narrowed before the tarsal end and carinate their whole length; the legs obscure brown, antennæ ferrugineous. The ocular ridges project more in the male than in the female.

Hab. Nara. About a dozen examples from a boletus, 27th June, 1881.

Byrsax spiniceps, sp. n.

Oblongus, supra modice convexus, dense squamosus; ♂ capite cornibus duobus spiniformibus.
L. 3–4 mill.

Oblong, moderately convex above, with a whitish squamaceous substance, which, in uninjured specimens, obscures all sculpture. The male with two long spine-like horns, which, when viewed sideways, are seen to be bent forwards in the upper half, ocular ridge projecting into an outline of an obtuse angle; the thorax, lateral margins widely explanate,

with markedly lirate edges. In the female the ocular ridge projects much less, and the thorax behind the neck is elevated in the form of two ridges.

I have only six specimens of this little species, and they are all more or less thickly covered with a whitish squamosity.

Hab. Yuyama and Nikko.

Diaperis niponensis, Lew.

Diaperis niponensis, Lew. Ent. xx. 1887, p. 217.

This species resembles a very large specimen of *D. boteli*, L.

Hab. Nikko, Mayebara, Junsai, and Sapporo. Commonest in Yezo.

Diaperis Lewisi, Bates.

Diaperis Lewisi, Bates, Ent. M. M. x. 1873, p. 14.
Diaperis rubrofasciatus, Reit. 1879.

Hab. Nagasaki, Kumamoto, Miyanoshita, and Tokio; Siberia (*Reitter*).

Derispia, gen. nov.

Body hemispherical, outline of the head, thorax, and elytra together being circular; the head relatively somewhat large, eyes small, coarsely granulate, palpi large, terminal joint oblong; the thorax explanate laterally, widely incised to receive the head, eyes visible from above; the scutellum triangular, but widest at the base; the elytra dilated at the sides, and in structure very similar to those drawn for *Leiochrinus satzumæ* (woodcut, fig. 2), but not quite so wide; the prosternum rather narrow, truncate behind, slightly narrowed between the coxæ; the mesosternum small and transverse; the metasternum arched between the coxæ; the anterior tarsi short and pilose beneath, linear but rather robust, the claw-bearing joint being as stout as the others, and the hind tarsus has the basal joint long, like those of *Basanus* and *Scaphidium*; the antennæ also rather stout, first joint larger and longer than the second, third longer than the second and a little constricted at the base, fourth stouter than the third and equal in size to each of the six following, terminal joint rather longer and oval.

Type, *Diaperis maculipennis*, Mars.

Leiochrinus coccinelloides, Westw., also belongs to this genus, the type of *Leiochrinus* being *L. discoidalis*, Westw., a very different insect. The species of this genus are apparently very numerous in the eastern tropics; I found six in Ceylon.

Leiochrinus, Westw.

Leiochrinus, Westwood, Tijdschr. voor Ent. xxvi. p. 68.

The genus *Leiochrinus* was founded by Westwood in 1883, and a figure of the type of the genus, *L. fulvicollis*, is given on pl. iii. fig. 14, and on pl. v. fig. 7 is a drawing of the posterior tarsus. The type of this genus evidently agrees with *L. satzumæ*, sp. n.; the head is entirely concealed under the thorax, the latter segment and the elytra forming an almost complete circular outline. With the head thus concealed the antennal orbits are absent. The form of the tarsi, also, in the genus is most peculiar. Westwood gave a drawing of the upperside of the type, and to supplement his figure I give here a woodcut, fig. 2, showing in outline the under surface of *L. satzumæ* and the fore tarsus. There are several genera in which the curious tarsi are, with more or less modified form, similar, so that I quite agree with Mr. Champion that it is best to group them together as Leiochrininæ. I think the position of the group is near the Diaperinæ, as they cannot be far separated from the genus *Derispia*, which, I think, is placed in a natural position if it is put near *Diaperis*.

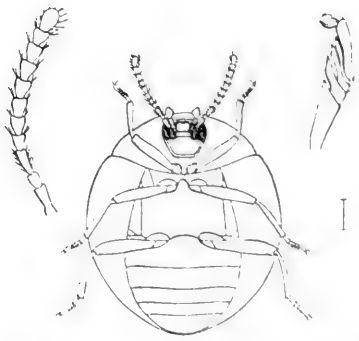
Leiochrinus satzumæ, sp. n. (Woodcut, fig. 2.)

Circularis, rufo-testaceus, nitidus; thorace disco transversim infuscato; elytris delicate punctulatis, disco rufo-testaceo, marginibus angustissimis testaceis.

L. 4 mill.

Thorax and elytra circular in outline, head impressed in the thorax and entirely concealed when viewed from above;

Fig. 2.



the tissue of the thorax is very thin and pellucid over the eyes, which can be dimly seen through it. The thorax has a

wide transverse dark band across its base; the elytra very faintly punctulate, the punctures most visible form a line close to the suture, a dark band occupies the external margins, but leaves the extremely narrow rim pale; the antennæ—four basal joints reddish, the others infuscate; the legs reddish or brownish yellow. When the antennæ are stretched out the second joint does not reach beyond the rim of the thorax.

Hab. Yuyama, Hitoyoshi, Fukahori, and Nara. Many examples beaten from foliage in which dead branches and twigs were interspersed.

Leiochrodes, Westw.

Leiochrodes, Westw. Tijdschr. voor Ent. xxvi. p. 69.

Type, *L. discoidalis* (pl. iii. fig. 15).

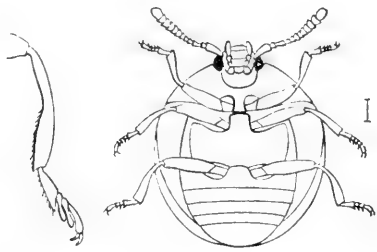
Leiochrodes convexus, sp. n. (Woodcut, fig. 3.)

Hemisphæricus, perconvexus, piceo-niger, nitidus; elytris haud striatis, impunctatis; antennis pedibusque rufo-brunneis, tibiis posticis curvatis.

L. $2\frac{1}{2}$–$2\frac{3}{4}$ mill.

Circular in outline, very convex above, piceous or black, shining, with the legs and antennæ reddish brown; the head, thorax, and elytra wholly smooth; the prosternum bisinuous posteriorly and widening out a little from the coxæ to the base; the hind tibiæ are bent and enlarged on their inner

Fig. 3.



edge like the intermediate tibiæ figured in this paper for *Ischnodactylus loripes*. This form of tibiæ has, however, in this species apparently no sexual purpose as it is found in all my specimens, but the structure enables the tibia, in a state of repose or in a state of simulating death, to be brought closely on to the femur which fits into it.

Hab. Nagasaki and Kioto. Occurs under damp decaying leaves in early spring.

Arrhenoplita (*Hoplocephala*) *asiatica*, sp. n.

Oblonga, nitida, rufo-brunnea; capite thoraceque rufis; elytris nigris apice excepto.
L. $6\frac{1}{2}$ mill.

Oblong, reddish brown; the head red, rather rugosely punctured, male with two erect horns close to the eyes, in the female the head is swollen only close to the eyes; the thorax red, evenly not closely punctulate; the scutellum obscurely red; the elytra black, with the apices red, punctate-striate, interstices sparingly punctulate; the antennæ and legs red.

Similar to *A. hæmorrhoidalis*, F., but the thorax is much wider and less convex laterally and the thoracic punctuation larger. *A. hæmorrhoidalis* occurs in Siberia as well as in Europe.

Hab. Sapporo. A boletus I found on an oak contained three males and one female.

Amarantha atrocyanea, Lew.

Amarantha atrocyanea, Lew. Ent. M. M. 1891, ser. 2, ii. p. 70 (*Metaclisa*, Duval).

The location of the genus *Amarantha* is doubtful. Faust placed it near *Arrhenoplita* (*Hoplocephala*), but the form of the sterna and the structure of the first segment of the abdomen more nearly resemble a species of *Hemicera*. The short tarsi, however, are similar to *Arrhenoplita*. *Amaranthus* is the name of a well-known flower of older date than Motschulsky's name. If the latter is rejected, Duval's name will serve.

Hab. Oyayama, Chiuzenji, Sapporo, and Junsai. Taken abundantly in South Yezo. It inhabits the touch-wood of decaying beeches.

Ischnodactylus loripes, sp. n. (Pl. XIII. fig. 6, ♂.)

Subdepressus, ovatus, piceus, nitidus; thorace marginibus, antennis, pedibus et epipleuris rufo-brunneis; elytris fortiter punctato-striatis.
L. ♀ 7, ♂ $8\frac{1}{2}$ mill.

Oblong oval, pitchy black, somewhat depressed; margin of the thorax, epipleuræ, antennæ, and legs reddish brown, and sometimes also the sutural interstice of the elytra is reddish; the head somewhat wide, rather densely, not coarsely punctured, not cornute in the male; the thorax transverse, slightly explanate laterally, punctured similarly to the head; the scu-

tellum feebly punctulate; the elytra rather long, parallel at the sides, strongly punctate-striate. The hind tibiæ of the male are bent, basal half slender, tarsal end from the middle enlarged.

The form of the hind tibiæ agrees somewhat with that of the intermediate tibiæ of *Platydema umbratum*, Mars. There is an undescribed species in the British Museum from Singapore which resembles it closely; the absence of the armature on the head of the male in this species does not seem to me sufficient to exclude it from *Ischnodactylus*.

Hab. Oyayama. Three specimens.

Platydema nigroæneum, Motsch.

Platydema musivum, Harold, 1878.

This species closely resembles *P. Dejeanii*, Cast., both in size and colour. Harold, in redescribing it as *P. musivum*, laid great stress on the elytra being "striato-punctatis," but in a long series of specimens half of them have the elytra punctate-striate. The armature of the head of the male is usually two tubercles, but sometimes there are two pointed but not slender horns. The colour of the epipleuræ is sometimes æneous, sometimes reddish.

Hab. Nikko, Miyanoshita, Kiga, and Oyayama. Common.

Platydema Dejeanii, Cast.

I have a series of examples which agree precisely with Siberian specimens referred to this species by Reitter and others.

Hab. Junsai, Sendai, and Nikko. Commonest in the north.

Platydema Marseuli, sp. n.

Platydema nigroæneum, Mars., 1876.

Oblongum, æneo-nigrum, nitidum; elytris distincte punctato-striatis; antennis pedibusque obscure brunneis.

L. $4\frac{1}{2}$–5 mill.

Oblong, greenish or brassy black; the head and thorax rather closely punctulate; in the male are two frontal horns, straight and pointed in well-developed specimens, in others the horns are reduced to two obtuse tubercles; the elytra distinctly punctate-striate, interstices rather flat and finely punctulate, and usually more brassy in colour than the thorax; the antennæ and legs are uniformly an obscure brown.

There is very little to distinguish this species from *P. nigro-æneum*, Motsch., except its size and that the wider joints of the antennæ are more transverse.

Hab. Nagasaki, Kumamoto, Miyanoshita, Kadzusa, and Yokohama.

Platydema higonium, sp. n.

Breviter ovale, convexum, æneum, metallicum; elytris distincte striato-punctatis; antennis pedibusque obscure brunneis.
L. $5\frac{1}{2}$–$6\frac{1}{2}$ mill.

Shortly oval, convex above, brassy, very shining; the head rather densely excavated between the eyes in both sexes, the male with two rather long and acute horns well separated from each and scarcely thickened at their bases; the thorax evenly, not very densely, punctulate, brassy, with a purple tint; the elytra, interstices flat, finely punctulate, striæ consisting entirely of rows of punctures; the antennæ and legs obscure brown.

This is the most metallic species in this series, and the only one in which the elytral striæ consist throughout of a series of punctures only, each puncture being clearly separated from another.

Hab. Hitoyoshi, Oguma, and Rakuwayama. Seven specimens.

Platydema sylvestre, sp. n.

Ovatum, convexum, æneum, submetallicum; capite in medio impresso; elytris fortiter punctato-striatis.
L. $4\frac{3}{4}$–5 mill.

Ovate, convex above, brassy or brassy green, somewhat metallic; the head semicircular in front, clearly and rather thickly punctulate, with a median impression between the eyes, impression deepest in the male; the thorax narrowest anteriorly, widening to base, lateral edge raised, punctulate, punctures finer and less close than those of the head; the scutellum smooth; the elytra strongly punctate-striate, interstices little convex, with scattered and extremely fine punctures; the antennæ and legs dull reddish brown. The male is apparently without armature on the head.

Hab. Hakone and Kiga. Six specimens.

Platydema recticorne, sp. n.

Oblongo-ovatum, supra convexum, piceum, nitidum; antennis, pedibus et epipleuris rufis; thorace punctulato; elytris fortiter punctato-striatis, interstitiis distincte punctulatis.
L. $4\frac{1}{4}$–$4\frac{1}{2}$ mill.

Oblong-ovate, convex above, piceous, shining; the head semicircular in front, reddish brown before the eyes, rather densely punctulate, the female with a median fovea between the eyes, the male with two slender reddish horns, straight, and reaching out beyond the head; the thorax punctured like the head, anterior angles rather broadly red; the scutellum very obscurely punctulate; the elytra—epipleuræ reddish, sometimes also the humeral angle is red, strongly punctate-striate, interstices also very distinctly punctulate; the antennæ, mouth-organs, and legs clear reddish brown.

In well-developed males the frontal horns measure from $\frac{1}{2}$ mill. to $\frac{3}{4}$ mill., but in a few specimens the forehead is scarcely more than tuberculate. This species in size and general sculpture corresponds with *P. Marseuli.*

Hab. Kiga, Nikko, Oyayama, and Konose. Rather common.

Platydema lynceum, sp. n.

Oblongo-ovale, purpureo-nigrum; oculos supra parum approximatis; capite thoraceque punctulatis; elytris valde punctato-striatis.
L. 7 mill.

Oblong oval, nearly black, with a faint purple tint; the head not cornute in either sex, irregularly and sparingly punctulate; eyes large and approaching each other above on the inner anterior edge, especially in the male; the thorax transverse, narrowest in front, widest behind, finely and sparingly punctulate; the elytra rather long, strongly punctate-striate, interstices microscopically and sparsely punctulate; the antennæ and legs dull brown. The sexes can be distinguished by their tarsi.

Hab. Nantaizan, Yokohama, and Junsai. Nine examples.

Platydema fumosum, sp. n.

Ovale, atrum, opacum; antennis articulis primo et secundo tarsisque rufis.
L. $6\frac{1}{4}$ mill.

Oval, densely black, opaque; the head finely and sparingly punctured, semicircular anteriorly; the thorax arched at the sides, bisinuous behind, punctured like the head; the scutellum triangular; the elytra, striæ fine and punctulate, interstices flat; the antennæ, two basal joints red, the others black; the legs dusky brown, tarsi reddish, basal joint of the anterior tarsus of the male slightly enlarged. Head not cornute in either sex.

In outline and colour this species resembles *P. umbratum*, Mars., an insect which measures 10 mill. and has the basal joint of the anterior tarsus in the male considerably enlarged; but there are no sexual differences in the tibiæ. I think *P. umbratum* and *P. malaccum*, Mars., and the above species might be very well separated from *Platydema*.

Hab. Kioto and Nara. Five examples.

Platydema scriptum, sp. n.

Oblongo-ovatum, rufo-brunneum, subopacum; elytris punctato-striatis, fasciis duabus dentato-sinuatis.
L. $2\frac{1}{2}$ mill.

Reddish brown, somewhat opaque; the head rather densely punctulate, clypeus reddish, semicircular in outline; the thorax punctured like the head, arched at the sides, colour darkest on the disk; the elytra punctate-striate, interstices opaque and impunctate, variegated with dark markings, which usually take the form of two dorsal dentate-sinuate fasciæ; the apex reddish brown, with the pattern widening out on the sides; the antennæ and legs reddish brown.

This small species resembles *P. hieroglyphicum*, Cast. Brul. The colour of the elytra is variable. This also, and those resembling it, ought, I think, to be separated from the genus *Platydema*.

Hab. Nagasaki. Three examples.

Basanus erotyloides, Lew. (Pl. XIII. fig. 7.)

Basanus erotyloides, Lew. Ent. M. M. 1891, p. 71.

This species is noticed here merely to call attention to the figure; the insect is black, with red or yellowish-red elytral markings, and the abdomen is of the same colour.

Hab. Found in most of the forests.

Scaphidema ornatellum, sp. n.

Ovatum, æneo-nigrum, nitidum; thorace plano marginibus utrinque canaliculatis; elytris a basi flavo-fasciatis; pedibus rufis.
L. $4\frac{3}{4}$–5 mill.

Ovate, brassy black, shining; the head irregularly punctured, anteriorly reddish; the thorax more finely and more sparingly punctured than the head, lateral margins distinctly canaliculate; the scutellum brassy or obscurely red; the elytra punctate-striate, interstices feebly convex, very sparingly punctulate, with a yellow fascia near the base on interstices 3–8; on the fifth interstice the fascia widens out

before and behind; the antennæ black, with three basal joints red or piceous; the legs reddish brown, rarely black.

Hab. Oyayama, Kiga, and Nikko. Twenty examples.

Scaphidema pictipenne, sp. n.

Ovatum, æneo-nigrum, nitidum; thorace parum convexo; elytris quadrifasciatis; antennis a basi pedibusque rufis.
L. $3\frac{1}{4}$–$3\frac{1}{2}$ mill.

This small species is very similar to *S. ornatellum*, but it is less broad and the thorax much less conspicuously canaliculate at the sides and convex on the disk; the elytra have a second fascia (although somewhat obscure) before the apex, and the apices are more pointed.

Hab. Nara. Three specimens.

Scaphidema discale, sp. n.

Ovatum, æneo-nigrum; elytris obsolete maculatis vel totis æneis; antennis a basi pedibusque rufis.
L. $3\frac{1}{2}$–4 mill.

Ovate, brassy black, shining; the head punctured somewhat closely, mouth-organs reddish; the thorax finely and sparingly punctured, little convex, especially behind the neck; the elytra punctate-striate, with a small flavous disk near the base on the fifth interstice; the antennæ, three basal joints red, rest black; the legs reddish brown.

The punctuation of the thorax is larger and closer in this species than in the others of this series; the elytra are relatively longer and the maculation is confined to a small obscure disk near the base of the wing-case. In a variety the flavous disk is absent.

Hab. Kashiwagi, Kiga, and Nikko. Six examples.

Scaphidema nigricorne, sp. n.

S. discali simillimum, sed differt antennis longioribus et totis nigris; elytris immaculatis; pedibus nigris, tarsis rufescentibus.
L. 4 mill.

This insect is larger than *S. discale*; the thorax less finely punctured and less narrowed anteriorly; the antennæ are wholly black, and the legs black with reddish tarsi. It is most similar to the European *S. æneum*, Payk.

Hab. Kiga. A single example.

Alphitophagus japanus, Mars.

I have taken this species abundantly in Ceylon. In a list of insects given in Tennent's 'Ceylon,' 1861, this species

stands under three different names, in three different genera, but it is not necessary to specify them.

Hab. Nagasaki and Bukenji, near Yokohama. I have seen this species in great abundance on many occasions.

Alphitophagus pallidicollis, sp. n.

Rufo-testaceus, capite thoraceque dense punctulatis; elytris nigro-fasciatis.

L. 3½ mill.

Reddish, pale brown, or yellow, antennæ and legs the same colour; the head and thorax evenly and densely punctulate; the elytra punctate-striate, interstices microscopically punctulate, with a black fascia at the base on interstices 2–6, and a second dorsal fascia entirely crosses the wing-case, the last is usually broadest at the suture; and in some examples the two fasciæ join on the sutural interstice.

Easily separated from *A. japanus*, Mars., by the colour, size, and the dense punctuation of the thorax.

Hab. Yokohama. Nine examples from a boletus at Bukenji in company with a large number of *A. japanus*, Mars.

Pentaphyllus oblongus, sp. n.

Oblongus, subparallelus, flavo-testaceus; elytris punctulatis, striis obsoletis; antennis pedibusque concoloribus.

L. 2⅓ mill.

Oblong, somewhat parallel at the sides, yellow-testaceous; the head distinctly and not closely punctured, with the surface microscopically strigose; the thorax arched at the sides, with the margin evenly elevated, anterior angles well rounded off, surface sculptured like the head; the scutellum small and triangular; the elytra punctulate, striæ obsolete, surface with very feeble leather-like sculpture, lateral margin raised like that of the thorax; the antennæ, articulations 1–2 rather robust and equal, 3–6 shorter and smaller, 7 slightly transverse, 8 distinctly transverse, 9–10 rather widely transverse, terminal joint nearly circular in outline, the last five joints forming a lax club.

This species is larger and more parallel than *P. testaceus*, Helw., and the antennæ are differently formed, with the articulations much more lax. But the seventh and eighth joints are transverse, although not very distinctly so, and I have no doubt the species are congeneric.

Hab. Yokohama, at Bukenji. One example.

Menimus niponicus, sp. n.

Flavo-testaceus, nitidus, supra convexus; capite thoraceque sparse

punctatis; elytris striato-punctatis; antennis pedibusque concoloribus.

L. 2¼ mill.

Yellow-testaceous, shining, convex above; the head rather large, eyes small, surface sparingly punctate, punctures somewhat large and irregularly set; the thorax punctured like the head, rather strongly marginate at the sides; the elytra marginate externally like the thorax, widest in the middle, obtusely acuminate behind, striate-punctate, the rows of punctures are not very regular, and in the interstices there are a few similar punctures which apparently add to their irregularity; the prosternal posterior process is continued behind the coxæ on the same plane as the anterior part and is scarcely widened out; in a species from New Zealand this process is a little depressed and slightly widened out. The antennæ, joints 7–10 form a compressed club, the seventh joint is smaller than the eighth, and is relatively larger than in the New Zealand species, which has a more lax club.

I have placed this species in *Menimus* without hesitation, notwithstanding the other known species in the genus are all from New Zealand, from whence Mr. Champion has kindly lent me an example.

Hab. Kiga. Found in the recesses (a foot from the bark) of a very large and decaying beech, in company with *Eugoniopus Lewisi*, Reit.; six examples.

Ceropria sulcifrons, Har.

Ceropria sulcifrons, Har. S. e. Z. 1878, xxxix. p. 353.

The fine iridescent colours of this species assume a circular form both near the humeral angle and before the apices of the elytra. In the other three species of this series the centre of the iridescence is so near the margin that the colours can only form a semicircle.

Hab. Kiga and Hakone (abundant), and on Oyayama.

Ceropria subocellata, Cast.

Ceropria subocellata, Cast. Brul. Mon. p. 308.

This species is broader and more oval in outline than *C. induta*, Wiedem., and it measures nearly 13 mill. In the male the anterior tarsi are scarcely dilated and the anterior and intermediate tibiæ are not dentate. There is a long series of it in the Bates collection from many localities.

Hab. Nagasaki. Three examples.

Ceropria striata, sp. n.

Oblongo-ovata, nigra, nitida; thorace distincte punctulato; elytris fortiter punctato-striatis, interstitiis convexis et obsolete punctulatis.

L. 11½ mill.

Oblong-ovate, black, shining; the head irregularly punctulate; the thorax bluish black, somewhat densely punctulate, lateral margin canaliculate, feebly sinuous behind the eyes, bisinuous at the base; the scutellum smooth, and as large again as in *C. induta*; the elytra strongly punctate-striate, interstices convex and nearly smooth, with a golden area over the hind coxæ, otherwise similar in colour to *C. induta*. In the male the anterior and intermediate tibiæ are bent and a little enlarged at the tarsal end, the enlarged part of the anterior tibiæ is denticulate on the inner edge.

This species closely resembles *C. induta*, but it is longer, with the lateral rim of the thorax more elevated, the scutellum larger, and the elytral interspaces more convex and less punctulate.

Hab. Kumakuni in Higo. Three examples.

Ceropria induta, Wiedem.

Ceropria induta, Wiedem. Zool. Mag. i. 3, 1819, p. 164.

Specimens of this species were named *C. subocellata*, Cast., by Marseul in 1876; it was originally described from Javan specimens. I have taken it commonly in Ceylon and Singapore, and it appears to be distributed all over the Oriental region.

Hab. Nagasaki and Oyama. Like the three preceding species in Japan, it occurs under the bark of Kuro-matzu (*Pinus massomana*, S. & Z.).

[To be continued.]

XLIV.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., late commanding.*—Series II., No. 1. *On the Results of the Deep-sea Dredging during the Season* 1890–91 (*concluded*). By A. Alcock, M.B., Surgeon-Captain I.M.S., Superintendent of the Indian Museum.

[Continued from p. 334.]

BRACHYURA.

Family **Inachidæ**.

Echinoplax, Miers.

85. *Echinoplax pungens*, Wood-Mason.

Echinoplax pungens, Wood-Mason, Ann. & Mag. Nat. Hist., March 1891, p. 259.

Station 115, 188–220 fathoms.

PLATYMAIA, Miers.

86. *Platymaia Wyville-Thomsoni*, Miers.

Platymaia Wyrille-Thomsoni, Miers, 'Challenger' Brachyura, p. 13, pl. ii. fig. 1.

Station 115, 188–220 fathoms, and Station 116, 405 fathoms.

ANAMATHIA, S. I. Smith.

87. *Anamathia Livermorii*, Wood-Mason.

Anamathia Livermorii, Wood-Mason, Ann. & Mag. Nat. Hist., March 1891, p. 260.

Station 112, 561 fathoms.

Family **Cancridæ**.

NECTOPANOPE, Wood-Mason.

88. *Nectopanope longipes*, Wood-Mason.

Nectopanope longipes, Wood-Mason, Ann. & Mag. Nat. Hist., March 1891, p. 262.

89. *Platypilumnus gracilipes*, gen. et sp. n.

[Wood-Mason, Admin. Report Marine Survey of India for 1890–91, p. 20, name only.]

Carapace much depressed, perfectly flat above, with the surface nearly smooth centrally and very finely and closely granular laterally, and with the regions indistinctly defined. The front has the form of a horizontally projecting bilobed lamella, with the free edge sharply and very evenly spinate and the sides turned abruptly downwards. The margins of the orbit are spinulate, the upper margin the more distinctly so, and the lower margin terminates internally in a strong oblique spine, the point of which inclines towards the sharply vertical tooth formed by the already mentioned downfolding of the lateral edge of the frontal lamella.

The antero-lateral borders of the carapace, which are arcuate and are shorter than the postero-lateral, are armed with three large spines, in front of, between, and behind which are several spinules. The pterygostomian regions are large and inflated, and the branchial apertures, especially the efferent aperture, are large and patulous.

The eye-stalks are large and are of moderate length; the corneal region is rather small.

The antennules are long and are transversely folded, their basal joint is large and inflated.

The antennæ are long, their basal joint is slender and free; the second joint lies within the internal orbital hiatus.

The inner edge of the meropodite of the external maxillipeds is convex, with a pair of little spines at the summit of the convexity; the succeeding joint arises at the antero-internal angle.

The thoracic legs are furnished with many spines and long hairs. The chelipeds, which are robust, are unequal; their prismatic meropodite has all its borders spiny; the short inflated carpus is sharply granular and spinulate in the distal half of its dorsal surface and along the outer edge, while the inner edge bears a pair of rather large spines; the palm is spinulate everywhere in the smaller cheliped, but only in the proximal third of its outer surface in the larger; the fingers also of the smaller cheliped are spinulate on the outer surface, while those of the larger cheliped are smooth; the cutting-edges of the fingers are finely and unevenly toothed.

The other thoracic legs are long, compressed, and slender, and have the meropodite spiny along both edges, the carpopodite and propodite spiny along the front edge, and the dactylopodite styliform.

Colour in the fresh state yellowish red.

An egg-laden female from Station 115, 188–220 fathoms, has the following measurements:—

Length of carapace 18 millim., breadth of carapace 20 millim., length of larger cheliped 27 millim., length of longest leg (fourth pair) 40 millim.

Family **Ocypodidæ**.

90. *Psopheticus stridulans*, gen. et sp. n.

Psopheticus stridulans, Wood-Mason, Illustrations of the Zoology of H.M. I.M.S. 'Investigator,' Crustacea, part i. pl. v. fig. 1 [no description].

Body and legs smooth and polished, quite devoid of hairs except for a few distant setæ on the front edge of the second to fifth legs.

The carapace is quadrilateral, convex from before backwards, and its length is three fourths of its breadth. The front is a prominent declivous lamina with the edges entire and sharp. The superior orbital margin is smooth and sharp, and, although strongly excavated on the whole, has a strong median convexity; the inferior orbital margin is microsco-

pically granular, and ends internally in a blunt-pointed tooth.

The lateral margins are armed in front with two very strong teeth, the anterior one of which, situated at the external angle of the orbit, surmounts a remarkable inflation of the whole infraorbital and infrahepatic region; this inflation culminates at the base of the spine in a finely granular eminence, against which a strong uniform tooth situated on the upper border of the meropodite of the cheliped can be played, producing in the dead animal a shrill sound.

The pterygostomian regions are small, but the branchial apertures are large and patulous.

The abdomen in the male is distinctly seven-jointed.

The eye-stalks are stout and the corneal region is reniform and expanded, its major diameter being one fifth the length of the carapace.

The antennules are long and are transversely folded.

The antennary peduncle lies within the internal orbital notch, the first joint being short and slender; the antennary flagellum is more than half the length of the carapace.

The external maxillipeds have the meropodite square, the succeeding joint springing from the antero-internal angle.

The thoracic legs are spiny. The chelipeds are subequal; the prismatic meropodite has distally on the lower edge two or three spines and on the inner edge a single one, while about midway along the upper edge is the large uniform tooth already mentioned; the rhomboidal carpus has two spines, one at the external the other at the internal angle; the palm is large and swollen, and the fingers, which have the cutting-edge strongly and unevenly toothed, are not capable of complete apposition.

The second to fifth legs are slender, compressed, and of moderate length; in all the meropodite is distantly and markedly spinate and the carpopodite closely and finely spinulate along the front edge—the spination in the case of the second pair only being indistinct, or even in part obsolete—and the dactyli grooved and extremely slender.

In the female the chelipeds are relatively feebler and the other legs shorter than they are in the male.

Colours rose-pink, corneal region violet.

Several specimens of both sexes from Station 115, 188–220 fathoms.

In the largest male and female the carapace is 15 millim. in length and 19 millim. in breadth, the cheliped in the male measuring 29 millim. and in the female 25 millim.

Family **Leucosidæ**.

RANDALLIA, Stimpson.

91. *Randallia lamellidentata*, Wood-Mason.

Randallia lamellidentata, Wood-Mason, Illustrations of the Zoology of H.M. I.M.S. 'Investigator,' Crustacea, part i. pl. v. fig. 5.

Carapace subcircular, inflated; the surface granular, beaded, and in the middle line and on the branchial regions pustular, the margins lamellar and irregularly lobulated.

The front is bilobed; the antero-lateral margin, like the anterior part of the postero-lateral, is extended horizontally to form a sharp lamella, which is cut up into several unequal lobes larger than the two lobes of the posterior margin. The hepatic, branchial, and intestinal regions are all very clearly delimited, leaving only the boundary between the gastric and cardiac regions undefined; in the centre of the tumid intestinal region is a blunt spine. The sternum is finely beaded.

The abdomen is finely granular, and although the segments from the third to the sixth are coalescent, they are all distinctly defined.

The eyes and orbits are very small, the latter having two fissures above and one below, and a pronounced hiatus internally. The antennulary fossæ are large; the antennary flagella are minute.

The external maxillipeds are large, with the exposed surface closely and finely beaded; the exopod, which is rather broader than the endopod, has the outer margin nearly straight and does not quite reach to the pointed extremity of the meropodite.

The thoracic legs are all granular or finely beaded. The chelipeds, though stout, are not remarkably prolonged, their length not greatly exceeding the breadth of the carapace; the bead-like granules on the upper edge of the meropodite are large; there is a small tooth on the outer side of the carpus at its distal end; the palm and the dactylopodite have the outer edge broadly and sharply crested, the immobile finger also being slightly carinated.

The remaining thoracic legs are short and slender.

Colour white, with a pinkish blush.

A male from Station 115, 188–220 fathoms.

Length of carapace about 12 millim., its breadth being about 13 millim.

Family **Dorippidæ**.

Ethusa, Roux.

92. *Ethusa andamanica*, sp. n.

This species closely resembles *Ethusa orientalis*, Miers ('Challenger' Brachyura, p. 330, pl. xxviii. fig. 1), from which it appears to differ only in the following points:—The carapace is smooth instead of being granular; the cervical and cardio-branchial sutures are ill- instead of well-defined; the tooth at the external orbital angle is not so prominent in relation to the front.

A male from Station 115, 188–220 fathoms.

Length of carapace about 9 millim., breadth about 9 millim., length of cheliped 11 millim., length of third leg about 29 millim., length of fourth leg 11 millim.

Compared with the other Indian species the most remarkable character of *Ethusa andamanica* is the robustness of the fourth and fifth pairs of legs.

93. *Ethusa indica*, sp. n.

Carapace finely and closely granular and a little broader than long.

The front is bilobed and four-toothed; the antero-lateral or external orbital angle forms, not a tooth, as in *Ethusa andamanica*, but a great spike projecting far beyond the frontal spines; the lateral margins are strongly convex in their branchial extent and then converge, so that the breadth of the anterior portion of the carapace is not two thirds that of the posterior portion. The cervical and cardio-branchial sutures are well marked, and the small tumid intestinal region stands out like a wart between the even more tumid branchial regions.

The eye-stalks are slender and are freely mobile; the eyes are small but well developed; the orbits are imperfect.

The basal joint of the antennules is not inflated. The antennary flagellum is only about half the length of the carapace.

The chelæ are equal; the meropodite and fingers are compressed and the carpus and palm inflated; the cutting-edges of the fingers are closely apposable and are finely crenulate in the distal half or two thirds.

The dactyli of the second and third legs are broad scimitar-like blades.

The fourth and fifth pairs of legs are filiform, granular, and in the distal third hairy.

An egg-laden female from Station 120, 240 fathoms, has the following dimensions:—Length of carapace 9·5 millim., greatest breadth a little over 10 millim., length of cheliped about 13 millim., length of third leg 33 millim., length of fourth leg 11 millim.

The most remarkable character of this species is the great size of the external orbital spines.

94. *Ethusa pygmæa*, sp. n.

Carapace and appendages very finely and closely granular; the length of the carapace not quite equal to the greatest breadth. The front is bilobed and four-spined; the antero-lateral or external orbital angle forms a spine, much as in the preceding species, only that it does not reach to the level of the tips of the frontal spines; the lateral margins are strongly convex in their branchial extent and then converge, so that the breadth of the carapace in front is only two thirds of its breadth behind. The cervical and cardio-branchial sutures are well marked and the gastric, cardiac, and intestinal regions are all quite plainly delimited.

The eye-stalks are slender, the eyes are slightly dilated, and the orbits are very imperfect.

The chelipeds are equal and the fingers are closely apposable and finely crenulate in the distal half to two thirds of the cutting-edge.

The second and third legs have long scimitar-like dactyli; the fourth and fifth legs are moderately stout.

An egg-laden female from Station 115, 188–220 fathoms, has the following dimensions:—Length of carapace 6 millim., breadth nearly 7 millim., length of cheliped about 8 millim., of third leg 22 millim., of fourth leg 8 millim.

This species closely resembles the preceding, from which it is distinguished by its much smaller size, by the better definition of the regions of the carapace, by the smaller antero-lateral spine, by the granulation of the thoracic legs, and by the more robust fourth and fifth pairs of legs.

95. *Cymonomops glaucomma*, gen. et sp. n.

Carapace subcircular; it and the appendages are very closely and finely granular beneath a dense pubescence. The front consists of three deeply cut lobes, the middle one of which is the largest and most prominent. The middle lobe

again is slightly cleft at the tip, and in the cleft is to be seen projecting the roof of the remarkably prolonged buccal cavity.

The external orbital angle, which is somewhat ventrad in position, also forms a projecting tooth, so that the orbito-frontal region, which is sharply delimited from the rest of the inflated carapace, has the form of a five-pronged crest or crown. The regions of the carapace are plainly delimited, excepting only in the case of the boundary between the gastric and cardiac regions. The pterygostomian regions are most remarkably puffed out.

The abdomen (in the female) is large, and the terminal segment has the form of a broad semicircular plate, broader than any of the other segments and nearly as long as all of them put together.

The orbits are capacious, but the eye-stalks are slender and the eyes are unpigmented and semiopaque.

The antennules, which are much larger and longer than the antennæ, are incapable of flexion beneath the front.

The external maxillipeds are of great length, in correspondence with the remarkable trough-like prolongation of the buccal cavity, which they completely close in below; their meropodite, which is prolonged far beyond the insertion of the palp, covers the bases of the antennules and antennæ, their tips in fact being visible from above; the slender exopod does not much surpass the ischium.

The chelipeds are short but massive, and are equal; the merus is curved, the carpus is very small, the palm is large, tumid, and crooked, and the fingers are broad, compressed, pointed, very closely apposable, and have their cutting-edge very finely denticulated.

The second and third legs are of great length, being more than four times the length of the body, the merus forming more than half their extent; their dactyli are filiform and are not much longer than their protopodite. The fourth and fifth legs have the family position, but are mere rudiments, being of hair-like tenuity and only about three fourths of the carapace in length; the fifth ends in a hook-like dactylus.

A female from Station 116, 405 fathoms, has the following dimensions:—Length of carapace 6·5 millim., breadth 6·5 millim., length of cheliped 9 millim., length of second leg 28·5 millim., of fourth leg 4·5 millim.

Colour in the fresh state chalky pink.

Family **Homolidæ**.

Homola, Leach.

96. *Homola megalops*, sp. n.

Carapace quadrilateral, its greatest breadth being fifteen sixteenths of its length, its surface like that of the appendages finely and sharply granular and pubescent. Viewed from in front the front edge of the carapace has the form of an extremely well-marked double ☋-shaped curve, armed throughout its extent with sharp spines and culminating in a concave declivous rostrum with a slightly cleft tip; a pair of spines on either side of the rostrum, forming the armature of the front proper, are stouter than any of the others, and immediately behind the inner spine of each pair is a sharp tubercle.

The rostrum itself in its basal portion descends between the antennules as a vertical plate which ends in a sharp epistomial spine. The lateral margins have a slight elegant double curve, are very regularly spinulate up to the level of the hepatic region, and end in a strong spine at the antero-lateral angle.

The gastric, cardiac, hepatic, and branchial regions are all distinctly delimited; the gastric region is crossed from side to side by a sinuous row of seven spines, and each hepatic region is surmounted by a puckered eminence.

The segments of the abdomen are all distinct and separate in both sexes, the second segment having a sharp spine centrally; all are granular and pubescent, and in the third to sixth the granules have a tendency to concentrate in a raised transverse band.

The eyes are very large, their major diameter being about one fifth the length of the carapace; they are borne on long, slender, granular, and hairy eye-stalks, and the hairs at the corneal margin form a heavy fringe.

The auditory tubercle is very prominent.

The external maxillipeds, like the other thoracic legs, are granular and hairy; the outer edge of their ischiopodite and meropodite is carinated, the carina of the meropodite forming a projecting lobe.

The chelipeds are symmetrical in both sexes and are about a carapace and a half in length; the three crests of the ischiopodite and meropodite, the four or five crests of the carpopodite, and the single (superior) crest of the palm are closely spiny, and the fingers, which are about the same length as the palm, have the cutting-edge sharp and entire.

The other thoracic legs are long, stout, and compressed, the third and fourth pairs, which are the longest, being twice the length of the chelipeds.

In the second to fourth legs the meropodite has both the anterior and the posterior edges closely spinate and the dactylus is long. In the fifth pair the meropodite is spinate on the posterior edge only, the anterior edge having only a single terminal spine. The fifth pair also differs in having a strong terminal spine on the posterior edge of the carpopodite, which joint is also longer than it is in the other legs. In the fifth pair a very efficient subchela is formed by the closing of the short dactylus against a serrated eminence that occupies the middle two fourths of the propodite.

From the orifice in the basal joints of the fifth pair of legs the vas deferens protrudes as a curved tube.

In the male the appendages of the first two abdominal somites are well developed; the first pair are long and hairy and reach to the base of the chelipeds; they are broadly tubular in their distal half and are papillated at the tip; the second pair are stoutish rods about two thirds the length of the first pair, and end each in a broad sucker-like disk. In both of these appendages all the normal component parts are recognizable, although of course modified.

In the female there are five pairs of abdominal legs, of which the first are uniramous.

Colour in life salmon-pink.

A male and a female were dredged at Station 115, 188–220 fathoms; they both have the same dimensions, namely:— Length of carapace 30 millim., breadth 28 millim., length of chelipeds 46 millim., length of third leg 94 millim., length of fifth leg 60 millim.

Order STOMAPODA.

Squilla, auctorum.

97. *Squilla tenuispinis*, Wood-Mason.

Squilla tenuispinis, Wood-Mason, Ann. & Mag. Nat. Hist., March 1891, p. 271.

Station 115, 188–220 fathoms, and Station 119, 95 fathoms.

98. *Squilla stridulans*, sp. n., Wood-Mason.

The late Professor Wood-Mason has recorded the following diagnosis of this species:—

"Dorsal integument foveolate-rugose, the sculpture coarser

on the median lobe of the carapace and between the sublateral carinæ of the free thoracic and abdominal terga than at the sides. Rostrum oblong, with slightly convergent concave and upturned sides, rounded antero-lateral angles, and concave or straight or slightly arched anterior margin, without longitudinal ridge, but with a slightly rounded elevation in the middle.

"Eyes large, asymmetrical in themselves, both lobes being greatly produced, the major diameter of their corneæ contained two and a half times in the antennal scale.

"Processes of antennulary ring curved, sharp, submucronate-triangular.

"Anterior end of ventral arc of optic ring weakly arched, with a small subacute tooth at each antero-lateral angle, ventrally convex posteriorly, the nauplius eye persistent on the anterior slope of the convexity.

"Median dorsal ridge of anterior lobe of carapace forked just in front of the dorsal tubercles, the prongs of the fork straight, contained about $2\frac{7}{10}$ times in the whole ridge. Carapace obtuse-angulated at the junction of the lateral and postero-lateral margins.

"The acute lobes of the outer ends of the fifth thoracic tergum are separated by a wide notch, the anterior lobe tending towards the ventral position; anterior lobe of the outer end of the sixth tergum is squarish, with the hinder angle acute.

"The dorsal crest of the carpopodite of the great raptorial limbs is entire; the dactylopodite weak and slender, its outer margin level for a short distance at the very base, whence it is regularly arched to the extremity, six-toothed, all the teeth distinctly separate to the very base; the outer and inferior apex of the meropodite is not spinous.

"Interrupted dorsal tubercles on second to fifth abdominal terga not cariniform; of the abdominal terga the lateral carinæ of the first to sixth, the sublateral carinæ of the third to sixth, and the submedian carinæ of the fifth and sixth terminate in a spine.

"Telson thin, with the submedian and sublateral spines of its free margin long and slender, with ten teeth between the submedians and fourteen between the submedian and sublateral on each side; median crest faintly notched; oblique ridges very short.

"In the caudal swimmerets the spinous prolongation of the base is exceedingly slender, with the blunt tooth on the outer margin of its inner and longer lobe reduced to a rudi-

mentary condition; the inner margin of the upper surface of the endopodite is very distinctly and regularly crenulate."

Station 119, 95 fathoms, and Station 120, 240 fathoms.

Order AMPHIPODA.

Family **Stegocephalidæ**.

Andania, Boeck.

99. *Andania spinescens*, sp. n.

The head is entirely concealed beneath the pointed hood-like expansion of the first thoracic segment.

The first four abdominal segments are carinated, the carina being prolonged backwards as a great spine overhanging the succeeding segment.

Eyes appear to be absent.

Colour in the fresh state pale lilac.

Carapace of *Andania spinescens*, natural size.

Station 110, 1997 fathoms; two specimens, both nearly 40 millim. in length from the tip of the overhanging hood to the end of the minute telson.

Owing to the mutilation of the appendages it is impossible to properly describe this species.

Specimens of two small blind species of Gammaroids were extracted from their burrows in the husk of a sunk cocoanut dredged from the bottom at Station 108, 1043 fathoms.

The species described in this paper that have not been already figured will be figured in "Illustrations of the Zoology of the R.I.M.S. 'Investigator,'" part iii., to appear either at the end of this year or the beginning of next year.

XLV.—*On some rare and interesting Crustacea from the Dogger Bank collected by Ernest W. L. Holt, Esq.* By Thomas Scott, F.L.S., Naturalist to the Fishery Board for Scotland.

The Crustacea which form the subject of this memoir were presented to me several months ago by my friend Mr. Ernest W. L. Holt. They were collected by him at the south-west end of the Dogger Bank in April 1892, while he was engaged on board the S.S. 'Resolute' carrying out a series of fishery investigations for the Marine Biological Association. The collection in which the Crustacea occurred was made by fixing a tow-net to the end of the beam of the trawl, as is done on board the Scottish Fishery Steamer 'Garland,' and which is a very effective method for capturing those free-swimming marine organisms whose habitat is usually near the bottom. The trawl on this occasion was down for about eight hours in water the depth of which varied from 20 to 26 fathoms. The locality where the collection was made may be given approximately as 70 to 80 miles east by north of Spurn Head at the mouth of the Humber. When the trawl was hauled up the tow-net fixed to the beam was found to contain a large quantity of living matter consisting chiefly of small Crustacea. In this single tow-net gathering the number of species of Crustacea that have been identified are as follows, viz. :—Three species of Decapoda, four species of Schizopoda, four species of Cumacea, twenty-two species of Amphipoda, and five species of Copepoda; a Pteropod, *Clione limacina* (Phipps) (*Clione borealis*, Pallas), was also obtained in the same collection.

Some of the Crustacea obtained in this gathering have not, so far as I know, been previously recorded from the English coasts; indeed the collection as a whole is a very interesting one, and shows how much may be done towards increasing our knowledge of the distribution of the British marine fauna by the adoption of proper methods of investigation, and also thereby tending to throw additional light on obscure fishery questions. Some remarks of the Rev. A. M. Norman on the importance of a knowledge of the Crustacea in connexion with fishery investigations may be appropriately quoted here. Dr. Norman says:—"No real progress can be made with respect to the food of fishes until investigators are familar with those Crustacea which constitute so large a portion of that food"*.

* 'Fourth Annual Report of the Fishery Board for Scotland,' p. 155

The following is a classified list of the species of Crustacea captured by Mr. Holt and arranged in the order in which they are referred to above.

Suborder DECAPODA.

Crangon Allmanni, Kinahan.

Crangon Allmanni, Kinahan, Proc. Dublin Nat. Hist. Soc. vol. iv. p. 80 (1857).

This species appears to be usually confined to off-shore waters, and may be distinguished from *Crangon vulgaris* not only by its colour when alive, but also by the abdomen having posteriorly a distinct median dorsal groove. *Crangon Allmanni* frequently forms an important part of the food of the haddock and the cod.

Crangon nanus, Kröyer.

Crangon nanus, Kröyer, Naturhistorisk Tidsskrift, ser. 1, vol. iv. p. 231 (1842).

This appears to be the *Crangon bispinosa*, Bell (Brit. Stalk-eyed Crust. p. 268, 1853), and seems to have a fairly wide distribution in British waters. It is, as its name implies, one of the smaller species of *Crangon*.

Pandalus annulicornis, Leach.

Pandalus annulicornis, Leach, Malac. Brit. t. xl.; Bell, Brit. Stalk-eyed Crust. p. 297.

This is one of the most valuable of the smaller Crustacea for food purposes. A regular and remunerative fishery of the "prawn" and the "common shrimp" is carried on at several places round the British coasts. The larger food-fishes also prey frequently on *Pandalus annulicornis*, the fragments of these Crustaceans often forming a large portion of the contents of the stomachs of such fishes. It appeared to be scarce at the south-west end of the Dogger Bank at the time the present tow-net gathering was collected.

Suborder SCHIZOPODA*.

Gastrosaccus spinifer (Goës).

Mysis spinifera, Goës, Crust. decapoda podoph. marina Succiæ, p. 14 (1863).

(1886); Rev. A. M. Norman, "On a *Crangon*, some Schizopoda, and Cumacea new to or rare in the British Seas."

* See also the Rev. A. M. Norman's memoir on the British Mysidæ (Ann. & Mag. Nat. Hist. ser. 6, vol. x. pp. 143–166 and 242–263, pls. ix. and x., 1892).

Gastrosaccus spinifer, Stebbing, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. pp. 114 and 328, pl. iii.

This crustacean has been obtained at several places in Scotland and the following English localities:—Off Whitby, Yorkshire, and at Starcross, Devon; and the locality now recorded is a new station for it on the east coast.

Erythrops Goësii, G. O. Sars.

Nematopus Goësii, G. O. Sars, Beretning om en i Somm. 1865 foret. Zool. Reise ved Kyst. af Christianias og Christiansands Stifter, p. 15 (1866).

Erythrops Goësii, id. Monogr. Mysider, p. 24, pl. i. (1870).

There are three species of *Erythrops* recorded for the British seas, and the largest of them scarcely reaches half an inch in length. *Erythrops Goësii* appears to be the rarest of the three in British waters; the only locality from which it has been recorded hitherto is the Firth of Forth, where it sometimes occurs in considerable numbers. The occurrence of *Erythrops Goësii* in Mr. Holt's collection from the south-west end of the Dogger Bank is therefore of interest not only because it is a new station for the species, but also because this station is much further southward than any of its hitherto recorded habitats.

Mysidopsis angusta, G. O. Sars.

Mysidopsis angusta, G. O. Sars, Zool. Reise 1863 i Christiania Stift. p. 30 (1864).

This species is readily distinguished from the other three British species of *Mysidopsis* by its *slightly forked* telson. I know of only four British records for *Mysidopsis angusta*, and they are all from places in Scotland; the present record therefore is an extension of its distribution on the east coast.

Schistomysis ornata (G. O. Sars).

Mysis ornata, G. O. Sars, Beret. om en i Somm. 1863 foret. Zool. Reise, p. 18 (1864).

Schistomysis ornata, Norman, "British Mysidæ," Ann. & Mag. Nat. Hist. ser. 6, vol. x. p. 255 (1892).

This is a widely distributed species in the British seas; it is a handsomely coloured species. The Schizopoda—especially those of the family Euphausiidæ—form an important part of the food of certain fishes.

Suborder CUMACEA.

Lamprops fasciata, G. O. Sars.

Lamprops fasciata, G. O. Sars, Om en i Somm. 1862 foret. Zool. Reise i Christianias og Trondhjems Stifter, 1863, p. 44.

The carapace of this species has three oblique lateral folds and the telson is furnished with five apical spines. *Lamprops fasciata* is very prettily marked. It was somewhat rare in the gathering from the Dogger Bank.

Diastylis Rathkii (Kröyer).

Cuma Rathkii, Kröyer, "Fire nye Arter af Slægten *Cuma*," Naturhistorisk Tidsskrift, ser. 1, vol. iii. p. 508 (1841).
Diastylis Rathkii, Sp. Bate, Ann. & Mag. Nat. Hist. vol. xvii. p. 451 (1856).

This is a large and fine species and occurs sometimes in considerable numbers. In the Dogger-Bank gathering it was somewhat scarce. I have on several occasions observed *Diastylis Rathkii* in the stomachs of fishes.

Diastylis rugosa, G. O. Sars.

Diastylis rugosa, G. O. Sars, "Om den aberrante Krebsdyrgruppe Cumacea og dens Nordiske Arter," Selskab. Forhandl. 1864, p. 41.

This species is considerably smaller than the last and was rather uncommon in the gathering.

Pseudocuma cercaria (Van Beneden).

Leucon cercaria, Van Beneden, Recherches sur la Faune littorale de Belgique, Crust., 1860, p. 85, pl. xiv.
Pseudocuma cercaria, G. O. Sars, Middlehavets Cumaceer, 1879, p. 114, pls. xl., xli., and xlii.

This was a moderately common form in the Dogger-Bank gathering. The species appears to be widely distributed in the British seas.

Suborder AMPHIPODA.

Parathemisto oblivia (Kröyer).

Hyperia oblivia, Kröyer, Grønl. Amfip. p. 70, pl. iv. fig. 19 (1838).
Parathemisto oblivia, G. O. Sars, Crust. of Norway, p. 10, pl. v. fig. 1 (1890).

This species was common in the Dogger-Bank gathering. It is one of the most important among the Amphipoda as fish-food. *Hyperia oblivia* appears to be more or less frequent

all over the North Sea, but is usually of rare occurrence on the west coast of Scotland. During the whole of my residence at Tarbert, Loch Fyne, in 1885-86, the only member of the Hyperiidæ I observed was *Hyperia galba*, a few specimens of which were obtained in one of the *Aurelia aurita* that had been cast ashore by the incoming tide. Mr. David Robertson states that he obtained a single specimen of *Parathemisto oblivia* near the Mull of Cantire; and this was the only one he remembers ever having met with in the Firth of Clyde *.

Euthemisto compressa (Goës).

Themisto compressa, Goës, Œfvers. af Kongl. Svenska Vetensk.-Akad. Förhandl. (1865).
Euthemisto compressa, G. O. Sars, Crust. of Norway, p. 12, pl. v. fig. 2 (1890).

This is a larger species than the last, and apparently somewhat erratic in its movements so far as its presence on the east coasts of England and Scotland is concerned. At one time it may be of frequent occurrence, or even quite common, while at another time not a single specimen can be obtained. A few specimens only were observed in the tow-net gathering from the Dogger Bank.

Callisoma crenata, Spence Bate.

Callisoma crenata, Spence Bate, Cat. Amphip. Brit. Mus. p. 85, pl. xiv. fig. 5 (1862).

Callisoma crenata appears to be a generally distributed species. If a dead half-decayed fish, sea-urchin, or such like is brought up in the dredge, *Callisoma crenata* is almost sure to be present, and sometimes in swarms, feeding on the putrid animal matter.

Hippomedon denticulatus (Spence Bate).

Anonyx denticulatus, Spence Bate, Cat. Amphip. Crust. Brit. Mus. p. 75 (1862).
Hippomedon denticulatus, G. O. Sars, Crust. of Norway, p. 56, pl. xx. (1890).

This fine species was frequent in the tow-net material from the Dogger Bank. It is readily distinguished from its allies "by the peculiar form of the tooth-like posterior projection of the last epimeral plates of the metasome" †.

* 'The Amphipoda and Isopoda of the Firth of Clyde,' by David Robertson, F.L.S., F.G.S., p. 65 (1888).
† G. O. Sars, *op. cit.* p. 57.

Orchomenella ciliata, G. O. Sars.

Orchomenella ciliata, G. O. Sars, Crust. of Norway, p. 69, pl. xxv. fig. 2 (1891).

This somewhat rare species was obtained sparingly in the Dogger-Bank gathering. It appears to have a fairly wide distribution, as Chevreux records it from the coasts of France.

Tryphosites longipes (Spence Bate).

Anonyx longipes, Spence Bate, Cat. Amphip. Brit. Mus. p. 79, pl. xiii. fig. 4 (1862).

Tryphosites longipes, G. O. Sars, Crust. of Norway, p. 81, pl. xxviii. fig. 3, pl. xxix. fig. 1.

This species occurred very sparingly in the Dogger-Bank material. Its known distribution extends to the Mediterranean.

Bathyporeia norvegica, G. O. Sars.

Bathyporeia norvegica, G. O. Sars, Crust. of Norway, p. 128, pl. xliii. (1891).

Bathyporeia norvegica was first recorded as British in the Ann. & Mag. Nat. Hist. 1892, ser. 6, vol. x. p. 205, from specimens obtained in the Firth of Forth. This appears to be the first record of its occurrence on the English coast. It is readily distinguished from any other allied form by its larger size and especially by the tooth-like form of the postero-lateral angles of the epimeral plates of the third segment of the metasome.

Bathyporeia pelagica, Spence Bate.

Bathyporeia pelagica, Spence Bate, Cat. Amphip. Brit. Mus. p. 174, pl. xxxi. fig. 6 (1862).

This is a smaller species than the last, and it has a fairly wide distribution. Several specimens occurred in the Dogger-Bank tow-net gathering.

Argissa hamatipes (Norman).

Syrrhoë hamatipes, Norman, Report of the 38th Meeting of the Brit. Assoc., 1868.

Argissa typica, Boeck, Crust. Amphip. bor. et arct. p. 45 (1870); G. O. Sars, Crust. of Norway, p. 141, pl. xlviii. (1891).

Argissa hamatipes, Scott, Eleventh Annual Report of the Fishery Board for Scotland, pt. iii. p. 213, pl. v. figs. 30, 31.

Several specimens of this curious species were obtained in the gathering from the Dogger Bank. The present is a new record of the species for the English east coast. It has been obtained at several places on the Scotch coasts.

Ampelisca typica (Spence Bate).

Tetromatus typicus, Spence Bate, Brit. Assoc. Report, 1855, p. 58.
Ampelisca Gaimardii, id. (non Kröyer), Brit. Sess.-eyed Crust. vol. i. p. 127 (1863).
Ampelisca typica, G. O. Sars, Crust. of Norway, p. 165, pl. lvii. (1891).

Several specimens of this species were obtained.

Amphilochus tenuimanus, Boeck.

Amphilochus tenuimanus, Boeck, Crust. Amphip. bor. et arct. p. 51 (1870).

The characters that distinguish this species from *Amphilochus manudens* are somewhat obscure. There is no tooth-like projection at the base of the dactyli of the gnathopods as there is in those of *Amphilochus manudens*. The last pair of epimeral plates of the metasome are simply angular and want the small but distinct denticle at the postero-lateral angles, and the telson is also longer. The present is the only record I know of for *Amphilochus tenuimanus* for the east coast of Great Britain. Mr. David Robertson has taken it in the Firth of Clyde, near Cumbrae.

Amphilochoides pusillus, G. O. Sars.

Amphilochoides pusillus, G. O. Sars, Crust. of Norway, p. 222, pl. lxxvi. (1892); T. and A. Scott, Ann. & Mag. Nat. Hist. ser. 6, vol. xiii. p. 147 (1894).

This species has only recently been added to the British fauna from specimens obtained in the Firth of Forth and St. Andrews Bay; and the present record is an interesting addition to our knowledge of its distribution in British waters.

Stenothoë marina (Spence Bate).

Montagua marina, Spence Bate, Cat. Amphip. Brit. Mus. p. 56, pl. viii. fig. 5 (1862).
Stenothoë marina, G. O. Sars, Crust. of Norway, p. 236, pl. lxxx. (1892).

A few specimens of this widely distributed species were obtained in the Dogger-Bank gathering.

Perioculodes longimanus (Spence Bate).

Monoculodes longimanus, Spence Bate and Westwood, Brit. Sess.-eyed Crust. vol. xi. p. 507 (1869).
Perioculodes longimanus, G. O. Sars, Crust. of Norway, p. 313, pl. cx. fig. 2, pl. cxi. fig. 1.

The distribution of this species extends from Norway to the Mediterranean, and it is of frequent occurrence in the British seas.

Pontocrates norvegicus, Boeck.

Pontocrates norvegicus, Boeck, Crust. Amphip. bor. et arct. p. 91 (1870).
Kröyera altamarina, Spence Bate and Westwood, Brit. Sess.-eyed Crust. vol. i. p. 177 (1863).

A few specimens of this species were obtained in the material from the Dogger Bank.

Synchelidium brevicarpum (Spence Bate).

Kröyera brevicarpa, Bate and Westwood, Brit. Sess.-eyed Crust. vol. xi. p. 508 (1869).
Synchelidium brevicarpum, G. O. Sars, Crust. of Norway, p. 318, pl. cxii. fig. 1 (1892).

This is a small species with curious gnathopods. It does not appear to be very common in the British seas.

Halimedon Mülleri, Boeck.

Halimedon Mölleri, Boeck, Crust. Amphip. bor. et arct. p. 89 (changed afterwards by Boeck to *H. Mülleri*).
Halimedon Mülleri, G. O. Sars, Crust. of Norway, p. 327, pl. cxv. (1892).

This was a somewhat rare species in the Dogger-Bank material.

Iphimedia ? obesa, Rathke.

Iphimedia obesa, Rathke, Acta Acad. Leop. t. xx. p. 85, pl. i. fig. 1 (1843).

A specimen apparently belonging to this species but somewhat imperfect occurred in the gathering from the Dogger Bank. The species has a wide distribution in the British seas. It is frequently ornamented with transverse bands usually of a rich brownish or reddish colour.

Apherusa borealis (Boeck).

Apherusa borealis (Boeck), G. O. Sars, Crust. of Norway, p. 441, pl. clv. fig. 2 (1893).

This species was of common occurrence in the Dogger-Bank material. The two dorsal tooth-like projections of the metasome appear to be more strongly developed in the male

than in the female; the telson is in the form of an elongate narrow triangular plate with an acute apex; a minute hair springs from a small marginal notch on each side of the apex. This is also one of the more common species of Amphipods in the Firth of Forth.

Megaluropus agilis, Norman.

Megaluropus agilis, Norman, Ann. & Mag. Nat. Hist. ser. 6, vol. iii. p. 446, pl. xviii. figs. 1–10 (1889); id. ibid. ser. 6, vol. iv. p. 123, pl. x. figs. 15–17 (1889).

Several specimens of this Amphipod were obtained in the material from the Dogger Bank; it appears to be generally distributed round the British coasts.

Dulichia, sp.

An imperfect specimen of *Dulichia* was obtained in the Dogger-Bank material; some of the more important appendages were absent, rendering specific identification doubtful.

Caprella, sp.

A few specimens of a *Caprella* were also obtained, but they were too imperfect for the species to be satisfactorily made out.

Suborder Copepoda.

This suborder was represented in the Dogger-Bank gathering by five species, all of which, with one exception, are more or less common in the British seas. The species are as follows:—*Calanus finmarchicus* (Gunner), one of the most abundant species in the gathering; *Pseudocalanus elongatus*, Boeck, frequent; *Temora longicornis* (O. F. Müller), abundant; *Mitridia armata*, Boeck, rare; and *Centropages hamatus* (Lilljeborg), frequent.

There was another and a smaller gathering, collected on the same date and near the same locality as the one now described; but the species were much fewer, and those that were represented in the material did not differ from those already referred to. In both gatherings *Sagittæ* were more or less common, and many of them were of large size.

XLVI.—*On Two small Collections of Neuroptera from Ta-chien-lu, in the Province of Szechuen, Western China, on the frontier of Thibet.* By Robert M'Lachlan, F.R.S. &c.

For the materials from which this paper has been drawn up I am indebted to my good friend Mons. René Oberthür, of Rennes, who obtained them from his collectors in the above-mentioned locality. Ta-chien-lu is situated, I believe, at a considerable elevation. The number of new forms in such comparatively small collections is remarkable and significant. In several respects the affinities are with Japan rather than with the Himalayas, notwithstanding the nearer proximity of the latter.

Trichoptera.

Fam. **Phryganeidæ.**

Neuronia (*Holostomis*) *regina*, M'Lach.

Holostomis Maclachlani, White, var. *regina*, M'Lach. Journ. Linn. Soc., Zool. xi. pp. 103, 104.

Nearly a quarter of a century has passed since I indicated the Japanese form of the Himalayan *H. Maclachlani* as probably a distinct species and suggested the name *regina* for it. Since then I have received and seen many examples of both forms from their respective habitats, and they keep themselves thoroughly distinct so far as coloration is concerned. I am now disposed to attach little importance to the apparently narrower wings in the Japanese insect. Of the common origin of the two forms there can be no doubt, but they appear to me now entitled to rank as species; and I am the more confirmed in this view because in the collection from Ta-chien-lu there is a single male which in colour conforms to the Japanese condition and not to the Himalayan. In wing-contour it is the same as the Himalayan (but so also are some examples from Japan). If any differences exist in the anal parts they are only very slight and remain to be detected.

Fam. **Limnophilidæ.**

Halesus amplus, sp. n.

Body fuscous above, ochraceous beneath. Head above and pronotum clothed with fuscous hairs, those on the front and

pleuræ ochraceous. Antennæ strong, shorter than the wings, brown, with yellowish annulations, and the basal joint is dingy yellowish. Palpi yellowish or testaceous. Legs testaceous, with not very numerous stout black spines on the tibiæ; on the anterior and intermediate tibiæ each spine arises from a black spot; tips of the tibiæ and of each tarsal joint black.

Anterior wings long, rather narrow, elliptical at the apex, the membrane finely granulose, and clothed, as are the veins, with fine short blackish hairs; on the postcostal region these hairs are long and strong, and there is a dense fringe of blackish hairs at the base of the costal margin. The ground-colour is smoky greyish (browner in the female), closely sprinkled with minute pale points, and on each side of the veins these points alternate in an irregular manner with darker spaces (especially on the apical sectors); on the lower edge of the cellula thyridii and on the lower edge of the postcosta is an interrupted blackish line; at the termination of the postcostal cellules is a rather conspicuous rounded pale spot. Neuration scarcely darker than the ground; discoidal cell very long and narrow, leaving only a short footstalk, apical cells all long, the first longer than those succeeding, oblique at its base, second to fourth nearly equal.

Posterior wings pale smoky grey, slightly iridescent; at the base of the costal margin are tufts of long silky pale hairs, and there is a fringe of similar hairs on the anal margin. Neuration pale, the anal sectors darker.

In the male the margin of the last dorsal segment is somewhat raised and excised in the middle, and proceeding therefrom is a black thickened portion produced into a rounded knob on either side and deeply excised in the middle. Superior appendages small and not prominent, ear-shaped or broadly sickle-shaped, yellowish, with pale hairs (intermediate appendages doubtful). Inferior appendages arising nearly contiguously from each side of the middle of the margin of the last ventral segment; viewed ventrally they are short, flattened, the inner edge deeply excised in its apical half and clothed with long yellowish hairs (concolorous with the appendages themselves); all the inner parts concealed.

In the female the margin of the last dorsal segment is slightly produced triangularly. Appendices flattened, subtriangular, their outer surface excavated. Side-pieces of last ventral segment small. Vulvar scale large, prominent, and yellow, consisting of two broad oblong side-lobes, rounded externally, and a contiguous middle lobe in the form of a long acute triangle of equal length with the side-lobes.

Length of body, ♂ 15, ♀ 16 millim. Expanse, ♂ 52, ♀ 56 millim.

One male, one female.

A large insect, with no parallel amongst strictly European forms. In contour of wings it resembles the European *Stenophylax concentricus*, M'Lach. et auct. (nec Zett.), but is larger and darker.

Stenopsyche griseipennis, M'Lach.

Three males and one female.

This identification is based on the supposition that one species, varying much in size and in intensity of colour, extends from the Himalayas, through North China, to Japan and the Loo-Choo Islands, a point that requires an exhaustive study to decide. The examples here under consideration have the anterior wings very darkly marbled and the posterior very opaque white, with broad fuliginous apex; some examples from Sikkim &c. in the Himalayas are similar in this respect; the smoky apex of the posterior wings appears to be only a matter of degree. At the most I think these can only be local forms, not perhaps sufficiently differentiated for specific distinction.

Neuroptera Planipennia.

Fam. **Panorpidæ.**

Panorpa diceras, sp. n.

Body pale orange-yellow, with black markings as follows:—on the head is a large spot in which the ocelli are placed, continued as a fine line between the basal joints of the antennæ and expanded into a triangle on the front below them; rostrum with two lines gradually convergent towards the apex; a line on either side of the body commencing on the prothorax and continued to the end of the fifth abdominal segment, broadest on the basal segments.

Antennæ and palpi black. Legs greyish yellow, with short blackish pubescence; tips of tarsal joints blackish, the last two joints of the intermediate and posterior tarsi nearly wholly blackish; spurs piceous; claws testaceous, with three or four long comb-like teeth within.

Wings moderate, subobtuse, dusky hyaline, the extreme apex pale fuliginous; otherwise without markings, save that the pterostigma is yellowish and rather long. Subcosta not extending to the pterostigma in either pair. Neuration black, but the

transverse nervules appear whitish in certain lights, as also does the base of the furcation of the upper cubitus.

Abdomen short, with fine silky whitish pubescence; all the segments to the fifth transverse. Third dorsal segment slightly produced into a rounded flap in its middle, apparently covering a cavity in the anterior portion of the fourth; sixth segment as long as the fourth and fifth united, oblong, the middle of its posterior end above is *produced into two short, strong, cylindrical, obtuse, slightly divergent horns*; seventh longer than the sixth, obconical, curved upwards, excised and narrowed at its base above; eighth about the length of the seventh, narrowly obconical, straight; cheliferous segment short, the lateral pieces strongly rounded, the chelæ shorter than the segment, turned inwards and crossing; on the inner edge of each is a tooth about the middle, after which the apical portion is excised, and there are probably one or two inner teeth at the extreme base; appendages flattened, closely applied to the edges of the rounded side-lobes, gradually dilated to near the apical portion, which is oblique inwardly, the inner edge with a fringe of rather strong distant black hairs (the whole cheliferous segment is more dusky in colour than those preceding it, and on its inner, or upper side if extended, is an appearance as of two long yellow hairy processes, damaged in the individual before me).

Expanse, ♂ 30 millim.

Only one individual is before me, remarkable for its pale colours and the conformation of the margin of the sixth segment.

Fam. **Ascalaphidæ**.

Idricerus exilis, sp. n.

Body slaty cinereous. Head above very densely clothed with long black hairs directed forward in a tuft between the antennæ; on the front is a dense tuft of blackish hairs, directed upwards, below the antennæ; below this the hairs are cinereous, mixed with black at the sides; clypeus and labrum yellow; palpi testaceous; mandibles piceous at tip. Antennæ wholly black (including the capitate club). Thorax above with cinereous hairs, mixed with blackish on the sides; pleuræ and breast with dense long whitish silky hairs. Legs reddish; tarsi black; on the anterior tibiæ beneath is (male only?) a dense cushion of pale ochreous hairs occupying the whole length; spurs black, those on the posterior tibiæ about as long as the first two tarsal joints; claws strong, black, rather longer than the terminal tarsal joint. Abdomen with

sparse long blackish hairs, moderately stout in male, its cinereous ground varied by a broad velvety-black annulation at the posterior end of each segment above (only to third segment beneath); on the side of the posterior margin of each dorsal segment is a short reddish line (scarcely visible on the terminal segments and probably altogether discoloured in examples in bad condition); terminal dorsal segment produced above, with a tuft of long blackish hairs; terminal ventral segment obtusely triangular on each side, with long blackish hairs.

Wings vitreous, with watery-blue iridescence, rather narrow, the inner margin slightly dilated before the termination of the cubiti; anal angle of anterior wings rounded, followed by a slight excision. Neuration wholly black, except at the extreme base and a short space at the base of the radius, which are yellowish (including the membranous attachments); pterostigma small, blackish fuscous, with two included nervules in the anterior and three in the posterior; postpterostigmatic area commencing with two rows of cellules, then going on to three and then to four, the cellules of the marginal series the smallest, those of the lower series the largest; about thirty-seven costal nervules before the pterostigma; four or five rows of cellules between the lower cubitus and the inner margin.

Length of body (♂) 34 millim. Expanse of wings 85 millim.; length of anterior wing 41 millim., greatest breadth 10 millim.; length of posterior wing 32 millim.

One male.

Apparently more closely allied to the Japanese *I. japonicus*, M'Lach., than to the North-Indian *I. decrepitus*, Walk., and *I. Elwesii*, M'Lach.

Fam. Chrysopidæ.

Chrysopa dasyphlebia, sp. n.

Body wholly very pale green, without markings of any kind. Head above with an elevated somewhat semicircular space, divided by a longitudinal median impressed line with an excavation on either side. Antennæ shorter than the wings, slender, whitish, a short straight hair at the apex of each joint excepting those towards the base; basal joint comparatively short, somewhat bulbous. Palpi whitish. Eyes deep black (in dead examples). Pronotum longer than broad, slightly narrowed anteriorly, with an impressed median longitudinal line, and a transverse sulcus posteriorly, sparingly

clothed with rather long whitish hairs, and there are similar hairs, but denser, on the abdomen. Legs whitish, clothed with concolorous hairs; tarsi slightly yellowish; claws testaceous, much dilated at the base, the apical portion slender, much curved, extending beyond the dilated portion.

Wings broad, subacute; in the anterior pair the costal area is narrow at the base, but the costal margin soon becomes gradually rounded and the area correspondingly broad; the margins with a dense fringe of whitish (or yellowish-white) hairs, and there are long divaricating hairs on the neuration; this latter is wholly pale green, with the following exceptions —in the anterior wings the veins in the costal area at the base are dusky blackish at their upper ends, and two or three small veins at the end of the postcostal region are incrassate and dusky blackish (but not always so); in the posterior wings the costal veinlets are blackish towards the base (in some examples there is an appearance as of long dusky spaces on the subcosta, but not of a decided nature); in both pairs of wings the sector does not run quite parallel with the radius, and the two series of gradate nervules are also not parallel; in the anterior wings there are ten to twelve nervules in the inner and ten to fifteen in the outer series; thirty to thirty-five costal nervules before the pterostigmatic area (this latter very faintly yellowish); dividing nervule of the third cubital cellule extending to rather more than half its length (but varying) and about one third beyond the insertion of the superposed nervule.

Expanse 36–46 millim.

I have seventeen examples before me.

In general form, pale colour, and very hairy margins and neuration this species bears some analogy to the much smaller European *Ch. alba*, L.; but I think there is no real affinity, on account of the differing arrangement of the neuration. It also recalls species of the genus *Leucochrysa*, M'Lach.*; but in that genus, as defined by me, the labrum is excised, the antennæ are much longer than the wings, and the divided portion of the third cubital cellule is more or less triangular (not oval).

N.B.—Dr. Gerstäcker, in describing some new species of Chrysopidæ from Japan (Mitth. nat. Ver. Neu-Vorpommern und Rügen, 1893), has a "*Nothochrysa*" *robusta*, which he compares with "*N.*" *pallida*, Schn., and "*N.*" *bipunctata*, Burm. But these two species have nothing whatever to do

* *Protochrysa*, Kolbe, Arch. f. Naturgesch. 1888, Band i. p. 174,= *Leucochrysa*, M'Lach. Trans. Ent. Soc. Lond. 1868, p. 208.

with the genus *Nothochrysa*, M'Lach.; neither, I think, has *N. robusta*, nor probably others described in the same paper. *Nothochrysa* is distinguished by its excised labrum, by the third cubital cellule being divided longitudinally into two more or less oblong parts, by the short stout antennæ, and generally robust form, all of which characters are absent in *Chrysopa pallida*, Schn.

Chrysopa punctilabris, sp. n.

Body green. Head above with a triangular excavated space bounded by raised edges; front whitish green, with nine conspicuous more or less oval black spots, viz. one between the basal joints of the antennæ, two on each side of the genæ placed obliquely, one on each side of the clypeus, and one on each side of the labrum. Palpi black, the joints pale at base and apex, the terminal almost wholly black. Antennæ shorter than the wings, slender, slightly testaceous, the basal joint green, bulbous. Pronotum transverse (broader than long), with two deep transverse sulci and a raised ridge between them, spotless. Legs whitish, with fine blackish hairs; tarsi slightly testaceous; claws testaceous, strongly dilated at the base internally. Abdomen clothed with whitish hairs.

Wings oval, moderately broad, subacute, all the margins densely fringed, and the neuration with strong blackish (whitish in certain lights) divaricating hairs; costal area broad, with 28 to 32 nervules before the slightly yellowish pterostigmatic space. Neuration green, varied with black as follows:—the costal nervules, those below the radius at their upper end, nearly all the basal nervules, those between the cubiti at one or both ends, some of the axils of the marginal furcations, and the gradate nervules; sector nearly parallel with the radius, and the two gradate series (seven to nine in each on the anterior wings) are also nearly parallel; dividing nervule of the third cubital cellule extending to about half its length and about one third beyond the insertion of the superposed nervule.

Expanse 28–34 millim.

Four examples.

Possibly of the group of *Ch. 7-punctata*. Should be easily recognized by the nine spots on the front, the presence of those on the labrum being exceptional.

Pseudo-Neuroptera.

Fam. **Ephemeridæ**.

Ephemera pictiventris, sp. n.

♀ *subimago*. Head and thorax above opaque whitish, more tinged with yellowish beneath. Eyes black, and they are connected by a black band. Antennæ having the second joint black, those succeeding slightly paler. A black line extends on each side along the thorax from below the eyes to the root of the anterior wing, and on each side of the meso-thorax there is a large round-oval black spot below the black line. Legs yellowish white; anterior femora with a dusky line internally, and dusky externally towards the apex; the corresponding tibiæ and tarsi dusky, the latter almost blackish, intermediate and posterior tarsi having the terminal joint dusky. Abdomen yellow, each segment above having a complete crescentic black marking, becoming more elliptical on the apical segments; venter with an oblique black streak on the sides of each segment, becoming straighter and more parallel on the antepenultimate and penultimate. Setæ black, the two outer with yellow basal joint; clothed with fuliginous hairs, which become longer and more dense on approaching the apex.

Wings opaque whitish, the costal margin as far as the radius tinged with yellowish. Neuration black, but yellow at the extreme base; the anal reticulation pale.

♀ *imago*. Head and thorax shining yellow; a broad black band connecting the eyes. Antennæ having the second and third joints black, the bristle whitish. Pronotum with a broad oblong black spot on either side. Mesonotum shining fuliginous in front, a black line in the sulcus that bounds the raised median portion; a black spot on the sides contiguous to the posterior angle of the pronotum; an elongate spot on the sides above the root of the anterior wings; a curved blackish streak on the sides above the intermediate legs, appearing as if trifid or quadrifid posteriorly, and there are blackish markings above the posterior legs. Legs yellow; anterior femora blackish on the edges, the tibiæ and tarsi wholly black; intermediate and posterior tarsi dusky. Abdomen yellow, with black crescentic markings above as in the subimago, but broader and more intense, and the sides of each dilated and connected with the oblique black lines on the ventral surface, which are also more intense and complete. (Setæ wanting.)

Wings hyaline, iridescent. In the anterior pair the subcostal area is faintly tinged with yellowish; the only markings are a blackish nodal dot on the subcosta, a smaller one below it on the sector, and a third at the point of furcation of the cubitus. Neuration black, passing into yellowish white at the extreme base and in the anal region; in the pterostigmatic region are two rows of irregular cellules. Posterior wings without markings, the basal portion of the subcosta conspicuously deep black.

Length of body, ♀ 14–17 millim., of setæ 18 millim. Expanse 39–46 millim.; length of anterior wing 19–22 millim.

Two female subimagos, one female imago.

Apparently nearly allied to *E. japonica*, M'Lach.; the male is a desideratum.

Odonata.

Subfam. *Libellulina*.

Pantala flavescens, F.

Many examples.

Sympetrum scoticum, Donov.

One female.

The wings at the base deep yellow as far as the basal area and on the anal border, which colour is continued in a less intense degree along the costal margin to beyond the nodus. The neuration is somewhat aberrant, inasmuch as the last antenodal nervule is continued into the subcostal area in all the wings except the left posterior. I find this condition not uncommon in the species, and it is usually asymmetrical.

Thecadiplax ardens, sp. n.

Closely allied to *Th. erotica*, Selys, but larger. Differs principally as follows:—The two shining black spots on the top of the front are usually (not always) united into a short transverse band. On the thorax above is a cuneiform (or triangular) black band in which is placed the dorsal carina; the humeral black band is broader, and the lower branch of the divided portion of this band above the legs is curved and connected with a complete oblique black line, in which is placed the mesothoracic spiracle; another oblique black line occupies the metathoracic suture (these two lines usually con-

nected by a black thread at the spiracle). In the male there is a triangular lateral blackish spot on the sides of segments 4 to 7; in the female these spots are much larger and occur on segments 3 to 7, and are confused with the blackish underside; in this sex segments 8 to 10 are wholly black, excepting a reddish spot on each side of 8, and with paler margins above on 9 and 10. Genitalia apparently not differing from those of *Th. erotica*, and the appendages not appreciably different; in both species (and probably also in the allies) the superior appendages are bifid at the upturned tips, and there are one or two minute denticulations below the tips. In the female the vulvar scale is perhaps more deeply divided and the two obtuse apical side-lobes broader.

In the wings the pterostigma is longer (3 to 3½ millim.); ten antenodal nervules in the anterior wings of the male, nine in the female.

Length of abdomen, ♂ 29 millim., ♀ 26½–27 millim. Length of posterior wing, ♂ 33 millim., ♀ 32–33 millim.

Two males, four females.

Although these examples (especially the females) vary somewhat *inter se*, it seems to me that they form either a distinct species or a marked local race.

Libellula basilinea, sp. n.

Closely allied to *L. quadrimaculata*, L.; differs especially as follows:—In the anterior wings are *two blackish streaks at the base, viz. one in the subcostal area extending to slightly beyond the arculus, the other occupying the whole of the median area.* In the posterior wings there is a streak in the subcostal area; the triangular spot is comparatively small, deeply excised beneath, deep black, and *not reticulated with yellow.*

Abdomen *beneath deep black, with seven isolated marginal subquadrate yellow spots*, that on the second segment small, the others large, but gradually decreasing to the eighth segment; these spots are reproduced on the sides of the dorsal surface, but are there more elongate.

One pair (♂ ♀).

As an additional character it may be stated that the costal margin as far as the median vein is yellow for the whole length of the wing, even in the postpterostigmatic area; in *L. quadrimaculata* this sometimes exists as far as the nodus, but not often beyond it.

Thus the main points in *L. basilinea* are:—(1) The two lines at the base of the anterior wings; (2) the triangular

spot at the base of the posterior not reticulated with yellow; and (3) the black ventral surface, ornamented with very distinct isolated yellow marginal spots. These combined differences are arrived at after a comparison with about fifty examples of *L. quadrimaculata* from various parts of Europe, Northern Asia, and North America.

In size *L. basilinea* equals the largest *L. quadrimaculata*.

In the basal streaks *L. basilinea* has affinity with *L. angelina*, Selys, from Japan, but in the latter there is a large triangular blackish spot under the pterostigma in all the wings, the basal triangular spot of the hind wings is reticulated with yellow, and the abdomen has no clearly defined yellow spots; but there is sometimes an approach towards them to be seen in *L. quadrimaculata*.

I have compared the appendages and genitalia of the second segment and the vulvar scale, without finding appreciable differences between *L. quadrimaculata* and *L. basilinea*, and I am not sure that any such exist between *L. angelina* and *L. quadrimaculata*, though the genitalia of the second segment look rather different.

Having regard to the fact that the only two individuals in the collection are precisely similar in their essential characters, I can only arrive at the conclusion that they represent a condition equally worthy of specific rank as is *L. angelina* of Japan.

Orthetrum japonicum, Uhler, var. n. *internum*.

Differs from the typical *O. japonicum* as follows:—In the labium *the middle lobe is wholly blackish* and *the side-lobes are broadly margined* (sometimes nearly wholly) *with the same colour*. On the thorax the black band separating the two large yellow spaces on the sides is broader, without (at any rate in adult examples) any trace of containing a yellow line.

In the wings the pterostigma appears to be slightly narrower and more or less deep black in adult individuals; *the triangle of the posterior wings apparently invariably traversed by a nervule* (without any nervule in the type form).

Nine males and one female, all very adult.

These may represent a species distinct from *O. japonicum*, and the fact that the triangle of the posterior wings is apparently always traversed by a nervule (in one example the triangle of the anterior is traversed by *two* nervules) may be sufficient to separate it; but having in view the instability of this character in individuals of other species from one locality,

I think it prudent to consider the specimens as constituting only a local form or race.

Among European species *O. japonicum* closely resembles *O. brunneum* in size and general form, and *O. cancellatum* in the structure of the genitalia of the second segment.

Orthetrum melania, Selys.

One male.

The spot at the base of the posterior wings is slightly smaller than in Japanese examples; otherwise I see no difference.

Crocothemis servilia, Drury.

One female.

Agrionoptera (?), sp.

One male, very doubtfully pertaining to this genus, left for further consideration.

Subfam. *Cordulegastrina*.

Cordulegaster pekinensis, Selys.

One pair (♂ ♀).

The male appears to agree sufficiently with the description, but is smaller (length of posterior wing 41 millim., of abdomen 50 millim.). The female agrees with the male in all essential characters: length of posterior wing 43 millim., of pterostigma $4\frac{1}{3}$ millim., of abdomen 54 millim.; 17 antenodal nervules in anterior wings.

De Selys queries the species as probably only a race of *luniferus*, Selys. The latter was from Moupin, in the same district as Ta-chien-lu; but the pair before me agree far better with *pekinensis*. The anal appendages of the male differ from those of the European *bidentatus* in having the upper (or submedian) tooth almost as pronounced as the lower. The anal triangle of the posterior wings has four cellules in *pekinensis* and three in *bidentatus*.

Subfam. *Æschnina*.

Æschna juncea, L.?

One female, doubtful in the absence of the male.

Subfam. *Calopterygina.*

Calopteryx Oberthüri, sp. n.

♂. Head, thorax, and abdomen above bright metallic green; clypeus somewhat metallic blue; labrum shining black; second joint of antennæ yellowish externally. Under mouth-parts, legs, pectus, ventral surface of abdomen, and anal appendages dull black. A pointed tubercle behind the eyes. Spines of legs closely placed and very long. Superior appendages much incurved, gradually incrassated to the apex, so that each forms an incurved obtuse club, dentate externally. Inferior appendages one third shorter, subcylindrical, slightly curved, the apex truncate.

Wings long and comparatively narrow, the inner margin dilated in the middle; nodus placed slightly beyond the basal third. Colour deep black, with bluish reflexions (becoming green on the posterior wings), *the apical fourth* (rather less in posterior wings) *hyaline*, slightly smoky, sharply defined, but the margin of this hyaline space, especially in the posterior wings, is very narrowly blackish; the costal cellules to about halfway to the nodus with a long triangular subhyaline space, and there are pale dots for a corresponding length in the minute cellules of the base of the inner margin. Neuration wholly black; costal nervure not metallic; principal sector contiguous to the median for a short space. About 48 to 50 antenodal nervules in anterior wing.

♀. Head as in male, but the labrum, a spot on each side of it, and the under mouth-parts are yellow, the labium infuscated; pectus yellow, which colour is continued along the metathoracic suture, and the base of the abdomen at its sides beneath is also yellow. The metallic green of the abdomen above passing into bronzy after the fourth segment; ventral surface whitish pruinose; lateral margins of eighth and ninth segments narrowly yellow; appendages shorter than the tenth segment, black.

Wings: the portion that is black in the male is here smoky brown, and in the posterior wings there is an appearance of a broad darker band terminating the dark portion. Neuration reddish; a narrow elongate (3 millim.) whitish *false pterostigma* commencing at the termination of the dark portion of the wing (slightly before in the posterior), occupying only the costal area, which is scarcely perceptibly dilated thereby. About 40 antenodal nervules in the anterior wing.

Length of abdomen, ♂ 54–55 millim., ♀ 48–50 millim.

Length of posterior wing, ♂ 40–41 millim., ♀ 43–44 millim.

Seven males, four females.

A very remarkable species and the only one in the genus with the same sharp delimitation of the pale apical portion of the wings; at first sight it reminds one of a gigantic *Euphœa* rather than a *Calopteryx*. The female has a vague resemblance to *C. cornelia*, and in its elongate and comparatively narrow wings the species may be compared with *C. cornelia* and *C. atrata*, both Chinese and Japanese forms. All the examples before me are mature.

C. grandæva, Hag., described in 1853, remains known only by the probably immature female type. There are many points in the description opposed to identity with *C. Oberthüri* (notably the absence of a pterostigma).

Archineura incarnata, Karsch.

Echo incarnata, Karsch, Berl. ent. Zeit. xxxvi. 1891, = *Archineura basilactea*, W. F. Kirby, Ann. & Mag. Nat. Hist., January 1894 (very immature).

One male of this magnificent insect.

I marvel that Dr. Karsch did not draw any comparison with the American genus *Hetærina* in the way of coloration, the carmine-red at the base of the wings existing only in that genus (with the allied *Lais pudica*) and in the species now under consideration; but of course it is only analogy. I am convinced that (as noticed by Karsch, Ent. Nachr. Heft vi. 1894) the type of *A. basilactea* is only an extremely immature example of the same species, and I am of opinion that the locality (Foo-Chow) given for it is erroneous, although it may have been brought to that port from the interior.

There is no connexion with *Sapho* as indicated by Kirby; but I doubt if the insect can be retained in *Echo* (which was unknown to Karsch, save by description). It is not necessary to go into minute details here; but the long, narrow, and only slightly dilated pterostigma is opposed to *Echo*, and the arrangement of the branches of the ramule, especially in the posterior wings, is conspicuously different. At present I retain Kirby's generic and Karsch's specific name.

Caliphœa consimilis, sp. n.

Head above metallic green, passing into blue, with a yellow spot on each side of the labrum and the second joint of antennæ yellow outwardly; back of head and under mouth-parts black. Thorax above metallic cupreous or green;

beneath (including coxæ and underside of trochanters) citron-yellow; an isolated metallic blue or green streak on the meta-thoracic pleuræ. Legs (excepting at base) black. Abdomen above bronzy green or purplish, segments 8 to 10 snow-white, pruinose; beneath black or with bluish pulverulescence, underside of first segment yellow. Superior appendages about the length of the tenth segment, black, forcipate, thickened at the base, the apical half suddenly turned inward almost at a right angle, dilated and upturned at the tip; on the outer edge of the inturned portion are four to six denticulations. Inferior appendages black, only slightly shorter than the superior, subparallel, distant, flattened, their apices internally much dilated in a triangular manner, the upper edge oblique and finely denticulated, the lower angle perhaps forming a tooth (but from the manner in which the opposing apices are applied one to the other it is difficult to decide).

Wings hyaline, faintly tinged with olivaceous. Neuration black; pterostigma oblong, 2 millim. long, covering two and a half to three cellules, black; 14 to 17 antenodal nervules in the anterior wing (many of the postnodal nervules are not coincident in the costal and subcostal areas); *two* nervules in the quadrilateral.

Length of abdomen 39 millim.; length of posterior wing 31 millim.

Two adult males.

N.B.—*Notholestes*, M'Lach. (Ent. Month. Mag. vol. xxiv. p. 31), 1887,= *Caliphœa*, Hag. (Selys, Add. Synop. Calop. p. 5), 1859, and *N. Elwesi*, M'Lach. (*l. c.* p. 32),= *C. confusa*, Hag. (*l. c.*). I have compared the typical examples of each; that of *C. confusa* is less mature. The pterostigma appears slightly broader and shorter in the type of *C. confusa*, but in all probability only in the way of individual variation (its paler colour is a result of immaturity).

C. consimilis is very similar, and the same description would apply almost equally well to either (the types of *consimilis* are still more mature), except that the *inferior appendages* appear to be formed in a different manner, and that there are *two* nervules in the quadrilateral instead of one.

In describing *Notholestes* as new I overlooked *Caliphœa*, on account of the latter having been placed in the "Légion *Calopteryx*," with which I venture to think it has no relationship; and I adhere to my original opinion that its affinities are with *Dicterias*. In the description of *Caliphœa* the words "Ailes petiolées jusqu'au *niveau* de l'arculus" are incorrect (*cf.* my description of *Notholestes*).

Subfam. *Agrionina*.

Erythromma tinctipennis, sp. n.

♀. Head black above, with a bronzy greenish tinge on the sides, clothed with long blackish hairs in front; front reddish yellow, the clypeus above and the labrum (excepting its margin) black (but wholly yellow in one example). Labium yellow. Back of head black. Antennæ black; second joint yellow at apex. Eyes brown. Pronotum black, its hind margin raised in a bluntly triangular manner, its side-lobes carunculated and deep yellow. Thorax black above, with complete yellow humeral (or humeral and juxtahumeral combined) band; the sides and breast wholly yellow, leaving a uniform isolated black band below the humeral; interalar region spotted with yellow. Legs black; the inner tooth of the claws scarcely shorter than the outer. Abdomen stout, black above, with bronzy greenish tinge, except towards the apex; on each side of the anterior margin of segments 3 to 6 is a small somewhat semilunate yellow spot; on segment 3 this is continuous with the yellow sides. Sides of abdomen yellow, interrupted with black at the sutures; a black ventral line extending the whole length. Appendages small, conical, black; valvules and their appendages black.

Wings hyaline, *tinged with yellow*, which is more intense on the anterior half. Neuration black; pterostigma dusky yellow, covering about one and a half cellules, its outer edge oblique; 3 to 5 antenodal cellules; 15 to 17 postnodal nervules in anterior wings, 11 to 15 in posterior; poststigmatical nervules simple or occasionally furcate.

Length of abdomen 25–26 millim., of posterior wing 22–24 millim.

Three females.

XLVII.—*On Two new Neotropical Mammals.* By Oldfield Thomas.

When describing last year in the 'Annals' a new *Geomys* from Guatemala, *G. grandis**, I referred with considerable doubt a specimen from Tehuantepec to the same form.

At the request of Dr. Merriam, who is engaged on a revision of the group, I have now re-examined this specimen,

* Ann. & Mag. Nat. Hist. (6) xii. p. 270 (1893).

which in the meantime has had its skull better prepared, as have the whole series of *G. grandis* skulls, and I find that it presents such differences as to demand specific distinction.

It may be called

Geomys scalops, sp. n.

Fur very short, sparse and hispid. Colour smoky brown, tending rather towards rufous (very near "Prout's brown" of Ridgway). Whiskers and hairs of chin, cheeks, belly, and feet shining whitish; but these are all so sparse that the general brown colour of the skin is not affected by them. No special muzzle, forehead, or ear-markings. Basal inch of tail with a few scattered hairs; the remainder naked.

Skull of medium form, without any exceptional flattening, expansion behind, or contraction or inflation in the interorbital region. Nasals rather short. Muzzle in region of hinder end of nasals remarkably flat, so flat indeed that nothing of the middle line can be seen in the lateral view of the skull. Ends of premaxillary processes broader than the frontal space between them. Interorbital space flat, parallel-sided, without inflations; postorbital processes slight but distinct. Occipital plane of skull slightly slanting forward, low, but not very widely expanded. Paroccipital processes running transversely outwards, not surpassing the condyles posteriorly, as they do in *grandis*. Inferior flattened surface of the tip of the maxillary zygomatic processes much shorter and smaller than in that species. Muzzle comparatively very low. Lateral processes of mandibular angles much less produced antero-posteriorly than in *G. grandis*.

Incisors deep orange in front, their groove deep, less widely open than in *G. grandis*, slightly inward of the middle line, the inner part of the tooth 44 per cent. of the whole. Molars small.

Measurements (taken from the dry skin, and therefore merely approximate):—

Head and body 270 millim.; tail 95; hind foot, without claws 40, with claws 45·2.

Skull: basal length 63, basilar length to henselion 56·7; greatest zygomatic breadth 40·8; nasals, length 26, greatest breadth 8; least breadth of muzzle above maxillo-premaxillary suture 15; greatest breadth of premaxillary processes at hinder end of nasals 5·7; interorbital breadth 14·2; tip to tip of postorbital processes 16·2; least breadth just above auditory meatus 26·7; greatest posterior breadth 39; posterior height from basion to top of occipital crest 18·4; tip to tip of paroccipital processes 27·5; palate, length from

gnathion 47; diastema 24·5; length of upper molar series (crowns only) 12·6; breadth of $\frac{m.1}{}$ 4; least height of muzzle on diastema 12.

Hab. Tehuantepec. Coll. Boucard.

Type: B. M. 79. 1. 6. 2.

The type specimen is evidently in summer pelage, as is shown by the extreme sparseness of the fur, the belly being in fact almost naked.

G. scalops differs from the species to which I doubtfully referred it by its smaller size, rather redder general colour, and, in the skull, by its more flattened forehead, the absence of the supraorbital inflations, less vertical height both in the muzzle and cranial regions, smaller and differently directed paroccipital processes, and smaller teeth.

Of other species, *G. Cherriei*, recently described from Costa Rica by Mr. Allen *, is so far smaller as to need no detailed comparison; while I owe to the kindness of Dr. Merriam an opportunity of examining a skull of his *G. gymnurus*, about which I had previously been rather doubtful, and which I now see has nothing whatever to do either with *G. grandis* or *G. scalops*.

In 1891 the Museum received from Mr. J. H. Hart, of the Trinidad Botanical Gardens, an Opossum which I doubtfully referred to *D. philander*, L. This specimen I have had occasion to re-examine in connexion with a skin sent for comparison by Mr. H. Caracciolo; and for reasons given below I now think it ought to be specifically separated from the Philander of the mainland.

In the list of Trinidad mammals the name of *D. philander* should therefore be altogether struck out and that of the new form substituted. This name I propose should be

Didelphys (*Philander*) *trinitatis*, sp. n.

Allied to but decidedly smaller than *D. philander*, L., the difference in size being especially marked in the skull and limbs, while the ears and tail are more nearly equal to, and therefore proportionately longer than, those of that species. Fur close and soft, somewhat straighter and less woolly than that of the Philander. Colour much as in the allied species, yellowish rufous above, buff below; the face greyish white, with a narrow median dark line. Heel without the minute extra external sole-pad generally present in *D. philander*. Tail very long, furry like the body for about its proximal

* Bull. Am. Mus. N. H. v. p. 337 (1893).

inch only, the fur extending about a quarter of an inch more along the tail below than above; rest of tail practically naked, but the lines dividing the scales with numerous minute and quite inconspicuous hairs running along them; in colour the substance of the tail is uniformly brown above and rather paler below, while in *D. philander* the terminal portion is whitish all round. Mammæ 3—1—3 = 7.

Skull very much as in the allied species, apart from its conspicuously smaller size. As so often happens, however, in the case of smaller species otherwise closely allied, the skull of the type, fully adult, agrees better in its form with younger specimens of the larger species, sharing with them a general roundedness, which disappears in equally aged examples of *D. philander*.

Dimensions of the type (an old female in spirit):—

Head and body 196 millim.; tail 289; lower leg 48; hind foot 30; ear 22.

Skull: basal length 44·4; greatest breadth 28; nasals, length 28·8, greatest breadth 6·9, least breadth 3·1; post-orbital processes, tip to tip, 15·3; intertemporal constriction 9·1; palate, length 25·6, breadth outside $\frac{m.3}{}$ 14·9, inside $\frac{m.3}{}$ 10·7; palatal foramen 4·8; length of molars $\frac{1-3}{}$ 6·7.

These measurements are taken in the same way as, and may be conveniently compared with, those given in the 'Catalogue of Marsupials' *, 1888.

Hab. Botanic Gardens, Trinidad. Presented and collected by J. H. Hart, Esq.

The differences between this form and the true *D. philander* were noticed by me in 1891 on the arrival of Mr. Hart's specimen; but I did not then consider myself justified in describing it on a single female specimen and in ignorance of the type locality of *D. philander*. Now, however, not only has Mr. Caracciolo sent a male skin, which agrees in every respect with Mr. Hart's female, but Messrs. Allen and Chapman † have also noted similar characteristics in a specimen collected in Trinidad by the latter author; while at the same time my inquiries about the Seba mammals ‡ have convinced me that the specimen *g*, measured in the 'Catalogue of Marsupials,' should be looked upon as the actual type of Linnæus's species. I have therefore no longer any hesitation in describing the Trinidad form as distinct.

* Pp. 338 and 341.
† Bull. Am. Mus. N. H. v. p. 230 (1893).
‡ P. Z. S. 1892, p. 309 *et seqq.* (see especially p. 316).

XLVIII.—*On a new Species of the Hepialid Genus* Œnetus. By the Hon. Walter Rothschild.

Œnetus mirabilis, sp. n.

Male.—Upperside. Fore wings opalescent sky-blue; costa, a central and a submarginal transverse band bright green; on the inner side of the central transverse band is a row of oblong white spots; basal half of fore wings and costa netted all over with greyish-white half-moon-shaped spots; outer half of fore wings crossed by four transverse rows of small whitish-grey rings enclosing a green spot.

Hind wings opalescent white: thorax and fore legs greyish green; abdomen white, with two enormous yellowish-brown lateral tufts at the base.

Underside of wings and body greenish white.

Expanse 5·5 inches=140 millim.

Hab. Cedar Bay, North Queensland.

Note.—Viewed from behind or in a bad light this moth does not exhibit the blue ground, but appears of a dull sage-green. The extraordinary tufts at the base of the abdomen are unquestionably the atrophied last pair of legs, which have been transformed into male scent-producing organs, in the midst of which the tarsi plainly project, though thin, abortive, and functionless.

XLIX.—*Note on the Food of* Sagitta. By Arthur T. Masterman, B.A. (Cantab.), Assistant Professor of Natural History, University of St. Andrews.

The food of this common pelagic animal has been a subject to which much attention has been paid, amongst others, by Mr. Scott *, Naturalist to the Scottish Fishery Board. He finds, partly by direct observation and partly by examination of the contents of the alimentary canal, that *Sagittæ* prey upon such Copepods as *Calanus finmarchicus* and small Amphipods (*Phoxus plumosus*, for example), and that small larval and postlarval fishes do not come amiss to them, which has an important bearing when the enormous numbers of *Sagittæ* which frequently occur in the tow-nets are taken into account. At any rate *Sagitta* must take its place amongst the enemies of the fry of our food-fishes. Recently Mr. Scott finds that *Sagitta* preys upon its own species, and he describes a case of this as observed by himself.

In September 1892 in the St. Andrews Marine Laboratory

* 'Annals of Scottish Natural History,' April 1892 and 1893.

one or two small colonies of *Obelia* obtained in the bottom tow-net were preserved, on account of the fact that they presented a curious appearance, several of the polyps having elongated processes attached to them. Prof. M'Intosh recently handed these specimens over to the writer to examine more closely; and an inspection soon showed that the elongated processes were young *Sagittæ* firmly united to the

Fig. 1.

Fig. 2.

contracted polyps. In figure 1 will be seen a drawing of the apical group of polyps of a hydroid colony, showing no less than three more or less digested *Sagittæ*. In figure 2 is seen a polyp from a similar colony, showing a *Sagitta* at a different stage of digestion. The young *Sagittæ* have evidently been caught by the head and held by the tentacles of the hydroids till death ensued. The process of digestion has then proceeded, the body of the victim being slowly absorbed into the digestive cavity of the polyps. We may easily imagine that the young *Sagittæ* attracted by the waving tentacles, and attempting to browse on the same, are quickly caught and held fast by them. Larger *Sagittæ* would probably feed upon the hydroids with impunity.

The digestive capacity of the Hydrozoa seems only to be limited by the size of the victim, and many instances of their voracity are known. The above is paralleled by the well-known cases of medusæ being found enveloping larval and postlarval fish, and by a case amongst the ctenophores of a *Cydippe* devouring a dead young fish, which occurred recently at the St. Andrews Laboratory.

L.—*Note on the Relation of the Land-Mollusca of Tasmania and of New Zealand.* By C. Hedley, F.L.S.

The number of this Magazine for January last contained an article in which my friend Mr. Suter discusses the relation between (*inter alia*) the snails of New Zealand and of Tasmania, concluding that they are closely allied. While assenting to the statements made in the body of the paper, from this deduction I must differ.

We are told that *Rhytida*, *Rhenea*, *Paryphanta*, *Laoma*, *Flammulina*, and *Endodonta* are common to either fauna. To these may be added *Helicarion*; and the interesting fossil *Rhytida Simsoniana*, Johnston (Proc. Roy. Soc. Tasmania, 1880, p. 24), a near ally of *R. Dunniæ*, Gray, may be quoted to reinforce the argument.

But to grasp the situation the whole fauna must be reviewed; and in doing so we find that, on the one hand, Tasmania contains, besides the above genera, *Liparus*, *Caryodes*, *Anoglypta*, *Cystopelta*, *Pupa*, and *Succinea*, while, on the other, New Zealand possesses *Placostylus*, *Schizoglossa*, *Otoconcha*, *Tornatellina*, *Athoracophorus*, and the operculates *Lagocheilus*, *Realia*, and *Hydrocena*.

The fact that Tasmania possesses no real land-operculates, the *Truncatella* included in Tasmanian lists being more a marine than a terrestrial animal, alone constitutes a profound gulf between the faunas. The widespread *Succinea* and *Pupa* have reached Tasmania from a source that did not communicate with New Zealand, while the reverse is true of *Tornatellina*.

Examining the common element we note that this includes about half the genera of each country, that all these range beyond, and some far beyond, the two countries, and that this element is chiefly composed of the smallest shells. Of all, *Paryphanta* has the most limited range, extending to Victoria (*atramentaria*); this genus is, however, vaguely defined, and its characters require a definition which may alter the supposed geographical range: *Rhenea* extends to Queensland (*splendidula*) and to New Caledonia (*luteolina*); *Rhytida* to British New Guinea (*globosa*) and to the Solomons (*Villandrei*); *Laoma* to South Australia (*pictilis*); *Flammulina*, or something very like it, is shown by Mr. Suter to reach Africa (*Pella Burnupi*); *Endodonta* ranges to the Philippines and to the Society Islands, and *Helicarion* through Malaysia and India to Africa.

Just as the fluviatile shells possess a wider range and inferentially greater powers of dispersal than terrestrial mollusks, so do minute land-shells gain more extended limits than bulkier forms. If a collection of Tasmanian or New-Zealand shells were put into a sieve, the shells that passed the meshes would roughly represent those with a wide range, and the shells retained those with a restricted one. That none of the larger, but all the smaller, species of Fiji (continental islands) are represented in Samoa (oceanic) is a significant illustration which may explain how the micro-snail faunas of Tasmania and New Zealand are, as Mr. Suter says, so closely allied, while the macro-snail faunas repudiate any relationship.

Conclusion.—None of the species and about half the genera of their respective land-molluscan faunas are common to Tasmania and New Zealand; this community does not embrace the Streptoneura. The common element for the most part is represented by minute species and widespread genera, and does not necessarily imply former direct land communication. As a whole the two faunas are wider apart than those of Britain and the Atlantic States of North America.

Sydney,
Feb. 19, 1894.

LI.—*A new Pedunculate Cirripede.*

By the Rev. Thomas R. R. Stebbing, M.A.

[Plate XV.]

Trichelaspis, gen. nov.

Valves five; the scuta trifid; the carina terminating in a fork at its base. The mandibles with five or six teeth; the first maxillæ very slightly notched. In each cirrus the two rami are subequal. The caudal appendages are one-jointed, spinose.

The name of the genus is derived from τρίχηλος, cloven in three, and ἀσπίς, a shield. The characters are but little removed from those of *Dichelaspis*; but since that name was chosen by Darwin to displace the earlier names *Octolasmis* and *Heptolasmis*, on the ground that those titles conveyed a false impression, it seems impossible to retain *Dichelaspis*, meaning a bifid scutum, for a species in which the scutum is very conspicuously trifid.

Trichelaspis Forresti, sp. n.

General appearance.—Capitulum compressed, the breadth about two thirds of the length, its occludent margin microscopically crenulate; the valves translucent, covered by thin membrane, approaching one another at certain points, but nowhere coming in contact; the peduncle slightly longer than the capitulum.

Scuta.—The occludent segment long, narrow, widening a little distally, the rounded apex approaching the tergum; the basal segment forming an angle of about seventy degrees with the occludent, which it does not quite equal in length, very narrow, apically pointed, the apex overlapping the fork of the carina; from the basal there arises a median segment, also very narrow and pointed, a little crooked, two thirds of the length of the occludent segment, from which it diverges much less than it does from the basal segment. All the segments are continuously calcified. The whole valve has a general resemblance to the figure of the scapular apparatus of a tortoise.

Terga deeply and widely bifid, so as to have a sort of collar-shape, the two apices approaching the apex of the occludent segment of the scutum; the two segments or lappets of the tergum are equal in length, widest at the middle.

Carina much bowed, narrow, a little widened towards the apex, which overlaps the terga without approaching them very closely; the fork at the base is variable, being in some specimens much more pronounced than in others.

Peduncle cylindrical, moderately stout, a little longer than the capitulum.

Labrum.—The crest has a row of minute tolerably acute teeth, the sides of the teeth being equal in length to their bases; the central teeth are more widely separate than those at the sides.

Mandibles.—There are in all six teeth, the largest, at the extremity of the convex margin, being remote from the rest; the convex border carries half a dozen pairs of setules, and the distal part of the opposite border is more densely setuliferous.

The *first maxillæ* have a group of three spines preceding the notch, which is minute; the rest of the border, which is very slightly advanced, carries five sets of smaller spines mixed with setæ.

The *second maxillæ* are broadly lamellar, surrounded with setæ or flexible spines, many of which are rather elongate.

Cirri.—The first pair are distant from the second and not

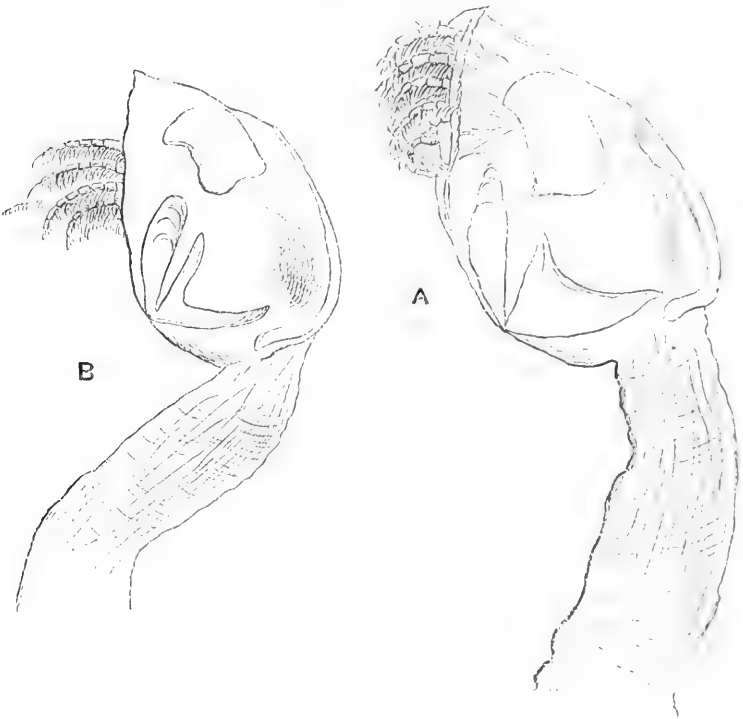
above half their length; they curl closely round the mouth-organs, the functions of which they may be presumed to assist; each ramus has seven segments, all of them furnished with numerous spines and all of them stout except the terminal one. The remaining pairs have rami of from twelve to fourteen segments, each segment carrying from eight to thirteen pairs of smooth spines, of which the distal are very long, the proximal very short; there is also a small group of spines at the apex of the outer margin of each segment. In all the pairs the peduncle is armed with many spines.

The *caudal appendages* are slender, shorter than the peduncles of the sixth pair of cirri, tipped with a group of spines, two of which are considerably longer than the appendages themselves. The penis is about equal in length to any one of the last five pairs of cirri; near the base it forms an abrupt crook; its breadth is considerably diminished near to the blunt apex, which is very hairy, small hairs or setules being more sparsely distributed over the whole length. The rings, which Darwin regards as equivalent to segments, are extremely numerous.

Size.—The length of the species is about a quarter of an inch, of which the peduncle occupies the larger half.

The name is given in compliment to W. R. Forrest, Esq., from whom I received the specimens. In sending me a small collection of animals from the West Indies Mr. Forrest says:—"May I call your attention to the growth (?) on a small piece of membrane, the cuticular lining of branchiostegite of a crayfish?" This growth proved to be a considerable number of specimens of the little cirripede here described, with the body projected from the capitulum, as shown in the figure. There was, however, one little group of three in which the body was within the capitulum. These were not situated, like the other specimens, either on the membrane or the podobranchia, but on the calcified joint which supports the branchia, and in these three the terga and scuta are not quite in conformity with those of the other specimens. In one of the three (fig. A, p. 446) the basal and median segments of the scutum are represented by the two acute horns of a single piece, and in a second (fig. B) the two segments are solidly combined below. The terga of these specimens are almost oblong, with a very slight excavation facing the apex of the occludent segment of the scutum. The third specimen, as far as could be seen without dislodging it, showed agreement rather with these two than with the rest. Darwin has noticed that the valves of *Dichelaspis Warwickii* are variable in shape, and probably that is the case with the present species. Even

in the prevalent form the median segment of the scutum varies considerably in respect to the proximity of its base to the base of the occludent segment.



Of the nine species of *Dichelaspis* discriminated by Dr. Hoek it is possible that *Dichelaspis Warwickii* (Gray) might conveniently be transferred to the new genus *Trichelaspis*, the carinal margin of the basal segment of the scutum in that species being in old specimens much hollowed out. It forms, however, obtuse, not acute apices.

EXPLANATION OF PLATE XV.

n.s. Natural size.
sc. Scutum.
T. Tergum.
C. Carina.
m. Mandible.
*mx.*1. First maxilla.
*mx.*2. Second maxilla.
*cir.*1. Cirri of first pair.
*cir.*6. Terminal part of a cirrus of the sixth pair.
p. Apex of penis.
c.a. One of the caudal appendages.

The mouth-organs are drawn to the same scale as the detached cirri and caudal appendage. The apical portions of the mandible, first maxilla, and penis are still more highly magnified.

BIBLIOGRAPHICAL NOTICES.

The Fauna of British India, including Ceylon and Burma. Published under the authority of the Secretary of State for India in Council. Edited by W. T. Blanford. *Moths.*—Vol. II. By G. F. Hampson. London, 1894.

The second volume of Mr. Hampson's work deals with the three allied families Arctiidæ, Agaristidæ, and Noctuidæ; but two subfamilies of the last-mentioned group—the Focillinæ and Deltoidinæ—are reserved for the commencement of Volume III.

Mr. Hampson's families are very comprehensive, his Arctiidæ including four families of the older authors, which he has very rightly reduced to the rank of subfamilies*; the family Agaristidæ remains as it was; but the third family, Noctuidæ, has hitherto been regarded as a tribe, under the denomination Noctuites, containing numerous ill-defined families, based upon characters often utterly worthless for classificatory purposes.

In consequence of the utter absence of system in the so-called "systematic" works produced less than half a century ago, one can readily understand what Lederer had to cope with when he sought to bring into order the Noctuidæ of Europe; but the task which this excellent lepidopterist set himself to do, and accomplished fairly satisfactorily, was a trifle as compared with that of the author of the present work.

Mr. Hampson takes nothing for granted; the work of his predecessors is carefully studied, corrected when necessary, and the arrangement of genera is based strictly on structural characters. Secondary sexual characters are not regarded as of generic value, but are utilized for *Sections* having a subgeneric rank. As regards species, Mr. Hampson is inclined to follow the old motto "In union is strength;" but in defence of this action he fairly admits in his Preface that "No attempt has been made in this or in the preceding volume to decide finally whether many of the forms described are entitled to rank as species, varieties, geographical or seasonal forms. Much more study of structure, and especially of the claspers of the male insect, will be needed before similar questions can be satisfactorily determined."

After this frank admission no lepidopterist will have any excuse for complaining that forms named by himself have not received specific rank; and any collector who, without looking up all synonyms, ventures to describe an Indian moth, will only have himself to thank if he subsequently discovers that he has renamed one of the forms not considered as sufficiently distinct to be kept separate by Mr. Hampson.

* The genus *Nyctemera* and allies, which formerly were regarded as constituting the family Nyctemeridæ, are placed next to the group of genera allied to *Hypsa* (Hypsidæ of the old classification) in the Lithosiinæ.

As in the first volume, the illustrations both of the species and their structure are extremely good, though, unfortunately, the details are not quite so sharp and clear in some of them; the antennæ (in some cases), instead of terminating in a fine thread-like point, show a defined terminal button. The process by which the figures are produced is probably largely answerable for this trifling blemish.

When completed the present work will, without doubt, be the most satisfactory revision of the families and genera of the Lepidoptera Heterocera which has ever appeared, either in our own or any other language. ARTHUR G. BUTLER.

Manual of Conchology, Structural and Systematic. With Illustrations of the Species. By GEORGE W. TRYON, Jun. Continuation by HENRY A. PILSBRY.—Vol. XIV. *Polyplacophora (Chitons).* Philadelphia. 8vo. 1892–3.

THIS most important and useful work on systematic conchology was commenced in the year 1879 by the late G. W. Tryon. That author was responsible for the first nine volumes and part of the tenth and the first four volumes of the second series, descriptive of terrestrial mollusks. At his death in 1888 the work was continued by Mr. Pilsbry, and from that time has been proceeded with without interruption.

The present volume is devoted to an account of four families of Chitons, namely Lepidopleuridæ, Ischnochitonidæ, Chitonidæ, and Mopaliidæ, the two remaining families, the Acanthochitidæ and Cryptoplacidæ, being reserved for the succeeding volume. This arrangement is to be regretted, as it will cause considerable inconvenience to have an Appendix and the Index to the entire group bound up in a separate volume.

The account of the Polyplacophora before us is by far the most important hitherto published, and, indeed, the only one which can pretend to anything like completeness. The introductory portion (pp. i–xxxiv) is devoted to a definition of the class, the description of the shell, the girdle, and the external features of the animal. Irregularities of growth and the collection and preservation of Chitons are also treated of, and the chapter concludes with an account of the progress in the study of these mollusks, the different classifications which have been proposed by Blainville, Guilding, Gray, H. and A. Adams, Shuttleworth, Middendorff, P. P. Carpenter, Dall, and Fischer, and the synopsis of the classification adopted by the Author, with an analytical key to the genera. The classification "is based mainly upon characters furnished by the articulating surfaces of the valves." In this connexion Mr. Pilsbry writes:—"The hard structure in this group is comparable to the vertebrate skeleton in the great variety of stresses to which it is subject. Each valve is not only acted upon by external forces and its body-muscles, but by the valves before and behind it and by the girdle.

Hard parts of great complexity have thus arisen, offering to him who can decipher their story clues as valuable for the construction of genealogical lines as have been found in the limb-bones of mammals or the hinge-teeth of bivalve mollusks." Attention has also been paid to the development of the gills, foot, and girdle, "and for the first time systematic use has been made of the sense-organs of the shell (tegumentum), and the system of sculpture of the latter." It is curious that the radula, which, as a rule, furnishes such important ordinal characters among the Gastropoda, presents but very slight variations in the Chitons, and is of no assistance in the classification of the group.

The rest of the volume consists of detailed descriptions of the families, genera, and species, which are illustrated by sixty-eight carefully executed plates, giving figures, of which nearly three hundred are original, of the exterior of the shells, the disarticulated valves, showing the insertion-plates, slits, and sculpture.

One of the most radical changes in the classification proposed by Pilsbry is the abandonment of the groups of regular and irregular Chitons. He arranges them into three principal divisions, namely Eoplacophora, Mesoplacophora, and Teleoplacophora. In the first *the valves lack insertion-plates, or, if present, they are unslit.* In the second *all valves possess insertion-plates, but are without eyes; valves i., i.–vii., or i.–viii. have slits; teeth smooth or but slightly roughened between the slits, never closely, finely pectinated.* In the third *all valves, or valves i.–vii., possess insertion-plates cut into teeth by slits; the teeth are sharply sculptured or "pectinated" outside by fine vertical grooves.*

These three "superfamilies" are again subdivided into families, subfamilies, genera, and subgenera.

The study of the Chitons is an exceptionally complex one, and therefore, considering the rapidity with which the work has been produced and the newness of the subject to the author, Mr. Pilsbry is to be congratulated upon the result of his labours in the monograph before us. In conclusion, it is satisfactory to observe that this work has done good service in putting a definite specific value upon the large number of manuscript names proposed by Carpenter which have in the course of the last twenty years found their way into many collections throughout the world.

Life and Rock. By R. Lydekker, B.A., F.G.S., F.Z.S., &c. 8vo. London, 1894.

This popular exposition of facts and theories relative to some warm-blooded and some cold-blooded back-boned animals, and some few shells, insects, sea-urchins, and others, consists of various essays that have been already before the public in periodicals, and are now arranged in twenty-one chapters, with sixty-three illustrations. Elephants, moles, porcupines, whales, deer, sheep, lemurs, armadillos, crocodiles, some fishes, and other representative animals are

reviewed. Teeth, skin-prickles, whalebone, parts of skeletons, and their structure are described in their places. The more theoretic subjects of "parallelism in development," the "distribution" of some groups of animals, the "oldest members" of some orders, the "extinction of animals," and "protective resemblances" are duly considered.

The account of Chalk and its associated strata, both in geographical and geological aspects, is interesting and correct; and so is the description of Flint, its nature and origin, in the succeeding chapter. These two essays—on a "lump of chalk" and a "flint-flake,"—together with the preceding Chapter XIX., on "Nummulites and Mountains," and Chapters XV. and XVI., mainly constitute the geological portion of the book, and, with the purely zoological chapters, make a very useful little volume of popular natural history for those whose tastes and studies lead them to the consideration of evolution, development, and mutual relationships of various members of the Animal Kingdom.

It is good and right of accomplished savants to popularize their best-known sciences, and this book is a favourable sample of such a work; but its title is too curt and crude, however desirable it may be to render in an elliptical form the idea of elucidating and illustrating the facts and theories of biology, so far as some of the living animals are concerned, and their relationship to those whose relics are found fossilized in the rocks. A similar, but worse, example of condensing English words is shown by the cramped, ambiguous, and, indeed, self-contradictory phrase "living fossils" for Chapter XV. at page 153.

The figures are mostly good, though not new; but it is time that the Russian Mammoth should be divested of its deceptive hoofs and skin of the head; and certainly the *hocks* in the Indian Elephant, at page 8, bespeak the inaccuracy of the European artist.

MISCELLANEOUS.

Note on Archineura basilactea, *Kirby*. By W. F. Kirby, F.L.S. &c.

I described this species in the 'Annals' for January last (p. 84), and Dr. Karsch now suggests ('Entomologische Nachrichten,' xx. p. 84) that it is the same as his *Echo incarnata* ('Berliner ent. Zeitschrift,' xxxvi. p. 455, 1891), and asks why I did not compare my new genus with the Indian genus *Echo* instead of with the African genus *Sapho*. It is true that the milky-white patch at the base of the wings of my type may assume a rose-red colour with age, and that the nervures, which are reddish in mine, might darken with age. But my species cannot possibly belong to *Echo*; and if Karsch's resembles it in any way I should be greatly surprised at his placing it in *Echo* at all, had he not admitted that he is wholly unacquainted with that genus, for the differences

in neuration are so considerable that I should hardly have thought it worth while to compare my specimen with the description of an insect described as an *Echo* when seeking to identify it. *Echo* has a very short broad oval pterostigma, and *Archineura* a very long narrow one (much longer than in *Sapho longistigma*, De Selys), and the dense reticulation below the lower basal cell is quite different in *Archineura* from either *Echo* or *Sapho*. I need not describe it, for it is shown in my figure and carefully described too; but the nervure bounding the lower basal area of the wing in *Sapho* slopes more obliquely towards the base than even in *Archineura*, while in *Echo* it is much shorter, straighter, and less conspicuous. It was the general character of the neuration which led me to compare *Archineura* with *Sapho* rather than with *Echo*. Karsch makes no mention of the remarkable neuration of the insect in his description, merely noting ordinary details; nor does he allude to the anal appendages. Consequently he gives few data beyond the long pterostigma which would suggest the identity of the two insects.

Researches on the Structure, Organization, and Classification of the Fossil Reptilia.—Part IX. Section 2. *On the reputed Mammals from the Karroo Formation of Cape Colony.* By H. G. Seeley, F.R.S.

The author re-examines the remains of *Theriodesmus*, and contests the interpretation of the carpus given by Professor Bardeleben, producing specimens of South-African Reptiles in which there is a single bone beneath the radius, as in *Theriodesmus*. This character is shown in a small skeleton, at present undescribed, which the author obtained from Klipfontein, Fraserberg, which he regards as referable to a new genus. Other evidence is produced supporting the interpretation of three bones in the proximal row in the carpus, in a specimen from Lady Frere. The author then compares the fore limb of *Theriodesmus* with that of *Pareiasaurus*, which was obtained subsequently, and arrives at the conclusion that the types of limb are too closely related to be referred to different orders of animals, and therefore that *Theriodesmus* must be transferred from the Mammalia to the Therosuchia.

The skull described as *Tritylodon longævus* is examined, and its close resemblance to the skulls of new Theriodonts is pointed out. The author believes that it shows evidence of possessing both prefrontal and post-frontal bones, which were situate as in Theriodonts, and circumscribed the orbits in the same way; so that, although the post-frontal bones appear to have met in the median line to form a crest, at the back of the frontal, there is no other character in the skull by which it can be distinguished from the skull of a Theriodont. It therefore appears to be reptilian, and thus would make known divided roots to the molar teeth in Reptilia, and a more complicated type of crown than in any Theriodont yet known.—*From the Proceedings of the Royal Society.* (Communicated by the Author.)

Researches on the Structure, Organization, and Classification of the Fossil Reptilia.—Part IX. Section 3. *On* Diademodon. By H. G. Seeley, F.R.S.

The author describes fragments of jaws and teeth from Upper Karroo strata at Wonderboom and Aliwal North, collected by R. D. Kannemeyer and Alfred Brown. They may possibly belong to more than one genus; but, in absence of sufficient knowledge of the skull to establish differences, the four species are referred to a new genus, *Diademodon*. Its hinder molar teeth have undivided roots, and low crowns, which are subquadrate or transversely ovate, surrounded by a diadem of low cusps, which are chiefly developed on the external and internal borders, with crenulations or minute cusps on the anterior and posterior margins of these teeth. There is a low central cusp in the middle of the crown from which slight ridges extend, chiefly in the transverse direction; but in the type species these ridges take the form of a cross. The species are distinguished by the form of the crown and the details of the cusps. The upper and lower teeth are opposed so as to be evenly worn, but the mandibular teeth are narrower.

These teeth are highly specialized, but distinct in plan from *Tritylodon*, and from all known Reptiles. They closely approximate to some of the higher Mammalia. The author refers *Diademodon* to a division of the Theriodontia in which the teeth become worn with use, which is named Gomphodontia.—*From the Proceedings of the Royal Society.* (Communicated by the Author.)

Preliminary Diagnosis of a new Gazelle from Algeria.
By Oldfield Thomas.

The type specimen of the following species has been brought from Algeria by Sir Edmund Loder, and generously presented by him to the National Museum.

Gazella Loderi, sp. n.

Size small; general colour very pale sandy, the various gazelle-markings all nearly obsolete. Ears long, whitish. Hoofs narrow and very much elongated. Horns long, very slender, lyrate, widely divergent above.

Hind foot, without hoofs, (c.) 280 millim.; length of fore hoof 64, of hind one 56; basal length of skull 173; horns round curves 330, circumference at base 95.

Hab. Sand-dunes of Le Souf, about 100 miles south of Biskra.

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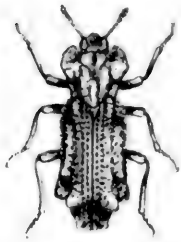

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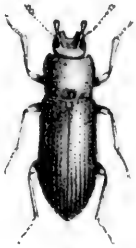

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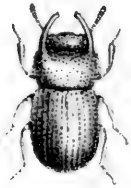

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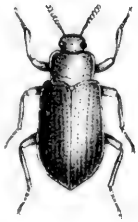

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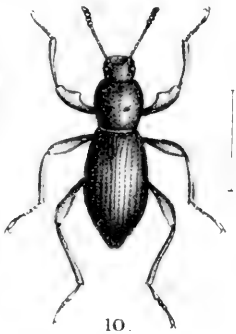

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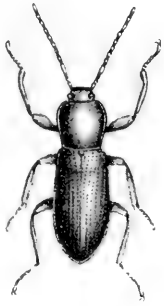


11.

M.H.Fisher del. et lith.

Mintern Bros. imp.

JAPANESE TENEBRIONIDÆ.

T.R.R Stebbing del

Mintern Bros. lith.

TRICHELASPIS FORRESTI. n. g. et sp.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 78. JUNE 1894.

LII.—*On the Land-Shells of the Natuna Islands.*

By EDGAR A. SMITH.

[Plate XVI.]

THE British Museum has recently received a most interesting series of land-shells collected by Mr. A. Everett at the Natuna Islands, situated to the north-west of Borneo. Not a single specimen from these islands has hitherto been obtained for the National Collection, and only one indigenous species, *Everettia cinnamomea*, has previously been recorded. The present collection consists of thirty-one species, eighteen of which apparently are undescribed, and the remainder are known inhabitants either of Borneo or the Malay Peninsula.

The Natuna fauna, so far as it can be estimated from the material at hand, appears to exhibit an equally close relationship with that of either of these localities. Four species are common to the Malay Peninsula and the Natunas, seven occur in the latter and Borneo, and two are met with in all three localities. The species occurring at Sirhassen do not, as it might be expected they would, from its proximity to Borneo, exhibit more of a Bornean than a Malayan facies, for of the sixteen species known from Sirhassen five are met with in Borneo and five in the Malay Peninsula. With regard to the species from Bunguran or Great Natuna, six of the twenty-six forms which occur on that island are also Malayan and seven are Bornean.

1. *Microcystis bunguranensis.* (Pl. XVI. fig. 1.)

Testa minuta, obtuse conoidea, angustissime perforata, polita, saturate olivaceo-fusca, tenuis, pellucida; spira breviter obtuse conica; anfractus $5\frac{1}{2}$, lente crescentes, leviter striatuli, ultimus ad peripheriam rotundatus, haud descendens; apertura parva, lunata; peristoma tenue, simplex, margine columellari anguste reflexo.
Diam. 2·5 millim., alt. 2; apertura 1 lata.

Hab. Bunguran.
A highly polished species of a dark olive-brown colour.

2. *Everettia cinnamomea*, Eydoux.

Helix cinnamomea (Valenciennes, MS.), Eydoux, Mag. de Zool. 1838, pl. cxvi. figs. 1–1 *b*; Pfeiffer, Mon. Hel. i. p. 54, iv. p. 42; Tryon, Man. Conch. ser. 2, vol. ii. p. 89, pl. xxix. figs. 46–48 (copied from Eydoux), as *Nanina*.

Hab. Natuna Islands (*Eydoux and Strubell in litt.*); Penang (*Pfr.*); Bunguran and Sirhassen (*Everett*).

The shell figured by Reeve (Conch. Icon. vol. vii. fig. 442) does not belong to this species, being perfectly distinct in form. The figure given by Eydoux is very good as regards form, but the colour in the copy of the work at hand is rather too red.

The examples from Sirhassen are not so large as those from Bunguran, and they have half a whorl less; but whether they are full-grown or not I am unable to say. They also differ in having the under surface of a more or less greenish tint.

3. *Nanina* (*Hemiplecta*) *Humphreysiana*, Lea.

Hab. Bunguran and Sirhassen (*Everett*); Natuna Islands (*Strubell in litt.*); Malacca (*auct.*).

There are two varieties of this species occurring at Sirhassen, one fairly well represented by the figure in the Conch. Cab. ed. 2, pl. xxxi. figs. 3, 5, of *Helix*. This form also occurs at Bunguran. The dark zone beneath the pale periphery is, however, generally more defined, and the upper surface is sometimes darker than the specimen figured. The second variety is entirely white, but covered with a light olive-yellow epidermis. It may be named var. *pallida*.

4. *Dyakia hugonis*, Pfeiffer.

Dyakia hugonis, Pfeiffer, Godwin-Austen, P. Z. S. 1891, p. 29, pl. v. figs. 5–5 *b*.

Hab. Bunguran (*Everett*); N. Borneo and Labuan (*auct.*).

Only two small examples, 24 millim. in diameter, were collected by Mr. Everett, and both are dextral.

5. *Trochonanina affinis.* (Pl. XVI. figs. 2, 2 *a*.)

Testa imperforata, conica, acute carinata, tenuis, fusco-cornea, subpellucida, supra vix nitida, infra polita; spira leviter concava, conica, ad apicem rotundata; anfractus 7, lente crescentes, primi tres vel quatuor lævigati, convexiusculi, cæteri minus convexi, oblique arcuatim striati, lirisque spiralibus paucis tenuibus supra suturam fuscescentem ornati, ultimus inferne convexiusculus, infra carinam excavatus, concentrice obsolete substriatus, haud descendens; apertura obliqua, angulatim lunata; peristoma tenuissimum, margine columellari ad insertionem inerassato, albo.
Diam. maj. 16 millim., min. 15, alt. 9; apertura 8 lata, 2·5 alta.

Hab. Bunguran and Sirhassen.

This species is closely allied to *T. conicoides* from Borneo. It differs, however, in the whorls increasing more slowly, so that the last is but very little broader than the penultimate, whereas in *T. conicoides* there is considerable difference. The body-whorl in the present species is more convex beneath, the aperture is of a slightly different form, and the few spiral liræ are coarser than in the Bornean shell.

6. *Trochonanina bunguranensis.* (Pl. XVI. fig. 3.)

Testa depresse conica, acute carinata, imperforata, supra sordide fusco-cornea, inferne pallidior, nitida: spira breviter convexo conoidea; anfractus 6, leviter convexi, supra suturam paulo concavi, lente crescentes, lirulis spiralibus pluribus, lineis incrementi obliquis decussatis, sculpti, ultimus utrinque carinam acutam impressus, infra convexiusculus, haud spiraliter lirulatus, antice haud descendens; apertura angusta, obliqua; peristoma tenue, acutum, margine infero in medio excurvato et versus carinam late sinuato, columellari ad insertionem inerassato et reflexo.
Diam. maj. 16 millim., min. 14·5, alt. 8.

Hab. Bunguran.

7. *Trochomorpha natunensis.* (Pl. XVI. figs. 4–4 *b*.)

Testa aperte umbilicata, orbicularis, acute carinata, tenuis, translucida, cornea, fuscescens; spira brevis, conoidea, ad apicem obtusa; anfractus 6, convexiusculi, supra suturam concavo depressi, lente accrescentes, superne et infra lineis incrementi tenuissimis striisque spiralibus tenuibus plus minus obsoletis sculpti, ultimus supra et infra carinam acutam æque convexiusculus, haud descendens: apertura parva; peristoma tenue,

simplex, marginibus distantibus, superiore oblique rectiusculo, ventrali arcuato.

Diam. maj. 11·5 millim., min. 10·75, alt. 5 : apertura 4·5 lata, 2·5 alta.

Hab. Bunguran and Sirhassen.

8. *Sitala carinifera*, Stoliczka.

Sitala carinifera, Stol. J. As. Soc. Beng. 1873, vol. xlii. p. 16, pl. i. fig. 8; Tryon, Man. Conch. ser. 2, vol. ii. p. 54, pl. xxv. fig. 16.
Trochomorpha kusana, Aldrich, Journ. Cincinnati Soc. N. H. vol. xii. p. 24, pl. iii. figs. 3–3 *b*.
Sitala kusana, Godwin-Austen, P. Z. S. 1891, p. 40, pl. iv. fig. 8.

Hab. Bunguran (*Everett*); Penang (*Stoliczka*); Bukil Pondong (*Möllendorff* *); Gomanton, N. Borneo (*Everett*).

I cannot discern any differences sufficient to separate the Penang and the Bornean shells. A single young example from Bunguran has much the appearance of *S. tricarinata* † from the Nilghiri Hills, India.

9. *Sitala baritensis*, Smith.

Sitala baritensis, Smith, Journ. Linn. Soc. 1893, vol. xxiv. p. 343, pl. xxv. fig. 3.

Hab. Bunguran (*Everett*); N. Borneo (*Everett*).

Three young specimens from Bunguran are indistinguishable from Bornean examples. *S. perakensis*, Godwin-Austen, is very closely allied and *S. angulata*, Issel, is also very similar.

10. *Sitala sirhassenensis*. (Pl. XVI. fig. 5.)

Testa breviter conica, carinata, angustissime perforata, tenuis, subpellucida, striis spiralibus tenuibus sculpta; anfractus $5\frac{1}{2}$, parum convexi, sublente accrescentes, supra suturam carino-marginati, ultimus ad peripheriam acute carinatus, haud descendens, infra medium convexiusculus; apertura angulate lunata; peristoma tenue, margine columellari superne reflexo, albo, perpendiculari.

Diam. 4 millim., alt. 3·75.

Hab. Sirhassen.

The spiral striæ are excessively fine, and, being crossed by equally fine lines of growth, the surface has a minutely cancellated aspect.

* P. Z. S. 1891, p. 333.
† Godwin-Austen, Moll. India, pl. x. fig. 10.

11. *Patula persculpta.* (Pl. XVI. figs. 6–6 *b*.)

Testa orbicularis, late umbilicata, minuta, tenuis, sordide albida, striis concentricis et spiralibus microscopice cancellata; anfractus $3\frac{1}{2}$, lente crescentes, convexi, sutura profunda sejuncti, ultimus ad peripheriam rotundatus, haud descendens; apertura parva, oblique lunata; peristoma tenue, simplex, margine columellari vix reflexo; spira depressa, supra anfr. ultimum vix elata.
Diam. 1·5 millim., alt. ·75.

Hab. Bunguran.
Under the microscope the minute cancellation of the surface is extremely pretty.

12. *Amphidromus perversus*, Linn.

Hab. Bunguran and Sirhassen.
Several forms of this variable shell occur in the Natuna collection. They may be thus described:—

1. Entirely white, generally with one or more oblique brown stripes or varices.
2. White below the suture in the last two whorls, closely striped beneath with rich brown, often pinkish towards the apex.
3. Yellow, but with a broad white zone below the suture, with or without one or two oblique brown varices (=*leucoxanthus*, Martens).

The above varieties from Bunguran are not always sharply defined, but intermediates occur between one or other of them. For instance, some examples have so much brown about them that they cannot be included in var. 1, yet they are not sufficiently coloured to come into var. 2. Sometimes specimens of var. 2 have a somewhat yellowish tint like var. 3, and the latter occasionally has more or less of brown striping upon the lower part of the penultimate and last whorls, as in var. 2. The latter variety is very like the form *melanomma*, Pfr. None of the Natuna examples appear to have the apex so dark as that species and none exhibit a yellowish peripherial zone; but not unfrequently there is a more or less defined submedian broad band as in the var. *inversus*, Müller.

4. Obliquely striped with dark brown upon a paler ground, darker below the sharply defined periphery (=*inversus*, Müller).

All the above varieties from the Natunas are represented

by sinistral and dextral specimens. The first three occur at Bunguran, the fourth at Sirhassen.

13. *Opeas subula* (Pfeiffer).

Opeas subula, Pfeiffer, Mon. Hel. vol. ii. p. 158 (*Bulimus*).

Hab. Bunguran and Sirhassen (*Everett*); Sarawak (*Hose, in Brit. Mus. and Mus. Cuming*); Cuba (*Pfr.*).

I cannot discover any differences in the specimens from the Natuna Islands and Borneo which are sufficient to separate them from West-Indian examples. Pfeiffer himself also failed to distinguish them, for a specimen from Sarawak in the Cumingian collection is labelled in his own handwriting "*B. subula*, Pfr." Mr. C. Hose has recently presented a large series of specimens, also from Sarawak, an examination of which supports this decision. It also seems to me questionable whether either *O. junceus* (Gould), from the Society and Sandwich Islands, or *O. oparanus* (Pfeiffer), from Opara, possess any real differences which can dissociate them from this species.

14. *Pupa Moreleti*, Brown.

Pupa Moreleti, Brown, Journ. de Conch. 1870, p. 393; Issel, Ann. Mus. stor. nat. Genova, 1874, vol. vi. p. 415 (*Vertigo*).

Hab. Bunguran (*Everett*); Labuan (*Brown*).

I am not quite certain of the identification of the Natuna specimens with this species, as they do not agree in every respect with the diagnosis. They have only five instead of six whorls, and the peristome is brownish, not white.

15. *Tornatellina natunensis*. (Pl. XVI. fig. 7.)

Testa parva, ovata, superne subconoidea, tennis, subpellucida, pallide fuscescens, imperforata, lineis incrementi tenuibus striata; anfractus 4, convexi, apex magnus, rotundatus; apertura perpendicularis, inverse auriformis, longit. totius $\frac{1}{2}$ paulo minor: perist. tenue, margine columellari leviter contorto, haud incrassato vel reflexo; lamina parietalis tenuissima, intrans.

Longit. 2·5 millim., diam. 1·5; apertura 1·3 longa, ·75 lata.

Hab. Bunguran.

This genus occurs in the Philippine Islands, but has not yet been discovered in Borneo.

16. *Cyclophorus aquilus*, Sowerby.

Cyclophorus aquilus, Sowerby, Reeve, Conch. Icon. figs. 45 *a*, *b*.

Hab. Bunguran and Sirhassen.

The specimens from the above localities of adult age agree precisely with the Malaccan form of this species. In very old examples, however, which have the outer surface more or less worn the aperture becomes of a bright orange-red and the lip is also tinted.

17. *Leptopoma natunense.* (Pl. XVI. fig. 8.)

Testa turbinata, anguste umbilicata, tenuis, pellucida, cornea, pone labrum pallide rufum vel album, striga nigra obliqua ornata; spira conica; anfractus 5, convexiusculi, liris vel carinis tenuibus (in anfract. penult. 4, ultimo 7) instructi, ultimus carina quinta ad peripheriam subangulatus, antice vix descendens; apertura magna, longit. totius $\frac{1}{2}$ paulo superans; peristoma duplex, margine interno leviter incrassato, externo tenui, plane dilatato ad umbilicum reflexo, extremitatibus callo tenuissimo junctis.

Diam. maj. 13·5 millim., min. 10, alt. 13·5; apertura intus 6·5 longa et lata.

Hab. Bunguran and Sirhassen.

The specimens from Bunguran have the peristome of a pale red tint, whilst in those from Sirhassen it is white.

This species bears a very close resemblance to *L. Mathildæ*, Dohrn, from Mindanao, and is merely a slight modification of that form. It differs in having a slightly narrower umbilicus, an additional spiral lira on the penultimate whorl, no fine spiral striæ or merely the faintest indication of them, and the peristome is more distinctly double, the outer margin being more flatly expanded.

18. *Lagochilus bunguranensis.* (Pl. XVI. fig. 9.)

Testa late umbilicata, depresse turbinata, saturate fusca, liris spiralibus tenuibus undique cincta, lineis incrementi obliquis subcancellata, epidermide rugosa, setosa, amicta; anfractus 6, celeriter crescentes, perconvexi, sutura profunda sejuncti, apicales duo læves, ultimus antice leviter descendens; apertura circularis, intus sordide cærulea, mediocriter magna; peristoma duplex, margine externo breviter expanso, acuto, interno paulo incrassato, cærulescente, superne leviter inciso.

Diam. maj. 17 millim., min. 13·5, alt. 12; apertura 6 longa et lata.

Hab. Bunguran.

This species is well characterized by its deep brown colour, the fine spiral liræ, the strong oblique lines of growth, and the rough epidermis produced into very short hairs upon the ridges. The thin horny yellowish epidermis consists of nine or ten narrow volutions.

19. *Lagochilus sirhassenensis.* (Pl. XVI. fig. 10.)

Testa turbinata, anguste perforata, sordide saturate fusca, liris spiralibus tenuibus instructa, epidermideque oblique striata; anfractus 5, convexi, sutura profunda sejuncti, apicales duo læves, fusco-cornei, ultimus ad peripheriam rotundatus, infra medium liris paucis magis distantibus quam superioribus; apertura longit. totius $\frac{1}{2}$ adæquans, intus cærulescens; peristoma anguste expansum, intus leviter incrassatum, marginibus callo tenui junctis, ad insertionem minute incisum.

Diam. maj. 10 millim., min. 8, alt. 9·5; apertura 4·5 lata.

Hab. Sirhassen.

This species resembles *L. bunguranensis* in colour and the spiral striæ, but differs in its more conical form, narrower umbilicus, and thinner epidermis. The operculum is very thin, yellowish, and consists of about ten volutions.

20. *Lagochilus natunensis.* (Pl. XVI. fig. 11.)

Testa turbinata, perforata, tenuiuscula, lutescens, rufo strigata et variegata, ad apicem saturate fusca, epidermide plus minus lamellosa, setosa et villosa induta; spira elata, conica; anfractus 6, mediocriter convexi, oblique tenuiter striati, liris paucis tenuibus (peripheriali cæteris majori) instructi, ultimus in medio lirula carinatus, antice leviter descendens; apertura mediocris, circularis, longit. totius $\frac{1}{2}$ vix æquans; peristoma intus incrassatum, cærulescens, extra tenue, expansum, marginibus callo tenui junctis; sinus minutus.

Diam. maj. 11·5 millim., min. 10, alt. 12; apertura intus 5 longa et lata.

Var. Testa, sub epidermide, pallide vel saturate cornea, concolor.

Hab. Bunguran and Sirhassen.

The epidermis of this pretty species has a somewhat silky appearance and is very finely lamellated in the direction of the oblique lines of growth and very shortly setose upon the spiral liræ; these usually number two or three on the upper whorls and five or six on the last, the one at the periphery being a trifle more conspicuous than the rest. When present the red markings radiate from the suture and extend somewhat zigzag over the body-whorl.

21. *Lagochilus exiguus.* (Pl. XVI. figs. 12–12*b*.)

Testa parva, conica, in medio acute carinata, late umbilicata, lutescens, strigis rufis radiantibus picta, epidermide tenui ad carinam et suturam fimbriata, induta; spira acute conica; anfractus $5\frac{1}{2}$, superiores rotundati, læves, tres reliqui convexiusculi,

inferne prope suturam carinis duabus tenuibus spiralibus cincti, lineis incrementi elevatis subdistantibus oblique arcuatis instructi, ultimus in medio bicarinatus, angulatus, inferne convexiusculus rufo radiatim pictus, leviter descendens; apertura circularis, superne minute sinuata; peristoma intus paulo incrassatum, extra acutum, tenue, undique sublate expansum, marginibus callo tenui junctis.

Diam. maj. 7 millim., min. 5·5, alt. 5·5; apertura intus 2·5 lata.

Hab. Sirhassen.

This species is remarkable for its small size, the two almost contiguous spiral keels or liræ at the periphery, which also pass up the spire just above the suture, but especially for the peculiar epidermis, which is produced into a sort of fringe upon the carinæ.

22. *Cyathopoma tricarinatum.* (Pl. XVI. fig. 13.)

Testa minuta, aperte et profunde umbilicata, turbinata, tenuis, cornea, lævis; anfractus quinque, apicales duo subglobosi, sequentes duo convexiusculi in medio carinati, ultimus carinis tribus tenuibus prominentibus (duabus circa medium, tertia umbilicum circumdante) instructus, haud descendens; apertura subcircularis; peristoma intus incrassatum, marginibus callo tenui junctis, externo paulo expanso, ad extremitates carinarum producto, columellari tenuiore.

Diam. maj. 2·25 millim., min. 2, alt. 2·25; apertura 1 alta et lata.

Operculum nigrescens, in medio excavatum, pallidum.

Hab. Bunguran.

The uppermost keel of the body-whorl is that which encircles the middle of the upper volutions, and the central one passes up the spire in the suture. The genus occurs in India, Ceylon, Borneo, and the Philippines.

23. *Cyclotus natunensis.* (Pl. XVI. figs. 14–14 *b*.)

Testa mediocriter late umbilicata, depresse turbinata, saturate castanea, strigis flavis a sutura radiantibus et zona macularum irregulariter sagittiformium ad peripheriam ornata, epidermide scabrosa, pilosa induta; anfractus 5, celeriter accrescentes, perconvexi, striis incrementi obliquis aliisque spiralibus sculpti, sutura profunda discreti, ultimus antice leviter descendens; apertura mediocriter magna; peristoma intus incrassatum, subcæruleum, continuum, margine dextro plane expanso, tenue, superne ad suturam haud profunde sinuato.

Diam. maj. 19 millim., min. 15, alt. 13; aperturæ diam. 7·5.

Hab. Bunguran.

In this species the whorls are smooth and rounded, but

they are clothed with a roughish epidermis, which is produced into short hairs arranged in spiral series and also in oblique rows upon the lines of growth. When the epidermis is removed only faint indications of spiral striæ are observable. The shelly operculum (figs. 14 *a*, *b*) is white externally, with a corneous nucleus, where it is slightly concave, and consists of seven or eight obliquely striated volutions. It is thick and deeply concave between the outer shelly margin and the inner corneous layer, which is of a bright red tint.

24. *Cyclotus minor*. (Pl. XVI. figs. 15, 15 *a*.)

Testa orbicularis, aperte umbilicata, sub epidermide crassiuscula, striata, lutescens; spira paulo elata, ad apicem obtusiuscula; anfractus $4\frac{1}{2}$, convexi, sutura profundissima discreti, superiores distanter costulati, cæteri tenuiter striati, ultimus vix descendens; apertura intus pallide cærulescens; peristoma intus leviter incrassatum, margine externo paulo dilatato, dein aperturam versus anguste reflexo, superne in alam parvam suturalem producto.

Diam. maj. 15 millim., min. 11, alt. 7; apertura 4·5 lata.

Hab. Bunguran.

Allied to *C. Boxalli* of Godwin-Austen, but much smaller, with the apex of the spire white instead of chestnut and the peristome externally peculiarly granulate-striate.

25. *Pupina Everetti*. (Pl. XVI. fig. 16.)

Testa ovata, superne acuminata, tenuis, pellucida, polita, rufescens; anfractus 6, læves, convexiusculi, infra suturam colore saturatiore anguste marginati, ultimus oblique descendens, sed ad labrum breviter ascendens; apertura subrotunda, superne producta, longit. totius $\frac{5}{12}$ adæquans; labrum incrassatum, leviter expansum, pallide carneum, in medio prominens, arcuatum; dens parietalis compressus, magnus, prominens, columellæ callo arcuato junctus; columella fissura angustissima obliqua terminata, latissime lingulata.

Longit. 12·3 millim., diam. 7·3; apertura 5 longa, 3·5 lata.

Hab. Bunguran.

This handsome species is a little larger than *P. ottonis*, Dohrn, from Mindanao, and of a darker colour; the penultimate whorl, viewed from behind, is higher in proportion to the last, and the linguæform termination of the columella is much broader in the present species. The operculum is thin, of a bronzy-yellow tint, and consists of about eight whorls.

26. *Pupina Evansi*, Godwin-Austen.

Pupina Evansi, Godwin-Austen, Proc. Zool. Soc. 1889, p. 351, pl. xxxix. figs. 3, 3 *a*.

Hab. Sirhassen; N. Borneo (*Everett*).

The type of this species was a dead shell from a cave-deposit. Mr. Everett has since presented to the Museum a living example from Bau, in N. Borneo; this is of a dirty pellucid appearance, with a pale peristome. The Sirhassen shells are of a brownish colour, becoming reddish towards the lip; they agree in other respects.

27. *Diplommatina rubicunda*, Martens.

Diplommatina rubicunda, Martens, Preuss. Exped. Ost-Asien, Zool. Bd. ii. p. 164, pl. iv. fig. 16.

Hab. Sirhassen (*Everett*); N. Borneo (*Martens and Everett*).

The specimens from Sirhassen are of a bright red colour, excepting the base of the body-whorl, which appears to be coated with a thin luteous deposit. The umbilical region is covered with a thin, smooth, and sharply defined callus, a feature not referred to by von Martens, but which is present in Bornean examples also.

28. *Diplommatina adversa* (H. & A. Adams), var. *natunensis*.

Diplommatina adversa, Pfeiffer, Mon. Hel. vol. iii. p. 586 (*Pavillus*); Godwin-Austen, Proc. Zool. Soc. 1889, p. 348, pl. xxxviii. fig. 3.

Hab. Bunguran and Sirhassen (*Everett*); Singapore (*Adams*); Sarawak, Busau (*Everett*).

The specimens from the Natuna Islands are smaller than the typical form of this species. They are mostly of a reddish tint, with an orange-red aperture, which looks a trifle smaller than in Bornean examples. The peristome is more rounded above, where it is appressed to the whorl, but certain pellucid lines seen through the transparency of the shell above the aperture are similar in both forms.

29. *Diplommatina Strubelli*. (Pl. XVI. fig. 17.)

Testa dextrorsa, ovata, superne acuminata, imperforata, succinea, ad apicem rufescens, tenuis; anfractus 6, convexi, liris tenuissimis obliquis ornati, superiores quatuor regulariter crescentes, penultimus maximus inflatus, ultimus paulo angustior, antice leviter ascendens; apertura irregulariter rotundata vel auriformis;

columella crassa antice rostrata, in medio dente valido munita; labrum duplex, aurantium, margine interno incrassato, externo expanso, inferne angulatim producto.
Longit. 2·5 millim., diam. 1·3; apertura cum labro 1.

Hab. Bunguran.

Across the body-whorl above the aperture a translucent line is visible, apparently indicating an internal lira. I have named this species after Herr Strubell, of Frankfort, who has kindly communicated to me a list of the species of land-shells known to him from the Natuna Islands.

30. *Diplommatina congener.* (Pl. XVI. fig. 18.)

Testa dextrorsa, ovata, superne producta, imperforata, rufo-succinea; anfractus 7, supremi duo subglobosi, læves, cæteri convexi costulis tenuibus obliquis instructi, in interstitiis spiraliter microscopice striati, penultimus ultimo latior, ultimus supra aperturam ad lineam nigrescentem peculiariter contractus; apertura subrotundata, ad basim columellæ leviter oblique canaliculata; columella obliqua, in medio dente parvo munita, superne labro callo juncta; labrum intus incrassatum, aurantium, externe expansum, paulo infra suturam angulatim productum.
Longit. 3 millim., diam. 1; apertura ·75 longa.

Hab. Bunguran.

The constriction above the aperture indicated by an almost perpendicular blackish-red line is very peculiar and at once distinguishes this species from its allies.

It is smaller than *D. symmetrica*, Smith, from North Borneo, and is furnished with a tooth on the columella, which is wanting in that species. The name *symmetrica* being already in use for a species of this genus from New Guinea, I take this opportunity of substituting that of *gomantonensis* for the Bornean shell.

31. *Helicina Martensi*, Issel.

Helicina Martensi, Smith, Ann. & Mag. Nat. Hist. 1894, vol. xiii. p. 59.

Hab. Sirhassen.

Var. *parva*.

Smaller than the typical form and a trifle more globose.

Hab. Bunguran.

The form of this species which occurs at Bunguran is considerably smaller than that from Sirhassen and is rather more globose.

The species is known from the Sulu Archipelago, N. Borneo, and Labuan.

EXPLANATION OF PLATE XVI.

Fig. 1. *Microcystis bunguranensis.*
Figs. 2, 2 *a*. *Trochonanina affinis.*
Fig. 3. —— *bunguranensis.*
Figs. 4–4 *b*. *Trochomorpha natunensis.*
Fig. 5. *Sitala sirhassenensis.*
Figs. 6–6 *b*. *Patula persculpta.*
Fig. 7. *Tornatellina natunensis.*
Fig. 8. *Leptopoma natunense.*
Fig. 9. *Lagochilus bunguranensis.*
Fig. 10. —— *sirhassenensis.*
Fig. 11. —— *natunensis.*
Figs. 12–12 *b*. —— *exiguus.*
Fig. 13. *Cyathopoma tricarinatum.*
Fig. 14. *Cyclotus natunensis.*
Figs. 14 *a*, *b*. —— ——. Operculum.
Figs. 15–15 *a*. —— *minor.*
Fig. 16. *Pupina Everetti.*
Fig. 17. *Diplommatina Strubelli.*
Fig. 18. —— *congener.*

LIII.—*On the* Tenebrionidæ *of Japan.*

By G. Lewis, F.L.S.

[Continued from p. 400.]

Addia, gen. nov.

The structure of the body in this genus resembles that of *Hemicera*, especially as regards the structure of the underside; the head is deeply inserted in the thorax, thus shortening the prosternum before the coxæ, and the hind coxæ are rather wide apart. The genus also resembles *Ceropria*, but in that genus the posterior coxæ are closer together and the head is less deeply set in the thorax. The fourth joint of the anterior tarsi in *Addia* (as seen in an Andaman Island species, for the males of others are not known) is as wide in the male as the third. The antennæ are somewhat slender, the third joint scarcely so long again as the first and second united, 4–6 shorter and equal, 7–10 slightly larger, equal, widest anteriorly, terminal joint circular and not pressed into the tenth. In the Pascoe collection there is a species of this genus from the Oriental Region bearing the MS. name I have adopted.

Addia scatebræ, sp. n.

Ovalis, supra convexa, nitida, obscure purpureo-æneo-nigra: elytris striato-punctatis, interstitiis impunctatis; antennis pedibusque obscure brunneis.
L. 7 mill.

Oval, convex above, black, shining, with a brassy-purple tint, the head punctulate, punctures not very dense but irregular, epistoma depressed; the thorax more clearly but somewhat similarly punctured, margin elevated laterally; the scutellum rather small, arched at the sides, obtusely pointed behind, smooth; the elytra striate-punctate, rows of points rather wide apart, interstices smooth, lateral margins elevated like the sides of the thorax until just before the apex; the antennæ obscurely brown, legs darker; the prosternum bisulcate between the coxæ. The antennæ are shorter in every joint than in *Elixota curva*, but otherwise not very dissimilar.

Hab. Miyanoshita. One female example in May. Probably at a later season more would been found, as this species seems to be a tropical or subtropical form.

Elixota curva, Mars.

Amarygmus curvus, Mars. Ann. Fr. 1876, p. 316.

This genus was founded by Pascoe in 1866, and placed in the Cnodaloninæ, but Pascoe says nothing of the singular position of the head. The head is bent downwards, "enfoncée dans le prothorax" as Marseul says, and only a very small part of it is visible when the insect is viewed from above. I have taken two species of this genus in Ceylon, and another at Singapore.

The present species is smaller and brighter in colour than *E. cuprea*, Pasc., from North China.

Hab. Nagasaki, Oyayama, and Yokohama. At the last place, near the race-course, I found an old camellia in which a large number of specimens were hibernating on the 26th March, 1880.

Phthora canalicollis, sp. n.

Oblonga, picco-nigra, nitida; thorace punctato, lateralibus canaliculatis; elytris punctato-striatis, punctis profunde impressis; antennis pedibusque rufo-brunneis.
L. $3\frac{3}{4}$ mill.

Oblong, pitchy black, shining; the head flat between the

eyes, clearly and rather densely punctured; the thorax deeply canaliculate laterally, feebly rugose within the channel, disk very clearly punctured, punctures larger than those of the head; the scutellum very small, smooth, and semicircular behind; the elytra punctate-striate, punctures large and deep, outer margin evenly dilated from the humeral angle to the apex; the antennæ and legs reddish brown.

The deep lateral thoracic canaliculation distinguishes this species from *P. crenata*, Germ., which in other respects it resembles.

Hab. Sapporo and Junsai. Two examples only.

Enanea, gen. nov.

Body oblong-oval, moderately convex; the head transverse, eyes very small, equally seen from above and below; antennæ robust, 10-jointed, joints compressed, the first short and stout, second, third, and fourth smaller, shorter and nearly equal, fifth, sixth, and seventh widen gradually, eighth and ninth rather wider than the seventh, terminal circular in outline; the thorax transverse, strongly marginate at sides, nearly straight before and behind; the scutellum rather large and wide, triangular; the elytra parallel at the sides to the middle, apices obtuse; the anterior coxæ close together, intermediate and posterior not quite so contiguous; the tarsi very short and closely corresponding in both sexes.

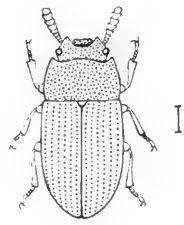
Enanea testacea, sp. n.

Oblongo-ovata, rufo-testacea, nitida; capite thoraceque sparse punctatis; elytris striato-punctatis; antennis pedibusque concoloribus.

L. 3 mill.

Oblong-ovate, red-testaceous; the head sparsely punctate, the male with two ear-like elevations, wide at the base, tips pointed, the centre of their bases being over the point of the insertion of the antennæ; the thorax punctured like the head, anterior angles somewhat rounded off, posteriorly rectangular; the scutellum with a few punctures; the elytra irregularly striate-punctate, interstices also with a few similar points; the legs, anterior tibiæ gradually widen from their bases and are angulate on the outer edge of the tarsal end; the under and upper surfaces are punctured alike (fig. 4).

Fig. 4.



It is more than probable that this is a type of a tropical genus.

Hab. Ichiuchi. Four examples on the 1st May, 1881.

Uloma latimanus.

Uloma latimanus, Kolbe, Archiv für Nat. i. Heft 2, 1886, p. 202, t. 11. fig. 34.

This species is relatively longer than *U. bonzica*, Mars., and measures 7 to 13 mill. The small examples are often pale in colour, like those recorded by Marseul for *U. bonzica*.

Hab. Miyanoshita, Hakone, and Chiuzenji. Common.

Corticeus colydioides, sp. n.

Cylindricus, elongatus, niger, nitidus; antennis tibiisque concoloribus, tarsis rufis; capite thoraceque punctulatis; elytris striato-punctulatis.

L. 5–5½ mill.

Cylindrical, elongate, black, shining; the head clearly and somewhat densely punctulate; the thorax rather less closely punctulate, much longer than broad; the elytra striate-punctate, with a few very fine punctures on the interspaces also longitudinally arranged; the pygidium exposed and punctulate; the tibiæ angulate near the tarsi.

Resembles in form the European *C. castaneus*, Schn., but the legs are much less robust and the colour black.

Hab. Miyanoshita, Hakone, Kiga, Nikko, and Konose. Occurs in decaying beeches.

Corticeus gentilis, sp. n.

Cylindricus, elongatus, castaneus, nitidus; antennis pedibusque concoloribus.

L. 3¼ mill.

The species differs from the last in size and colour. The head rather densely and distinctly punctulate; the thorax scarcely longer than broad, more sparsely punctulate than the head; the scutellum, punctures obsolete; the elytra striate-punctate, with rows of intervening punctures, but the sculpture is not so clear and well-marked as in *C. colydioides*; the pygidium, punctuation very fine and not dense.

Hab. Yokohama. Under the loosened bark of *Zelkowa Keaki*, Sieb. Two examples.

Toxicum tricornutum.

Toxicum tricornutum, Waterh. Ent. Month. Mag. 1874, xi. p. 126.
Toxicum umbrosum, Har. 1880.

This species differs from the two following in being cylindrical.

Hab. Oyayama, Yuyama, Usui-toge, and on the plain of Fujisan. Common.

Toxicum funginum, sp. n.

Parum elongatum, subcylindricum; thorace transverso, postice et antice bisinuato; elytris striato-punctatis.
L. 12½–13¼ mill.

Densely black, opaque, somewhat elongate; the head irregularly punctate; the thorax also irregularly not closely punctate, transverse, bisinuate before and behind, lateral margin narrowly elevated; the scutellum impunctate; the elytra striate-punctate, interstices flat; the antennæ, two basal joints and the palpi piceous. The male with two upright, somewhat slender horns, rather close together, on the edge of the clypeus, and two larger and longer ones on the inner ocular edge, little bent and clothed at and near the apices with long fulvous or reddish hair. In less developed specimens the edge of the clypeus has two tubercles, and the horns near the eyes are short and only clothed on their apices. The female has a well-marked semicircular carina on the inner edge of the eye.

Hab. Ichiuchi, Nara, and near the lake of Ogura. Twenty specimens.

Toxicum tuberculifrons, sp. n.

Atrum, opacum, parum elongatum; thorace postice bisinuato; elytris punctato-striatis.
L. 11½–12½ mill.

Densely black, opaque, somewhat elongate; the head irregularly punctured, punctures sometimes largest between the eyes; the thorax rather broader than long, not very closely punctured, anterior angles a little produced, not sinuous behind the head, bisinuous at the base, lateral margin narrowly canaliculate; the scutellum obscurely punctured; the elytra, striæ very faint or shallow near the suture and punctate, near the apex and outer margins the wing-cases are more clearly punctate-striate. The male has a well-marked tubercle in the middle of the frontal edge, with the angles before the eyes well-raised and a ridge on the interior edge of the eye which is most prominent in front. The female has only a similar, but rather less elevated, ridge over the eye.

Hab. Oyayama, Tokio (Tanaka), and Nara. Fifteen examples.

Anthracias, Redtenbacher.

Anthracias, Redtenbacher, Fn. Austr. ed. 2, 1858, p. 617.

Bates considers the characters given for this genus are insufficient to separate it from *Toxicum* (Ent. Mo. Mag. x. 1878, p. 45), but there are four species from Japan which differ from the species of *Toxicum* found there in having a 3-jointed club to the antenna, eyes completely divided by the ocular ridge, and the absence of hair on the cephalic armature. It seems to me as convenient to use the two names as to divide *Toxicum* into two sections, as Bates has done, on the completeness or incompleteness of the ocular carina. At the same time I am aware of at least one species from India which has a 4-jointed club and a complete ocular ridge, but perhaps a third genus ought to be founded for these. Pascoe also notices that very similar species of *Toxicum* have the club of the antenna sometimes 3-, sometimes 4-jointed (Journ. Ent. ii. p. 454).

Anthracias duellicus, sp. n. (Pl. XIII. fig. 8.)

Elongatus, cylindricus, niger, subnitidus; capite thoraceque dense punctatis; elytris irregulariter striato-punctatis, utrinque parallelis.

L. 12–15 mill.

Elongate, rather cylindrical, black, little shining; the head somewhat coarsely and densely punctured; the thorax bisinuous at base, marginal edge narrow and a little produced at the anterior angle; the scutellum punctured and nearly semicircular behind; the elytra, the striæ consist of double rows of irregular punctures, interstices feebly convex, parallel at the sides; the antennæ and legs piceous. Male: the outside edge of the clypeus on each side is produced and raised somewhat triangularly, with the apices obtuse, over the eyes are two long rather slender horns, punctate, bent a little outwards if viewed longitudinally, viewed sideways crescent-shaped on the anterior edge; in undeveloped males the horns are short and stouter. In the female the ridge over the eyes is tubercular.

Hab. Yuyama, Kadzusa, Niigata, and Junsai.

Anthracias punctatulus, sp. n.

Elongatus, subcylindricus, ater, opacus; capite thoraceque dense punctatis; elytris striato-punctatis, interstitiis conspicue punctulatis.

L. 9½–10 mill.

Elongate, rather cylindrical, densely black, opaque when

not abraded; the head densely punctured and the thorax also, the latter broader than long, lateral edge finely raised, anterior angle impressed behind the eyes, bisinuate at the base; the scutellum punctulate; the elytra striate-punctate, with the interstices conspicuously punctulate; the antennæ and legs black. Male: clypeus nearly straight in front, edges near the antennæ a little widened out and raised, with two horns over the eyes, erect, rather short, and more widely apart than those of *A. duellicus*. In the female the carina over the eyes is short and not much elevated.

Especially known from the others in this series by the flat and somewhat densely punctulate interstices of the elytra. When specimens of *Anthracias* and *Toricum* become abraded there is a tendency for their opacity to disappear.

Hab. Oyayama, Oguma, and Goka in Kumakuni. Three specimens.

Anthracias fagi, sp. n.

Elongatus, subcylindricus, niger, subopacus; antennis pedibusque rufo-piceis; thorace parum dense punctato; elytris punctato-striatis.
L. 8–9 mill.

Elongate, rather cylindrical, black, somewhat opaque; the head rather densely punctured; the thorax, lateral margin but little raised, anterior angles not produced, little rounded off, hind angles rectangular; the scutellum obscurely punctulate; the elytra punctate-striate, punctures irregularly set, interspaces feebly rugose and punctulate; the antennæ and legs pitchy red. Male: the ocular carina (the ridge that crosses the centre of the eye) is continued in front and spread out over the base of the antenna, frontal edge widely and feebly emarginate, two short horns somewhat wide apart stand erect over the eyes. Female: inner margin of the eye little elevated anteriorly, clypeus anteriorly nearly straight.

Hab. Nikko. Four examples from an old beech tree, 31st Oct., 1880.

Anthracias boleti, sp. n.

Elongatus, subcylindricus, niger, opacus; antennis pedibusque concoloribus; elytris striato-punctatis, interstitiis planis et impunctatis.
L. 8–8½ mill.

Elongate, somewhat cylindrical, when not abraded densely black and opaque; the head densely punctured; the thorax similarly punctate, bisinuous behind only, more convex

behind the neck than that of *A. fagi*, and anterior angles more depressed, the lateral margin is in consequence less visible above; the scutellum obscurely punctulate; the elytra striate-punctate, interstices flat, with leather-like sculpture, impunctate; the antennæ and legs black. Male: clypeus with an outline nearly straight, ocular carina anteriorly spread out over the base of the antenna, with two short, obtuse, and somewhat tubercular horns over the eyes. The female has a small carina over the anterior portion of the edge of the eye.

This species is similar to *A. fagi*, but the convexity and depression of the anterior angles of the thorax, the sculpture of the elytra, and the colour of the antennæ and legs are, amongst others, good distinguishing characters.

Hab. Oyayama and Oguma. Seven examples.

Setenis insomnis, sp. n.

Elongatus, niger, subnitidus; thorace punctato haud canaliculato; elytris striato-punctatis; ♂ metasterno haud piloso.
L. 26–28 mill.

Elongate, black, rather shining; the head somewhat densely punctured on the neck and anterior portion, more sparingly between the eyes; the thorax marginate at sides and base, margin interrupted behind the neck, punctured rather more finely than the head, with a feeble median longitudinal impression (absent in some examples); the elytra striate-punctate, interstices with a leather-like sculpture; the fore tibiæ longer and more bent in the male than in the female; the metasternum free of pilosity in both sexes; the antennæ, third joint somewhat longer than the fourth.

This species differs from *S. valgipes*, Mars., in the male having a smooth metasternum and simple intermediate and hind tibiæ; in both sexes the chief differences are the want of a thoracic canaliculation and the third joint of the antenna is shorter and stouter. A species from Mantchuria (*S. villosipes*) noticed by Marseul has the metasternum furnished, like *S. valgipes*, with yellow hair.

Hab. Buno (one example); Sapporo (abundant).

Setenis higonius, sp. n.

S. insomni simillimus, sed magis elongatus; capite obscure et tenuiter punctato, fronte sutura obsoleta; ♂ metasterno haud piloso.
L. 31 mill.

This species is extremely similar to *S. insomnis*, but it is

larger, the elytra longer, the thorax wider anteriorly, the head and neck lightly and obscurely punctured; the frontal suture (well defined in the other species of this series) can only be feebly traced in certain lights, and the metasternum is free of pilosity in the male.

The district in which it was found is the same as that in which *S. valgipes* is common.

Hab. Yuyama. One male example.

Setenis valgipes, Mars.

Nyctobates valgipes, Mars. Ann. Fr. 1876, p. 117.

In the male of this species the median area of the metasternum is densely pilose. Marseul does not mention this, but he notices that *N. villosipes*, Mars., from Mantchuria, is similarly clothed. If it should prove that he attached this last character to the wrong species (he corrected his proof more than two years after parting with his manuscript), my *S. insomnis* may be the same as his Mantchurian species.

Hab. Nagasaki, Konose, and Yuyama. Common in old firs (*Pinus massomana*).

Setenis striatipennis, sp. n.

Elongatus, niger, nitidus; thorace canaliculato et bifoveolato; elytris valde punctato-striatis.
L. 20 mill.

Elongate, black, shining; the head anteriorly rather densely punctured, more sparingly between the eyes; the thorax with a narrow and rather shallow median channel and two foveæ on each side of it before the base, punctate like the head between the eyes, lateral margin narrowly raised, hind angles rectangular; the elytra strongly punctate-striate, interstices very finely punctulate. The sexual differences are slight; in the male the anterior tibiæ are longer and rather more incurved; the metasternum is not pilose.

Agrees somewhat with *Nyctobates semisulcata*, Fairm.

Hab. Yuyama and Konose. Common in the Kuro-matzu (*Pinus massomana*).

Setenis noctivigilus, sp. n.

Elongatus, niger, subnitidus; antennis pedibusque rufo-piceis; capite thoraceque opacis; elytris parum valde punctato-striatis.
L. 15 mill.

Elongate, black; head and thorax somewhat opaque, elytra somewhat shining; antennæ, mouth-organs, frontal anterior

edge, and legs pitchy red; the head punctate, sparingly and rather finely before the frontal suture, punctures larger between the eyes; the thorax marginate at the sides and base, margin interrupted behind the neck, irregularly (not closely) punctured, anterior angles rounded off, hind angles rectangular; the scutellum behind nearly semicircular in outline, with a few very irregular punctures; the elytra rather strongly punctate-striate, interspaces a little convex; the antennæ, second joint short, third more than as long again, 4 to 6 equal, 7 stouter, 8 to 10 equal and moniliform, terminal oval.

It appears right now to place this and the four preceding species in Motschulsky's genus *Setenis*, of which *S. valgus*, Wiedem., is the type. *Nyctobates* is now reserved for *N. gigas*, L., a large American species.

Hab. Oyama and Kashiwagi. Only two male specim

Tenebrio obscurus, F.

Von Heyden has reported the capture of this species in Japan (Deutsch. ent. Zeitschr. 1879, p. 353).

Lyprops sinensis, Mars.

This species is extremely abundant both in China (Foochow and Kiukiang) and Japan. It is most abundant in the dead stems of *Batatas edulis*, which is often hung up in trees in masses to dry in both countries.

Hab. Kiushiu and main island.

Lyprops cribrifrons, Mars.

This is a very different species to the last, and is usually found resting under stones.

Hab. Nagasaki. Not found in North Japan nor is it very abundant in the south.

Hemicera zigzaga, Mars.

Harold has stated that this species is the same as *Tetraphyllus Latreillei*, Lap., a Javan species, and one similar to *T. lunuliger* of this series. Schönfeldt, in his Catalogue, 1891, p. 261, has also united them. I cannot understand how these errors have arisen, as one is an oblong species measuring 11 mill., the other a hemispherical species of about 6 mill.

Hab. Nagasaki. Appears after the summer rains.

Eucyrtus cæruleus, sp. n. (Pl. XIII. fig. 9.)

Atro-cyaneus, nitidus; pedibus concoloribus; antennis nigris; thorace utrinque marginato, punctato; elytris striato-punctatis, interstitiis punctulatis.
L. 9–10½ mill.

Bluish black, legs concolorous, antennæ black; the head clearly punctured, not emarginate anteriorly, sides rounded off over the bases of the antennæ; the thorax margined at the sides, with a very narrow rim along the edge, punctured like the head; the scutellum smooth; the elytra striate-punctate, with the interstices flattish and distinctly punctulate, sides margined like the thorax, obtusely acuminate at the apices; the antennæ, five basal joints moniliform, third longest, sixth to the tenth wide and transverse, eleventh circular; the male has the anterior tibiæ swollen and very feebly emarginate on the inner edge near the tarsi.

The form of the feet, antennæ, and the contour of the thorax and elytra of this small species resemble those of *Eucyrtus pretiosus*, Dej., and I have no hesitation in placing it in the same genus. The structure of the sternal plates also agrees in both species. The antenna is figured to show its sculpture.

Hab. Yuyama and Ichiuchi. Taken sparingly in the moist forests on the banks of the Kumagawa in May and June.

Tetraphyllus lunuliger, Mars.

Artactes lunuliger, Mars. Ann. Fr. 1876, p. 129.

The species of this genus are hemispherical and usually found in the tropics.

Hab. Nagasaki, Kumamoto, Oyayama, and Yuyama. Common; found in the spring in the centre of Kiushiu.

THYDEMUS, gen. nov.

The head moderately large, anteriorly semicircular, forehead between the eyes nearly flat and somewhat wide; ocular ridge crosses about one third of eye; eye lobe-shaped, upper part largest. The antennæ rather long and slender, basal joint short and stout, second very short, third longer than the first and second together; these joints are smooth, the next four are very slightly shorter than the third and nearly equal in length; joints 8 to 11 are as long as the third, after the third all are roughened. The thorax transverse, marginate, and convex, narrower than the elytra; the scutellum triangular,

moderately large ; the elytra rather long, parallel at the sides, deeply striate ; the prosternum narrow between the coxæ, posterior process keeled and pointed ; the intermediate tibiæ are slightly bent and a little swollen at the tarsal end.

Type *Scotæus purpurivittatus*, Mars.

There are four species of this genus in the Bates collection standing under the MS. name I have preserved ; all are a bright green with purple markings. One from Siam resembles *T. purpurivittatus* very closely.

Hab. Nagasaki and Hiogo. Not uncommon in July after the rains.

Gnesis helopioides, Pasc. 1865.

Tromosternus Haagi, Har. Abh. Brem. p. 131 (1876).

Pascoe received this species from Dr. Adams, who collected insects on landing at different places from a man-of-war which was for some time off the Japanese coast. I think this species, like *Idisia ornatus*, Pasc., can only be regarded as Japanese at present. I have a second species of the genus from the Andaman Islands, which is, however, a very different insect to *G. helopioides*.

Hab. Nagasaki, Kobé, Kashiwagi, and Sado.

Misolampidius, Solsky.

Misolampidius, Solsky, Hor. Soc. Ent. Ross. 1875, p. 292.
Ptilonix, All. Mitth. Schweiz. ent. Ges. vol. v. p. 61.

Type *M. tentyrioides*, Sol. t. i. fig. 7.

Heliophygus? molytopsis, Mars., and *Helops clavicrus*, Mars., should be placed in Solsky's genus. The genus *Ptilonix* was founded by Allard in 1877 to receive a species similar to the above ; but Solsky's name has precedence.

Misolampidius (*Heliophygus?*) *molytopsis*, Mars.

The male of this species is extremely like the female of *Helops clavicrus*, Mars., but the punctuation of the thorax is fine and scattered and the male has the anterior tibiæ bent or sinuous on the inner edge. Marseul gave Niigata as the locality for it, but this was a misprint.

Hab. Nagasaki and Ichibosayama. I have only two male examples.

Misolampidius rugipennis, sp. n. (Pl. XIII. fig. 10.)

Obscure brunneus, subopacus ; capite thoraceque dense et grosse punctatis ; elytris interstitiis conspicue rugosis.

L. 13 mill.

Obscurely brown, more or less opaque, antennæ with two basal joints reddish; the head clearly punctured before the frontal suture, behind the suture densely punctured, with a vermicular sculpture; the thorax without a lateral margin, similarly punctured, with the vermicular sculpture more general, and some of the punctures, especially those on the disk, are ocellate; the elytra are punctate-striate, with the striæ and punctures more or less obliterated in different individuals by a rough leather-like sculpture (not very distinctly shown in the figure here), which at times makes the specimens opaque. The anterior femur has a somewhat acute tooth on the middle of the inner edge.

This species somewhat resembles *P. clavicrus*, Mars., but the femoral tooth is more acute, the tooth on the intermediate tibiæ of the male is wanting, and the surface-sculpture wholly different, and in no specimen is the colour black. I have a species a little similar to this from Siam, but it is without a femoral tooth and the interspaces of the elytra are tuberculate.

Hab. Hakone, plain of Fujisan, Oyayama, and Nikko. Common.

Stenophanes rubripennis, Mars.

Helops rubripennis, Mars. Ann. Fr. 1876, p. 137.
Ptilonix rubripennis, All. Mitth. Schweiz. ent. Ges. vol. v. p. 62.

The male of this species has a somewhat acute tooth in the middle of the anterior tibia and the fourth to seventh joints of the antennæ are relatively slender. The type examples are rather immature, the elytra are sometimes nearly black. *Stenophanes mesosterna*, Sols., the type of this genus, is well illustrated in a figure (*vide* Hor. Ross. xi. 1875, p. 295, t. i. fig. 8), and perhaps *S. rubripennis* is not specifically distinct from it.

Hab. Kobé, chiefly on Maiyasan, taken whilst traversing old trees at night-time.

Stenophanes strigipennis, Mars.

Helops strigipennis, Mars. Ann. Fr. 1876, p. 138.

This species differs from the above in having the tooth of the anterior tibia less acute; but the best distinguishing structural character is, however, in the relative shortness of the fourth to seventh joints of the antennæ. This species is always quite black.

Hab. Sapporo and Junsai; "west coast" (*Adams*).

Lamperos cordicollis, Mars. (Pl. XIII. fig. 11.)

Helops cordicollis, Mars. Ann. Fr. 1876, p. 141.

Allard founded the subgenus *Lamperos* (Mitth. Schweiz. ent. Ges. 1880, vol. v. p. 57) to receive *Helops brunneus*, Mars., and four other species. *H. cordicollis*, Mars., varies in colour from brassy green to black, and the intermediate tibiæ are curiously denticulate on the inner edge in the male. There is a reference to *Lamperos* also in the 'Abeille,' 1876, Rév. Helop. vrais, p. 6.

Hab. Yuyama, Nagasaki, Kobé (on Maiyasan), Oyama, and Kadzusa.

Lamperos elegantulus, sp. n.

Parum elongatus, æneus vel viridis, nitidus; elytris striatis, striis tenuissime crenulatis; antennis pedibusque læte rufis vel obscure brunneis.

L. 7–9 mill.

Rather elongate, æneous or bluish green, shining; the head densely punctulate, eyes prominent, narrowly reddish over the antennæ; the thorax, punctures much less closely set than those of the head, especially in the female, arched at the sides, with a narrow lateral rim, rim and narrow anterior border reddish; the elytra striate, striæ obscurely crenulate. Male: mouth-organs, antennæ, and legs clear red; tibiæ not bent, fore tibiæ angulate at the tarsal end. Female more robust than the male, and the antennæ and legs dull brown or pitchy red.

This elegant little species somewhat resembles *L. cordicollis*, but the thorax is arched not cordiform, the intermediate tibiæ in the male are not denticulate. In *L. cordicollis* the anterior tibiæ of the male are rounded off on the outer edge at the tarsal end.

Hab. Hakone, Miyanoshita, Nikko, and Kashiwagi. Seven examples.

Plesiophthalmus nigrocyaneus, Motsch.

P. æneus, Motsch.; *P. nigritus*, Motsch.; *P. ænescens*, Mars.; *P. sericifrons*, Mars.; and *P. glabricollis*, Lew., in litt.

This species is exceedingly variable in colour and also in sculpture, and I believe all the above names refer to one. The colours of the upper surface vary from black to dark blue, or from brassy to greenish bronze, and the legs are usually black or reddish brown, but I have examples with bright red legs. The female usually has the thorax more distinctly punctured than the male; *P. glabricollis* is a female

with the thorax coarsely and densely punctured, and there is a male in my collection in which the thorax is nearly smooth. The males have an emargination in the middle of the posterior edge of the fifth abdominal segment, the forehead, when not abraded, is pubescent, and the eyes approach nearer to each other than in the female. The elytral striæ vary in either sex; in some examples they are deeply impressed and the interstices are convex, in others they are lightly impressed and the interstices are flat.

This species is extremely abundant throughout Japan at low and intermediate elevations between June and September. At Nara on the 13th June the pupæ were more abundant than the imagoes, but at the end of the month I failed to find a pupa.

Hab. All the islands.

Plesiophthalmus spectabilis.

Plesiophthalmus spectabilis, Har. Abhandl. Ver. Brem. iv. 1875, p. 293; Deutsch. ent. Zeit. xxii. 1878, p. 79.
Plesiophthalmus obesus, Mars. 1876.

This is a very distinct species; the last segment of the abdomen is not emarginate in the male. Harold published his species before Marseul's paper went to the press.

Hab. Nagasaki, Kobé, and Nikko, but not very common. I have taken it also at Kiukiang in China.

Plesiophthalmus lævicollis, Har.

Plesiophthalmus lævicollis, Har. Deutsch. ent. Zeit. xxii. 1878, p. 79.

This species, like the last, has no abdominal emargination in the male; the legs are often of a bright red colour.

Hab. Nikko, Kioto, Nara, and Kashiwagi. Abundant: found on old railings and on the rafters of old houses at night.

Ainu, gen. nov.

The characters of this genus are like those of *Strongylium*: the antennal orbits are well elevated, but the antennæ are very long and slender; the anterior and intermediate tarsi have four joints dilated and padded on the under surface; the prosternum is continued nearly on the same plane behind the coxæ; and the mesosternum has a median carina which corresponds to the level of the prosternal keel. These characters also separate it from *Camaria*, from which it differs also in having the base of the first abdominal segment pointed between the coxæ.

Ainu tenuicornis, sp. n.

Elongatus, subcylindricus, subtus brunneus, supra submetallicus: elytris viride tinctis; antennis, partibus oris, pedibusque brunneis.
L. 12–13 mill.

Elongate, subcylindrical, rather convex, reddish brown beneath, somewhat metallic above; the head pitchy, irregularly, not closely punctate, sometimes with an impression between the eyes, epistoma, antennal orbits, and mouth-organs reddish brown; the thorax rather broader than long, lateral margin well-marked, anterior and posterior edges narrowly reddish, surface punctured and coloured somewhat like the head, but with a purple or greenish tint; the scutellum triangular, smooth; the elytra rather strongly punctate-striate, interspaces convex and smooth, sutural interstices sometimes reddish; the antennæ long and slender, reaching backwards to the middle of the elytra, third joint more than twice as long as the first and second together. The tarsi agree in form in both sexes.

There is a species of this genus in the Pascoe collection from Penang. In facies the species resembles somewhat *Camaria spectabilis*, Pasc.; an insect, however, which measures 30 millim., and has the tarsi, antennæ, and first abdominal segment differently formed. Pascoe placed *Camaria spectabilis* in the Helopinæ, and *Camaria variabilis* (*Sinopium*) in the Strongyliinæ.

Hab. Nishimura and Kurigahara. Six examples.

Strongylium japanum, Mars.

In the male the fourth segment of the abdomen is widely, almost wholly, excavated.

Hab. Nagasaki. Found on decaying cherry-trees near the Temple of Suwasama. Appears only after the summer rains.

Strongylium niponicum, sp. n.

Elongatum, æneo-nigrum, nitidum; elytris profunde punctato-striatis, interstitiis impunctatis, tibiis femoribusque parte rufis.
L. 16 mill.

Elongate, rather cylindrical, black with a greenish or brassy tinge; the head punctate, foveolate between the eyes; the thorax, anterior and posterior margins slightly raised, lateral marginal line ceases behind the anterior angle, punctuation coarser than that of the head, with a fovea on each side before the base, sometimes with a shallow, smooth, median

channel; the scutellum obscurely punctured, wider than that of *S. japanum*; the elytra strongly punctate-striate, interspaces convex and impunctate, apices obtuse; the antennæ, second to fourth joints more or less reddish, others infuscate; the legs nearly black, with the bases of the femora and tibiæ usually reddish, anterior tibiæ not bent in the male. The fovea between the eyes is sometimes absent.

This species is smaller than *S. basifemoratum*, Mäkl., from China, but there is a strong resemblance between the two species.

Hab. Nikko, Kashiwagi, Tsukubayama near Tokio, and in Sado.

Strongylium impigrum, sp. n.

Elongatum, cylindricum, brunneo-nigrum, nitidum; fronte in medio foveolato; thorace longitudinaliter impresso, margine laterali integro; elytris profunde punctato-striatis; antennis pedibusque obscure rufo-brunneis.

L. 11½ mill.

Elongate, cylindrical, brownish black, sometimes with a faint brassy tint; the head punctate, epistoma reddish, foveolate between the eyes; the thorax punctate, with a median longitudinal channel and a shallow fovea near the base on each side of it, anterior and posterior margin raised, lateral marginal rim complete; the scutellum small; the elytra long, parallel at the sides, deeply punctate-striate, interstices convex, impunctate; the antennæ and legs reddish brown, tarsi paler.

This is the most slender species of this series.

Hab. Yuyama, Ichiuchi, Hitoyoshi, Kashiwagi, Miyanoshita, and Nikko.

Strongylium Marseuli, sp. n.

Strongylium costipenne, Mäkl.?, Mars.

Piceo-brunneum, subopacum; thorace densissime punctato; elytris 9-costatis, sutura elevata; antennis, tibiis tarsisque rufo-brunneis.

L. 9–12 mill.

Rather dull pitchy brown, the head rather roughly punctured, the punctures largest and closest near the neck, obscurely foveolate between the eyes; the thorax very densely punctate throughout, lateral margin usually complete, but not very well marked towards the base, swollen laterally in the middle, median channel faint and sometimes absent; the scutellum distinctly punctate; the elytra narrowly elevated at the suture, with nine smooth costæ on each elytron, inter-

spaces regularly foveolate, with a transverse bar between each fovea; the antennæ reddish brown, third joint long, fourth also long, but a little shorter than the third, joints 5–10 each a little shorter than the one before it; the legs, tibiæ sometimes, tarsi generally reddish.

Doubtless very similar to *S. costipenne*, Mäkl., from Borneo, to which species Marseul doubtfully assigned it, but after reading the description of Mäklin's species I cannot think it is the same. The colour and sculpture of the scutellum alone seem to warrant this assumption.

Hab. Nagasaki. Found on old trees after midsummer.

Strongylium helopioides, sp. n.

Piceo-brunneum, nitidum; capite thoraceque densissime punctatis: elytris perconvexis, striato-punctatis, interstitiis planis lævibus, disco subæneo.

L. 6½ mill.

Pitchy brown, anterior edge of the thorax, bases and apices of the elytra, tarsi and bases of the thighs paler; the head densely, coarsely, and somewhat rugosely punctured; eyes rather small; the thorax punctured like the head, with an obscure linear area on the disk smooth, without a lateral margin; the scutellum smooth, triangular, and very minute; the elytra striate-punctate, interstices between the punctures smooth, disk somewhat brassy, apices slightly dehiscent; the antennæ somewhat slender at the base, joints 7–11 stouter; the tarsi, except the claw-bearing joint, reddish.

The antennæ of this small species and the facies generally somewhat resemble a species of *Misolampidius*. This and *S. japanum* are the only species in this series with dehiscent elytra.

Hab. Fukahori near Nagasaki. One male example, 25th February, 1881.

Strongylium brevicorne, sp. n. (Pl. XIII. fig. 12.)

Æneo-brunneum, nitidum; capite thoraceque grosse et parum dense punctatis; elytris profunde punctato-striatis; antennis brevibus, infuscatis (basi excepta); pedibus rufo-brunneis.

L. ♂ 8, ♀ 10 mill.

Somewhat elongate, brassy brown, sometimes with a greenish tint; the head coarsely and densely punctured, sometimes with a small smooth space between the eyes, eyes relatively smaller than those of *S. impigrum*; the thorax rounded off anteriorly, with two impressions, one on each side before the base, lateral rim well-marked, punctate, punc-

tures round and deep, and less thickly set on the disk than on the sides, anterior and posterior margins reddish, the scutellum triangular, red, and smooth; the elytra deeply punctate-striate, interspaces smooth and convex; humeral angle reddish; the antennæ shorter and more robust than any other of this series.

I have a species from Ceylon which closely resembles this in the antennæ and in the punctuation and in lateral margin of the thorax.

Hab. Nara, Kashiwagi, and Nagasaki. Ten examples.

A paper on the Japanese Cistelidæ, Melandryidæ, and Lagridæ is partly finished, and I hope it may appear during the current year.

List of species, with synonymy.

Phellopsis suberea, *Lew.*, 1887.
Blaps japonensis, *Mars.*, 1879.
Pedinus strigosus, *Fald.*
Micropedinus algæ.
—— pallidipennis.
Opatrum expansicolle.
—— pubens, *Mars.*
—— orarium.
—— persimile.
—— japanum, *Motsch.*
—— coriaceum, *Motsch.*
—— recticolle, *Motsch.*
sexuale, Mars.
—— villigerum, *Blanch.*
Cædius marinus, *Mars.*
Hadrus scaphoides, *Mars.*
Idisia vestita, *Mars.*
—— ornata, *Pasc.*, 1866.
Lichenum seriehispidum, *Mars.*
Phaleria Riederi, *Fald.*
Emypsara Adamsi, Pasc.
——*flexuosa*, Pasc.
Phaleria Hilgendorfi, Har., 1878.
—— subhumeralis.
Epiphaleria atriceps.
Trachyscelis sabuleti.
Bolitophagus felix.
—— reticulatus, *L.*
—— pannosus.
Dicræus bacillus, *Mars.*
Atasthalus dentifrons.
—— bellicosus.
—— incurvatus, var.?
Bolitonæus mergæ.
Byrsax niponicus.
—— spiniceps.
Diaperis niponensis, *Lew.*, 1887.
—— Lewisi, *Bates*, 1873.
robrofasciatus, Reit., 1879.
Derispia maculipennis, *Mars.*
Leiochrinus satzumæ.
Leiochrodes convexus.
Arrhenoplita asiatica.
Amarantha atrocyanea, *Lew.*, 1891 (Metaclisa, *Duval*).
Ischnodactylus loripes.
Platydema nigroæneum, *Motsch.*
musivum, Har., 1878.
—— Dejeanii, *Cast.*
—— Marseuli.
nigroæneum (Motsch.), Mars.
—— higonium.
—— sylvestre.
—— recticorne.
—— lynceum.
—— fumosum.
—— umbratum, *Mars.*
—— scriptum.
Basanus erotyloides, *Lew.*, 1891.
Scaphidema ornatellum.
—— pictipenne.
—— discale.
—— nigricorne.
Alphitophagus plagiatus, *Mars.*
—— japanus, *Mars.*
—— pallidicollis.
Pentaphyllus oblongus.
Menimus niponicus.
Ceropria sulcifrons, *Har.*, 1878.
—— subocellata, *Cast.*
—— striata.
—— induta, *Wiedem.*

Addia scatebræ.
Elixota curva, *Mars.*
Phthora canalicollis.
Enanea testacea.
Uloma bonzica, *Mars.*
—— latimanus, *Kolbe*, 1886.
Alphitobius diaperinus, *Panz.*
—— piceus, *Ol.*
mauritanicus, F.
Lyphia exigua, *Mars.*
Corticeus colydioides.
—— gentilis.
Palorus depressus, *F.*
melinus, Herbst.
—— exilis, *Mars.*
—— floricola, *Mars.*
Toxicum tricornutum, *Waterh.*, 1874.
umbrosum, Har., 1881.
—— funginum.
—— tuberculifrons.
Anthracias duellicus.
—— punctatulus.
—— fagi.
—— boleti.
Setenis insomnis.
—— higonius.
—— valgipes, *Mars.*
—— striatipennis.
—— noctivigilus.
Encyalesthus violaceipennis, *Mars.*
Notiolesthus foveolatus, *Mars.*
Menephilus arciscelis, *Mars.*
—— medius, *Mars.*
—— lucens, *Mars.*
Tenebrio ventralis, *Mars.*
—— obscurus, *F.*
—— alternicostatus, *Mars.*
Lyprops sinensis, *Mars.*
Lyprops cribrifrons, *Mars.*
Heterotarsus carinula, *Mars.*
Hemicera zigzaga, *Mars.*
Eucyrtus cæruleus.
Tetraphyllus lunuliger, *Mars.*
Thydemus purpurivittatus.
Læna rotundicollis, *Mars.*
Gnesis helopioides, *Pasc.*, 1866.
Tromosternus Haagi, Har., 1876.
Misolampidius molytopsis, *Mars.* (Ptilonix, *All.*, 1877).
—— clavicrus, *Mars.*
—— rugipennis.
Stenophanes rubripennis, *Mars.*
—— strigipennis, *Mars.*
Lamperos brunneus, *Mars.*
japonicus, All., 1877.
—— cordicollis, *Mars.*
—— elegantulus.
Plesiophthalmus nigrocyaneus, *Motsch.*
æneus, Motsch.
nigritus, Motsch.
æneseens, Mars., ♂.
sericifrons, Mars., ♂.
glabricollis, Lew., in litt. ♀.
—— spectabilis, *Har.*, 1875.
obesus, Mars.
—— lævicollis, *Har.*, 1878.
Ainu tenuicornis.
Strongylium japanum, *Mars.*
—— niponicum.
—— impigrum.
—— Marseuli.
costipenne, Mars.
—— helopioides.
—— brevicorne.

EXPLANATION OF PLATE XIII.

Fig. 1. *Phellopsis suberea.*
Fig. 2. *Bolitophagus felix.*
Fig. 3. *Atasthalus dentifrons.*
Fig. 4. —— *bellicosus.*
Fig. 5. *Bolitonœus mergæ.*
Fig. 6. *Ischnodactylus loripes*, ♂, and intermediate tibia.
Fig. 7. *Basanus erotyloides.*
Fig. 8. *Anthracias duellicus.*
Fig. 9. *Eucyrtus cæruleus* and antenna.
Fig. 10. *Misolampidius rugipennis.*
Fig. 11. *Lamperos cordicollis*, ♂, and intermediate tibia.
Fig. 12. *Strongylium brevicorne* and anterior tarsus.

Note on Shoguna rufotestacea, *Lew.* (Ann. Mag. Nat. Hist. ser. 6, vol. iv. 1889, p. 274).

Fairmaire in 1886 described a species of *Shoguna* under the generic names of *Holocephala* and *Pachycephala*, both of which were preoccupied, and in the Pascoe collection there are several species standing under the MS. name of *Thione*. The genus seems to be represented by very numerous species in many parts of the tropical and subtropical zones. In the figure referred to above there are five joints given to the hind tarsus, but under a high microscopic power only four are visible.

LIV.—*On the Nutritive and Excretory Processes in Porifera.*

By Arthur T. Masterman, B.A., late Scholar of Christ's College, Cambridge, Assistant Professor and Lecturer on Zoology at the University of St. Andrews.

An abundance of young colonies of many of the commoner sponges in St. Andrews Bay gave opportunity for an investigation into the processes of nutrition and excretion as carried on in the group Porifera.

The experiments described below were carried out with small colonies of *Grantia compressa*. Particles of carmine were found to give the best result, although other colouring-matters were tried.

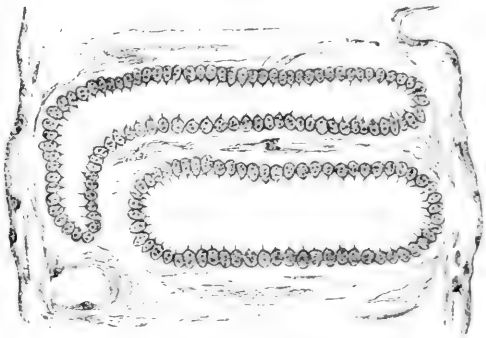
The colonies were all placed in sea-water with fine carmine particles in suspension, and allowed to remain there for two minutes; they were then removed, washed, and placed in sea-water.

At the expiration of short periods of time, varying from fifteen seconds to forty-five minutes, single colonies were removed, killed in osmic acid, and sectionized. It was hoped that a series of this kind would present a gradation of the changes undergone by the particles during digestion and excretion; but, partly owing to the difficulty of washing effectually, and so keeping extraneous carmine from being absorbed, and partly owing to a different rate of absorption and digestion in colonies varying in size, the sections do not show so distinct a gradation as was expected. The general course of the metabolic circuit through the sponge can, however, be clearly made out.

In figure 1, as in all the earlier sections, the carmine particles are seen to be confined to the choanocytes, and in

the first series fifteen seconds after being removed from the carmine solution the choanocytes are all well charged with particles. A minute examination brings to light just a few particles here and there in the endodermal pinnacocytes, which are, at any rate, sufficient to show that these cells are at least capable of absorbing substances, though there are too few to allow us to assign a digestive function to them.

Fig. 1.



Transverse section of *Grantia*, showing loaded choanocytes.

There can be no doubt that in *Grantia* at least the choanocytes form the active ingestive tissues.

In all the series up to about three or four minutes the choanocytes still have carmine in their substance, but later than this they gradually lose it, until as late as ten or twelve minutes they are practically free of all particles. Amongst the charged choanocytes we notice that here and there are cells which have commenced to lose the definite cell-outline which distinguishes the normal choanocyte, and, later, to lose their flagella. Stages in this process of phagocytic degeneration can be observed, and although at first cells undergoing this change are scattered here and there in the endodermal chambers, yet in some of the series there are whole chambers which have been reduced by this process to the state of an amœboid multicellular mass, in which the only indication of the former cellular condition is the row of cell-nuclei dotted about in its substance.

Such an appearance is shown in figure 2 *b*, where the amœboid mass is seen to be in direct protoplasmic connexion with the mesodermal elements; and there is every reason to interpret this appearance as a wandering inwards of the transformed choanocytes. In fig. 2 *a* is seen an endodermal chamber in which some of the cells have not reached so

advanced a stage of "transformation" as others, and some of these former still retain their cell-outline.

By selecting suitable examples we can compile a complete series showing the gradual transformation of a choanocyte to the amœboid condition. Such a series is represented in fig. 3.

Fig. 2.

Fig. 3.

Fig. 2.—Transverse section of *Grantia*, showing two radial chambers and nephrocytes.

Fig. 3.—Series A, B, C, D, showing transformation of a choanocyte; camera, high power.

References.

a. Radial chamber, with progressing transformation.
b. Radial chamber, with amœbiform choanocytes.
nc. Nephrocytes.
v. Vacuoles around food.

Fig. 3 *a* is a choanocyte (drawn by camera under high power) showing the contained carmine particles. This is the flagellated ingestive phase. In *b* we find that the cell-outline has become less distinct, and this is especially so at one end, which is the inner end or the end away from the flagellum. This condition becomes more pronounced in the phase drawn at *c*, and, finally, at *d* we have the cell in the amœboid digestive phase, practically unrecognizable from an amœboid mesodermal cell.

Concurrently with this change the cell leaves the flagellated chamber-wall and migrates into the mesoderm. What ulti-

mately becomes of it in this part of the sponge is very difficult to make out.

The transformed choanocyte either completes the course of intracellular digestion itself, or it is devoured by mesodermal phagocytes together with its contained nutritive particles. The choanocyte, however, at this stage so closely resembles the mesodermal cells that its ultimate fate cannot be followed in sections.

We have certain cases described which lead one to suppose that the cells may be devoured by phagocytes. Thus Dendy (4) figures a phagocytic cell in close contact with a choanocyte, and I have observed a few appearances in these sections which appear to be phenomena of a like nature. Delage (3) found that in the larva of *Spongilla* the "ciliated" cells are engulfed in the indifferent amœboid cells, and some at least are digested; the others, on the other hand, emerge later and form the endodermal pinnacocytes and choanocytes. These and other instances show that it is not an unknown phenomenon for the choanocyte to be eaten by the phagocytes.

At the same time there is not sufficient evidence in this sponge for such an assumption, and perhaps the real process is that intracellular digestion is conducted by the incurrent choanocyte, but that if this laden cell is unable, through an excess of nutrient material or through a low metabolic activity, to conduct the processes of digestion itself, it falls a prey to the mesodermal cells, just as do degenerating tissues in the phenomenon of phagocytosis occurring in the development and life-history of many forms.

The radial chambers appear always to be lined almost uninterruptedly with choanocytes in all later stages of digestion, and we may therefore conclude from this that the vacated places of the immigrating choanocytes are filled up either by re-transformed choanocytes or by mesodermal cells which assume the collared phase. One or both of these processes must obviously take place in order that the sponge may not be reduced to an amœboid mass without radial chambers. This result has actually been obtained in several cases cited below, when the sponges had been overfed.

We thus find that:—

1. The process of ingestion is conducted *almost entirely* by the choanocytes.
2. These choanocytes travel to the interior of the colony, and in doing so assume the shape of mesodermal phagocytes.
3. The process of digestion is conducted in the so-called

mesoderm either intracellularly by the loaded choanocytes or in some cases perhaps by a phagocytic digestion of choanocyte and its contents.

4. The immigrated choanocytes are replaced in the wall of the chambers by cells from the inner tissues, which assume the shape of choanocytes.

The continual morphological transformation above indicated appears to be the normal process of digestion in, at any rate, the simpler sponges.

To this statement two objections present themselves :—

Firstly, Sollas (15) has already, when criticising experiments conducted under similar conditions, taken exception to them, remarking that "there is at present no proof that carmine is a food, or that if it is sponges will readily feed upon it." This objection of course holds good with the above in common with all other feeding experiments, and they will be of no value if carmine be *proved not* to be a food.

Assuming it to be not so, it seems difficult to understand why the choanocytes should so very readily absorb large quantities of it. Minute particles of sand or other mineral matter if taken at all by the choanocytes must be very rapidly ejected, as their presence in these cells cannot be demonstrated; at least I have, after repeated attempts, been unable to do so. This being so, it is not too great an assumption to suppose that the choanocytes can and do exert a selective power, and are not obliged to absorb and ingest anything and everything which is presented to them, provided it fulfil only the necessary physical requirements of size &c. Again, it can be easily shown that numbers of small animals (young starfishes &c., Ruffer (12)) can and do feed upon carmine when it is presented to them, or, at any rate, they behave to carmine in exactly the same way as they do to any nutrient material.

Lastly, there is not wanting evidence that the carmine particles undergo a certain amount of change in the tissue of the sponge. Lendenfeld (9) finds that the larger particles, after having been expelled from the tissues, have lost their angular outline, and adduces this observation to show that they have at least undergone some change in their passage through the tissue of the sponge. I have also observed that in many of the loaded amœboid cells there are vacuoles developed around the enclosed particles (fig. 6), perhaps indicating that a process of digestion is going on.

Taking these facts into consideration, it does not seem to be too great an assumption to suppose that most animal

organisms react towards carmine particles in the same way as they do towards undoubted foods. It is evident that this is all we require to assume for our purpose, without discussing the point as to whether a sponge, for example, can be kept alive for an indefinite period by feeding it upon carmine exclusively.

The second objection which might be urged is that the choanocytes were overfed, and that therefore the phenomena above described are of a pathological nature.

In this connexion Hæckel (6) has observed that in many calcareous sponges he found specimens in which the flagella had atrophied and the flagellated cells had assumed the amœboid state.

Metschnikoff (10) finds and describes allied phenomena in *Ascetta clathrus*, and he also notes that feeding with an excess of carmine causes obliteration of the chambers in *Halisarca pontica*, the whole interior of the colony being reduced to an amœboid mass.

Carter (2), Lieberkühn (8), and others give instances of the same kind.

Sedgwick (13), after quoting some of these instances, remarks:—"The collared cells are thus inconstant, and appear to be merely parenchyma-cells specially modified under certain conditions and capable of passing back into their original form when the need for them has passed away."

Sollas (14) mentions an appearance like that of a collared cell budding off an amœboid cell into the mesoderm.

Bidder (1) states that in *Ascetta* the collared cells wander through the ectoderm and, becoming perforated, form a pore; and there are numerous other cases in the development of sponges which show that the collared cells arise from amœboid and are readily transferred into either stage. The apical growth of sponge-colonies probably proceeds on the same lines.

All the cases above cited, in which the transformation of collared cells is effected in the adult sponge, are usually regarded as pathological, and so they probably are in the sense that they are the result of normal processes driven to an extreme; and it does not follow that all transformation of the collared cells upon feeding must necessarily be pathological.

In these experiments care was taken to avoid as far as possible all unnatural factors. Freshly obtained apparently healthy colonies were used, and attempts were made to avoid an excess of carmine either as to quantity or size of the particles. There is also no appearance in the sections which would point to overfeeding, all the collared cells being uni-

formly charged with a fair amount of minute carmine grains.

The fate of the loaded amœboid cells can be easily followed. In sections of colonies which were killed as late as or later than five minutes from the time of removal from the carmine (or seven minutes from the first immersion in the latter) the ectodermal outline is seen at places to be interrupted, as in fig. 2 or fig. 4, by a protrusion of the mesodermal substance to the exterior, with the appearance of a volcanic crater, and at some of these points are clearly seen a number of amœboid cells, which we may term "nephrocytes," charged with carmine particles and evidently in the act of leaving the sponge.

Fig. 5 shows a pair of these cells which were free in the paragastric cavity, seen under high power.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 4.—Mass of nephrocytes escaping from ectoderm.
Fig. 5.—Mass of nephrocytes free from colony.
Fig. 6.—Amœboid digestive cell.

These are mesodermal cells or metamorphosed choanocytes (it is obvious that it is quite impossible to pronounce definitely whether they are really the actual choanocytes which ingested the carmine in the incurrent canals), which are destined, upon the processes of digestion being completed, to leave the colony, carrying with them the solid waste products of excretion. We have here an example of a process of *intracellular* excretion for the removal of waste solids, quite distinct and apart from the liquid excretory processes which doubtless take place through the medium of the water-currents caused by the choanocytes.

A similar intracellular excretion is well known to exist in many Metazoa, as shown, for instance, by Durham in *Asterias* and by other observers in *Phyllirhoë*, *Bipennaria*, &c.

The clear recognition of this intracellular excretion as occurring throughout the Metazoa concurrently with the liquid intercellular excretion would perhaps go far to explain the morphological differentiation of the excretory organs in this group, and seems to have a direct bearing upon the origin and significance of the cœlom.

The "nephrocytes" find their way to the exterior, so far as can be seen, *mainly* through the "ectoderm" or outer limiting layer of the colony; but there is no doubt that many also break through into the paragastric cavity, or even into the incurrent canals. A number of these loaded nephrocytes may be seen lying just under the outer layer, and they might under some circumstances, as referred to above, be mistaken for amœboid cells which are performing the function of *ingesting* carmine.

From the above facts we can now summarize the processes of digestion and excretion in *Grantia compressa* as follows:—

(1) Ingestion of food-particles into the substance of the choanocytes, or, at any rate, mainly into them, the possibility of their absorption by other parts, such as the ectoderm or endoderm, being undoubted, but practically of no importance compared with the former.

(2) Morphological transformation of the choanocytes into amœbiform cells, in no way differing in appearance from so-called mesoderm-cells.

(3) Immigration of these cells to interior, where intracellular digestion takes place. This stage is probably concurrent with stage (2).

(4) Replacing of the immigrated cells by fresh choanocytes arising from morphologically transformed mesoderm-cells.

(5) Excretion of the solid waste particles by amœboid nephrocytes, which burst through the limiting layer of pinnacocytes (mostly the outer layer, but not confined to that part) and leave the colony, probably to disintegrate.

In very briefly comparing these results with those of other observers we note that Carter (2) describes having traced the course of carmine-particles in the young *Spongilla*, and remarks that they are absorbed by the "spongozoa" (choanocytes), and that at the expiration of fifteen minutes the particles are again set free by these cells. Although he does not speak with any great certainty upon the course taken by

these particles, he seems convinced that both in this form and in *Teichonella labyrinthica* the "spongozoa" are the actively ingesting layers.

Sollas (15) has also verified these observations upon colonies of *Spongilla*, stating that the choanocytes alone take up the particles of carmine.

Heider (7) experimented upon species of *Oscarella*, and he seems to have been led to the same result.

Von Lendenfeld (9) conducted a series of feeding experiments upon the Aplysinidæ, and his results led him to believe that the ingestion was conducted by the amœboid mesoderm-cells lining the subdermal cavities, and that the particles after digestion by these cells were ejected into the flagellated chambers and driven out by the choanocytes. He finds that the choanocytes do absorb carmine particles, but believes that these are soon ejected unchanged.

It is quite possible that concurrently with the development of subdermal cavities there is a change in the distribution of the digestive function; but it is difficult to believe that the choanocytes should perform the function of ingestion (apart from that of digestion) in so many simple sponges, and that they should not only lose this function in Aplysinidæ, but should actually take on the special one of assisting excretion.

It is worth noting that the metabolic circuit which I make out to be normal in *Grantia* is, allowing for the absence of subdermal cavities in this form, exactly the reverse of that in the Aplysinidæ, as observed by Von Lendenfeld.

This is worth mentioning, because in early experiments I found that I had not been careful to avoid the entrance of accidental particles of carmine after removal from the solution, and also had not subjected the sponges for a short enough time to the action of the carmine mixture, and hence the later stages (of excretion) might easily have been mistaken for early stages of ingestion. I think it therefore possible that, if the Aplysinidæ of the above-mentioned investigator were left in the carmine for a longer period than is required to complete the metabolic circuit, the sections following this experiment might equally well be interpreted as indicating that the carmine particles were absorbed by the choanocytes and ejected by the subdermal amœboid cells.

Lendenfeld certainly seems to write with great conviction, but some of his sponges appear to have been left for a long time in the carmine, *e. g.* as much as a quarter of an hour. It is remarkable in what an exceedingly short time the particles

are scattered throughout the mesodermal parts of the colony, at least in *Grantia*.

On the other hand, it is possible that, together with the morphological differentiation of subdermal cavities, there may be a physiological change of function, and that, as suggested by Sollas (15), the phenomena described by Lendenfeld may be allied to those of inflammation in higher Metazoa. One may grant that the subdermal amœboid cells may have a function of ingestion of foreign bodies, without assigning to them the main function of the nutrition of the colony.

In a later work Lendenfeld (9) comes to the conclusion that carmine is only deposited in the amœboid cells quite exceptionally, as, for instance, in the case of lesion of the outer layer of cells, and that under normal circumstances it is the choanocytes only which absorb the carmine.

These statements and results are criticized by Metschnikoff (11), who points out that Lendenfeld grants that fat-globules are taken in by the mesodermal phagocytes; and he also declares that Lendenfeld's figures give "direct indications of the presence of carmine grains in the amœboid cells of the mesoderm."

He remarks also as follows:—"Although *it has not so far been definitely ascertained how the foreign particles penetrate the mesoderm after they have reached the interior of the sponge*, yet it has been clearly shown that they are largely absorbed by the mesodermic cells themselves. . . . Grains have been enclosed by the endodermic cells as well as by the amœboid phagocytes of the mesoderm.

"In certain sponges there are very few mesodermic cells, which consequently take a small part in englobing foreign bodies; in others, again, especially in the siliceous kinds, the mesoderm is much better developed, and its more numerous cells can therefore take in a proportionately larger number of these minute particles. There are a few species, such as the *Siphonochalina coriacea*, whose mesodermic cells alone enclose all foreign bodies, so that the cylindrical cells of the endoderm merely serve to keep up the continuous passage of the fluid through the sponge."

I have attempted to supply the deficiency indicated above by the italicized words of Metschnikoff, at least for *Grantia*, and I think it most probable that in the least differentiated sponges, e. g. *Ascetta*, we have so-called "endodermic" cells which perform at least two functions, ingestion and digestion, and that they change their form from flagellate to amœboid according as they perform the one function or the other. In the higher differentiated sponges the "mesodermic" cells

become divided off to a greater degree into two morphological types concurrently with a more complete division of physiological labour—so much so that, as Metschnikoff indicates above, some forms occur in which there are choanocytic cells performing *only* the function of locomotion (of the particles).

These cells we should expect to find remaining constant throughout life, and they thus form a real *epithelium* of cells. The function of digestion, on the other hand, is here entirely performed by the mesodermic cells. Hence within the sponge group we find a process of physiological division of labour connected with the processes of ingestion and digestion, which may largely account for the morphological differentiation as seen in the various types. The smaller the proportion of the choanocytic endodermal area to the pinnacocytic area the less part (we shall expect to find) the individual cells of the former will take in the digestive processes and the more they will be differentiated into a definite "tissue" performing as a predominant function throughout life that of ingestion—that is to say, *intercellular* ingestion into the canals of the sponge and *intercellular* excretion through the osculum of the same, whereas their former function was that of *intracellular* ingestion, digestion, and excretion.

In the sponges, then, there is *intercellular* ingestion and excretion, as in all Metazoa, but there is no *intercellular* digestion, at any rate in the lower forms, a very important feature in comparing them with the Cœlenterata.

The Porifera would also appear to really consist of two layers only, one definite and fixed—the ectoderm—and the other, Metschnikoff's meso-endoderm, consisting of unspecialized cells, any of which may give rise to ova, spermatozoa, locomotive, excretory, skeletal, or digestive phases which have their corresponding temporary morphological modifications.

It is interesting to note that the probable process of digestion indicated above shows a very low type of Metazoan metabolic processes. Any one of many cells in close contiguity engulfs solid food particles, which it reduces to the liquid state, or the parts of them that are capable of being so reduced, by digestive processes. It then parts with most of its liquid nutrient material to the surrounding cells by diffusion or a modified process of a like nature, and is expelled or emigrates from the colony, carrying with it the solid waste products.

This probably represents the scheme of all *intracellular* digestion, and a modified form of it is found in the processes of ingestion as conducted by the "yellow cells" of Annelida,

as also in the numerous phenomena of amœboid ingestion in higher Metazoa.

The discussion of the origin of the Porifera and their relationship to the Choanoflagellata on the one hand, and to the Cnidaria on the other, must be left to specialists in this group; but the facts shown above certainly seem to have a direct bearing upon this difficult question. The fact that the inner layer cells assume mastigopod and myxopod stages under different physiological conditions strengthens the resemblance between the simpler sponges and the colonial Choanoflagellata, and the absence of *intercellular* digestion (with the morphological differences necessarily correlated to this) points to a fundamental difference between the former and the Cnidaria.

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LV.—*Descriptions of Eight new Species of Butterflies from New Britain and Duke of York Islands, in the Collections of the Hon. Walter Rothschild and Mr. Grose Smith, captured by Captains Cayley Webster and Cotton.* By H. Grose Smith.

Papilio Websteri.

Male.—Upperside. Both wings black. Anterior wings with a curved row of six white spots between the veins towards the apex, the first above the costal nervure narrowly

linear, the second and fourth the largest, the latter being concave on its outer edge, the third and fifth smaller, the sixth the smallest; the apex beyond this row is dusted with a few grey scales, and there are rays of grey scales in the cell. Posterior wings with a large greenish-white patch across the disk and the outer fourth of the cell, that part which lies above the upper subcostal nervule not extending inwardly towards the base, as in other species of this group; the outer edge of the white patch is emarginate and somewhat concave between the veins. Incisions in both wings narrowly white.

Underside. Anterior wings brown-black, with the curved row of spots towards the apex as on the upperside, but larger, between which and the apex is a series of rays of greyish-brown scales between the veins. Posterior wings black, with a submarginal row of seven rufous-brown spots, crossing the wings from below the costa to the anal angle, the first, sixth, and seventh spots being the largest; inside the row of spots are a few patches of blue scales, those towards the anal angle being the most conspicuous. Incisions on the posterior wings broader and more conspicuous than on the upperside.

Female.—Both wings dusky brownish grey, dusted with brown scales. Anterior wings crossed from the costa, a little beyond its middle, to near the outer angle by a curved row of white spots, dusted on each side with grey scales and divided by the veins, those at the end of the cell, which they slightly invade, the most elongate, thence gradually diminishing towards the outer angle. Posterior wings with a large white patch, the upper part of which is bounded by the upper subcostal nervule, crossing the outer third of the cell and extending downwards along the submedian nervure, with some grey scales between that nervure and the inner margin, the outer edge of the white patch radiates between the veins and is clearly defined; a rufous subquadrate spot above the anal angle, followed by another between the two lowest median nervules. Incisions narrowly white.

Underside as above. On the anterior wings the curved row of white spots is more distinct and invades the end of the cell, which is broadly and irregularly marked with black. On the posterior wings the white patch extends nearly to the inner margin, there is a submarginal row of rufous bars between the veins, the spot above the anal angle is larger than on the upperside, and there are clusters of blue scales in the interspaces of the median nervules outside the white patch. Incisions more broadly white than on the upperside.

Expanse of wings, ♂ 4, ♀ $4\frac{3}{4}$ inches.

Hab. New Britain.

Belongs to the group of *P. ormenus*, Guér., and other allied species. The male differs from them principally in having the row of spots towards the apex of the anterior wings curved, less oblique, and further from the apex, and on the posterior wings in the upper part of the white patch on the upperside not extending inwardly along the costa towards the base. The female differs in having the curved row of white spots which crosses the anterior wings much more restricted, the patch on the posterior wings being pure white, wider, and more clearly defined.

Vadebra eboraci.

Male.—Upperside. Anterior wings velvety brown, with a submarginal row of four indistinct bluish-white spots between the veins towards the apex (absent in some specimens, nearly obsolete in others). Posterior wings with the outer two thirds the same colour, the inner third, including the upper part of the cell and the space between the upper median nervule and the costal margin, paler dull brown; one or two indistinct submarginal spots between the veins towards the apex (absent in some specimens).

Underside. Both wings more rufous velvety brown than on the upperside. Anterior wings with a dull streak dusted outwardly with a few whitish scales above the submedian nervure from the base to two thirds of its length, the space below that nervure to the inner margin whitish grey; a small spot in the cell, three or four spots beyond it, situate vertically below each other, of which the first and third are the largest and roundest, and a submarginal row of seven spots following the contour of the outer margin, curved rather sharply towards the apex and costal margin. Posterior wings with a large spot towards the end of the cell and a curved row of seven similar spots beyond it; a submarginal row of seven spots between the veins, the spot above the first subcostal nervule the largest, the others smaller and gradually decreasing in size; three or four minute spots a little before the outer margin, towards the apex; the spots on both wings bluish white.

The *female* resembles the male, but is rather paler on the upperside, with two spots between the veins towards the apex of the posterior wings; on the underside of the anterior wings the dull streak above the submedian nervure of the male is represented by a conspicuous pinkish-grey patch.

Expanse of wings 3 inches.

Hab. New Britain and Duke of York Islands.

Vadebra lacon.

Male.—*Upperside* darker velvety brown than in *V. choraci*, and with the anterior wings suffused with purple; on those wings are two small purple spots near the apex between the veins, and two minute submarginal spots between the median nervules. Posterior wings with the costal and outer marginal area paler brown, with two small purplish-white spots between the veins towards the apex.

Underside. Both wings paler dull brown. Anterior wings with a spot near the end of the cell; a row of five spots crossing the disk beyond the cell, the two uppermost elongate and curving inwardly, the third nearly obsolete, the fourth larger and round, the fifth triangular with the apex pointing inwardly, two or three very minute submarginal spots between the median nervules and two larger spots near the apex; a very narrow pale streak below the third median nervule; the space below the submedian nervure in the middle is greyish. On the posterior wings is a spot near the end of the cell; a row of five spots surrounding the cell, two spots towards the apex, as on the upperside, and a row of small spots between the veins a little before the outer margin, two spots in each interspace; all the spots pinkish blue-white.

The *female* resembles the male on the *upperside* of both wings, but is rather paler; on the posterior wings are three subapical round spots whiter than the two spots in the male.

On the *underside* all the spots and markings are larger than on the upperside.

Expanse of wings, ♂ $2\frac{3}{8}$, ♀ $2\frac{7}{8}$ inches.

Hab. New Britain.

Mynes Cottonis.

Male.—*Upperside* resembles *M. eucosmetos*, Godm. & Salv., but the pale area is purer white. On the anterior wings the pale patch towards the apex is less conspicuous, being scarcely visible. On the posterior wings the pale area is more restricted, the outer third of the wings being more broadly and more bluish black.

Underside. The subapical pale patch is pure white, not tinged with yellow as in *M. eucosmetos*, and is considerably narrower; the pale area in the middle of the wings is also pure white, but more extended, and the red submarginal spot between the upper median nervules is much smaller. On the posterior wings the red costal band at the base of *M. eucosmetos* is extended uninterruptedly into the interspace between

the costal nervure and the upper subcostal nervule, and extends over it towards the apex until it joins the dark outer-marginal band; the outer three fourths of the costal margin is broadly black, the basal fourth being red, below which is a large black patch at the base, as in *M. eucosmetos*, which extends over the basal part of the cell and of the interspace above it; the outer third of the wings is blue-black, in which, between the median nervules and submedian nervure, are situate three greenish-yellow patches and a series of submarginal pale streaks.

Expanse of wings $2\frac{1}{4}$ inches.

Hab. New Britain.

One male, in the collection of Mr. Grose Smith.

Mycalesis maura.

Male.—Upperside. Both wings resemble *M. æthiops*, Butl., but the zone round the ocellus on the anterior wings is rather brighter fulvous and the pale space under it is more conspicuous. On the posterior wings the disk is crossed by a row of four ocelli, of which the first and fourth are the smallest and the third is much the largest, the fulvous zones round the ocelli being very bright and wider than in *M. æthiops*, the two middle zones being confluent, and each of the zones surrounded by a narrow dusky ring; the space outside the ocelli to the outer margin is pale olivaceous buff-colour, in which are situate two undulated lines, the inner of which is broader than the outer; a dark streak crosses the disk between the end of the cell and the ocelli.

Underside with the outer third of both wings much paler than in *M. æthiops*, the outer edge of the dark basal portion of the wings being more undulated and tinged with rufous brown; both wings crossed before the middle by undulated rufous-brown lines; the space in which the ocelli are situate on the posterior wings is much paler buff and the zones round the ocelli are brighter than in *M. æthiops*.

The *female* on the upperside resembles the male, but the ocelli are much larger and the fulvous zones round them are paler and broader, the number of the ocelli on the posterior wings being increased to six. On the underside the pale space in which the ocelli are situate is broader and whiter than in the male.

Expanse of wings, ♂ $1\frac{7}{8}$, ♀ 2 inches.

Hab. New Britain.

Very close to *M. æthiops*; the spots on the underside of the posterior wings are arranged somewhat differently and more regularly.

Mycalesis matho.

Male.—Upperside resembles *M. terminus*, Fabr., but differs as follows:—Both wings are shorter and rounder, the basal half of the anterior wings darker and more rufous; the space in which the discal ocellus is placed is paler and the ocellus is much larger; the space beyond the ocellus to the outer margin is paler and is traversed by a narrow dark line. The posterior wings are darker rufous brown and the two middle ocelli are larger.

On the *underside* the ocelli on both wings are larger and the outer third of the wings is paler; the inner two thirds is crossed in the middle by two undulated brown lines, of which those on the posterior wings are the more distinct.

The *female* resembles the male, the pale fulvous area in which the large ocellus on the anterior wings is placed being clearly defined.

Expanse of wings 1⅝ inch.

Hab. New Britain.

Near to *M. terminus*, Fabr., and *M. remulia*, Cram. This species had been previously sent to me by the Rev. Mr. Rickard in some numbers.

Epimastidia albo-cærulea.

Male.—Upperside brilliant cærulean blue, with the outer margins of both wings black. Posterior wings with the costal third greyish black.

Underside white, with the outer margins of both wings broadly dull black, centred with velvety-black lunules, bordered inwardly with bright blue lunules and outwardly with conical bright blue spots, towards the base of which are situate a series of velvety-black bars, almost covering the outer edge of the blue spots, which is only indistinctly seen.

Expanse of wings 1¾ inch.

Hab. New Britain.

Very near *E. arienis*, Druce, from the Solomon Islands, but more brilliant blue on the upperside, and on the underside the outer dark margins, in which the blue lunules and spots are very brightly distinguished, are broader and blacker.

Thysonotis esme.

Male.—Upperside resembles *T. cepheis*, Druce.

Underside. Both wings more cinereous grey, with the pale spaces on them more cinereous white. On the anterior wings the pale space does not extend quite so far over the

disk towards the outer margin. On the posterior wings the metallic colouring at the base of both wings and in the discal band across the posterior wings is more bluish and less golden green, while the black velvety spots in the band are more extended inwardly; the outer edge of the band is further from the outer margin and more convex between the veins. Both wings are broader and more rounded at the apex.

Expanse of wings $1\frac{3}{8}$ inch.

Hab. New Britain.

LVI.—*Observations on the Derivation and Homologies of some Articulates.* By James D. Dana *.

The term Articulates is used here in preference to Arthropods, because the latter group is believed to be not a natural one, Crustaceans and Insects being less closely related to one another, as indicated beyond, than Annelids and Insects.

Derivation of Limuloids and Crustaceans.—As has been suggested by Lankester, it is probable that all the Articulates are successional to the Rotifers. There is reason for believing further that the types of Annelids, Crustaceans, and probably that of Limuloids had their independent Rotifer origin.

The Nauplius, or larval form of a Crustacean, shows, by its having but three pairs of limbs (two besides an antennary pair), that the type is not successional to a many-jointed Annelid, but rather to some *Pedalion*-like Rotifer. The discoveries of Prof. C. E. Beecher announced in the preceding and earlier numbers of this 'Journal' leave no doubt that the Trilobites are multiplicate Isopod Crustaceans, precursors of the normal Isopods, as the true Phyllopods, also multiplicate species, were precursors of the Decapods †.

The Eurypterids, the early form of the Limuloids, are related to Crustaceans in number of body-segments, it being 19, as in the Tetradecapods, and in the fact that 13 of these 19 segments pertain to the thorax and abdomen. But the wide distinction exists that the Eurypterids have no thoracic or

* From the 'American Journal of Science,' May 1894, pp. 325–329.

† In the Author's 'Report on the Crustacea of the Wilkes Exploring Expedition,' the Rotifers are made the lowest subdivisions of Crustacea (p. 1408), and the Trilobites are placed, with a query, in the subdivision of Tetradecapods, as multiplicate forms under the type. In the text above the expression *true* Phyllopods is used, because most of the so-called Phyllopods of the Palæozoic exhibit, in the specimens, no evidence that they are multiplicate, that is, have an excessive or abnormal number of body-segments or appendages.

abdominal limbs, and the only true feet which they have are also at base mouth-organs, that is organs that pertain to the head. Moreover, as has been shown by Packard and others for the *Limulus*, they do not pass through the Nauplius stage in their development. These diversities and agreements appear to indicate a derivation for the Limuloids nearly like that of the Crustacean type, but probably not *from* Crustaceans. But since Limuloids cannot yet be proved to have existed before the Trenton period in the Lower Silurian, a derivation from some species related to the Ceratiocarids is possible. Since many, if not all, of the Eurypterids were freshwater or brackish-water species, the transfer to fresh water may have been an incident attending the divergence, and also an explanation of their attaining so great dimensions, fresh water having been their protection. The large Eurypterids, several feet in length, would have been helpless among Sharks and Ganoids.

Derivation of Arachnids.—The line to the lower and earlier Arachnids, that is, to the Scorpions, leads up, according to Van Beneden, Packard, and others, from the early *Pterygotus*-like Limuloids. The early Scorpion, as well as the modern kinds, has the same number of body-segments as a *Eurypterus* or *Pterygotus*—namely, 7 thoracic and 6 abdominal (precisely the normal number in Crustaceans),—the same *cephalic* relations of the legs, the same absence of abdominal appendages, a like absence of thoracic appendages from all the segments excepting the first two, and similar functions in the members pertaining to these two segments. Further, according to B. Peach, these early Limuloids sometimes have, like the Scorpions, pairs of "combs" or pectinated organs on the underside of some of the thoracic segments.

But in this change from an aquatic to a terrestrial species the upward progress in structure was great. The four posterior pairs of feet in the terrestrial Scorpion have no longer the low-grade feature of serving as jaws as well as feet, but are simply feet; they are the chief organs of locomotion, and only those of the anterior pair are appendages to the mouth. The antennæ are shortened to pincers (falces), that also serve the mouth. The four pairs of feet are thus *cephalic* organs, if comparison be made with the Limuloids and Crustaceans, though in arachnology they are called *thoracic*. In the later true Spiders the body had lost its true Eurypteroid abdomen, but had still, in Palæozoic species, its distinctly segmented thorax; and this thorax is the abdomen of arachnology. It is segmented in some modern species, while in others the subdivisions have become obsolete or are but faintly indicated.

The abdomen of the Eurypterid, however, exists as a slender-jointed thread in *Geralinura* of Scudder, of the Carboniferous, which has its Illinois and also Bohemian species, and has survived till now in the modern *Telyphonus*.

Derivation of Myriapods and Insects.—Myriapods, although inferior to Insects, are as yet known only from the early Devonian. The Devonian species, and also those of the Carboniferous, are of the Millepede or lower doubly multiplicate section of Myriapods, with one exception, that of the remarkable few-jointed caterpillar-like *Palæocampa* of Meek and Worthen.

The fact of a line of succession from Worms to Myriapods and from Myriapods to Insects has not been proved by geological discovery. The derivation of Myriapods from some type of Annelids is zoologically suggested, as long since recognized, by the apparently transitional form of *Peripatus*, a low-grade Myriapod resembling much the larva of some Insects, and by the like multiplicate structure of Annelids and Myriapods. It might be inferred also from the resemblance of the *Palæocampa* of the Illinois Carboniferous to the caterpillar of an Insect of the genus *Arctia*, as remarked by Scudder.

Myriapods are regarded as the precursors of Insects on account of their approximate resemblance to the latter in antennæ and the appendages of the mouth, and because also of the worm-like form of most Insect larvæ, these larvæ appearing to be survivals of the Myriapod stage. In the change from an Annelid and Myriapod to an Insect the *multiplicate* feature disappeared and the number of parts became essentially the fixed normal number of the type, both as regards the body-segments and their jointed appendages.

The rise of grade from the Myriapod to the Insect involved the appropriation of the three body-segments of the Myriapod bearing the three anterior pairs of feet (which correspond normally to half the body-segments of the head of an Isopod Crustacean) for forming the isolated middle section of the body, called the thorax, and the suppression of all the other pairs of feet. In both Spiders and Insects the change involved also a general concentration of the structure toward the cephalic nervous centre, that is a shortening of the range of cephalic control, and especially the distance to the posterior limit of locomotive action. Compared with a crab, the highest type in the Crustacean series, its superior, an ant, is a very little thing.

The fact that in low-grade Insects there is no proper metamorphosis, while in the higher, as they rise in grade, the

Crustaceans.	Limuloids.			Arachnids.		Myriapods.	Insects.
Tetradecapods.	*Eurypterus.*	*Pterygotus.*	*Limulus.*	*Scorpion.*	*Phrynus.*	*Lithobius.*	
1. 1st Ant. 2. 2nd Ant. 3. M. 4. Mx. 5. Mx. 6. Mx.	0 M-P. M-P. M-P. M-P. M-P.	Ant. M-P. M-P. M-P. M-P. M-P.	Ant. M-P. M-P. M-P. M-P. M-P.	Falces M. P. P. P. P.	Falces M. P. P. P. P.	Ant. M. Mx.	Ant. M. Mx. & L.
Head.	Head.	Head.	Head.	Head	Thorax. Head	Head.	Head.
1. P. 2. P. 3. P. 4. P. 5. P. 6. P.	Fol. P. Fol. P. 0 0 0 0	Fol. P. Fol. P. 0 0 0 0	Fol. P. Fol. P. Fol. P. Fol. P. Fol. P. 0	0 Comb. 0 0 0 0	0 0 0 0 0 0	P. P. P. P. P. P. P. P. P. P. P. P.	P. P. P.
Thorax.	Thorax.	Thorax.	Thorax.	Thorax.	Abdomen.	Abdomen.	Thorax
1. App. 2. App. 3. App. 4. App. 5. App. 6. App.	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0			0 0 0 0 0 0
Abdomen.	Abdomen.	Abdomen.	Abdomen.	Abdomen.			Abdomen.

15 pairs of feet in *Lithobius*, 21 in *Scolopendra*, 200 in some Myriapods.

larval stage is lower and lower in embryonic level, suggests that the larval stage results from an attendant retrograde embryonic change to a line parallel with the Myriapod, and beyond to the memberless condition of a worm. The principle appears to be a general one among animals, and thence the higher the species the longer the stage of youth.

The relations in body-segments and limbs between the classes of Crustaceans, Limuloids, Arachnids, Myriapods, and Insects are shown in the table (p. 505). The segments of the body are numbered along the left margin; the zero opposite signifies that the segment, though present, has no appendage.

In this table the following abbreviations are used:—Ant., antenna; App., pairs of jointed appendages, either pediform or branchial; M., mandible; Mx., maxilla; P., feet; M-P., feet that serve also as jaws; Mx. & L. (under Insects), maxillæ and labium; Fol. P., foliaceous or lamellar feet or appendages.

Under the Limuloids the genus *Eurypterus* fails of antennæ, but they are present in *Pterygotus* and are chelate; and this chelate (or thumb-and-finger) form characterizes also the modern *Limulus*, the Scorpions, and the common Spiders. In the table the two pairs of maxillæ of Insects are assumed to belong to a single body-segment, as held by many zoologists, including (as he himself informs the writer) Prof. S. I. Smith; the table shows that, with this admission, the thorax and head of an Insect are essentially homologous with the head of a Tetradecapod Crustacean.

LVII.—*New Species of* Cyclophorus *and a* Spiraculum *from the Khasi and Naga Hills, Assam.* By Lieut.-Col. H. H. Godwin-Austen, F.R.S. &c., and Col. R. Beddome, F.L.S. &c.

Cyclophorus Muspratti, sp. n.

Shell umbilicated, turbinate, slightly keeled; sculpture, apex smooth, the whorls thence are longitudinally ribbed and striated, increasing in strength near the suture from above downwards, and crossed by the lines of growth, producing a decussate surface; this is coarser and rougher on the last whorl and under surface. Colour madder-brown, crossed by mottled broken white lines on whorls 3 and 4. Spire conic,

moderately high, sides slightly convex, apex sharp; suture shallow; whorls 5, sides convex, the last somewhat keeled; aperture circular, oblique; peristome white, not thickened, slightly reflected.

Size, type: maj. diam. 48·75, min. 39·0; alt. axis 22·25 mm.
largest: „ 50·0, „ 42·0; „ 23·0 „

Loc. Naga Hills (*Doherty*); Maokokchung, Naga Hills (*Muspratt*).

In the young shell the longitudinal striæ are very sharp and distinct, quite lirate in appearance; this character separates it from the other species of *Cyclophorus* from these hills.

Cyclophorus nagaensis, sp. n.

Shell umbilicated, turbinate, not keeled; sculpture, lines of growth only, without any spiral lines being visible. Colour grey-brown, more ochraceous below, when wetted of a madder-brown colour; a white line on the periphery, bounded by a broad very dark band, shaded off below; the third whorl is crossed by narrow wavy white lines; in the next growth these lines are wider apart and zigzag in outline; the next and final growth is plain. Spire depressedly conoid, apex subacute; suture shallow; whorls 5, rounded; aperture subvertical, large, circular, grey within; peristome not much thickened, scarcely reflected, bright orange-red.

Size: maj. diam. 45·0, min. 36·0; alt. axis 21·0 mm.

Loc. Naga Hills, near Khonoma and Kigwema, 5000–6000 feet (*Doherty*); Maokokchung (*Muspratt*).

The form of this species is very similar to *C. Pearsoni*, but the red of the lip is more intense than in shells from the typical locality; its very smooth surface also distinguishes it.

Cyclophorus pœciloneurus, sp. n.

Shell umbilicated, turbinate, keeled; sculpture, apex smooth and shining; five distinct lirate ribs run contiguous to the suture on the lower margin of the whorls, commencing with the third whorl; these have two finer thread-like ribs between them, and similar fine liration is continued above and on the lower surface of the shell, crossed by strong lines of growth on the epidermis. Colour umber-brown, marbled with madder-brown, given off from a few strong spots of this colour next the suture; the peripheral rib is dashed with white at intervals. Spire conoid, sides flat, apex sharp; suture shallow; whorls 5, subconvex, the last sharply keeled, forming a strong rib; aperture oblique-ovate, ample on the outer margin, grey

within; peristome white, well thickened in mature shells, sharply reflected.

	Maj. diam. mm.	Min. diam. mm.	Alt. axis. mm.
Type	31·0	25·75	15·0
Col. Beddome's largest sp.	33·0	26·0	16·0
Var. with red lip (*aureolabris*, Nev.) . . .	34·5	27·5	15·5

Loc. Type from the Lahúpa Naga Hills, Munipur (*coll. Lieut.-Col. Godwin-Austen*), and eastward to the Dihing.

Lieut.-Col. Godwin-Austen found two specimens of this species in the Lahúpa Naga Hills, in 1873; the late Mr. Ogle sent him three from the neighbourhood of the Dihing River, far to the eastward. Mr. Doherty obtained it in the Naga Hills, and Col. Beddome lately recorded it from Mr. Muspratt from Maokokchung, in the Naga Hills. In these eastern hills this form takes the place of *C. zebrinus* of the Khasi Hills &c., but it is much larger, the spiral ribbing is much stronger, the whorls are more convex, and it is more openly umbilicated.

All the specimens in Lieut.-Col. Godwin-Austen's collection, and also those collected by Mr. Doherty, are white-lipped shells; among the specimens received by Col. Beddome the red-lipped predominate *.

The coloration is very variable; in some, as in the type, the marbling occurs in fine zigzag lines far apart, in other examples these are so closely run together as to give the shell a beautiful ruddy colour.

Cyclophorus Fultoni, sp. n.

Shell somewhat depressedly turbinate, rather widely umbilicated, periphery rounded; sculpture nearly smooth, under a lens a fine, close, oblique, vertical striation is apparent, which is obsoletely decussated with delicate spiral lines. Colour a uniform dark ruddy brown or madder-brown above and on the sides, but several narrow and two or three broader dark longitudinal bands are distinguishable in a strong light, pearl-white beneath. Whorls 5, the last very large, rather suddenly increasing towards the aperture, the last three apical whorls

* Nevill, in his 'Hand-list,' 1878, p. 268, does not separate the Eastern forms, but names three specimens sent to the Indian Museum by Mr. S. E. Peal, from Sibsagar, as var. *aureolabris*. He says, "The largest variety I have yet seen and the only one with a coloured peristome, in this case a brilliant orange-colour." It may therefore stand under the above name.

rising suddenly; suture shallow; aperture wide, nearly circular, a little higher than broad, oblique; peristome continuous, rather thickened, slightly reflected, pale yellowish, columellar margin rounded; operculum of the same colour as the shell, having 5 or 6 acutely defined volutions, the interspaces with the usual oblique lines of growth.

Size: maj. diam. 49, min. diam. 13; alt. axis, max. 20, min. 19 mm.

Loc. Khasi Hills; three specimens obtained by Mr. Fulton.

The affinity of this beautiful species is with *C. siamensis*, from which it differs in its more depressed form and more oblique aperture, and especially in the coloration. The exact locality is not known; the Khasi Hills is a large tract, and many species found on the northern slopes draining to the Brahmaputra are not found on the south side, while intervening is a high grassy plateau with a very scanty number of land-shells.

Spiraculum nagaense, sp. n.

Shell discoidal, upper surface flat, widely umbilicated; sculpture, strong longitudinal striation, covered with a thick epidermis, with two parallel bands of close-set hairs on the periphery. Colour umber, with a series of darker bands crossing the whorls. Spire quite flat; suture deep, the sutural tube is 4·5 mm. behind the peristome, is well developed, arched and bending over, and lies directed backwards and parallel with the suture; whorls 5, rounded, the last descending very slightly; aperture circular; peristome thickened, white, continuous, with an angulate notch above and close to the body-whorl; operculum widely spiral, shelly, whitish grey.

Size: maj. diam. 17·5, min. 14·0; alt. axis 5·25 mm.

Loc. Maokokchung, Naga Hills (*Muspratt*). In coll. Col. Beddome.

This small form may be distinguished from *S. hispidum*, var. *minor*, of Teria Ghat in the Khasi Hills and base of the Dafla Hills, in the form and direction in which the sutural tube lies backward on the shell; in *hispidum* it lies across and nearly at right angles with the suture, in this new form it is on the line of the suture.

LVIII.—*On the Affinities of the Cretaceous Fish* Protosphyræna. By A. Smith Woodward, F.L.S., of the British Museum (Natural History).

In 1889 * it was incidentally pointed out that a remarkable resemblance could be observed between the jaws and dentition of the Cretaceous fish *Protosphyræna* and those of the Upper Jurassic genus *Hypsocormus*. Since that date further important information has been published in reference to the osteology of the first-named genus †, while beautiful examples of *Hypsocormus* have been acquired by the British Museum from the Lithographic Stone of Bavaria and the Oxford Clay of Peterborough. The opportunity is therefore afforded for extending comparisons further, and I undertake this task with all the more interest since it is now proved beyond doubt that *Protosphyræna* differs from all known "Teleostei" (i.) in the structure of the pectoral fins, (ii.) in the development of the splenials in the mandible, (iii.) in the structure of the large teeth, and (iv.) in the presence of a large gular plate, followed by a numerous series of comparatively short and broad branchiostegal rays.

All the new evidence combines to show that the original suggestion of five years ago was one of some importance, and it now appears that *Protosphyræna* and *Hypsocormus* resemble each other in at least the following seven prominent characters.

(1) *Rostrum and Upper Jaw.*—The ethmoidal region is consolidated into a pointed rostrum, usually more produced in *Protosphyræna* than in *Hypsocormus*, but similarly fused at the base with the small vomers, which bear a pair of very large teeth ‡. As shown by an example of *H. tenuirostris* in the Leeds collection from the Oxford Clay of Peterborough (Brit. Mus. no. P. 6917), the premaxilla is triangular in that fish, and both this bone and the maxilla agree closely with the corresponding elements of *P. nitida*, as described and figured by Felix (*loc. cit.* pl. xiii. fig. 1). As in *Proto-*

* Smith Woodward, "Preliminary Notes on some new and little-known British Jurassic Fishes," Geol. Mag. [3] vol. vi. p. 451 (1889).

† J. Felix, "Beiträge zur Kenntniss der Gattung *Protosphyræna*, Leidy," Zeitschr. deutsch. geol. Gesell. vol. xlii. pp. 278–302, pls. xii.–xiv. (1890); A. R. Crook, "Ueber einige fossile Knochenfische aus der mittleren Kreide von Kansas," Palæontogr. vol. xxxix. pp. 109, 110 (1892).

‡ From the Cambridge Greensand the writer is acquainted with undescribed evidence of a species of *Protosphyræna* with a snout as short as in *Hypsocormus tenuirostris*.

sphyræna, so in *Hypsocormus* the premaxilla bears a few very large teeth, the maxilla having smaller and more numerous teeth.

(2) *Cheek-plates.*—Besides the large postorbital cheek-plates in *Protosphyræna* Felix also notes (*loc. cit.* p. 282) some comparatively small secondary postorbitals forming the actual hinder border of the orbit. Exactly the same arrangement is observed in *Hypsocormus* (Brit. Mus. nos. P. 6011, P. 6917), as also in the allied genus *Pachycormus* *.

(3) *Mandible.*—The mandibular symphysis is similarly constituted in the two genera under comparison, the stout (anterior) splenials entering the symphysis, rapidly tapering behind, and each bearing one or two very large teeth in addition to the smaller teeth. In both genera also the anterior end of the tooth-bearing margin of the dentary bone curves downwards and is provided with about three large teeth pointing forwards. The present writer has never observed any evidence of a distinct presymphysial bone in either genus.

(4) *Structure of the large Teeth.*—Felix observes (*loc. cit.* p. 289, pl. xiv. fig. 4) that, when viewed in transverse section, the large teeth of *Protosphyræna* exhibit a remarkably complex structure. They are, in fact, compound, showing a number of distinct small pulp-cavities, each surrounded by its own separate zone of vasodentine. Precisely the same structure can be seen in a transverse section of a large tooth of *Hypsocormus Leedsi* in the British Museum (no. P. 6914).

(5) *Branchiostegal Apparatus.*—The large gular plate and numerous broad branchiostegal rays shown by Felix in his figure of *Protosphyræna* (*loc. cit.* pl. xii. fig. 3) are exactly similar to the corresponding plates in *Hypsocormus* and *Pachycormus*, and only approached among "Teleostei" in *Elops* and its allies.

(6) *Pectoral Fins.*—It is now proved † that the pectoral fins of *Protosphyræna* are the well-known fossils described by Cope under the name of *Pelecopterus* ‡; and on comparing these with the corresponding fins of *Hypsocormus* as shown in the British Museum (nos. P. 6011, 6917), it will be observed that there is a very close general resemblance. The fin-rays are unjointed except quite at the extremity, and they are all

* H. E. Sauvage, "Note sur le Genre *Pachycormus*," Bull. Soc. Linn. Normandie, [3] vol. vii. p. 144, pl. iv. (1883).

† A. R. Crook, Palæontogr. vol. xxxix. p. 110.

‡ E. D. Cope, 'Vertebrata of the Cretaceous Formations of the West,' p. 244*a* (1875).

very closely pressed together; in both cases the anterior edge of the fin is oblique, some of the anterior rays terminating successively at the border (considerably more in *Protosphyræna* than in *Hypsocormus*); and in both cases the anterior edge is roughened by a deposit of a hard enamel-like substance. Unfortunately there is as yet no precise information concerning the basal bones of the pectoral fin in *Hypsocormus*.

(7) *Axial Skeleton of Trunk*.—Negative evidence can only be regarded as of slight value, but it is nevertheless noteworthy that traces of vertebræ are wanting in all the known specimens of *Protosphyræna*. It seems likely indeed that this fish will eventually prove to have possessed a persistent notochord as devoid of peripheral ossifications as that of *Hypsocormus* and *Pachycormus*; and in this connexion it is of interest to record that two fragmentary examples of the trunk of a small *Hypsocormus*-like fish have been discovered in the Upper Cretaceous of Sahel-el-Alma, Mount Lebanon. One of these specimens is in the British Museum (no. 49531) and the other in the Syrian Protestant College, Beyrout; and although no remains of a *Protosphyræna*-like skull have hitherto been met with in the same deposit, the present writer has little hesitation in predicting that such will eventually be found. The axial skeleton of the trunk in these fossils exactly resembles that of *Hypsocormus* in the form and disposition of the close series of neural and hæmal arches; the squamation cannot be distinctly seen, but must have been very delicate; and the remains of the dorsal fin are well in advance of those of the anal fin.

In conclusion, it may therefore be stated that *Protosphyræna* is not a "Teleostean" in the ordinary acceptation of the term, and that none of its characters hitherto discovered warrant its separation from the family to which the Jurassic genera *Hypsocormus* and *Pachycormus* are referred. It differs from both in the lateral compression of the teeth, and future discoveries may reveal still more distinctive features; while it is not easy as yet to estimate the true value of some of the points of resemblance noted above. It must suffice at present merely to suggest a profitable form of comparison to be made when still more satisfactory specimens of *Protosphyræna* are available for study.

LIX.—*Description of* Apogonia ferruginea, *Fabr., from the Type in the Banksian Collection of Coleoptera.* By Charles O. Waterhouse.

Some time since I had occasion to examine the type of *Melolontha ferruginea*, F. (Spec. Ins. i. p. 41), now placed in the genus *Apogonia*; and as the species of this genus are difficult to determine, I think the following description, drawn up at the time, may be useful.

Apogonia ferruginea, Fabr.

Ferruginea, nitida: capite sat parce punctato, clypeo brevi, anguste reflexo-marginato, confertim fortiter punctato, antice recte truncato; thorace laxe sat fortiter punctato; scutello lævi; elytris fortiter punctatis, bicostatis, costis angustis vix elevatis; pygidio sat fortiter sat crebre punctatis.
Long. 9 millim.

Hab. Coromandel (*Coll. Banks in Brit. Mus.*).

This species is of a ferruginous colour, but in some lights has a very faint æneous tint on the forehead and thorax. The clypeus is coarsely and very closely punctured, straight in front, with the angles of the truncature obtusely rounded. The forehead has the punctures moderately strong, generally separated from each other by about two diameters of a puncture. The thorax is obliquely narrowed in front and slightly so at the base, broadest behind the middle, the sides rounded posteriorly; the punctures are moderately strong and are generally separated from each other by about one and a half or two diameters of a puncture. The elytra have the punctures much stronger, and the punctures are generally separated by about one and one sixth times the diameter of the punctures; the lines of punctures on each side of the narrow costæ are similar to the other punctures and are scarcely nearer together, so that the costæ are not very conspicuous; towards the side there is a slight indication of a third costa; the first costa is nearly uniform throughout, the second is a little dilated at the base and narrowed at the apex. The pygidium is small and has the punctures similar to those on the thorax, but a little closer together.

LX.—*Two new Species of* Myrmeleonidæ *from Madagascar.*

By Robert M'Lachlan, F.R.S. &c.

Palpares insularis, sp. n.

Head above yellow, much swollen, but with a deep longitudinal sulcus; on the front part of the top there is a transverse shining black band connecting the eyes, joined to a diamond-shaped black spot on the middle of the vertex, in which is the sulcus; front black; clypeus and labrum bright yellow, on the former is a row of distant black hairs. Palpi black, the labial enormously long. Antennæ black, inserted in yellow sockets; the basal joint clothed with black hairs. Thorax yellow above, with three longitudinal black bands, one median, the others lateral (on the metathorax the black bands become somewhat vague); hairy clothing blackish on the pronotum, whitish and curled on the mesonotum (posteriorly) and metanotum; pronotum rather broader than long, the front and hinder margins strongly raised: thorax beneath black, sparingly clothed with whitish hairs; a large yellow spot at the insertion of each pair of legs and also under each pair of wings. Legs black, with strong spinose black hairs; spurs and claws piceous. Abdomen dull yellowish above, passing into blackish after the third segment; this latter with numerous black points, whence spring cinereous hairs. In the male the abdomen is much more slender and longer than in the female, and the pale colour above is extended to the fourth or fifth segment; superior appendages scarcely longer than the last segment, black, stout, curved upward, cylindrical and obtuse, the opposing apices applied one to the other; they are clothed with very long black hairs; inferior appendage one half shorter, polished, rounded at the apex, convex beneath.

Anterior wings broad (especially in the female), the extreme apex slightly angular; hyaline, with a very slight greyish-yellow tinge, marked with smoky black as follows:—there are rudiments of three oblique bands, one consisting of a spot under the radius in the basal fourth, a second, antemedian, is formed of two spots (often united), extending from the radius half across the wing, the third is postmedian and comprises a rather large subradial spot more or less connected with smaller spots below it (all these spots are more or less fenestrated with paler); the costal area is strongly marked with black spots rather regularly placed

and often triangular in form; similar spots are seen on the inner margin, and nearly the whole disk of the wing is black-spotted, more strongly in the basal and apical portions; at the latter the spots are often united into a maculose anteapical band, and the extreme apex itself is narrowly margined (the part of the wing least spotted is between the subradial oblique indistinct bands); pterostigma yellowish, rather distinct; neuration whitish yellow, blackish where it traverses the black markings, the radius black at the base. Posterior wings hyaline, with black markings:—in the costal area to about the middle are spots as in the anterior; a few small spots forming a broken angular line about the furcation of the lower cubitus; there are also three transverse bands, the first about the middle, arising under the radius, then angulated outwardly in an obtuse manner in the middle of the disk, and continued to the inner margin as three branches, which may be wholly or partially connected with the band or wholly disconnected; a second somewhat similar band is placed beyond the middle, and usually arises below the costa, but is sometimes only connected therewith by spots, its termination on the inner margin being as irregular and uncertain as the first band; the third band is macular and anteapical, and the apex itself is narrowly black; pterostigma and neuration as in the anterior, but the radius, cubiti, postcosta, and ramule of the lower cubitus are black for at least the basal fourth.

Length of body, ♂ 62–64 millim., ♀ 53–57 millim. Expanse of wings, ♂ 114–124 millim., ♀ 135–142 millim.; breadth of anterior wing, ♂ 19–20 millim., ♀ 22–24 millim.

Apparently common. I have ten examples before me, and have seen many more. There is reason to believe that the markings of the wings vary locally, as in most species of the genus. Allied to *P. caffer* and *speciosus* of the African continent, and more especially to the former, on account of its broad wings. It is the only described species from Madagascar, but I have seen others in a French collection.

Myrmeleon validus, sp. n.

Head and thorax dull blackish above, dusky yellowish beneath, somewhat clouded with darker. Antennæ black, nearly as long as the entire thorax and of nearly equal thickness throughout; the apex acute. Head much broader than the pronotum, much swollen above, with a median impressed longitudinal line, and two others, less deep, one on either side of the median, the space enclosed between the outermost lines

being smooth, with two faint yellow marks posteriorly; the posterior angles each with a large yellowish spot extending round the eyes to the sides of the front; on the front the antennal sockets are yellowish; there is a short yellowish median line below the antennæ and a broader median yellowish line on the clypeus, the posterior margin of which is also yellowish, as are the bases of the mandibles (otherwise the front is black); pronotum slightly longer than broad and very slightly narrowed anteriorly; a transverse sulcus divides it into two subequal parts, on the anterior part is a transverse row of four yellowish spots and on the posterior another row of three similar spots, all more or less rounded, and there are sparse, long, erect black hairs. On the front part of the raised portion of the mesonotum are two small yellowish spots (seldom visible), otherwise the thorax is spotless above. Legs stout, yellowish, all the femora and tibiæ with a piceous line externally and an additional piceous line internally on the intermediate and posterior femora, and an annulation of the same colour near the base of the posterior tibiæ; tarsi piceous externally, the basal joint yellowish, as long as the second to fourth united, the fifth nearly equalling the first to fourth, spurs piceous, much shorter than the basal joint. Abdomen slender, uniformly fulvous above, paler beneath (but in the female the apical portion often passes into blackish above); in the male the abdomen is terminated by two up-directed valvules (or appendages), closely applied one to the other, with a yellow wart at their base, and clothed with long and strong black hairs; in the female are two short, stout, cylindrical inferior appendages *, clothed with long black hairs, shorter than the narrow, swollen, terminal dorsal segment, which is clothed with similar hairs.

Wings long, rather broad, acute at the apex, the posterior scarcely shorter than the anterior and only slightly narrower; costal margin of the anterior straight; the postcosta entering the inner margin soon after the first fourth of the length of the wing; both pairs are hyaline, highly iridescent, uniformly tinged with pale fulvous, which deepens slightly in the apical portion, and quite without markings, excepting the conspicuously large oval whitish pterostigma; neuration fulvous, the network very dense, and to this is largely due the uniform

* The presence of these short appendages or cerci would seem not unnaturally to indicate that the individuals possessing them are males, and not females; but in this case it is not so, for, apart from other characters, they are present only in those examples in which the knob (or "pelote") at the extreme base of the inner margin of the posterior wings is to be seen, and this latter is a sure indication of the male in those Myrmeleonidæ that possess it.

fulvous coloration of the wings; the corneous knob at the extreme base of the inner margin of the posterior wings of the male is small, rounded, and pale in colour; the costal area in these wings slightly dilated for a short distance near the base.

Length of body, ♂ 40–48 millim., ♀ 42–54 millim. Expanse of wings, ♂ 93–110 millim., ♀ 95–131 millim.; breadth of anterior wing 12–18 millim.

Apparently common. Thirteen examples are before me, and I have seen at least fifty. Probably the largest species of *Myrmeleon* as restricted. In form and general structure, and even in the markings of the head and thorax, evidently allied to *M. quinquemaculatus*, Hag., *M. polyzonus*, Gerst., and *M. lethalis*, Walk. (partim), of the African continent, but abundantly distinct. In my analysis of Walker's species (Journ. Linn. Soc., Zool. ix. p. 279) I stated that, of the examples named by him, the one bearing the label "*lethalis*" is identical with *quinquemaculatus*, and that the other two equal *Formicaleo leucospilos*, Hag. Walker's description was apparently drawn up from these latter.

LXI.—*Lateral Eyes in the* Galeodidæ.

By H. M. Bernard, M.A. Cantab., F.L.S., F.Z.S. (from the Huxley Research Laboratory, South Kensington).

The Galeodidæ have hitherto been thought to be unique among the larger Arachnids in not possessing lateral or accessory eyes. Such eyes, however, occur in all the specimens which I have so far examined, but in a position which fully accounts for their having been overlooked.

Passing the Arachnids in review, we have what I am now inclined to consider as the most primitive condition in the Mygalidæ. The ocular tubercle persists in this family, with the paired median eyes and the accessory eyes grouped upon it. As I have elsewhere* explained, the ocular tubercle may be considered to be the remains of the original dorsal surface, left like an island between the cephalic lobes, which have elsewhere met in the middle line.

In other Araneids the ocular tubercle is obliterated, and the eyes are scattered about on the forehead.

In *Phrynus* the ocular tubercle persists in its original position at the anterior end of the suture between the cephalic lobes. The accessory eyes have apparently *wandered off* laterally, and are found as a small group on each side, halfway

* "On the Head of *Galeodes* and the Procephalic Lobes of Arachnidan Embryos," Zool. Anz. no. 426 (1893).

between the ocular tubercle and the lateral edge of the dorsal surface.

In *Thelyphonus* the ocular tubercle appears to persist near its original position, while the lateral eyes have moved further back than in *Phrynus*, and are close to the lateral edge of the dorsal surface.

In *Scorpio* the median eyes persist, as a rule, upon an ocular tubercle, which has, however, in many cases travelled back along the suture between the cephalic lobes. The accessory eyes appear to have travelled off sideways while the ocular tubercle still occupied its original position, *i. e.* was at the anterior end of the suture between the cephalic lobes. They are found along the fronto-lateral edge of the dorsal surface.

In the Chernetidæ the median eyes appear to have atrophied, while the lateral eyes persist in one or two pairs at the edges of the dorsal surface.

In the Phalangidæ, as a rule, only the median eyes are developed; but lateral eyes also occur in rare cases, although those figured by Blanchard * have been shown to be glands.

In the Galeodidæ we have the median eyes on a sharply demarcated ocular tubercle situated in the original position, that is, at the anterior end of the suture between the cephalic lobes. The accessory eyes apparently, as in *Scorpio*, wandered off laterally, *i. e.* in the transverse plane, thus retaining their frontal position. But the enormous development of the mandibles, which is doubtless a secondary acquirement, together perhaps with the development of the curious foldings of the cuticle (to form the buttresses upon which the mandibles rotate), have led to the shifting of the eyes down, over the edge of the dorsal surface, on to the lateral surface, so that they now look downwards and forwards (fig. 1).

In spirit-specimens the eyes themselves appear, when looked at with a pocket-lens or even with the naked eye, as whitish patches, which vary greatly in form and arrangement. In fig. 1 they are seen to have run together to form a long oval patch; in fig. 2 there are two eyes—the anterior an oval, and the posterior a minute, nearly circular mass of pigment; whereas in fig. 3 they appear about equally developed. I have not yet seen more than two on each side.

That these eyes are atrophying I think is apparent from their irregular forms and, perhaps, from their position. But, on the other hand, in some cases (*cf.* fig. 3) they have a well-developed ganglion and regularly arranged retinal cells, the

* 'Les Arachnides,' pl. xxx.

Fig. 1.

Fig. 3.

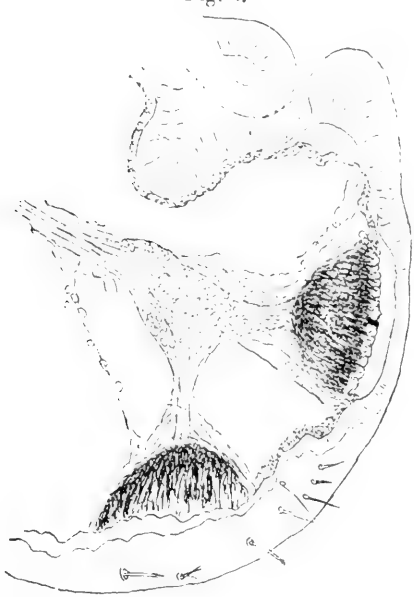


Fig. 2.

Fig. 1.—Outline drawing of the anterior end of a specimen of *Rhax melana*, Oliv., showing the position of the lateral eyes (*e*); *me*, median eyes on the ocular tubercle.

Fig. 2.—Portion of cuticle from a specimen of *Galeodes arabs*, Koch, cleared, showing the thickness of the cuticle, and a pair of eyes like plugs of pigment in chitinous pits.

Fig. 3.—Tangential section through the same region of a small (and perhaps young) *Rhax* (from Tashkend); two eyes are seen, with nerves and ganglion. As the fragment of the section was not *in situ*, its position in the sagittal plane is only approximate. A portion of the complicated infolding of the cuticle which forms the mandibular buttress appears in the section.

finer structure of which I have been unable as yet to make out. I could find no trace of a hypodermis between the retinal cells and the cuticle.

The eyes have completely lost all traces of a lens. The chitin is thinned away over them, so much so that very minute eyes are little more than plugs of pigment in deep chitinous pits (fig. 2).

I have thought it advisable to publish these notes in advance, as some time must still elapse before my work on the Galeodidæ is ready for publication.

LXII.—*Description of a new Longicorn Beetle of the Genus* Diaxenes, *which has been found injuring some imported Orchids.* By C. J. Gahan, M.A.

The genus *Diaxenes*, Waterh., has up to the present included but a single described species, and with regard to the locality of that species nothing very definite was known. The one example of *D. Taylori*, Waterh. (Ann. & Mag. Nat. Hist. ser. 5, vol. xiii. p. 128), which the British Museum contained was found in the Royal Nursery, Chelsea, where it was gnawing off the stems of an orchid from Manilla, of the genus *Phalænopsis*. Three additional examples are, I find, contained in the Pascoe collection; these are ticketed "Moulmein," though on what authority is not stated, and cannot now be ascertained. My reasons for giving Burma as the habitat of the new species are stated below. This new species has also, like its congener, exhibited a special taste for orchids, especially those of the genus *Dendrobium*.

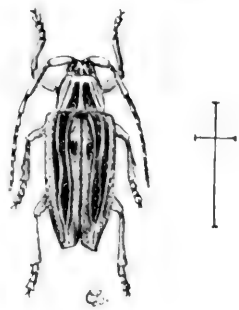
Diaxenes dendrobii, sp. n.

Fortiter punctatus; pube fulvo-brunnea sat dense vestitus: prothorace elytrisque albescente lineatis, lineis elytrorum dorsalibus sinuatis; scutello fusco, puncta centrali et limbo externo albis; antennis grisco-fulvis, articulis 4° ad 6^{um} plus minusve infuscatis. Long. 10–16, lat. $3\frac{1}{2}$–$5\frac{1}{2}$ mm.

Hab. Burma. On species of *Dendrobium*.

Strongly and rather closely punctured, with the punctures partly concealed by the close pubescence; this is mostly of a fulvous brown or drab colour, but there are darker brown areas on some of the interspaces between the whitish lines; the pronotum bears three white lines, one median and one towards each side, the two latter converging anteriorly. Each

elytron has about six lines of a slightly yellowish tint, of which one lies along the outer margin, the second sets out just below the shoulder and is continued in a nearly straight direction along the side of the elytron, the third proceeds from the upper part of the shoulder and joins the second a little before the apex; the next two lines are dorsal in position, they are subparallel to one another in the anterior fourth of the elytron, behind which they rather abruptly converge; after again diverging slightly they converge to join one another at about the beginning of the apical fourth, whence they are continued as a single line up to the outer angle of the oblique apical truncature; the sixth is a very short line passing back from the base. In addition to these six lines an ashy-grey streak may be seen along the suture, with a rather faint and broken white line limiting it on the outer side. The body underneath has a drab pubescence, with dark brown areas. The pro- and mesosterna and the lower part of the sides of the prothorax are almost black in colour. The legs and antennæ are covered with a nearly uniform drab-coloured pubescence; but in some examples the intermediate joints of the antennæ are more or less dark brown towards the tip. The front of the head is also in some examples of a dark brown or nearly black colour; but this is partly due to the rubbing away of the pubescence.



Four examples of this species are now in the British Museum collection; they were all taken alive in England upon imported orchids. One was presented by the late Mr. J. C. Bowring, who found it in his conservatory; two were sent by Mr. M'Lachlan, with the information that they were certainly imported with *Dendrobium nobile* and were playing havoc with the leaves and pseudobulbs of some plants of this species; a fourth specimen, recently presented by Sir Archibald Buchan-Hepburn, was found upon the flower of *Dendrobium atropurpureum*.

There are examples also in the museum of the Hon. Walter Rothschild at Tring; these were likewise found on orchids of the species *Dendrobium nobile*, which, Dr. Jordan informs me, were imported from Moulmein. The areas of known distribution of the two species of *Dendrobium* mentioned appear to overlap only in Burma; so I think I am quite justified in assigning Burma as the habitat of the new species of *Diaxenes*.

LXIII.—*On a new African Genus of* Mustelidæ.

By Oldfield Thomas.

In September 1889 Mr. F. J. Jackson, when collecting at Mianzini, Masai, a locality at which he found several other new mammals, trapped a small badger-like animal and recognized it at once as being a new form. Up to the present time, however, from various causes, the specimen has been mislaid, and even now only the skin can be found, although thorough search has been made for the skull.

But even without the skull the skin shows such remarkable characteristics that I am unable to refer it to any known genus, and must therefore create a new one for its reception. This may be called

Galeriscus, gen. nov.

General build about that of the Grison (*Galictis* [or *Galera*] *Allamandi*). Ears short, closely hairy. Fur thick, though short. Tail medium. Claws intermediate in size and form between those of the Meline and Musteline sections of the family. Toes *four on each foot only*, the two median distinctly longer than the subequal lateral ones; palm and sole-pads naked. General coloration Grison-like.

Galeriscus Jacksoni, sp. n.

Size and proportions very similar to those of the Larger Grison, as also is the general colour, with the prominent exception that the black on the muzzle and throat is entirely absent. Fur thick, close and soft, but only from one half to three quarters of an inch in general length; throughout it is composed of a close underfur, among which are mixed numerous straight hairs. Nose-pad naked, sharply defined behind from the hairs, which run forwards to form a median angle; below there is a naked median groove running down to the upper lip.

Face pale brownish white, the eyes with a few browner hairs surrounding them. On the crown the longer hairs gradually become ringed subterminally with black, resulting in a rich black-and-white grizzling, which extends backwards over the whole dorsal surface to the base of the tail. Hairs of ears outside grizzled grey like the crown, those inside yellowish white. Chin pale whitish brown like the face; cheeks, throat, and sides of neck deep yellow; centre of belly blackish. Limbs from shoulders and hips downwards deep

blackish brown. Large pads of palms and soles naked, but the whole plantar surface of the feet is thickly hairy. Claws thick and strong, their upper curvature about as in *G. Allamandi*, but they are far stouter, especially terminally; the fore and hind ones are about equal in length; in colour they are deep brown, the hind ones tipped with white. Tail nearly half the length of the head and body, well-clothed with long coarse hairs, which on its basal half are inconspicuously ringed subterminally with black, but gradually become wholly white on its distal half.

Dimensions of the type (an adult skin, sex unknown):—

Head and body (approximate) 540 millim.; tail (c.) 235, with hairs 250; hind foot (from calcaneum) without claws 90, with claws 98. Longest fore claw, in a straight line above, 13·5; ditto, hind foot, 12. Length of radius 67, ulna 84, tibia 88.

Hab. Mianzini, Masailand, 8000 feet.

Coll. F. J. Jackson, September 1889.

This interesting animal, when laid beside representatives of the other allied genera, is readily distinguishable from all of them, firstly by the entire absence of either a pollex or a hallux, *neither* of these digits being absent in any other member of the suborder Arctoidea, while the Herpestine *Bdeogale** and *Suricata* are the only genera in the whole of the Carnivora which resemble it in the absence of both. But apart altogether from this diagnostic character, one would not know in what genus to place the animal, and this is a test by which the validity of all proposed new genera should be tried. Were it, in that case, Brazilian in locality it might be referred to *Galictis* (whose synonym, *Galera*, is so well known that I have presumed to use it for the basis of the generic name), although the shorter ears and thicker claws would still indicate considerable divergence. Of the Old-World genera all the Meline forms are separable by their longer and straighter claws, as are the Musteline ones by their having these shorter and more curved. Coming to African forms, we have only the coarse-haired, short-tailed, and large-clawed *Mellivora*, and the delicately built and parti-coloured *Ictidonyx* and *Poecilogale* to deal with; and no one could possibly refer Mr. Jackson's animal to any of these.

Of course I would not be understood to say that *Galeriscus* is really more closely related to *Galictis* than to any Old-

* From *Bdeogale* itself *Galeriscus* is readily distinguished by its generally Musteline, or, rather, Meline, appearance, its broader head, larger nose-pad, and short hairy ears. Its feet, however, are undoubtedly very like those of that animal.

World genus, as its true relationship can only be settled when its skull and teeth are known; but so far as build and claws go, and on these the family has been classified, it certainly has a striking resemblance to its American analogue.

Mr. Jackson is much to be congratulated on the present important addition to the long list of his zoological discoveries, which is, perhaps, the most interesting of them all. New Carnivores of any sort are always few and far between, while of genera the last discovered were *Æluropus* and *Bassaricyon*, described respectively in 1871 and 1876.

BIBLIOGRAPHICAL NOTICES.

An Index to the Genera and Species of the Foraminifera. By Charles Davies Sherborn.—Part I. A to Non. 8vo. 240 pages. City of Washington, U.S.A. November 1893.

This is one of the "Smithsonian Miscellaneous Collections," No. 856, published by the Smithsonian Institution, which has given to the world a vast mass of useful literature on a great variety of scientific subjects. This is the first half of a work, forming a part of volume 37 of the "Collections;" the remaining part is to be published in 1895, together with a Preface, and such emendations as may be found necessary. The preparation of the manuscript of this Index occupied the years between 1885 and 1889. The printing was commenced in 1890; and, the Smithsonian Institution having been liberal in the transmission of proofs, considerable time has necessarily been taken up by author and printer in ensuring accuracy among about 10,000 names of genera and species, with their references, in this part of the Index.

That there should be so large a number of published names of Foraminifera, whether definitely described or merely noticed, under the first fourteen letters of the alphabet, is at first sight astonishing; and the greater is the obligation of Rhizopodists to Mr. C. D. Sherborn, F.G.S., F.Z.S., for collecting them in a systematic manner, and to the Smithsonian Institution for the considerate liberality shown in printing and publishing this extremely valuable and voluminous Index.

We already know Mr. C. D. Sherborn to be an ardent, industrious, and conscientious bibliographist, especially of the Foraminifera (see notice in the Ann. & Mag. Nat. Hist. ser. 6, vol. ii. pp. 424, 425, November 1888); also (with Mr. A. S. Woodward) of the British Fossil Vertebrata (Ann. & Mag. Nat. Hist. ser. 6, vol. vi. pp. 337–339, April 1890); and in other branches of bibliography, with indications and rectifications of dates, much wanted and well appreciated by zoologists and others. Indeed, the grandly designed Index to

Recent and Fossil Animal Species (from the date of Linnæus), to which he has devoted and still devotes very much of his valuable time, under the auspices of the Director of the Natural-History Branch of the British Museum, and of the Keepers of the Zoological and Geological Departments, is not only worthy of all praise, but deserves Governmental aid; for an enormous mass of material has already been carefully prepared by him, and is available to the several Officers of the Museum, saving them much time and trouble and ensuring accuracy in their Natural-History researches.

In the Smithsonian Index before us some of the genera take up large spaces; thus—

Flabellina, $3\frac{1}{2}$ pages.
Biloculina, 5 pages.
Frondicularia, $9\frac{3}{4}$ pages.
Marginulina, $12\frac{1}{2}$ pages.
Dentalina, $16\frac{1}{2}$ pages.
Nodosaria, 23 pages.
Cristellaria, $25\frac{1}{2}$ pages.

As about from 40 to 45 published names occur in a page, an approximation to their number may be arrived at. The Index does not omit the older terms, such as "Nautilus" (occupying 8 pages), "Cornu Ammonis," "Frumentarium," &c., by which some of the most common of the fossil Foraminifera of Italy and others from the Mediterranean and Adriatic were known to early naturalists.

The Author gives very many useful, though short, remarks in brackets [ ], as to the history, modifications, or synonymy of the names, or the nature and source of the specimens referred to. Cross-references are numerous, and greatly enhance the value of the Index. In fact the book can be used readily and with profit throughout for the genera and species of Foraminifera published down to 1889.

It is rich not only with material, but with the conscientious exactitude of a naturalist experienced in bibliography, well acquainted with Foraminifera, and also with those who work on them and willingly give him all the aid they can in carrying out the arduous task he has thus far so successfully completed.

The scientific world gratefully accepts this noble result of the Smithsonian generosity, in having this closely but clearly printed book, which is welcome to a very large class of naturalists in all the Continents, produced and distributed freely and without stint, as is the usual liberal custom of that great Institute at Washington.

Horns and Hoofs, or Chapters on Horned Animals.
By R. Lydekker. London: H. Cox.

A year or two ago Mr. Lydekker contributed a number of articles on Hoofed Big Game to the 'Field' and 'Land and Water.' These chapters were headed:—"Wild Oxen," "Wild Sheep and Goats," "The Antelopes of Asia," "African Antelopes," "The Deer of Asia," "The Deer of South America," "Wild Pigs," and "Rhino-

ceroses, Ancient and Modern." Reading them at the time, they seemed exactly suited to the tastes of that class of sportsmen who take an intelligent, though perhaps secondary, interest in natural history. The descriptions were not too technical, and there were few hard names, while the geographical distribution of the various families, genera, and species was sketched in a manner well calculated to stimulate further research and enterprise among visitors to wild countries, especially to the elevated districts of Central Asia, as well as some portions of the Indian region. For instance, the remark that no Englishman has ever shot—or, it is believed, so much as seen—a Takin (*Budorcas taxicolor*) alive, although this antelope dwells within sight of British Assam, would be likely to stir up some keen sportsman to circumvent, if possible, the political restrictions which are the cause of this reproach; and, for the matter of that, it is about time that we imitated the Russians in prosecuting our "purely scientific" explorations a little more boldly. The more reflective—we had almost said ruminative—sportsman will find material for thought in the statement that "although all living wild oxen have horns in both sexes, yet certain fossil species are known in which these were absent in at least the females; and it has been suggested that it is due to this circumstance that 'polled' races of oxen are so readily produced, this being, in fact, a reversion to a condition in which both sexes of the ruminants were normally hornless." Perhaps he may think there is a good deal in this, and argue that, because the tail-less variety known as the "Manx" cat is so readily produced, therefore the ancestor of the domestic puss was deficient in a caudal appendage—an analogy which *may* be false! But, enough of the sportsman: let us turn to the naturalist, of whose notice Mr. Lydekker hopes that the work may not prove unworthy. Undoubtedly there are many things, in this collection of odds and ends, of which the average "naturalist" can bear to be reminded. It cannot be too often dinned into him that the "aurochs" is the extinct wild ox, and is *not* the European bison; or that the musk-ox is not merely "found," but is plentiful, in some parts of Greenland (a fact unknown to the author of the article in the "Big Game volumes" of the Badminton series, and, it would seem, to most of the reviewers of that work). Not every naturalist realizes that the great preponderance of antelopes in Africa is merely a feature of the present epoch, and that there is strong evidence that this group previously inhabited Southern Europe and Asia, whence it was partially driven by climatal and other changes. Nor does every one know that the "Roman-nosed" Saiga antelope, of the Kirghiz steppes, was found in Eastern Poland a century ago, and that not only are the remains of representatives of the genus found in Moravia and in the south of France, but also in Belgium, while in 1890 the frontlet and horn-cores of a male were actually obtained in the Pleistocene deposits of the Thames Valley. Many similar points might be cited, and, so far, we have nothing except praise for Mr. Lydekker: but for the naturalist it was not sufficient to string together a lot of articles, and to recast some of them, with the

addition of some fresh illustrations; and we very much regret that the Author has not bestowed upon the present work that small amount of extra labour which would have rendered it complete in itself. As it stands, we have the Old-World Antelopes, but nothing about the Giraffes; the American Prong-horned Antelope is not mentioned (at least, it is not in the index), nor is the Rocky Mountain Goat (*Haplocerus montanus*); and the red-deer group is discussed, with barely an allusion to the Wapiti. This would have been intelligible if an arbitrary line had been drawn at Old-World species; but such is not the case, for there is a special chapter devoted to the deer of South America. The Elk and the Reindeer are treated under the head of "Asiatic Deer," but nothing is said about their American representatives beyond the incidental remarks that the former is not specifically distinct from the moose, nor the latter from the caribou. These and some other omissions diminish the value of a very readable and instructive work.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

February 21, 1894.—Dr. Henry Woodward, F.R.S., President, in the Chair.

The following communication was read:—

"Note on the Genus *Naiadites*, as occurring in the Coal Formation of Nova Scotia." By Sir J. William Dawson, K.C.M.G., LL.D., F.R.S., F.G.S. With an Appendix by Dr. Wheelton Hind, B.S., F.R.C.S., F.G.S.

The specimens referred to in the paper occur most abundantly in calcareo-bituminous shales along the coast, at the South Joggins, and were described by the Author in 'Acadian Geology,' in 1860. A collection of them has been submitted to Dr. Wheelton Hind. In Q. J. G. S. vol. xix. Mr. Salter referred the shells described as *Naiadites* to his new genera *Anthracoptera* and *Anthracomya*. In correspondence with Mr. Salter, the Author held that the shells were probably freshwater, and objected to the name *Anthracomya* as expressing an incorrect view of the affinity of the shells; he also stated several reasons in support of his opinions. The Author continued to use the name *Naiadites*, but does not object to the division of the species into two genera, for one of which Salter's name *Anthracoptera* should be retained. Additional reasons are given for the freshwater origin of these shells, and the Author expresses his gratification that their affinities have been so ably illustrated by Dr. Hind.

Dr. Wheelton Hind believes that the 'genus' *Naiadites* contains three distinct genera, for one of which the name must be retained.

He proposes to retain the name for the forms called *Anthracomya*, affirming as this word does an altogether wrong affinity for the genus. (The name *Naiadites* was proposed in 1860; *Anthracomya* in 1861.)

Dr. Hind is not able to state that any of the species submitted to him by Sir J. W. Dawson are the same as British forms. The shell originally described as *Naiadites carbonaria* is, he has no doubt, an *Anthracoptera*. He gives notes on *N. arenaria*, *N. angulata*, and *N. lævis*.

MISCELLANEOUS.

Saw-flies on Solomon's Seal. By W. F. Kirby, F.L.S. &c.

For two years past plants of Solomon's Seal (*Polygonatum* or *Convallaria multiflora*) growing in Dr. Günther's garden at Kew have been infested by saw-fly larvæ; and on the 6th of May of the present year Dr. Günther captured a considerable number of specimens of a saw-fly on the plant, which proved on examination to be *Phymatocera aterrima*, Klug. Although this species will probably be found to be common where its food-plant occurs, it does not seem to have been noticed in England except by Curtis, who described and figured it in vol. xxi. of the 'Transactions of the Linnean Society,' pp. 39–42, pl. v., as long ago as 1850, from specimens bred from larvæ received from Lord Goderich, who had noticed them for several years previously devouring the leaves of the only plant of Solomon's Seal in Lord Ripon's garden at Putney. Curtis called the insect *Selandria Robinsoni*, believing it to be undescribed.

The only other saw-fly noticed by Kaltenbach in his 'Pflanzenfeinde' as feeding on *Convallaria multiflora* is *Blennocampa fuliginosa*, Schrank.

It is worthy of note that all the specimens of *P. aterrima* which Dr. Günther caught were males, which, it seems, appear a day or two before the females begin to emerge. With them was a single specimen of a *Blennocampa*, also a male—not, however, *B. fuliginosa*, but *B. fuscula*, Klug (=*pusilla*, Klug), a rose-feeding species, the presence of which among the specimens of *Phymatocera* was probably quite accidental.

As *Phymatocera aterrima* has been so rarely observed in England, it appears worth while to call attention to its re-occurrence. There were previously only two German specimens in the British Museum collection, and no British ones.

Although the day was warm and bright, the specimens were remarkably sluggish, and allowed themselves to be picked off with the fingers.

Natural History Museum, South Kensington,
May 9 1894.

Pteropods with Two Separate Sexual Openings.

By H. McE. Knower.

Having recently had occasion to review the anatomy of *Cavolinia longirostris*, by means of sections of specimens obtained by the U.S. Fish Commission schooner 'Grampus,' I find that the statement in text-books and elsewhere, that all Pteropods have but a single external opening for the hermaphroditic sexual organs, is not correct. *Cavolinia longirostris* (to which species my specimens apparently belong) has two distinct and separate sexual openings.

There is a large hermaphroditic gland, lying posteriorly and dorsally in the visceral sac, which is asymmetrical, being more developed on the left side. In this gland the youngest ova are found in the centre, immediately around the intraglandular portion of the duct, the oldest ova with considerable yolk at the periphery. The male elements arise from lines of cells running from the periphery towards the centre. A single duct leaves the gland from its anterior face, dorsally and far to the left. Receiving the seminal vesicle near this point of origin, the duct runs over to the right towards the median plane. Near the middle line it opens into the anterior face of a large glandular sac, which has much folded walls. This sac is the muciparous gland, and the duct ends on reaching it. Sections do not show a separate albumen-gland described for the genus. They do show that some of the folds of the walls of the single cavity of the gland are lined with non-glandular ciliated cells, while others have distinctly glandular cells. The seminal vesicle is, as described, a long saccular appendage of the duct, with its end dilated and coiled up on the left side of the stomach. The muciparous or, rather, uterine gland is quite large; it lies in the anterior portion of, and occupies most of the left side of, the visceral sac. Quite near the point where the hermaphroditic duct opens into the uterine gland the vas deferens arises from the gland on its anterior right corner, to the left of the median line. This is a *closed* ciliated tube, not a ciliated groove (in which this species differs from all other Pteropods), which curves around on the right to the dorsal surface of the fins, to run anteriorly and open at the sac of the invaginated penis. *On the left side of the uterine gland sections in all planes show a second opening from the reproductive system to the exterior.* This is a slit-like aperture on a slight papilla, on the anterior surface of the visceral sac and to the left. The opening leads directly into a ciliated fold of the uterine gland, the ciliated cells of which turn out at the lips of the aperture and become continuous with the epithelium of the external surface of the body. There can be no doubt that this is a natural opening, and near it is found the seminal receptacle, a thin-walled sac filled with spermatozoa and lying on the left face of the uterine gland. This seminal receptacle opens into a fold of the uterine gland, not far from the external opening just described, which I take to be a vaginal opening.

In the possession of two separate sexual openings *Cavolinia longirostris* differs from all other Pteropods. The opening on the right side leading to the penis is perhaps to be homologized with the single aperture of other species. All that is necessary is the closure of the usual ciliated groove to form a tube to the penis, and this is an evident advantage in ensuring the transference of the male products. Another opening (vagina) becomes a necessity as soon as the more primitive right one is given over entirely to the male products; and this may account for the new aperture on the left side. In other words, the other Pteropods represent the more primitive condition of the hermaphroditic duct, while *Cavolinia longirostris* has become more specialized by the acquisition of a separate opening for each sex. The anatomy of the adult does not, of course, show whether, as Korscheldt and Heider ('Lehrbuch der vergleichenden Entwicklungsgeschichte der wirbellosen Thiere,' p. 1088, fig. 644 *c*) would put it, there has been a splitting of a primitively single opening into two, or whether a new independent opening has been acquired into the left side of the uterine gland. Perhaps the study of the ontogeny of the sexual organs of this species will settle the question.

Contrary to Pelseneer ('Challenger' Report on the Pteropoda, pt. 3, p. 19), the heart of *Cavolinia longirostris* is on the *left* side, agreeing with Souleyet's figure of *Cavolinia tridentata*, for which see Lang ('Lehrbuch der vergl. Anatomie,' p. 664, fig. 469).

Muscles in the fins are distinctly striated, a condition which Lang states ('Lehrbuch der vergl. Anatomie,' p. 695) is not found in mollusks, but which Kellogg ("A Contribution to our Knowledge of the Morphology of Lamellibranchiate Molluscs," Bull. U.S. Fish Commission, vol. x. 1890) found in the adductors and heart-muscles of Lamellibranchs. Paneth ('Archiv mikr. Anatomie,' Bd. 24), describing a similar appearance in the fins of *Cymbulia* and *Tiedemannia*, decides this is not natural, but artificial striation. I have not been able to study living tissue, but the striation, as I find it, is very distinct, and looks in every way like ordinary striated muscle.—*Johns Hopkins University Circulars*, May 1894, pp. 61, 62.

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END OF THE THIRTEENTH VOLUME.

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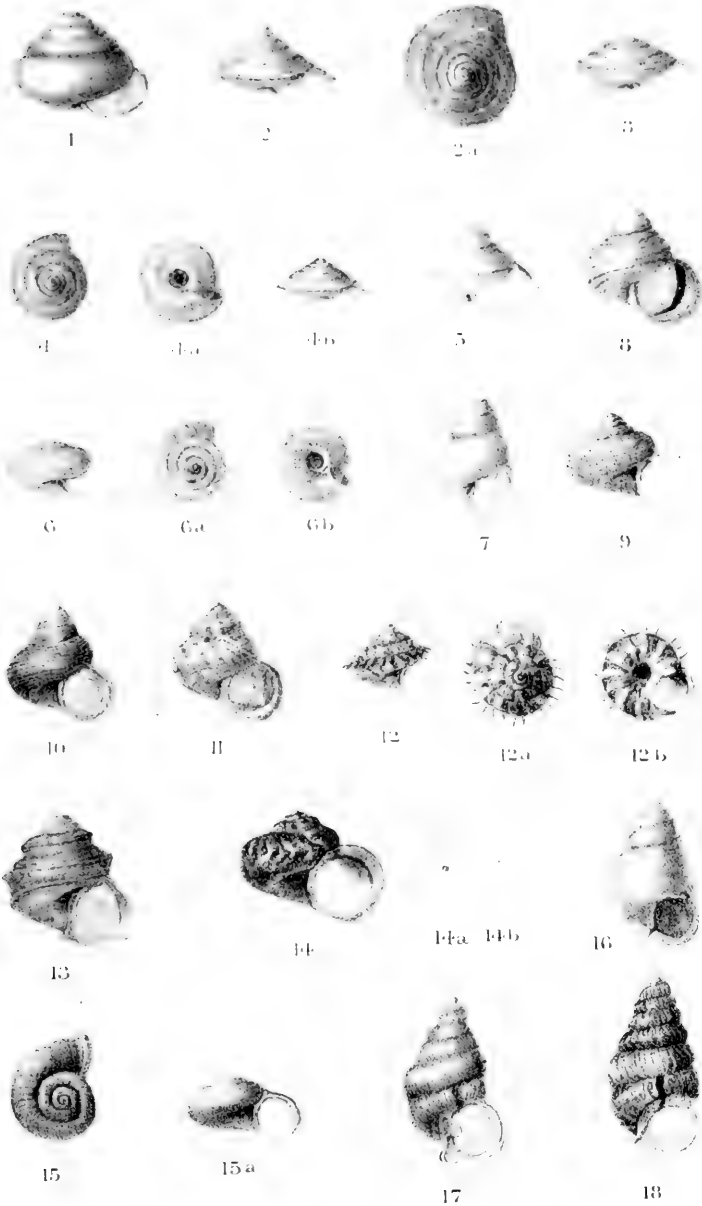

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